LEAVES | Leveraging Agricultural Value Chains to Enhance Tropical Tree Cover and Slow Deforestation

BACKGROUND PAPER

PROFOR
INNOVATION AND ACTION FOR FORESTS

Agroforestry Shea Parklands of Sub-Saharan Africa: Threats and Solutions

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Executive Summary

Introduction to Shea

Natural stands and managed shea agroforestry parklands cover 300-350 million hectares (ha) of Sahel-Sudanian-Savannah Africa. Over millennia, indigenous wild woodlands have been converted to wooded and farmed parklands in which naturally regenerating trees are selected, protected, and managed through a rotational farm-fallow system. Shea butter and other non-timber forest products (NTFPs) or tree crops are staples of village diets and secure 10-25% of household incomes through village-level production. Women suffering from poverty are heavily reliant on tree crops such as shea butter for their livelihoods.

Shea forms the hub of a carefully-managed food and wood fuel agroforestry production system with the majority of collected shea kernels destined for local consumption. Shea butter is of major dietary importance across an African zone home to 200 to 300 million people. Shea annually provides 7 to 10kg of dietary fat per person in many communities.

In addition to its nutritional value, shea is traditionally used for personal care. Shea butter became a key ingredient in the international personal care industry in the 1980s when the firm L'Occitane first began using it in boutique cosmetics. Most consumers, researchers, and development workers alike incorrectly perceive that the hand-crafted, cosmetic use of shea is its main sale.

In fact, shea use in cosmetics is only 10% of total exports. The greatest international demand for shea is for use in the confectionery industry, which demands high-tech processing. Since 1960, fractionated shea stearin has been increasingly used as an ingredient in cocoa butter alternatives (CBAs) in chocolate. Since the EU cocoa and chocolate directive 2000/36/EC came in to force in August 2003, there has been a 600% surge in annual demand for shea kernels. Annual exports have risen from an average of about 50,000 to between 300,000 and 350,000 equivalent tons of shea kernels.

At least 50% of collected shea kernels are used to make butter or oil for local consumption in West Africa. A group of about 10 multinational firms tightly control sourcing, extraction, fractionation, formulation technology, and marketing of shea products. Forty-five percent of the West African crop is sold to this group of companies for production of shea stearin. Only 10% of all shea exports are destined for the international personal care sector and only half of this amount is from village-crafted sources. Most press and publicity material on shea focuses on this small, village-crafted segment of the market.

Threats to Shea Parklands

Parklands across Sahel-Savannah eco-zones are significantly threatened by invasive land use change. Millions of shea and other native trees are being cleared to make way for modernized farming, urbanisation, mining, and wood fuel extraction. Rapidly declining tree densities in parkland landscapes are linked with soil erosion, poor water infiltration, and erratic or reduced rainfall, each of which has a detrimental impact on agricultural productivity. In addition, fallows, which are vital for wood fuel production and for regeneration of the forest system, are shrinking or disappearing while at the same time herbicides stunt plant growth. Insecticides, coupled with habitat and fodder loss, reduces insect populations - notably honey/stingless bees - resulting in lower shea fruit yields and fewer resources available for migratory bird populations.

Fuel and water needs also stress the shea parkland environment. As the most common tree in the native landscape, shea trees are frequently used for firewood and charcoal. However, without fallows for regeneration, the decline in shea trees is now a major threat to parkland sustainability. Further, the growth of the industrial post-harvest processing of shea kernels requires large amounts of water and wood fuel. Very limited research and few development efforts have been focused on sustainable water usage and reduced wood fuel use in shea processing.

In addition, land tenure, political, and cultural issues threaten the shea market and production processes. Land tenure security and tree usufruct arrangements do not encourage the protection and planting of shea and other native trees. Attempts at mechanization of processing largely benefit men and international firms, but not women. Mass outward migration, terrorism, political instability, urbanization, climate change, and unregulated mineral extraction further threaten the shea industry. Instability, tribal, and religious tensions have increased across the shea zone. Insecurity and clashes are rife in Mali, Central African Republic, South Sudan, northern Nigeria, and even Burkina Faso. This instability has a major impact on the ability of governments and aid agencies to implement programs and policy changes in the region. Instability further negatively impacts private sector operations in shea production. Finally, attempts at governmental control, monopolized marketing boards, inappropriate taxation, and price fixing have acted as disincentives to investment and growth.

Parkland depletion strongly effects shea kernel collection and production at the village level. More and more labor and time are required to collect shea fruit in highly depleted parklands. As a result, despite high gross margins, annual personal income from shea kernel sales is small and continues to decline. Despite growth in exports of shea kernels and butter, most value is added outside the parkland zones.

Finally, market insecurities and tempered demand limit shea's contribution to food security and real income. International edible oil regulatory conditions constrain potential demand and use of whole shea. Whole shea remains a fraction of the shea market. The export market for shea kernels is therefore largely a derived demand as the majority is destined for use as a CBA in confections. Further, shea kernel price is dependent on the relative prices of cocoa butter and other legally approved alternative fats. In addition, there is a lack of global uniformity regarding the legal definitions of the term *chocolate* that prevents further expansion of shea's use in confections. In the personal care sector, the international market for shea butter in cosmetics is limited by price, supply chain transparency, and the quality and existence of alternative ingredients.

Solutions for Parkland Restoration

Addressing the threats to shea parklands requires changes to international markets, innovative technologies, water and fuel economy, and the mitigation of social and political threats. International buyers must understand that rapid, on-going parkland degradation is threatening long term supply positions. Incorrectly perceived as wild, untameable, and slow to mature, shea trees are quite conducive to improved management. Shea is easily propagated from both fresh seed (fruition within 7-15 years after planting) and grafted scions (fruiting within 3-5 years). With tenurial changes, skill transfer, and financing solutions, parkland restoration can become a viable option. Incentives need to be offered for commercial shea nurseries and the breeding of early maturation, regular-, and high-yield varieties. On-farm trials of intercropped shea, farmer-managed natural regeneration (FMNR), and the replanting of shea with other indigenous trees can be a part of climate-smart agroforestry programs that can increase both annual tree and crop productivity.

Unsustainable wood fuel and water use in the shea supply chain can be addressed through certification schemes to ensure that shea production uses sustainably sourced fuel and water. Experiments should be undertaken to find more energy efficient processing methods and to determine whether centralised toll-curing of kernels is profitable to women as a viable and energy efficient option. Sustainable wood fuel production should be promoted using NTFP-woodlots, hedgerows, rotational fallows, and coppiced-FMNRs. Alongside landscape fire control programs, low cost irrigation and water-sourcing solutions for tree planting are needed.

Land reforms must ensure secure land tenure and tree usufruct rights for those planting, protecting, and tending on-farm trees. Local government authorities require education on the urgent need to empower tree-planting farmers and the need to combat taboos on the planting and protection of native tree species. Government production licenses and agribusiness loans can be conditioned upon tree planting and green energy targets. These conditions can include the preservation of shea and other indigenous trees and restoration/re-planting of parklands and woodlands.

Village-level, female-orientated technological advances in oil-seed collection and processing should be disseminated to increase local profitability and efficiency in upstream shea production. Surveys to assess the nutritional and economic importance of shea need to be undertaken in different parts of the zone. In addition, a major sales and marketing campaign should be undertaken to promote the use of whole and fractions of shea butter in foods in Africa and overseas. A consumer facing label and brand should be developed to differentiate and market village-crafted shea butter independent of industrially processed butter. Multilateral and bilateral donors should be encouraged to include shea butter as a key source of edible oil in supplementary feeding programmes. Finally, linkage with green (tree-planting) markets should be encouraged and U.S. GRAS and global CODEX regulations should be revised to permit or to more clearly define the edible uses of whole refined shea butter and its fractions.

Progress So Far

Until recently, shea tree research has remained limited. Parkland sustainability programs such as those championed by the USAID-sponsored Global Shea Alliance are just beginning. Challenges to restoration abound and include tenurial insecurity, poor environmental control, the scarcity of resources such as seedlings, and proper management skills. However, landscape restoration experts have begun to unite and target their efforts to restore shea parklands. Currently a range of restoration activities are beginning across the shea zone and include projects and institutions such as:

- Sustainable Shea Initiative (USAID and GSA members)- Ghana, Nigeria, Togo, Benin, Côte d'Ivoire, Mali, Burkina Faso;
- FEATS project (Global Affairs Canada) – Ghana;
- Great Green Wall – regional;
- Evergreen Agriculture (EU) - Mali, Ghana (with World Vision, ICRAF, etc.);
- AgNRM (USAID) – Ghana;
- ProAgri- Benin;
- CRIG – Ghana (including involvement of FAO); and
- NIFOR – Nigeria.

Considerable damage has been done to the health and sustainability of shea parklands over the last 10 years. The sooner key stakeholders accept that there is a serious problem and that all parties need to take responsibility for the solution, the sooner the situation can be reversed. Approximately 100 million ha of parklands need at least 5-10 shea trees per ha to be planted over the next 10 years. This is a total of 500 million to 1 billion seedlings. This level of sowing should be sufficient to supply both domestic and export needs in the coming 10-20 years. Business cases and business plans for farmers and investors must be drafted. These plans must include information on how proper agroforestry can improve soil conditions and food production. Further, governments can provide information on how the private agriculture and forestry sectors can become involved in the propagation, breeding, and planting of shea and other indigenous species.

Even if all stakeholders were to collaborate more closely to achieve these goals, existing national and regional organizations working in the sector lack the resources to meet current demands. Coordination and funding across the entire shea parkland area are required. The World Bank can play a part in stimulating and catalysing the formation of a Parkland Alliance that would include private sectors stakeholders from the agricultural and agroforestry industries, policy makers, urban planners, financiers, investors, pastoralists, conservationists, civil society representatives, and research facilities to name but a few. As a first step, an immediate, high level regional meeting in the African shea zone is highly recommended.

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Acronyms

AgNRM	Agricultural Natural Resource Management Project (USAID funding)
CBAs	Cocoa Butter Alternatives (includes cocoa butter equivalents, improvers and substitutes, CBEs, CBIs and CBSs)
CBI	Centre for the Promotion of Imports from developing countries
CIFOR	The Center for International Forestry Research
CILSS	Permanent Interstate Committee for Drought Control in the Sahel (French: Comité permanent inter-État de lutte contre la sécheresse au Sahel)
cm	Centimeter
COCOBOD	Cocoa Marketing Board of Ghana
CODEX	The Codex Alimentarius is a collection of internationally recognized standards, codes of practice, guidelines, and other recommendations relating to foods, food production, and food safety
CRIG	Cocoa Research Institute of Ghana
CS	Case Study from Six Shea Countries
EC	European Commission
ECA	East and Central Africa
EFTA	European Free Trade Association
EPOPA	Export Promotions of Organic Produce from Africa
EU	European Union
FAO	Food and Agricultural Organization
FAP	Fatty Acid Profile
FDA	Food and Drug Administration
FEATS	Farmers' Economic Advancement through Seedlings Project (Global Affairs Canada funding)
FFA	Free Fatty Acids
FMNR	Farmer-Managed Natural Regeneration
Fr.	French
g	Gram
GHS	'New' Ghana Cedi
GPS	Global Positioning System
GRAS	United States Generally Recognized as Safe (edible food regulation)
Gt C	Gigaton of Carbon
ha	Hectare (2.47 acres)
HACCP	Hazard Analysis and Critical Control Points
HTS	Harmonized Trade System
ICCO	Interchurch Organization for Development Cooperation
ICRAF	The World Agroforestry Centre
IMF	International Monetary Fund
IMO	Institute for Marketecology
INCI	International Nomenclature of Cosmetic Ingredients
ISO	International Organization for Standardization
ITC	International Trade Centre
kg	Kilogram (2.2 pounds)
kJ	Kilojoules
km	Kilometer
LEAVES	Leveraging Agricultural Value Chains to Enhance Tropical Tree Cover and Slow Deforestation
LUC	Land Use Change
m	Meter
Mg C	Megagram or ton of carbon

mm	Millimeter
NGOs	Nongovernmental Organizations
NIFOR	Nigerian Institute for Oil Palm Research
NOP	National Organic Program
NTFP	Non-Timber Forest Product or tree crop
º C	Degrees centigrade
ODI	Overseas Development Institute
PAFB	Projet d'Appui aux filières Bio-Alimentaires du Burkina Faso
PAHs	Polycyclic Aromatic Hydrocarbons
PBC	Produce Buying Company (Ghana Ltd.)
PMF	Palm Mid-fraction
POP	Palmitic-oleic-palmitic Fatty Acids
PPPs	Public-Private Partnerships
RDA	Recommended Daily Allowance
REDD+	Reducing Emissions from Deforestation and forest Degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks
RSPB	The Royal Society for the Protection of Birds (UK)
SETs	Shea Kernel Equivalent Tons
spp.	Species
StOSt	Stearic-Oleic-Stearic Fatty Acids
t	Metric Ton (1,000 kg)
TAGs	Tri-acyl-glycerides
TCP	Terrestrial Carbon Project Credits
U.S.	United States of America
UK	United Kingdom
UNDP	United Nations Development Program
USAID	United States Agency for International Development
USD	United States Dollars
VBN	Vogelbescherming [Society for the Protection of Birds] Netherlands

Image 2. Shea Firewood from Agricultural Land Clearance

Source: Joseph Hunwick

1 Agroforestry Parklands – Physical Structure and Distribution

1.1 Introduction

With countless vernacular or local names, *Vitellaria paradoxa* (synonym: *Butyrospermum paradoxum* or *parkii*), internationally known as shea in English or karité in French, is a small to medium-sized tree averaging 10 – 15 meters (m) high with a minimum height of 7 m and a maximum height of 30 m.[1] As a pioneer species of savannah woodlands, shea readily establishes itself on cleared and ploughed lands. Flowering and fruiting has been reported to commence after a vegetative phase of 7–15 years, with grafted material known to fruit after 3-5 years. The wood is durable, and though not cut for timber, it can be used for building poles, mortars, and household utensils. As a firewood, *V. paradoxa* is excellent and can be made into charcoal for food cooking. Though less favored by bird species, the flowers are an important source of nectar and pollen for insects including honey and stingless bees. Reports state trees are productive for 150-200 years, yet further studies on carbon dating and dendrochronology are urgently needed to verify these figures.

1.2 Definition of Parklands

"Agroforestry parklands are land-use systems in which woody perennials are deliberately preserved in association with crops and/or animals in a spatially dispersed arrangement and where there is both ecological and economic interaction between the trees and other components of the system."[2]

Image 3. Mechanically Cultivated Shea Parklands with no Tree Regeneration

Source: Joseph Hunwick

[1] Following many years of committee discussions and publications, McNeill and Turland (2011) clarified taxonomic amendments and the correct names and authorities for the two subspecies of shea are therefore:

- *Vitellaria paradoxa* subsp. *paradoxa* C. F. Gaertn.
- *Vitellaria paradoxa* subsp. *nilotica* (Kotschy) A. N. Henry & al.

[2] Bonkoungou EG, Alexandre D-Y, Ayuk ET, Depommier D, Morant P, and Ouadba J-M. (1994). Agroforestry Parklands of the West African Semi-arid Lands. Conclusions and Recommendations of an International Symposium. Ouagadougou. 25-27 October 1993. ICRAF/SALWA.

Box 1. The Traditional Shea Parkland Farming System: A Case Study from Northern Ghana

Beginning with a piece of virgin, unmanaged area of savannah woodland, a male farmer will request permission from a local chief and/or assigned landowner to cultivate a defined portion of land in a pre-agreed manner. The farmer will clear and cultivate this land, performing any required rituals to pacify the land and tree gods to ensure fertility and good harvest, usually in consultation with the elders (e.g. tindaana). Certain individual trees (of appropriate species, size, health, and location on the farm) will be kept, while all others will be either cut down to the base, ring-barked, or base-burnt with piled vegetation. Cut trees and vegetation are usually used for fuel wood, building materials, fencing, medicinal supplies, etc. Generally, no effort is made to grub up the tree roots and tree stumps are maintained for regrowth during fallow periods. In contrast, no "coppice" stumps remain when lands are "permanently" farmed. Seedlings do not reach a height at which farmers will protect, and so without farmer-managed natural regeneration (FMNR) or replanting, no young tree recruitment or fuel wood production is possible.

On this 'first' clearing, soils are usually piled up into yam-mounds, often including ash, charcoal, and other vegetation, which will compost and form a nutrient rich media for the yams (*Dioscorea* spp.). Some of the dead trees will often be left standing to dry for subsequent harvesting for timber and fuel wood needs and to support the yam vines. Other crop species are intercropped between the trees either during the first or subsequent years of farming. These include various bean species (e.g. cowpeas, bambara beans, and pigeon peas), sorghum, millet, maize, cassava, groundnuts, etc. Only shallow hand-ploughing (using a short-handled hoe) is employed for preparation, weeding, and harvesting to ensure that only the top few centimeters of organic-rich soils are utilized, and any desirable tree seedlings are protected. Lands are typically farmed for 3-5 years before being left fallow.

Once the land is noted as becoming less fertile, and/or another piece of land becomes available or assessed as having returned to being suitable for farming, the first piece of land is left fallow so that nutrients may replenish naturally. In areas with high pressure for land, this may be as little as 2-3 years or as long as 15-25 years where human populations are low. In the wooded parklands of West Gonja, Ghana, a farmer will typically manage four pieces of land, farming a portion for three years before moving onto the next area which has been left fallow for 12 years.

1.3 Parkland Evolution

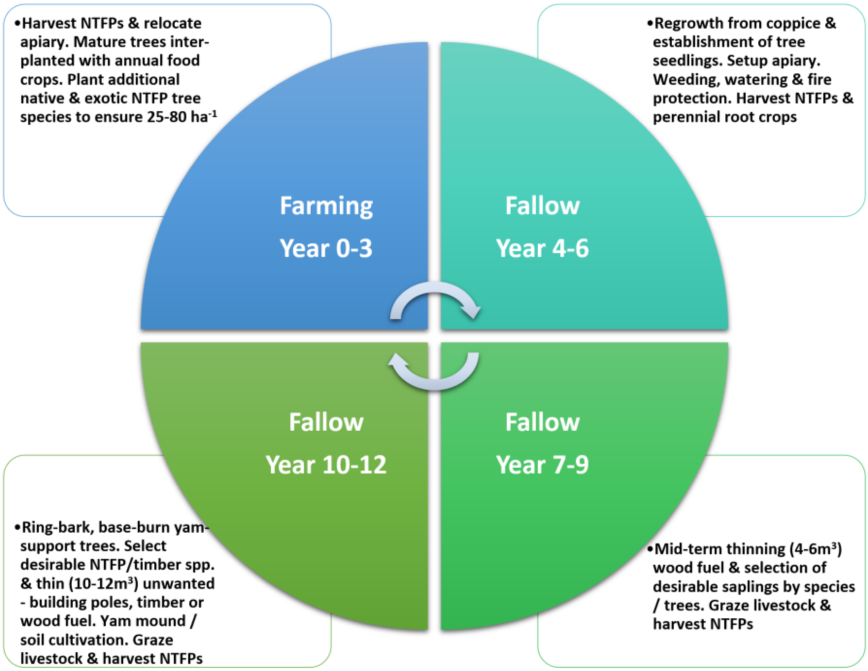
In shea parklands, the composition and density of the woody vegetation is altered by man to facilitate its use. Mature, well-spaced, healthy, and productive trees are maintained when woodlands or fallow lands are cleared for farming activities (keeping 15–50 trees per ha is common, e.g., 10–15% of the woody stems of the 150–500 stems usually found in mature, "natural" guinea savannah woodland). After only a few cycles of farming for 3-4 years then fallowing for 5-15 years – additional protection of new recruits from additional regeneration and removal of deadwood – the distinctive features of shea parklands soon become apparent. To illustrate the reality of traditional parkland management, we describe a representative case example of a typical shea zone farm cycle as illustrated in Box 1 and Figures 1 and 2.

Figure 1. Contrasts Between Parkland Management Styles

a) Permanent cultivation (note lack of coppiced stumps) b) Rotational cultivation (coppiced stumps left to regenerate)

Source: Peter Lovett

Figure 2. Rotational Shea Parkland Farming - Four Plot 12-year Example



Source: Peter Lovett

1.4 Regeneration and Germination

Regenerating trees rapidly grow back in fallow land, either from existing rootstock as coppice shoots, or as newly established seedlings. During the farming period, shea fruits germinate immediately when seeds fall onto tilled soils, sending down a long tap-root with a cryptogeal germination mechanism prior to a shoot with leaves emerging from 5-10 cm underground. Farmers only keep saplings that have achieved a minimum size, e.g. waist height, requiring undisturbed time to grow.

Image 4. Abundant Shea Regeneration

Source: Joseph Hunwick

1.5 “Use It or Lose It”

When farmers perceive that trees and their products are valuable due to increased economic worth of their non-timber products, greater demand, or declining availability, they invest in the protection and reproduction of parkland and actively involve themselves in projects that encourage specific tree uses. Farmers neglect or cut down the forest for wood fuel use when the value of the forest resource is lower than the alternative income to be derived from other forms of farming, trade, mining, or industrial activity. Surveys in northern Ghana indicate potential maize harvests of 10-12 bags of per acre with a value of GHS 120 per bag, but only 1 -2 bags of shea kernels valued at GHS 120 per bag collected from the same area. This clearly shows the relative attractiveness of maize in the region.

Image 5. Conversion of Grubbed-up Shea Trees into Charcoal

Source: Joseph Hunwick

1.6 Shea Parklands pre-1900

Despite limited records we know that this area was generally wetter and better wooded than it is now (e.g., Lake Chad water levels). Rotational farming was being practiced effectively and records from archaeological sites throughout the region show that shea has been a managed crop for 100s, if not 1000s of years. Over this time, few areas suitable for farming have been left untouched and there are many examples of abandoned shea parklands in now gazetted conservation areas. Mungo Park’s descriptive diary from over 220 years ago offers insights as to how shea parklands were and continue to be managed. (Box 2)

Box 2. Observations on Shea: Mungo Park 1797

“About eight o’clock we passed a large town called Kabba, situated in the midst of a beautiful and highly cultivated country, bearing a greater resemblance to the centre of England than to what I should have supposed had been the middle of Africa. The people were everywhere employed in collecting the fruit of shea trees, from which they prepare the vegetable butter mentioned in former parts of this work. These trees grow in great abundance all over this part of Bambarra. They are not planted by the natives but are found growing naturally in the woods; and in clearing woodland for cultivation every tree is cut down but the shea.”

“The tree itself very much resembles the American oak, and the fruit–from the kernel of which, being first dried in the sun, the butter is prepared by boiling the kernel in water—has somewhat the appearance of a Spanish olive. The kernel is enveloped in a sweet pulp, under a thin green rind; and the butter produced from it, besides the advantage of its keeping the whole year without salt, is whiter, firmer, and, to my palate, of a richer flavour, than the best butter I ever tasted made from cow’s milk. The growth and preparation of this commodity seem to be among the first objects of African industry in this and the neighbouring states, and it constitutes a main article of their inland commerce…”

Source: Mungo Park, Travels in the Interior of Africa 1795-97 – Volume 2

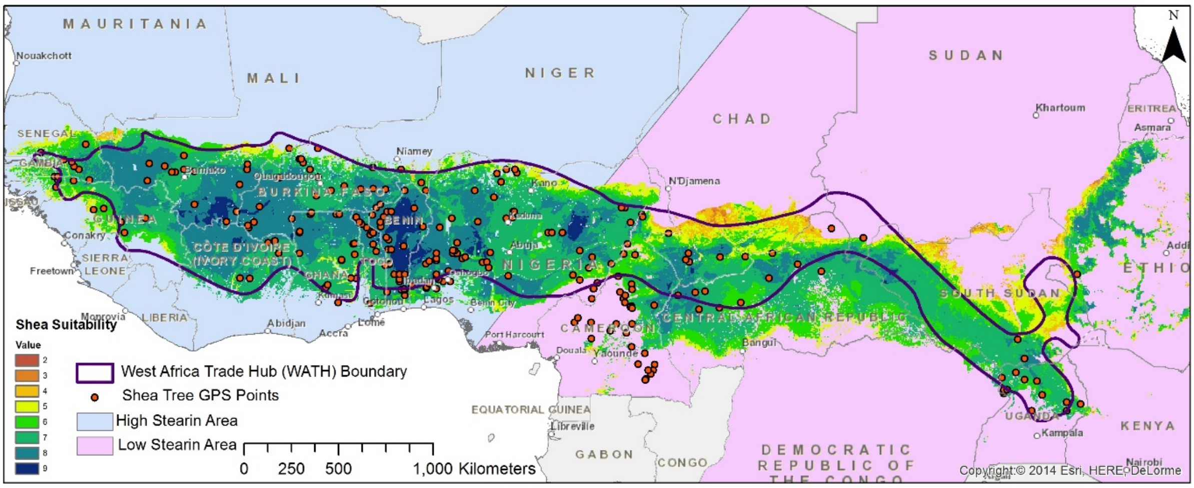
Fallows were likely to have been over 25 years and, with simple tools, cutting was labor intensive. Unwanted large trees would likely only be killed by ring-barking or base-burning, although there is widespread evidence of intensive metal-smelting operations, using wood charcoal. Local farmers would have grown a range of annual crops such as millet, sorghum, and legumes like pigeon-pea during the 3-6-month rainy season and extensively used non-timber forest products growing on or under trees like shea, dawa dawa, and baobab to provide vital sources of dry season food, especially leafy vegetables, protein, key vitamins, and minerals. They also provided a wide range of traditional medicines, natural dyes, etc. Land would have been more plentiful and communally owned with the land closest to the villages being the most intensively cultivated by the original settlers. Newcomers were generally allocated the lands more distant from the villages.

1.7 Geographic Distribution

1.7.1 Shea's distribution zone

Shea trees grow across an area which covers approximately 3.5 million km^2, about one third of the United States' land area. The shea belt stretches from Gambia and Senegal in the far west to Sudan and Uganda in the east, including Gambela, the lowland area of western Ethiopia. In total, shea has been botanically verified as naturally occurring in 21 countries across the African continent. The rainfall in the species range is seasonal, dry for 4 to 8 months (November to April) with between 600 mm to 1,500 mm of rain per year. The average temperature is between 24 and 32 ºC with a minimum of 21º C and maximum 36º C. The human population of the parkland zone is estimated to be around 200 million. Figure 3 shows a combined map that uses three methods to visualize the shea growing zone – GPS points of botanical records, an outline developed from literature and field visits, and a suitability model developed with 8 environmental parameters.

Figure 3. Land Suitability Modelling of Shea (*Vitellaria paradoxa*) Distribution[3]



1.7.2 Core exporting nations

Many millions of women in eight West African countries (Benin, Burkina Faso, Cote d'Ivoire, Ghana, Guinea Conakry, Mali, Nigeria and Togo) are currently estimated to collect up to 1 million tons of de-husked shea, of which an estimated 350-500,000 t are annually exported either as unprocessed shea kernels, whole shea butter, or fractionated shea stearin.

1.7.3 Sub-species *paradoxa* versus sub-species *nilotica*

Although there is currently a contiguous belt of this tree species range, shea's East and Central African (ECA-shea) variety (*Vitellaria paradoxa* ssp. *nilotica*) is confirmed as genetically different and occurs east of Cameroun's Adamawa Highlands, overlapping with ssp. *paradoxa* in eastern

[3] https://www.sciencedirect.com/science/article/pii/S0143622815000387

Nigeria. Current distribution of genetic diversity is hypothesized to be a result of previous climatic changes, survival in refugia, and influence on gene flow by animal vectors and human agroforestry activities. There is a clear geographic trend that shows that shea butter becomes increasingly hard (stearic-rich) from east to west due to variable ratios of saturated to unsaturated fatty acids.

1.8 Occurrence in West Africa

Shea parklands dominate many landscapes across the Sahel-Savannah region. For instance, in Mali, the agroforestry parkland system occupies about 90 percent of the agricultural land area. In Burkina Faso, parklands are found throughout settled zones where agriculture is practiced, i.e. most of the country except for the extreme North, East, and parts of the South and Southwest where human population density is low. The parkland system is also recognized as the most common production system in Katsina State in northern Nigeria. With savannah lands occupying two-thirds of the country, a discontinuous cover of scattered trees in crop fields has been noted across large expanses of north Ghana. Despite these studies, there is a notable lack of a coordinated definitions and quantitative assessment of this land-use system at the sub-regional level. In Ghana, the Forestry Commission makes no distinction between natural open-forest and agroforestry parklands.

Table 1: Ghana Definitions, Tree Cover 2001-2015 Degradation, and Parkland Canopy Cover Model[4]

Closed forest = Canopy Cover >60%
Open forest = CC 15-60%
Minimum tree height 5m, min. area 1 ha
No classification of natural vegetation versus agroforestry
Cropland = agricultural lands with <15% CC
Grasslands = non-agricultural lands with <15% CC (fallow?)

Table 2. FC data on forest cover in three northern regions

- *Open forest = traditional shea agroforestry parklands?*

YEAR	CATEGORY	FOREST COVER
2001	Open Forest	2,628,574.80
	Close Forest	81,605.90
2015	Open Forest	595,252.00
	Close Forest	31,916.80

Canopy *diameter/m*	**5.0**	**6.5**	**8.0**	**9.5**	**11.0**	**12.5**
Canopy radius/m	2.5	3.3	4.0	4.8	5.5	6.3
Canopy area CA/m2	19.6	33.2	50.3	70.9	95.0	122.7
CA @ 10 trees per ha	196.3	331.8	502.7	708.8	950.3	1227.2
CA @ 25 trees per ha	490.9	829.6	1256.6	1772.1	2375.8	3068.0
CA @ 50 trees per ha	981.7	1659.2	2513.3	3544.1	4751.7	6135.9
CA @ 75 trees per ha	1472.6	2488.7	3769.9	5316.2	7127.5	9203.9
CA @ 10 trees per ha %	2.0%	3.3%	5.0%	7.1%	9.5%	12.3%
CA @ 25 trees per ha %	4.9%	8.3%	12.6%	**17.7%**	**23.8%**	**30.7%**
CA @ 50 trees per ha %	9.8%	**16.6%**	**25.1%**	**35.4%**	**47.5%**	**61.4%**
CA @ 75 trees per ha %	14.7%	**24.9%**	**37.7%**	**53.2%**	**71.3%**	**92.0%**

Data source: Ghana Forestry Commission; photo credit: Peter Lovett

1.9 Governance and the Cultural Environment

1.9.1 Land tenure, tree usufruct, and gender

Land ownership and usufruct rights are a highly complex matter across the entire shea parklands belt. Traditionally, land is communally owned with the land closest to the villages being the most intensively cultivated by the original settlers, while new comers generally are allocated the more distant lands from the villages. Shea and other native trees are usually considered the property of tribal/clan lineages. A woman married into a founding lineage thus collects from trees retained in fields and fallows of her husband's lineage. Shea fruits and other tree crops (dawadawa, tamarind, baobab, etc.) are then harvested by the women of the male-farmer's family with secure usufruct (access rights) during active farming periods. In some cases, women keep all revenue earned. In others, a proportion needs to be included in household accounts depending on type of field farmed.

[4] Definitions and forest cover: Ghana Forestry Commission; Canopy area model and photo: Peter Lovett

Image 6. Management of Savings by Shea Women

Source: Joseph Hunwick

Box 3. The History of State Control in Some West African Countries

In Ghana, the post-independence government has progressively been active in governing the shea trade for export. From 1949, exports of shea kernels have been controlled by different means through licensing and export control. In the 1980s this changed progressively to direct involvement in purchasing operations by the Cocoa Marketing Board and its subsidiaries. During the late 1980s (i.e. the period immediately before liberalization), local trading operations and transportation were administered by the Produce Buying Company (PBC), a purchasing division of the Cocoa Marketing Board (now named COCOBOD). While IMF/World Bank structural adjustment policies have gradually removed direct state control; and the role of the private sector and state intervention policy changes regularly as political regimes alter. During the mid-nineties, following down-turns in cocoa demand, the sector was de-regulated and private sector firms were given open access to trade in shea kernels. There was no change in the cocoa law, under which the national mandate shea was positioned, and PBC re-entered the shea market in in 2009 through the construction of a large shea crushing facility in Buipe, followed soon after by a government floor price in 2011. [5,6] Another example of recent state intervention is in Benin where the government has upped the export tax on shea kernels by nearly 300% to encourage more local processing. In Burkina Faso, the government has always played a major role in the development and regulation of the "filière" while in almost all the shea zone some form of forestry laws exist that theoretically control what farmers do with their shea trees.

1.9.2 State intervention

The role of the state in the shea industry has fluctuated considerably throughout its commercial history. As soon as colonial administrations saw the potential of international kernel exports to become a source of foreign exchange, they saw opportunities for direct and indirect tax revenues. States have also seen major fluctuations in global demand for kernels and felt the need to protect collectors through a range of price stabilization or protectionist trade schemes. Although the precise form and structure of state interventions has differed somewhat throughout the region, almost all the shea-belt states have attempted to play a significant role in regulating access to land and tree usufruct as well as attempted interventions in shea trade either directly (marketing boards or authorities) or by the control of export licenses to private traders and exporters. (Box 3)

1.10 What is Going Wrong in the Shea Sector?

1.10.1 Climate change

A review of the literature reveals both positive and negative impacts of climate change, but any improvements to tree cover are more than offset by human interventions and land use change (LUC). Data tends to indicate that shea parklands should be able to withstand the shocks of climate change better than some other systems. According to a recent Overseas Development Institute (ODI) study on this subject focusing on Burkina Faso, the shea tree is largely tolerant of a range of climate variables.[7] Rather than being considered a receptor for climate change risks as with cocoa, it has the potential to withstand a changing climate and to protect damage to other crops. The report further stated climate

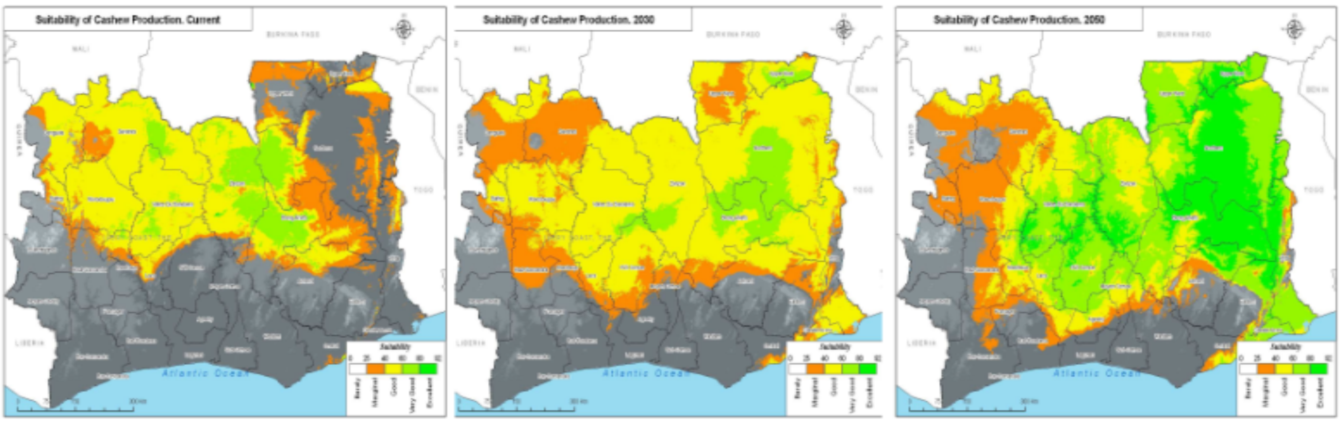
[5] https://www.ghanaweb.com/GhanaHomePage/NewsArchive/Buipe-Sheanut-Processing-Factory-A-Dream-Come-True-172421
[6] http://vibeghana.com/2011/10/10/government-announces-floor-price-for-sheanut/
[7] http://www.cakex.org/sites/default/files/documents/10508.pdf

change presents a ‘threat multiplier’ to the shea value chain, interacting with other non-climate factors characterizing the wider Burkina environment, economy, and society.

1.10.2 Climate change modelling

There are predictions for increased and more intense rainfalls in the northern parts of the shea parkland in the next 50 years, with increased minimum temperatures in the north of the belt and increased maximum temperatures in the south. This should extend the area suitable for growing shea towards the north. Flooding and soil erosion are expected as more likely with lower tree cover. Without higher tree cover, water infiltration and aquifer recharge are reduced. With increased shea tree cover, vital shade and higher soil moisture would be available for annual crops. As with modelling done for cashew, it is expected the ecological zone suitability will expand northwards with predicted climate change. (Figure 4)

Figure 4. Cashew Climate Modelling[8]



Climatic modelling of the two sub-species has suggested that the eastern sub-species *nilotica* is more likely to suffer from climate change factors than western sub-species *paradoxa*, which benefits from western monsoonal winds. Therefore, rehabilitation efforts are needed for eastern regions, though commercial interest and export demand remains focused on sub-species *paradoxa*.

1.10.3 Impact of climatic change on the community

A local proverb from Mali states:

> *‘Ni shi denna san o san, musow be lafiya’ (‘In any year that the shea trees fruit a lot, women will relax’)*

In a recent survey, 93% percent of women in Mali indicated they have perceived diminished shea tree fruit yields since they were children. In addition, 80% of respondents believed the cause of decreased yields was lack of water due to low rainfall while others cited parasites, trees aging, wind, hail, or a combination of these factors with lower rainfall. Additionally, a focus group of elder women expressed the view that population growth combined with decreased shea tree yields has reduced the amount of fruit each woman can collect. Women must collect fruits by flashlight in the early hours of the morning. Otherwise, women collectors believed they could not collect enough fruits to make sufficient butter to satisfy their needs. In 2017, during tree-planting trainings in Ghana, women stated the parklands were *undergoing menopause* – due to low yields and lack of regeneration.

1.10.4 Modern farming practices and impact on parklands

Traditional parkland system farm-fallow rotations are being rapidly replaced by permanent cultivation methods to meet higher food production demands. Given land scarcity due to population pressure and farmland competition for other crops to assure food security, there are now serious threats to the protection and preservation of shea parklands. This report contends that recent drivers to mechanize

[8] http://www.africancashewalliance.com/sites/default/files/documents/ghana_ivory_coast_climate_change_and_cashew.pdf

the farming systems to produce maize, soya, rice, sorghum, groundnuts, cotton, etc. using fertilizers, insecticides, herbicides, and fungicides are having a major detrimental effect on the length of the fallow, the biodiversity, and the overall ecological health of the shea parklands.

Although up to date LUC data is very limited for the shea parkland zone, at the turn of the century, agricultural expansion and multi-million-dollar projects sprang up across the sub-region, largely undocumented. Thousands of tractors and a significant tonnage of agrichemicals are being imported into Cote d'Ivoire, Ghana, Burkina Faso, Mali, Nigeria, and elsewhere. Mature trees are frequently reported as being ring-barked, based-burned, or even bulldozed during both small- and large-scale agricultural operations to clear for settlements, to extract wood fuel, etc. Recent studies estimate the range of threats to this species in Burkina Faso including overexploitation for wood fuel, overgrazing and trampling by livestock, intense fire, climate change, cotton farming, mineral extraction, and a combined threat assessment. (Figure 5)

1.10.5 Lack of data on mechanical ploughing

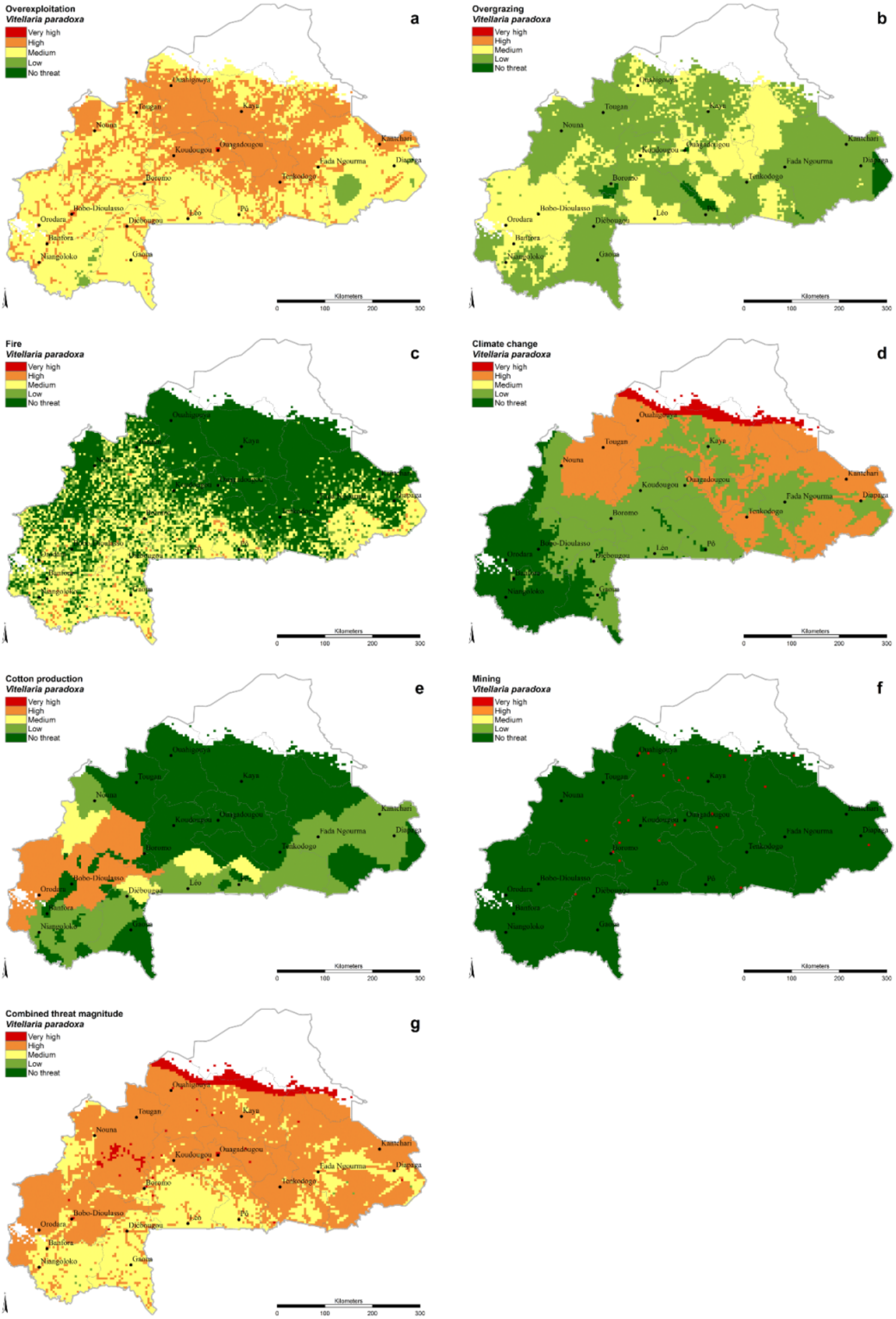
Collecting up-to-date information on imports of tractors, heavy equipment, and agrochemicals into the shea zone is critical. We expect the situation will differ across the region with tractor use and chemical inputs highest in Cote d'Ivoire, Nigeria, and Ghana and least in poorer more inaccessible regions like South Sudan and Chad.[9] (N.B. The latter countries are of less interest to buyers from the confectionery market.) Other studies have shown the use of mechanical tractors and oxen drawn ploughing equipment is more damaging to parkland tree populations than the use of donkeys. The latter are easier to move around trees but donkey populations across Africa have been decimated due to demand from China so that this semi-mechanized farming option is currently not possible.[10]

Image 7. Hand versus Tractor Ploughing

Source: Joseph Hunwick

[9] http://spore.cta.int/en/article/lessons-learned-from-ghana.html
[10] https://www.nytimes.com/2018/01/02/science/donkeys-africa-china-ejiao.html

Figure 5. Threats to *Vitellaria paradoxa* Survival in Burkina Faso[11]

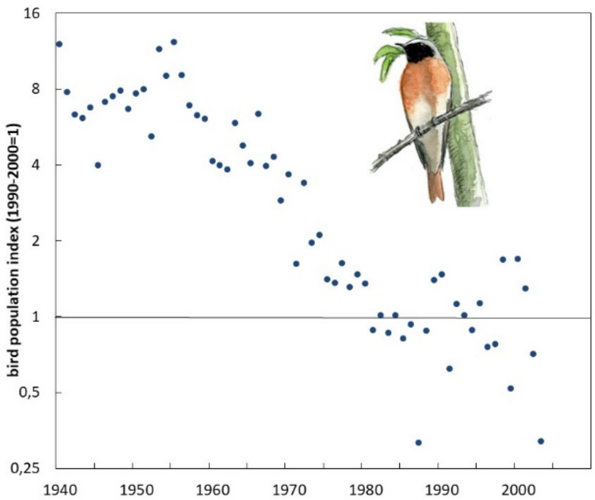


11 http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0184457

1.10.6 Impact of LUC on biodiversity and insect pollination

Pressure on the shea parklands is not just affecting numbers and density of shea trees, the whole ecological system appears under pressure. Increasingly, evidence suggests that degraded shea parklands, now being created by removal of other species of trees and shrubs, are failing to provide suitable habitat for migratory birds coming from South-Western Europe to overwinter in warmer climes whilst feeding on insects. Figure 6 shows populations of a typical migratory bird species overwintering in the Sahel-Savannah since 1940. Termed as "shea deserts," these landscapes now frequently lack mosaics of land use and the preferred diversity of tree species. Insect populations, including vital pollinators such as honey and stingless bees, are also in decline. This decline is of serious concern as demonstrated by recent research on the dependence of shea flowers on insect cross-pollination.

Figure 6. Historic Decline of the Common Redstart[12]



1.10.7 Impact of timber and wood fuel extraction

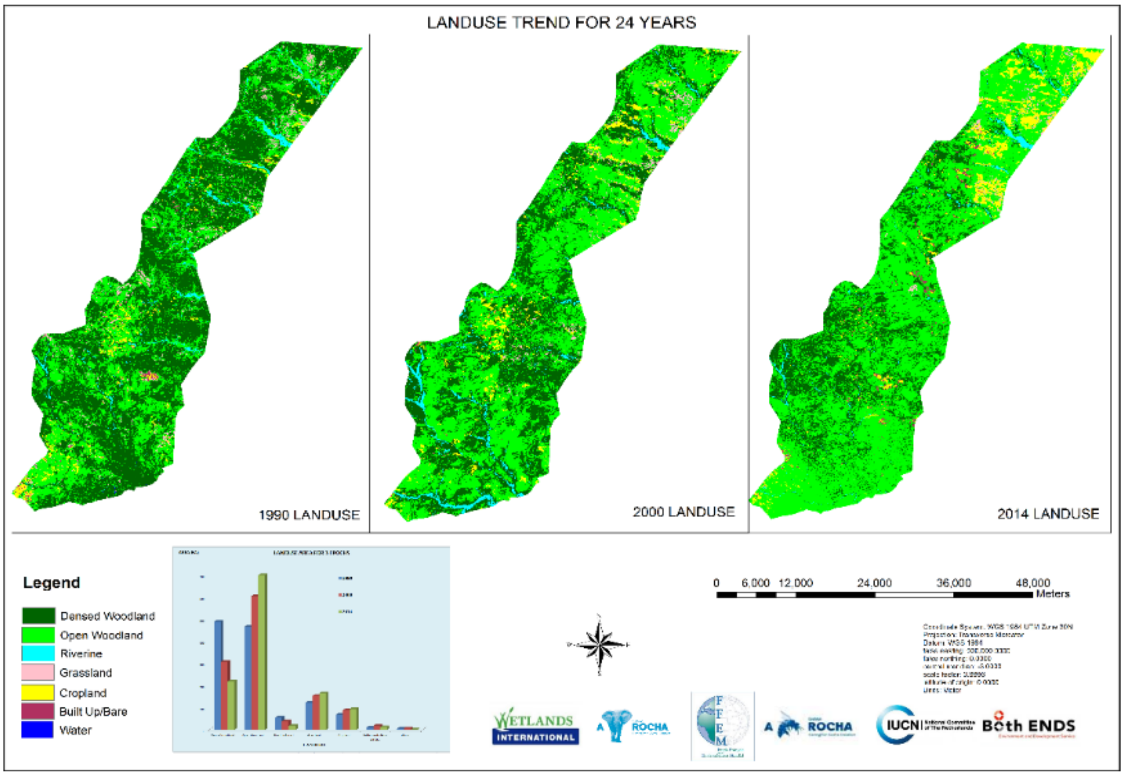
To satisfy urban and export demand, African forest administrations have allowed ever increasing felling and export of both hardwood timber and wood fuel from shea parklands. (Figure 7) Present harvesting practices are unsustainable with rapid degradation of the landscape to a point where restoration is becoming an expensive option due to opening of canopy cover and allowing fire to invade the landscape. As shown above in Table 1, results in Ghana are dramatic, with areas defined as "open forests" with canopy cover from 15%-60% having fallen more than 2 million hectares between 2001-2015. With Ghanaian definitions stating land use with greater than 15% canopy cover is open forest, shea densities in the 1990s were recorded as 20-30 mature trees per ha. It is likely that much of these lands were shea parklands and fallows, which amounts to an 80% degradation of Ghana's shea agroforestry production system in less than 15 years.

[12] http://www.altwym.nl/uploads/pdf/living_on_the_edge_Britsh_Birds_Newton.pdf

Image 8. Wood Fuel Market in a West African City

Source: Joseph Hunwick

Figure 7: Land Use Change 1990-2014, West Gonja District Ghana (Rocha, IUCN, et al.)



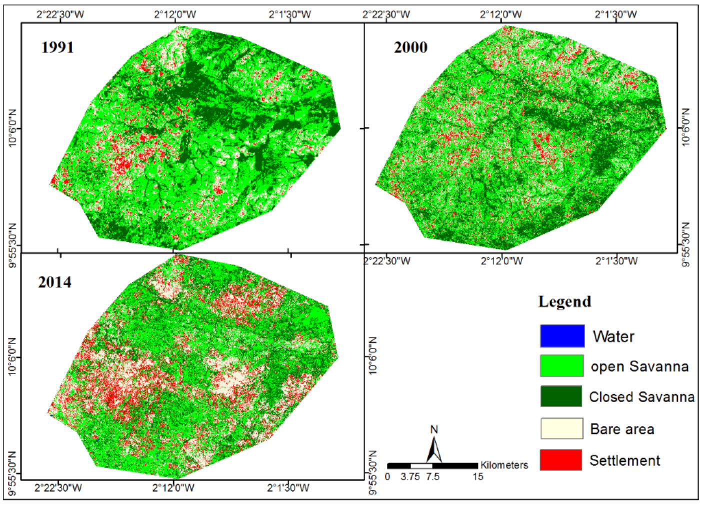
1.10.8 Shea as a traditional wood fuel

Shea is the most common tree species in these parklands, so naturally it is also the most readily available as dead wood for cutting. This does not necessarily mean that this practice is illogical or unsustainable, although in many places there is are traditional or official bans on the use of shea wood as firewood or charcoal. It is not uncommon that development actors perceive that 'natural' woodlands are being degraded because of excessive fuel wood harvesting by local populations. Development actors have misgivings about farmers' abilities to manage tree resources adequately and are concerned that local practices indiscriminately lead to permanent desertification, land degradation, and the loss of biodiversity and other ecosystem services. In the great majority of cases, these lands perceived as 'natural' woodlands are not virgin dry forests but are agroforestry landscapes that have been man-managed for centuries. Economic tree species have been favored through selection for human use. Fallow rotations in place, these are sustainable wood fuel production systems.

1.10.9 Impact of urbanization and mining

An increasing number of remote sensing studies across mining areas in the shea zone of Sub-Saharan Africa are showing evidence of remarkable land degradation and reduction in vegetation in many areas.

Figure 8. Land Use Change 1991-2014 Wa East District, Ghana[13]



Evidence shows that the increase of bare lands are the result of mining activities and the expansion of settlements. The latter is of critical importance as some of the most productive and accessible shea parklands used to surround the smaller settlements before recent conversion to residential areas.

Image 9. Urbanization of Shea Parklands

Source: Joseph Hunwick

1.10.10 Impact of fire

In 2015, Shea Network Ghana undertook a survey to ask collectors, village elders, and local politicians as to what they thought the major reason for deforestation. Results indicated that nearly a third (28%) thought it was due to fire, just under 19% that it due to indiscriminate cutting, the same amount thought it due to residential development, 16% through it due to farming, and under 10% thought it due to charcoal. The variation between groups was surprisingly similar.

[13] https://www.degruyter.com/downloadpdf/j/geo.2015.7.issue-1/geo-2015-0058/geo-2015-0058.pdf

The occurrence and role of fire as a management tool in the Sahel-Savannah is commonly misunderstood as cause and effect are often confused. There are multiple reasons for fires. Some are natural from lightning strikes. Others are deliberately set early in the dry season to encourage fresh grass growth for cattle. Farmers typically burn late in the dry season. Farmers pile vegetation at tree bases during fallow clearance to deliberately kill unwanted individual trees and to provide a concentrated source of potash for annual crops. Other types of fire are lit by hunters and some escape into the landscape following attempts to clear weeds near settlements.

Image 10. Fires across Heavily Degraded Parklands

Source: Joseph Hunwick

The shea landscape has a mosaic of fires that are lit at different times and for different land uses. Rarely are mature shea trees killed by fire, and young saplings usually survive as woody-rootstocks, reshooting after each burn cycle until managing to grow high enough in one season to escape the fire level. Once farms become permanent without fallows, fire intensity rapidly declines due to lack of biomass. In woodlands, the key cause of irreversible degradation results from the entry of intense fires following largescale canopy cover loss after timber and wood fuel extraction.

1.11 Institutional Capacity and Political Instability

Population growth, climate change, and mass migratory movements have placed a huge strain on the already weak and poorly financed institutional infrastructure in the shea parklands. Many of the governments in the countries of the region are struggling to maintain long lasting peace and security over portions of their territories. Civil war, ethnic struggles, and terrorist attacks have been commonplace in countries like Mali, Nigeria, Chad, Central African Republic (CAR), South Sudan, and Burkina Faso, all of which have current United Kingdom travel advisories in place.[14] The lack of political stability has not only discouraged private sector investment in the region, but has also limited the capacity of these countries to effectively use official development assistance. Nongovernment organizations, often based overseas, have taken over many of the training, educational, and extension functions contributing significantly to the development agenda in some cases taking on/over roles that should have been played by the governments themselves[15].

1.11.1 Educational capacity

Although ancient cities like Timbuktu and Kano in the shea parkland zone were great centers of learning in the 15th and 16th centuries the development of modern educational institutions in the zone has been minimal for the last 200 years. The number of functioning universities, colleges, and government research centers both per square km and per 1000 people is lower than almost anywhere

[14] https://www.gov.uk/foreign-travel-advice/nigeria

in the world. This lack of research capacity has not only hampered the development of the sector, but has skewed private and public-sector investment to the most accessible and administratively strongest countries like Ghana, Senegal, and Benin. Chad, CAR, South Sudan, and northern Nigeria are largely ignored.

1.11.2 Population growth and migration

The shea parkland zone has experienced some of the fastest growth in population as well as the highest levels of outward migration in the world. South Sudan at 3.9%, Niger and Uganda at 3.2%, and Burkina Faso and Mali at just under 3% top the global population growth charts while Nigeria's population has increased by 12+ million in just the last 5 years. This population growth places increasing pressure on natural resources of these countries and also leads to short- and long-term migration. The droughts of the 1970s followed by the political instability of recent years has promoted massive emigration from shea parklands zone. The issue of immigration of West African political and economic refugees into Western Europe is one of the most important topics dominating EU politics at the moment. Ensuring the economic health of the shea parklands and developing projects that can create jobs for the youth in this region could have a direct impact on the issue of African emigration.

1.11.3 The Rise of religious fundamentalism

Instability in the sub-region of West Africa has increased religious tensions such as Boko Haram and Al Qaeda in the Maghreb. The shea parklands have traditionally formed the frontier between the Islamic nations of the Maghreb and the coastal regions where traditional religions and Christianity dominate. The radicalization of Islam and the emergence of Al Qaeda in the region has further complicated matters and resulted in violence and instability in Mali, CAR, South Sudan, northern Nigeria, and even Burkina Faso. These tensions are felt right across the shea parkland belt. While it is unlikely to play a major part in the day to day restoration of parklands, these tensions have a major impact on the abilities of government and aid agencies to implement programs and policy changes in the region. It also dramatically impacts on the foreign policy views of international donors and radically restricts travel to the zone by international private sector staff.

1.11.4 Conflict with pastoralism

Traditional pastoralists have grazed across the shea zone, typically moving from north to south according to the rainfall seasonality. Their animals have provided much needed manure to farming plots and fallow land. In turn, the fallows have offered pasture for the animals especially in the dry season. Recently, transhumant pastoralist and sedentary/migrant farmers have engaged each other in an internecine warfare that is threatening the peace and stability of various countries in the shea parkland zone, with conflict primarily over resource use, damage to crops, and the blocking of transhumant corridors (i.e. farming along the valleys and stream/river banks and uncomplimentary agricultural policies by government). Recently, these conflicts have assumed a dangerous dimension with the infusion of ethnic, religious, and political factors. Cattle rustling, the availability of dangerous weapons, intra-pastoralist conflicts, mercenary elements, and dangerous drugs have all added to the issue[16], [17].

[16] https://edition.cnn.com/2018/07/27/africa/nigeria-herdsmen-boko-haram-report/index.html
[17] https://www.irinnews.org/news-feature/2018/09/04/mali-fulani-dogon-extremism-stirs-intercommunal

Image 11. Rising Conflicts with Fulani Pastoralists and Modern Development

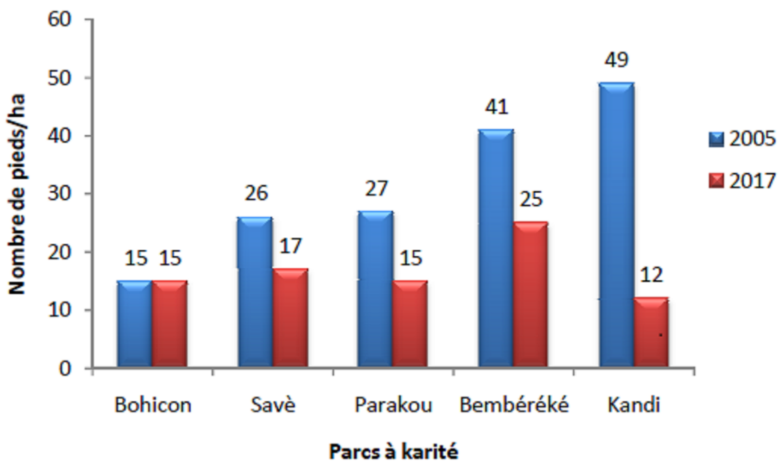
Source: Joseph Hunwick

1.11.5 LUC impact on shea tree densities

Although the authors of this report have personally seen and received countless reports (including case studies commissioned for this report) regarding levels of parkland degradation, reliable proof of these trends from parkland inventory are scarce. Recent surveys in south Burkina, however, show that there were significant differences between fields and fallow for *V. paradoxa*, the density in the fallows being 26–28 trees ha^{-1} compared to 13–14 trees ha^{-1} in the fields. The shortening or disappearance of the fallows is having a dramatic effect on reproduction rates and the survival of saplings large enough to be protected. The numbers of seedlings of *V. paradoxa* were almost without exception significantly higher under crowns than outside under *Parkia biglobosa*. These seedlings originate from seed falling either from the mother tree above or from seed brought to the tree by another vector such as birds or bats perching in the trees eating the fruits of *V. paradoxa*, or humans taking their lunch break under the tree, also eating fruits. The decline in wildlife vectors is having a direct effect on tree regeneration.

Recent inventories across Benin demonstrated significantly lower shea densities as compared to 2005. (Figure 9) This is of serious concern in relation to availability of a collectable shea crop.

Figure 9. Comparison of Average Densities of Shea Trees between 2005 and 2017, Benin[18]



2 The Production System

2.1 Collection and Post-Harvest Processing (curing)

2.1.1 Shea fruit collection

Shea fruit, unlike most other tree crops, do not require picking from the tree. Women and children usually collect the ripe fruit from the ground early in the rainy season between April and August in Northern Ghana and southern Burkina Faso. Where possible, the harvest is collected as quickly as possible due to rapid germination or rotting that spoils oil quality. Vigorous vegetation growth at the start of the rains, soon makes collection difficult. During a good season, up to 45-55 kg of fruit can be collected per person per day, although this is very dependent on tree density, yield and access from the village. The collection basin usually holds about 25 kg of fresh fruits, though loads of 43 and 47 kg have also been recorded. One survey in Burkina Faso suggests that only trees within a day's walk (about 12km each way) are visited. Routes were planned to maximize visits to uncollected trees and the survey found that a total of 46 trips by one 28-year-old woman allowed collection of 1150 kg of fruit, yielding approximately 350 kg of dried kernels.

2.1.2 West African curing methods

After hand collection, in West Africa, fresh shea fruits are processed post-harvest, usually with a boiling in water treatment, preferably for 15–40 minutes within one week of collection and then sun-dried followed by a de-husking step within 3–4 days. After de-husking and desiccation, ideally to below a recommended 7–8% moisture content to prevent fungal infection, *cured* kernels are held in jute sacks or woven baskets and stored in dry, well-vented locations.

The alternative, less-favored, *curing* method in West Africa is smoking the seeds in large clay chimneys. Although methods are changing, this latter practice has been typical in certain locations in Mali, northern Cote d'Ivoire, and Nigeria. This method is not recommended by international buyers due to low extraction efficiency and EU regulation (835/2011) on carcinogenic PAHs (polycyclic aromatic hydrocarbons).

2.2 ECA-Shea Post-harvest Processing

Kernels of the East and Central African, subspecies *nilotica* (ECA-shea) variety are approximately 25% less rich in stearic acid and about 25% richer in oleic acid. They are of reduced commercial

[18] Gnangle, P. (2017), le karité Béninois: entre promotion des femmes rurales et création durable de valeur ajoutée. 115 p. Rapport d'étude. PARASEP

interest to the confectionery sector due to low Stearic-Oleic-Stearic (StOSt) content. The key difference for post-harvest processing or *curing* of ECA-shea is that instead of either boiling or smoking, the fresh fruits are typically de-pulped and laid out in the sun to dry "raw" without any other heating stage. After de-husking, these sun-dried, raw kernels are also then stored as above prior to processing.

2.2.1 Returns from harvesting shea kernels

Margins from the collection of kernels is generally high but the actual number of bags collected per rainy season, is very low. Table 2 below provides empirical data from north Ghana.

Table 2. Collection, Post-harvest Processing Costs, Revenue, and Margins of Kernel Production ($ = USD)

Fixed costs (firewood, water, utensils) per ton dry kernel	$35.39
Labor costs (from ergonomic studies/minimum wage) per ton dry kernel	$169.98
Production cost per ton dry kernel – raw material [fresh fruit] at zero cost	**$205.37**
Revenue per ton – farmgate sales summer 2016	$367.77
Gross margin (%) = (Revenue – Production cost) / Revenue	44.2%

Source: USAID (2016) Ghana Agriculture and Natural Resource Management Project: Natural Resource Product Sector Analysis – Shea Roadmap. Agreement Number: AID-641-A-16-00010

2.2.2 Collection volumes

Evidence suggests that apart from the key high stearin zones, there is under-collection of as much as 50% of fruits in many regions of the shea parklands. This is despite the fact that margins from collection are high and women are often in desperate need of cash during the harvest. The reasons for this are complex and include a lack of time, a lack of transport and containers, the presence of snakes and other hazards near the trees, a lack of access to low density trees, and a lack of market. The inter-annual and intra-population variability of production are also disincentives to hand-collection. It cannot be overemphasized that any increase in this performance will lead to proportional increase in their income. Sensitivity analyses demonstrate that increased collection from an average of 3 bags per year to 12 bags could potentially increase women's annual gross margins from USD$40 to USD$235 per annum.

2.2.3 Recommended kernel quality

If good post-harvest processing practices are followed, desiccated shea kernels have a high oil or fat content that averages of 45%-55%. Individual tree oil content ranges from below 25% to more than 60% depending on the source tree and subsequent handling practices. The fatty acid profile (FAP) predominantly consists of stearic and oleic fatty acids with a smaller percentage of linoleic acid (4-7%). The current commercial market prefers shea kernel quality with: Free fatty acids (FFA) <6%, stearic acid >35%, kernel fat content 45-55%, water content < 7%, and impurities < 1%. It should be noted that this excludes kernels of the sub-species *nilotica*.

2.2.4 Yields per tree

Average per tree yield ranges widely from 2kg to 20 kg of dry de-husked shea kernels per tree per year. Farmers and traders in many areas speak of a 3-year cycle of productivity. A low yield followed by a high yield, followed by a medium yield, followed by a low yield (and so on). However, this has not been verified statistically. Studying fruit yield over 3 years in Burkina Faso, Boffa (1999) found that 42% of trees produce no fruit at all, 34% produce fruit in 1 out of 3 years, 15% in 2 out 3 years, and 9% every year. The high percentage of unproductive trees should be noted.

A recent study in Benin confirmed this wide variation. It showed a mean fruit yield per tree of 1,136 fruit in 2013/2014. This dropped by nearly 30%. to 791 per tree in 2014/2015. In contrast, shea fruit yield increased by just under 10% (from 649 to 715 fruits per tree) in young fallows during the same period and by 48% on old fallow land over the same period (Benin C.S. 2018).

2.3 Traditional Shea Butter Extraction

2.3.1 Market choice

Women in the shea parklands have a range of limited market choices. They can sell their kernels to industrial or hand-crafted processors based locally and abroad, they can convert the kernels into butter/oil to be consumed at home, or they can produce for cash sales at local markets or to exporters.

2.3.2 Water extraction

In West Africa, methods of traditional extraction involve crushing sun-dried kernels into smaller particles either by hand with simple tools or mechanically in 'crushers', dry roasting to desiccate and denature any remaining lipases, grounding into a fine paste on a stone quern or in a mechanical grinding mill, and then mixing with cool-warm water and "hand-kneaded or beaten" until an aerated emulsion of the stearin-rich fat has formed. Following the addition of copious cold water, this emulsion floats to the surface as cream on milk and is scooped off by hand before being boiled to dry the oil, decanted, and filtered clean of impurities.

Image 12. Mechanical Grinding & Hand-Crafted Shea Butter Extraction

Source: Joseph Hunwick

2.3.3 Oil yields

Typical extraction rates recorded by dry kernel weight in West Africa ranged from 20% to 42%, the highest rates recorded for best quality 'tunnel-dried' kernels. An average of 35%–40% is now typical of well-informed and well-practiced cooperatives across north Ghana. The typical kernel oil-content of approximately 50% suggests they are achieving an extraction efficiency of 70–80% for a 'village-refined,' edible oil. In contrast, mechanical expellers extract 33%-35% by weight of cleaned-kernel, though adding hexane improves oil extraction to 48% by weight (96% efficient, edible only after refining)[19].

[19] If oil content of the kernel is 50%, and extraction by weight is 48%, then efficiency is 96%. Mechanical plus solvent extraction has a higher yield, yet the oil will not be edible until is fully refined – unlike the village crafted butter

2.3.4 ECA-shea extraction

In East and Central Africa, the raw sun-dried kernels are traditionally heavily dry roasted and often scorched while mixed *whole* in sand or ash before being ground into a paste, as above. This paste is then boiled in water (akin to the traditional method used for palm kernel oil extraction) and the shea oil is skimmed or decanted from the surface. The oil is further boiled to dry, decanted, and sometimes filtered to clean it.

2.3.5 Returns from shea butter production

As can be seen from Table 3 below, based on empirical evidence from northern Ghana, margins from hand crafted butter manufacture are low, but if availability of female labor is high, as it is in rural villages during the dry season, then even low, year-round income is still a good revenue generating opportunity. Premiums from organically certified produce increase margins significantly, although this hand-crafted market may be under threat due to the emergence on the market of mechanically extracted fairly-traded or organic certified shea kernels. See Section 3.7.5 below for additional details.

Table 3. Returns from Hand Crafted Shea Butter ($ = USD)

Fixed costs per ton of butter (firewood, labor, utensils)	$279.94
Raw material cost (farmgate 2016, extract @ 35%) per ton of butter	$1021.60
Labor costs (from ergonomic studies/minimum wage) per ton of butter	$137.25
Production cost per ton of butter	**$1438.29**
Revenue per ton of butter – summer2016	$1500.00
Gross margin (%) = (Revenue – Production cost) / Revenue	4.1%

Source: USAID (2016) Ghana Agriculture and Natural Resource Management Project: Natural Resource Product Sector Analysis – Shea Roadmap. Agreement Number: AID-641-A-16-00010

2.4 Industrial Extraction of Shea Butter

2.4.1 Expeller and solvent extraction

The industrial method of shea butter extraction uses palm kernel expellers fitted with top kettles or cookers, which heats shea kernels with a steam jacket to more than 80-90°C to ensure expelled shea butter is liquid oil. De-husked shea kernels, preferably boiled and sun-dried as described above, are cleaned of impurities and then fed into top kettles using conveyors before being dropped into a continuously turning screw-press with capacities ranging from 3 to approximately 100 ton per day. The hot oil can be then cleaned and dried using vibrating filters, vacuum driers and filter-presses before being stored in heated tanks prior to using ISO or flexi-tanks for bulk international transport. The residues after crushing, known as *shea cake*, are usually hexane extracted to increase oil yield and the remainder then used for firing boilers to heat steam for top kettles or exported as biomass and a low-grade addition to cattle feed.

2.4.2 Solvent acetone fractionation

To separate the StOSt-rich stearin and olein fractions from each other and to remove any polyisoprenic hydrocarbons, shea butter is usually *wet* fractionated. The polyisoprenes are undesirable unsaponifiables having rubber-like properties, high melting points, and resulting in filters and machinery being difficult to clean. One method used to wet-fractionate shea butter involves filtering out the high-melting StOSt-rich stearin fractions under vacuum obtained following low-temperature crystallization in substantially anhydrous acetone. An alternative, but currently less cost-effective method, is supercritical carbon dioxide dry fractionation. These are high technology processes and cannot be done at village level. When a third fractionator in Ghana comes online at the end of 2018, an estimated half of all shea stearin production will take place in Africa.

2.5 Refined, Formulation-ready Shea

2.5.1 Refining options

To date, whether for food or cosmetic use, the majority of refined, formulation-ready, whole shea butter and shea stearin is processed in Europe or Asia. Whether made in Africa or Europe, almost all shea butter destined for the EU market is funneled through about 10 specialist refineries such as Zor (Cargill), SRC, Olvea, Bunge Loders Croklaan, AAK, Fuji Oils, Wilmar, etc. prior to use in finished product formulations.

2.5.2 African refining capacity

Recently, refining capacity is emerging in West Africa. However, for material from these plants to enter the global food and cosmetic industry they need to comply with international regulatory standards (HACCP, ISO, CODEX, Organic, Fair Trade, etc.). Franchised joint ventures with experienced global refinery companies are probably the best way for African companies to enter the global market. There are, however, large potential opportunities to use refined shea butter/oil in the domestic edible oil markets of Africa particularly in Nigeria and Mali, where there are huge volumes of kernels not exported

2.6 Shea Production and Processing Economics – What is Going Wrong?

2.6.1 Lack of profitability studies

There are few detailed and accurate studies of the profitability for village women in the shea parklands of harvesting and post-harvest processing shea kernels and the extraction of shea butter. One reason for the large variation in results relates to how women's opportunity costs are calculated.

2.6.2 Margins along shea supply chains

Analyses of different stakeholders in Uganda indicates that shea collectors have the highest gross margins in the supply chain (68%). Village processors who buy shea kernels to process shea butter have gross margins of only 27%. Wholesalers and retailers have gross margins of 12% and 21%, respectively. These figures compare well with detailed calculations undertaken by researchers in West Africa which indicate a 44%-67% margin from collection and sale of kernels, but only a 4%-18% margin from the manufacture and sale of hand-crafted butter.

2.6.3 Gender sharing of benefits

While shea production is primarily a women's activity, their rights for access and management are not straight forward as patrilineal societies dominate in the shea zone. Where mediated by male household heads, arrangements exist that are intricately dependent on tenure, usufruct, economic value of products collected, and community contexts. Studies in Burkina Faso showed that while most cash income is retained by women, 27% of women gave portions of shea earnings to their husbands in cash or in kind. Hence there is considerable variation as to the division of both costs and benefit sharing from shea harvesting and processing in parkland locations.

While women are the primary collectors and post-harvest processors of shea kernels, they are usually the weakest stakeholder in the shea supply chain having little visibility, security of land tenure, or tree usufruct. They also obtain a very small proportion of the total revenue generated by the value chain. On average, they only have the capacity to sell 1-3 bags of shea kernels per annum. It is interesting to note that income from the production of shea firewood and charcoal goes almost entirely to men, whereas most of the income from the sale of shea kernels and butter goes to women.

2.6.4 Parkland value addition

Most recent projects to "improve" harvesting, curing, and processing have been developed by men living outside the shea parklands and have benefited men living in towns and cities. The value addition is usually far-removed from the parklands in the hands of consolidators and factory owners. Margins at the farm and village levels are still very low. This leaves women and their husbands little incentive to protect naturally regenerated shea or plant shea seedlings in lands being converted to intensive annual crop production.

Non-timber forest products (NTFPs) are an important and generally underreported component of overall rural family income in shea parklands. It is not just the annual total contribution that matters but the amount at different times of the year. Estimates of the household income derived from NTFPs average around 8% to 20%, but these figures usually greatly underestimate the value of home use. Surveys of percent of total income from only shea in Benin and Burkina Faso show widely different results ranging from 8% to 35% of total income. Moreover, as this income goes mainly to women, shea kernel and butter sales can represent up to 80% of their cash income in the main kernel exporting areas.[20] But, as calculations during the formation of the GSA indicate, the employment impact of shea for CBA production can be very significant. (Box 4)

3 Shea Consumption

Box 4. Number of Shea Collectors Involved to Make a Typical U.K. Chocolate Bar

- Typical 100g bar of milk-chocolate
- Contains 5 % non-cocoa fats
- 20% of these fats are shea stearin (1% of bar)
- ≈7g dry shea kernel per bar
- 300 million bars sold in UK annually
- 2,100 tons dry shea kernel
- 25,200 bags harvested by 8,400 to 25,200 women (@ 1 to 3 bags/person)

3.1 Traditional Utilization of Shea

In West Africa, shea butter continues to be utilized as the staple "oil or fat" in the household, as a cooking ingredient for deep or shallow frying, soups, sauces, breads, etc., as an ingredient for soap and skin-pomade, as an illuminant. Forty years ago, Malian traditional shea consumption was recorded as ~21g per person per day in rural areas of the shea zone.[21] Thirty years ago, 80% of people in northern Benin consumed shea butter as their staple oil.[22] In northern Uganda and South Sudan, the dark-brown, smoky-nutty flavored oil, which is liquid at tropical temperatures, is sold in bottles and served as a condiment dressing over meals typically consisting of carbohydrates with a protein-rich sauce. The shea fruit-pulp is a famine season source of nutrients including vitamin C and caterpillars of the *shea defoliator* silk moth (*Cirina butyrospermi)* are eaten for protein.

3.2 Local Use Pre-19th Century

Ibn Battuta (1352–1353) and Mungo Park (1795-1797) recorded shea's widespread consumption and trade during their travels. George Ekem Ferguson, a Fante geologist in Ghana in 1900, also recorded abundant shea trees and butter trade. Archaeobotanical evidence for shea consumption and trade dates to at least the year 2,000, possibly 4000–5000 BP.

3.3 Current Local Trade for Food and Nutrition

The lack of almost any detailed surveys on annual, seasonal, or historic trends in household shea butter consumption is surprising.

[20] The lack of detailed up-to-date information on the contribution of NTFP to total income in the shea parklands suggests that more studies in this area are required.
[21] Fleury 1981.
[22] Agbahungba and Depommier 1989.

3.4 Production Volumes

UN Food and Agricultural Organization (FAO) statistics indicate an annual average collection of 750,000 t of shea kernels in Africa of between 2005 and 2013. We estimate that 55% to 75% were consumed domestically while the remainder, 25% to 45%, were exported. Exports from West Africa in a similar period amounted to 200,000 (33%)–350,000 (58%) of the 600,000 shea kernel equivalent tons (SETs).

3.5 Local Consumption and Nutritional Value

The total human population of the shea belt is estimated at 200 million, of which 112 million are estimated using FAO data to live in shea parkland areas. If we assume 40% of the population consume an annual average of 8 kg per head per year this would suggest that 346,000 t of shea butter is annually consumed (1+ million SETs with 33% extraction). [23]

Box 5. Online Nutrition Facts: Shea butter, beurre du karité (Fr.)

Vitellaria paradoxa

Source: Wikipedia & other online sources

Amount per 1 tablespoon		14 g	
~2 tablespoons ≈ per person African daily shea consumed mean =			27.4 g
Calories		120	240
% Daily Value			
Total Fat	14 g	21%	42%
Saturated fat [*stearic*]	6 g	30%	60%
Polyunsaturated fat (*linoleic*)	0.7 g		
Monounsaturated fat (*oleic*)	6 g		

FAO statistics indicate average intake of oil/ fat in sub Saharan Africa ranges from 15 kg to 16.5 kg per annum. Box 5 shows typical nutrition values from shea fats. This is generally less than the recommended minimum 15% of total energy consumption from fat/oil.[24] As mentioned above, one of the few detail studies undertaken in northern Benin indicates that more than 80% of northern Benin (1.8-2 million people) use shea as their main dietary fat. Its daily consumption in this zone in 2010 was estimated at 26.3 g per person, which translates to 28,800 t shea kernels per annum.

The nutritional value of the shea fruit pulp has also been underestimated. Although difficult to commercially exploit because of its short storage life, women and children eat the fruit pulp regularly throughout the season. The pulp forms from 33%-80 % by weight of the whole fruit, which is typically between 20-30 g. Fifty (50) g of shea pulp can satisfy 98%–332% of the daily dietary requirements of vitamin C for pregnant mothers and children ages 4–8.

3.6 International Demand for CBAs

3.6.1 Early, up to mid-1990s

In 1914, shea was traded in small amounts at ten pounds sterling per ton in Liverpool. Both French and British colonies began to export shea kernels and shea butter to Europe, where it could be used to produce margarine. Messrs Loders and Nucoline Limited of Silvertown, U.K. developed palatable and stable cocoa butter substitutes (CBSs) in 1887, resulting in the 1950s launch of a coconut fat-based substitute named Nucoa. By 1956, Unilever (UK) had developed and patented the cocoa butter equivalent (CBE) Coberine™. Subsequently, Aarhus Oliefabrik (Denmark) launched Kewax in 1960. This was followed and replaced within a decade by Illexao™.

[23] Village level surveys indicate that average annual consumption of Shea butter in sub-Saharan countries ranges between 7.3 up to 10 kg per person (Boffa 1999; Dah-Dovovon 2006).

[24] http://www.who.int/nutrition/topics/3_foodconsumption/en/index3.html

3.6.2 Market growth (mid-1990s – today)

By the mid-1990s, shea was already well known as a rich source of symmetrical StOSt tri-acyl-glycerides (TAGs), particularly when fractionated as shea stearin. Co-formulated with PMF, the symmetrical palmitic-oleic-palmitic (POP) TAG-rich mid-fraction of palm oil, shea stearin became the main ingredient for formulating cocoa butter alternatives (CBAs). Shea soon evolved as the main source of StOSt as illipe supplies, a key alternative ingredient, became increasingly uncertain. Although more difficult to process than alternatives as shea needs fractionating with solvents, the big CBA importers realized that large volumes could be sourced consistently from the shea parklands. Moreover, they could keep a tight control of the required processing technology.

At the turn of the 21st century, a small group of firms capable of shea fractionation and CBA formulation (Aarhus Oliefabrik, Karlshamn AB, Loders Croklaan, Fuji Oils, and the 3F Group) shared a solid business proposition with high margins and relatively large volumes of CBA demand. Most extraction and all fractionation and formulation stages were done outside Africa.

3.6.3 Recent export growth

Recent estimates of the total annual export crop from the region had risen from around 150,000 tons prior to 2004 to as high as 500,000 SETs by 2013 and were sourced from just eight West African nations: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea-Conakry, Mali, Nigeria, and Togo. The current annual average export is probably closer to 370,000 SETs. The *rolling-average* annual demand for shea kernels is expected to exceed 400,000 SETs by 2020 even without the additional demand from U.S., if and when regulatory changes there allow the incorporation of CBAs into chocolate. The structure of this value chain and how the product flows from collectors to European retailers is outlined in Figure 10 below.

Figure 10. The Shea Butter Market Structure and Value Chain[25]

[25] https://www.cbi.eu/sites/default/files/market_information/researches/product-factsheet-europe-shea-butter-2015.pdf

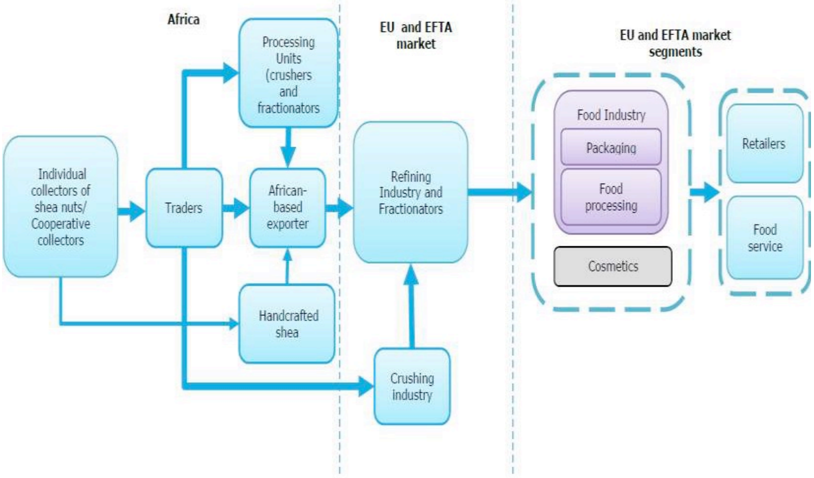
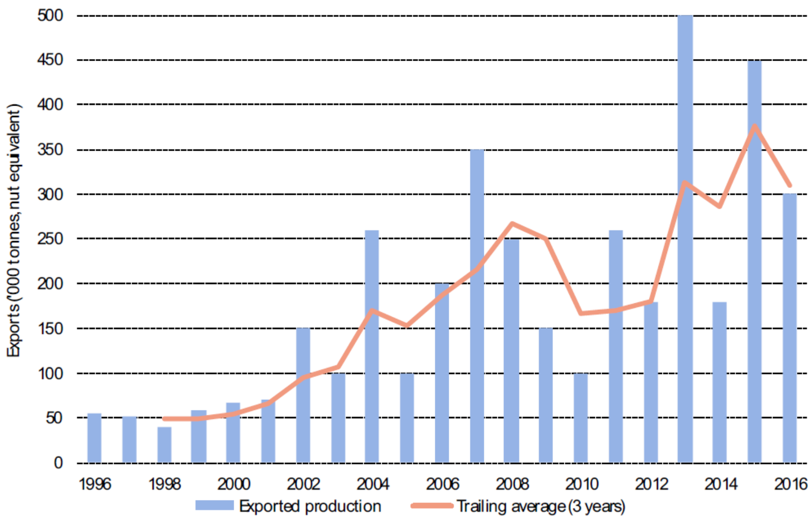


Figure 11. Exported Production ('000 tonnes, kernel equivalent)[26]



3.6.4 Outlook for CBA markets

Until the financial crisis of 2008, the outlook for shea remained bullish with 6-7% annual growth rates. After a fall in demand between 2008-2013, exports have picked up again with some bumper crops and increased cocoa butter prices due to predictions of cocoa supply shortfalls in current and future years. Chocolate companies continue to look to CBAs to smooth cocoa butter price fluctuations while ensuring premium products in chocolate confectionery with the improved functionality that CBAs offer. Although the mature European chocolate markets have remained relatively flat, demand for CBAs in the Asian and Latin American markets has been high and is predicted to grow strongly in coming years.

3.6.5 Demand for shea kernels is a derived demand

The profitability of using shea butter in the confectionary sector is largely due to the relative cost of shea butter to cocoa butter. Barring local demand for butter as an edible oil staple, shea kernel demand is a *derived demand*. Once the cost of procuring shea kernels rises above a certain point, industry can switch to just using cocoa butter or the other cheaper exotic fats that are legally allowable as CBA ingredients. Furthermore, changes to chocolate regulations may mean that, enzymatically modified fats and algal butters might also become viable alternatives. In the case of the cosmetic sector, there are many other available alternative ingredients such as jojoba, coconut, mango and palm oil.

[26] https://www.lmc.co.uk/

3.6.6 Cocoa butter pricing

Since peaks of USD$9,323 per ton in July 2008, the cocoa butter market dropped over 75% to the lows of December 2011 when prices as low as USD$2,222 per ton were recorded. West African cocoa production volumes reached record highs in 2011 and the ongoing global recession resulted in reductions in cocoa demand growth. Meanwhile, the accentuated demand for cocoa powder in Asian markets saw grinding ratios (powder to butter) drop to below 0.92, and a glut of cocoa butter appeared on the market. Following a degree of global recovery, fears for lower cocoa production and disruptions to supplies as a result of Ebola led to a dramatic recovery in cocoa bean prices (to more than USD$3,350 per ton) and butter ratios (more than 2.5). Poor grind data and harvest predictions in October 2014 resulted in cocoa butter again exceeding USD$8,000 per ton that year. Following large harvests and low grinding volumes, cocoa bean prices again collapsed to lows of USD$1,900-2,100 per ton during the 2017-2018 season. The grinding ratio, however, ended 2017 at about 3.7 in Europe, giving cocoa butter prices of about USD$7,500 per ton. This was expected to continue to drive interest in CBAs for the 2018 harvest.

Even if one ignores the sale of by-products from extraction, fractionation and refining such as kernel residue, olein, karitene, mono- and di-glycerides), typical revenue from a ton of fractionated unrefined shea stearin is around USD4,000 per ton (factory prices, 2016-2017 requiring around 6-7 tons of shea kernels). Even with high use of 30% shea stearin to 70% PMF (USD1,000 per ton), crude ingredient costs for a ton of CBA may still be lower than USD2,000 (exclusive refining, transport, formulation, etc.). This highlights the derived demand nature of shea and one business case for CBAs – valorization of palm oil.

3.6.7 Local industrial processing

After several unsuccessful attempts by African-lead consortiums to develop profitable bulk shea crushing facilities in West Africa, in 2006, the first large scale crushing and fractionating plant in Africa was commissioned through an ADM-Wilmar joint venture in Tema, Ghana. Additional processing plants with financial investment from a range of international edible oil companies (all with hexane extraction, some with acetone fractionation technology) are now well established in Benin, Burkina Faso, Ghana and Togo. Others, including unprofitable processing plants lacking solvent extractors, are also planned or being renovated in Cote d'Ivoire, Mali and Nigeria. If all this capacity were to become operational (more than 20 plants in 7 countries), it is estimated that the entire West African shea crop currently collected could be processed mechanically in West Africa[27].

3.7 Importance of Shea in Beauty Care

3.7.1 Functionality

Shea butter acts as a skin conditioning agent and viscosity increasing agent (thickener). Its function as a dermal conditioner is twofold. First, it is a humectant, it helps retain moisture and lessens the loss of water by forming a barrier on the skin's surface. Second, it works to reduce the appearance of rough patches and dry flakes on the skin.

3.7.2 Unsaponifiables

Shea butter also has many bioactive properties, including UV protection due its triterpenes in the unsaponifiable portion – a group of biochemicals which, unlike other fatty oils, do not turn into soap. The 5-7% average unsaponifiable content of whole shea butter is higher than most other vegetable oils. It has therefore attracted attention of cosmetic chemists worldwide. Analysis of these unsaponifiables has revealed a wide range of interesting and useful bioactives with anti-oxidant, anti-inflammatory, anti-tumor, UV-protective, and protease-inhibition properties that include triterpenes,

[27] In 2017, amongst others, major firms involved along industrially processed shea supply chains included AAK, Loders Croklaan, Fuji Oils, The 3Fs Group, Wilmar, Fludor, Nioto, Cargill, SRC, and Olvea. Major mergers and acquisitions continue in the sector and in the first quarter of 2018 as Bunge finalised its acquisition of 70% of Loders Croklaan.

phytosterols, polyisoprene hydrocarbons (karitene), tocopherols, and catechins (polyphenols – flavanols), with dry kernels consisting up to 0.4% of the latter.

3.7.3 Cosmetic demand

The demand for shea butter as an international cosmetic ingredient began in the early 1980s. This market now represents an estimated 10% of total African exports or 35-45,000 SETs. This equates to an estimated use of 10,000-15,000 t of shea butter worldwide. A significant portion, 2,000+ t, currently enters U.S. markets. Exports of hand-crafted butter have increased from 190 t in 1999 to an estimated 4,000 t in 2011 and are believed to have exceeded 8,000 t in 2017. The growth rate for this market has been running at over 25% per annum for over two decades. Approximately half of all international personal care use is estimated to come from hand-crafted sources, whilst industrially processed (including use of olein and other fractions) makes up the other 50%.

3.7.4 Certification of shea butter

In recent years, interest in certification of shea butter for use in the personal care industry in both Europe and the U.S. has grown. Since they source shea butter from many well-organized women's groups at 'above market' prices, The Body Shop now uses an internal system, *Community Trade*, with third party auditing. The Fairtrade Labelling Organization developed international guidelines for fair-trade production of shea butter. These are not popular due to high fixed prices, usually four times the local market price, and are only appropriate for brands buying directly from producer groups. Many ongoing initiatives now source organic shea butter. L'Occitaine, the French cosmetics company, sources from women's groups in Burkina Faso. Ecocert organically certifies for Songtaaba and Lacon. Certified groups were linked to Projet d'Appui aux filières Bio-Alimentaires du Burkina Faso (PAFB). A more realistic *Fair for Life* scheme run by the Institute for Marketecology (IMO) certifies many groups in north Ghana and Togo, from which Sundial Brands and Alaffia source their shea butter from. One project in northern Uganda had become organically certified with assistance from Export Promotions of Organic Produce from Africa (EPOPA), but regrettably collapsed due to contamination from a large-scale malaria spraying program. Although most companies performing organic certification are European, according to the U.S. National Organic Program (NOP) website, many of the same companies involved in the West African region are already accredited or have applications being considered for certifying the sale of organic products in the U.S. and Japanese marketplaces.

3.7.5 Industrial production certified

Until recently, organic and/or fair-trade certification was used to highlight the fact that maximum value addition was retained in the villages within or adjacent to shea parklands. The role of hand-crafted shea butter production by local women was widely publicized worldwide by the beauty industry. There then followed a wave of growth in the demand for certified hand-crafted butter, with one being synonymous with the other. Now, however, an industrially processed, organically certified shea butter has emerged onto the world market with the result that organically certified shea butter is no longer synonymous with being produced by the hands of rural African women. Due to a lack of market differentiation, this 'industrial organic production' poses a large threat to the employment and income opportunities for hand-crafted, village-refined shea butter processors. This situation requires urgent action.

3.7.6 Organic refining

As stated earlier, all shea used in commercial cosmetic and confectionary products requires a further refining stage before use in formulations. Due to increasing demand from the natural cosmetic sector for 'non-chemically-extracted' whole, refined shea butter with intact organic and fairly-traded certifications, a physical refining process that does not use inorganic chemicals has been developed and is now used to refine all organic, fairly-traded and conventional whole shea butter. This process involves a series of organically certifiable stages using organic citric acid for degumming, bleaching clays, steam-pasteurization, and micron-filters that can remove free fatty acids, peroxides, latexes, carbon particles, and other impurities including pigmented biochemicals. This leaves the shea butter pure white, odorless, without any detectable protein content, but still with the desirable TAG profile and the majority of bioactives intact. Typical losses are 1.5% in butter volume per 1% FFA. Hand-crafted, village-refined shea butter usually has less than 3% FFA content, and industrially extracted butter has more than 10-15%.

3.8 The Regulatory Scene

3.8.1 International and regional trade standards for shea

The Harmonized Trade System (HTS) has listings for shea products, although lack of standardized use prevents trade clarity. Shea kernel trade, depending on recipient or exporting country, is specifically listed under the HTS code 1207.99.91, 1207.92 or 1207.99.10.00.[28] It is often recorded under just 1207: *Other oil seeds and oleaginous fruits, whether or not broken*, which prevent differentiation from other African oil-crops such as palm or sesame. Shea kernel meal or cake, the residue after oil extraction, is usually exported under the generic HTS codes for residues, 2306 or 2306.90.90. Shea butter is usually exported under the HTS code 1515, where the applicable subheading for the shea butter is the generic code 1515.90.20.00: *Other fixed vegetable fats and oils and their fractions, whether or not refined, but not chemically modified other: nut oils*. Other codes exist for shea when listed as specific ingredients, fractions or when combined into cosmetic products or soaps. Use of specific and unique codes for shea products would assist with clarity of trade volumes and policy development.

A regional CODEX standard for unrefined shea butter, CXS 325R-2017, was finally adopted in 2017. Although 'improved' village-refined hand-crafted butter from premium quality shea kernels may sometimes meet the quality criteria defined (Table 4), these standards will usually not be possible without additional refining.[29] Despite shea being listed in CODEX documents for bulk transported edible oils and fats, neither whole shea butter nor its fractions (commonly used in chocolates and other European edible products), have specific listings in the international CODEX STAN 210-1999 for named vegetable oils for human consumption. Currently, no internationally agreed trading standards on shea kernel quality (and therefore pricing) exist, although a GSA initiative is working towards this goal.[30] A three-minute 3D animation for "Quality Shea Nuts - Best Practices for Production" has been developed by Scientific Animations Without Borders (SAWBO) and is currently being dubbed into key languages and dialects in the West African shea zone.[31]

Table 4. Extract from The Regional CODEX Standard for Unrefined Shea Butter, CXS 325R-2017[32, 33]

[28] http://cet-database.org/gra/index.php?p=prehscodes.php&s=1207
[29] http://www.fao.org/fao-who-codexalimentarius/en/
[30] http://www.globalshea.com/work/projects/13/Shea-Kernel-Quality-Standards
[31] http://sawbo-animations.org/video.php?video=//www.youtube.com/embed/EmO-fQcwYT8
[32] http://www.fao.org/fao-who-codexalimentarius/home/en/
[33] http://www.fao.org/fao-who-codexalimentarius/sh-proxy/es/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCODEX%2BSTAN%2B325R-2017%252FCXS_325Re.pdf

3.2.2 *Quality criteria*

Unrefined shea butter shall meet the quality criteria specified in Table 1 of this standard.

Table 1. Quality criteria

Characteristics	Unrefined shea butter		
	Grade 1[a]	Grade 1[b]	
	Maximum level	Minimum level	Maximum level
Water content (%)	0.05	0.06	0.2
Free fatty acids (%)	1	1.1	3
Peroxide value (milliequivalents of active oxygen/kg oil)	10	11	15
Insoluble impurities (% m/m)	0.09	0.1	0.2

The limits of these descriptive key variables of composition and quality of generic unrefined shea butter may appear very broad, with a large range of values between minimum and maximum values. This is because the descriptors consider the actual variation in characteristics found in shea butter in all production areas.

a. The first grade of unrefined shea butter can be used for direct consumption;

b. The second grade of unrefined shea butter can be used for the food industry (confectionery, chocolate, edible oil or the base for margarines).

3.8.2 Standardization of cocoa butter replacement in chocolate

The EU cocoa directive 2000/36/EC, implemented by member states in 2003, allowed the use of palm, illipe, sal, kokum, shea, and mango vegetable fats in legal chocolate.[34] Use of enzymatically modified fats was prohibited. This legislation, supported by sophisticated patented refining and fractionation technology, further strengthened the market position of about 10 key edible oil companies that largely control the shea export market.

The importance of this directive was to standardize and subsequently increase demand in Europe, but it also provided the basis for changing chocolate definitions across the world. Subsequently, chocolate regulations, standardized to match that of Europe, have been adopted in South America, Oceania, Eastern Europe, India and China. This has allowed CBA and shea demand to increase as use in chocolate products in all these countries rose.

3.8.3 Other EU labelling legislation

The EU approved a new regulation on October 25, 2011, which includes re-labelling of vegetable oils and fats on edible products to ensure that food labels carry essential information in a clear and legible way. This legislation increases the opportunity to raise edible shea visibility in European. Previously it was just listed as "non-cocoa butter fats."

Additional regulatory controls relating to shea include maximum levels for PAHs allowable in food products. Details can be found on CBI's shea butter factsheet.[35]

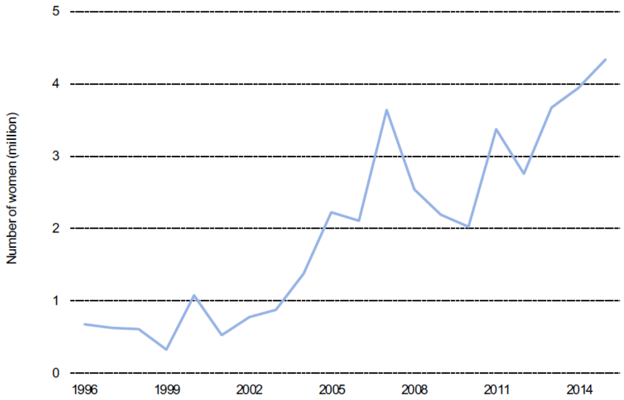
3.8.4 Shea regulation in the U.S.

Of the large chocolate-consuming markets, the U.S. does not currently permit the use of exotic fats to replace cocoa butter in chocolate recipes. Fractionated, refined, and named as "sheanut oil," shea stearin has had current GRAS status (Generally Recognized as Safe - 21CFR184.1702) in the U.S. since 1998.[36] The petition was originally filed in 1988. Approximately 2,000 tons of shea stearin is used an ingredient in *non-cocoa-butter-replacing* confectionary coatings and fillings in the U.S. Vegetable fats other than cocoa have always been permitted in East Asia, and Japan has special grades of quasi-chocolate that can contain high levels of shea.

[34] http://eur-lex.europa.eu/homepage.html
[35] https://www.cbi.eu/sites/default/files/market_information/researches/product-factsheet-europe-shea-butter-2015.pdf
[36] https://www.gpo.gov/fdsys/pkg/FR-1998-05-27/pdf/98-13917.pdf

Since collaboration between USAID West Africa Trade Hub and Manchester Trade Ltd. in 2009, one driver for regulatory reform for the use of shea in chocolate in the U.S. has been to increase the livelihood opportunities for Africa shea collecting women.[37] The growth in numbers of shea collecting women is shown in Figure 11. This led to an ongoing attempt to change U.S. chocolate legislation to allow the use of CBAs to replace a portion of cocoa butter. A petition was filed with the Food and Drug Administration (FDA) in 2013 by Sidley Austin LLP on behalf of the Alliance of African Shea Associations. To date, the legislation remains unchanged following industry resistance.

Figure 11. Estimated Numbers of Women Collecting Shea Kernels for Export[38]



4 Fixing the Problems

4.1 Introduction

There are many commercial, socio-political, and environmental reasons to revitalize shea agroforestry parklands. It is critical we positively empower the communities who live there and help prevent the increasing violence, poverty, and mass emigration. This process will not get far until and unless it makes business sense to fix the problem, and both local and global stakeholders recognize sustainable value propositions across vast shea parkland landscapes. Below we outline what these might be:

4.1.1 International value propositions

Shea is an invisible substitute in the edible specialty fats sector. Approximately 90% of exports are used in chocolates, baking products, ice creams, pastries, etc. It is also a highly visible ingredient in the personal care sector, used in moisturizing creams, soaps, shampoos, and sun-lotions. The underlying triple bottom line business case for shea parklands, however, clearly demonstrates the potential for this traditional agroforestry system to provide for a global value proposition that includes the following three components.

1. **The Environmental Imperative**. Proven sustainable over millennia, maintenance of traditionally farmed agroforestry parklands ensures protection of biodiversity, carbon stores/sinks, water catchments, soil fertility, and regional climates. These ecozones cover 300-400 million ha of Sahel-Savannah zones, buffering the more humid zones of West, Central, and Eastern Africa against encroachment by the Sahara Desert. The West African sub-region alone harbors 70% of global cocoa production alongside significant cotton, maize, rice, soya, sorghum, cashew, groundnut, palm, and rubber potential. Current shea parklands contain an estimated 20-50 Mg C per ha of above and below stored carbon, which indicates that carbon stored across the entire shea zone is 6-17.5 Gt C. With 25-80 intercropped trees per hectare,

[37] https://www.ictsd.org/bridges-news/bridges-africa/news/a-sweet-deal-how-a-change-in-us-chocolate-labelling-rules-could
[38] https://www.lmc.co.uk/

parklands can sequester 2-6 Mg C per ha per annum.[39] In addition, if recent research proves accurate, namely that increasing tree cover reduces storm intensity, then parkland restoration is a wise investment opportunity.[40] This zone feeds many tropical storms into the warm Atlantic Ocean waters, the so called "hurricane alley." In 2017, hurricane damage costs alone exceeded USD$200 billion.[41]

2. **The Social Imperative**. Shea parklands provide culturally-secure, gender-orientated livelihoods for many of Africa's poorest women. It is estimated that 16 million women collect shea kernels. Due to the multiplier effect (1.58), many additional employment and income opportunities are created along the shea supply chain for many millions of households. These opportunities help to ensure maintenance of family values, social-adhesion, health, farm productivity, food security, and education for future generations. This is in a vulnerable semi-arid zone that has had rapidly growing emigration rates to urban and western economies and is currently occupied by 200+ million people. Education indicators are some of the weakest, while fertility rates are some of the highest on Earth. The need to provide secure and supportive links to many rural communities across the zone has never been more important. It is proposed that current and potential employment and income from indigenous tree crops can have a significant impact in overcoming many of these issues.

3. **The Security Imperative versus Value Addition at Source**. With increasing poverty and frustration among the people of the Sahel-Savannah, religious fundamentalism is on the rise and insecurity now impacts numerous areas of the shea zone including Burkina Faso, Chad, Cote d'Ivoire, Mali, Nigeria, and Niger.[42] There have been large international investments, notably from Europe impacted by immigration and terrorism, aimed at countering these threats to stability across the West African sub-region.[43] Investment in traditional agroforestry farming systems like shea can provide links to local, regional, and international markets. Together with provision of sustainable ecosystem services, abject poverty can be overcome and a better place to live re-established. This may mitigate against the biggest drivers of emigration, child and drug trafficking, and insecurity, which are certainly very topical political issue in Europe and across the West African sub-region at present.

4.2 Fixing the Ecology

4.2.1 Preservation and restoration of fallows

When considering parkland restorative methods, it is important to distinguish between two systems. System A includes systems like those in the existing shea parklands that are based broadly on natural, mostly random, regenerative practices followed by selection and management of key tree species (*keep or cut*). System B includes systems like those in oil palm zones that are based on the purposeful and deliberate planting with intensive tending of trees whose species have been deliberately chosen and positioned in landscape locations

What these practices have in common is that, in both cases, people (individual farmers or entire communities) actively influence natural biological regeneration processes to achieve patterns that better suit their needs. Under both systems, protection from fire, watering and weeding around young trees may be necessary to help them survive. The key benefit of System A using natural regeneration is the low cost as compared to raising and planting tree seedlings, but tree regeneration needs time and

[39] http://library.uniteddiversity.coop/Permaculture/Agroforestry/Carbon_Sequestration_Potential_of_Agroforestry_Systems-Opportunities_and_Challenges.pdf
[40] https://forestsnews.cifor.org/51566/forests-versus-hurricanes
[41] https://www.climate.gov/news-features/blogs/beyond-data/2017-us-billion-dollar-weather-and-climate-disasters-historic-year
[42] https://www.washingtonpost.com/world/africa/un-experts-warn-of-intensified-terrorist-threats-in-sahel/2018/03/02/9bbc01f0-1e53-11e8-98f5-ceecfa8741b6_story.html
[43] https://af.reuters.com/article/africaTech/idAFKCN1G71J0-OZATP

avoidance of soil cultivation. This is a key issue where a shortage of land for farming exists and the demand for food crops leaves farmers viewing 'native tree cover' as detrimental and a waste of land resources. In addition, without optimal silvicultural practices, there is limited choice on which species, locations, and numbers of saplings will naturally regenerate.

Despite the added costs of seed collection, nurseries, and planting labor, the key benefits of System B, which uses more purposeful planting methods, is the offer of species choice, landscape location, and the opportunity to more rapidly capture genetic improvements that reduced maturation periods, produce less erratic or higher landscape yields, and can selection for preferred oil types and seed yields.

4.2.2 Less tangible opportunities (hurricanes, carbon storage, biodiversity, etc.)

Terrestrial carbon project credits (TCP) might help finance shea parkland replanting schemes, but as Balderas-Torres[44] reported, transaction costs are often very high at between 17 % and 24 % of the project value. Their study estimated that for farms averaging 13 ha, carbon prices between USD$5.3 and USD$11.5 per Mg CO2-eq (USD$19.3– USD$42.1 per Mg C) were required in order to break even in projects involving up to 1,538 farmers. Due to low tree density, slower growth, and comparable carbon prices, projects in the Sahel-Savannah would require about 20,000 farms with 6+ ha to break even.

Other potential concepts relating to tree planting could include Ecosia's scheme to provide EUR€0.50 per planted tree (but only if more than 1 million trees planted per project) or the development of a model where an *interim* payment (before fruiting commences) is given to farmers for each 4-5-year-old successfully established sapling.

Image 13. Raising Two-year Shea Seedlings

Source: Joseph Hunwick

In addition, there could be opportunities to undertake some form of ecosystems service or carbon payment at the landscape scale where areas of parklands are restored to meet acceptable canopy cover levels. This, however, is complicated by variability in definitions. FAO uses a 10% canopy cover for forest, excluding agricultural lands, whereas Ghana uses 15% cover to define open forest.[45] Since they are native, shea trees are included. However, this definition lacks any classification of agriculture intercropped by shea and other native trees in parklands. This situation confounded the UNDP team during early stages of developing a REDD+ shea landscape proposal for north Ghana.

[44] https://www.sciencedirect.com/science/article/pii/S0921800909003942

[45] Per the FAO: "Forest is land spanning more than 0.5 ha with trees higher than 5 m and a canopy cover of more than 10 %, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use."

Due to scales of restorative work required across the Sahel-Savannah corridor, high investment levels would need to be considered. There is a critical need for more definitive research results in regards influence of tree cover on tropical storm intensity and the potential impact on hurricane formation in the Atlantic. Discussions with The Center for International Forestry Research (CIFOR) and other key researchers studying this opportunity are highly recommended.

Biodiversity degradation remains of high concern, particularly in relation to larger mammals. It is now assumed lions are extinct in Ghana. There has also been growing concern for smaller organisms such as the reduction in insect diversity, population levels, particularly in regards pollination of crops (including shea), and food for migratory insectivorous birds. Bird Life International, RSPB (UK), and VBN (Netherlands) having been very active in lobbying for support on this issue, and it is understood that a recent grant[46] of EUR€2.8M has been awarded to ICCO and VBN for a landscape restoration project across Malian and Burkinabe parklands.

4.3 Fixing the Production System

4.3.1 Breeding and production of planting material

Traditionally shea seedlings are not produced in nurseries in villages. Virtually all existing parkland seedlings are the result of natural regeneration in farm-fallow rotations followed by selection of saplings with care and attention by farmers to ensure the growth and survival of the best of them (*unconscious selection*). Technologically, no major constraints exist to raising shea seedlings in commercial nurseries (*conscious selection*). Key issues relate to who will buy them and on what terms? Further, who will make the effort to tend them to maturity? This also concerns the cost-benefits of providing larger, more expensive trees with lower mortality rates versus cheaper smaller trees.

Despite limited investment in shea tree nurseries to date, 4 or 5 enterprises have recently begun to propagate shea seedlings on a semi commercial basis. About 500,000 seedlings are expected to be planted with support from GSA's sustainability program through various initiatives across West Africa in the coming years. In addition, social forestry projects have already planted 50,000+ trees in Mali and there are similar efforts ongoing in Burkina Faso. These initiatives still lack the scale of restoration assistance required. Currently over 100 million ha of parklands need a minimum of at least an additional 5-10 shea trees per ha (or 500-1,000 million seedlings) planted within the next 10 years to add and replace lost shea trees in order to produce a sustainable crop for the local food security and international exports predicted within the coming 10-20 years.

Nevertheless, public sector investment into shea tree improvement has been minimal. ICRAF has a small project aiming to develop foundational resources for the genome-enabled improvement of shea under a University of New Hampshire / Cocoa Research Institute of Ghana / West African Crop Improvement Centre project. A proposed public/private sector partnership with CRIG in Ghana also aims to develop a long-term public resource for the shea improvement community that will serve as a publicly accessible repository of germplasm, genotypic, and phenotypic data on shea.

4.3.2 Towards on-farm planting of shea trees

The concept of planting shea trees, however, is alien in many villages with many constraining cultural values concerning land security or tree usufruct laws and even traditional taboos against planting many native tree species. Furthermore, there is the question of ownership both in terms of private tenure versus village, and men versus women usufruct. Assuming these traditions and taboos can be overcome, for which there are strong positive signs of doing so, due to farmer concerns about the rapid disappearance of certain tree species, then the future for "modernized" agroforestry parklands is bright.

[46] https://www.vogelbescherming.nl/actueel/bericht/postcode-loterij-steunt-birds-bees-and-business-in-burkina-faso

What are the economics of planting a shea tree? With returns from shea unlikely before 10+ years, other sources of income from the tree are required to ensure co-investment of farmers' labor, water, fire-protection, etc. This would need to come from intercropped foods or from NTFPs such as dyes, mushrooms, honey, or premium wood fuels. Co-investment could also result from crowd-sourced, consumer linked tree-planting initiatives such as green bonds or corporate sustainable supply chain investments.[47] Of course, at the end of the 10-year period, what guarantee does the farmer have that the tree will produce quality shea kernels or that someone will be interested to buy them? Some form of crop insurance program would probably also be required against a buy back arrangement from major shea buying firms.

Many constraints exist in relation to local farmers' willingness to pay for and to plant native trees. A theory of change needs to be wrapped into a process which will incorporate the new concept of planting native trees including previously thought of 'useless' *pauper* species as compared to well-known exotic timber and fruit tree species. How can agroforestry with native trees be branded as sexy, profitable, and successful as compared to those exotic species already perceived as 'improved'? In addition, traditional tenure and usufruct regulations surrounding tree planting on tribal lands need to be overcome, modified, or evolved. Business cases leading to profitable enterprises need to be developed alongside landscape scale education and planting programs on natural lands to champion the concept.

These all add up to the result that few are willing or able to plant indigenous trees of any use. It is therefore recommended that a strategy of awareness and advocacy is developed which aims to empower farmers to plant and manage multi-purpose indigenous trees in the shea parklands. Tree nurseries will be required and first stage example locations for planting utilized, e.g. public or state lands such as schools, hospitals, boundaries, etc.

Image 14. African Farmer with 12-year-old Planted Shea Tree with Heavy Mast

Source: Joseph Hunwick

Although deliberately planting shea is hardly ever done, surveys indicate a considerable interest from farmers for "improved" shea varieties which would visually clarify the associated tenurial and usufruct rights of the planter. For shea improvement programs to succeed, breeders need to transform people's perceptions from what is currently considered a 'wild' tree into the equivalent of an improved 'exotic' tree. This might be in terms of shortened time to fruition, increased productivity,

[47] http://www.undp.org/content/sdfinance/en/home/solutions/green-bonds.html

and display of desired characteristics (fruit, kernel, fat composition of kernels, etc.), as well as its size and shape.

4.3.3 Advantages of developing shea nurseries

There are several advantages to developing shea nurseries. Nurseries can select seed of high quality and known provenance, can produce large numbers of seedlings of uniform size and quality very quickly, can provide job opportunities for local tree nurserymen, can protect young plants from fire and or bird/animal attack, can give plant head start with water and fertilizer, and can lower seedling mortality rate.

ICRAF and other research centers have built up some material, but germplasm from across the entire shea belt needs to be systematically screened and selected. Shea germplasm at the extreme limits of its distribution area should be conserved for adaptation to drought in the dry northern part of the range and to relatively humid areas in the south, especially if the species may shift in both directions with climate change.

4.3.4 Novel production systems - alley cropping methods

Alley cropping in Africa, particularly to produce fast growing firewood sources alongside food crops, has been quite successful in some areas. Moreover, nitrogen fixing trees like *Faidherbia,* which grow in the shea parklands, have also been shown to help provide both fodder for animals and also fertilizer for the intercrop.

Although on-farm planting of trees in straight lines in the alley-cropping of shea has rarely been tried in West Africa, there are many advantages foreseen from the system:

- The greatest benefit will be to increase per ha shea tree densities and, as a result, reduce time taken and the traveling distance required by women to collect fresh shea kernels. It will also make it easier to protect the shea harvest from animals (squirrels, rats) or pilferage.
- Trees planted in-line should make it more cost-effective to introduce drip or bubble irrigation at least for the early, critical years of establishment. This could potentially speed up growth dramatically.
- Line-planting will facilitate easier tree pruning as well as the easier removal vines or creepers as well as allow for mechanical weeding within and even between rows. It should also make it easier to apply manure/fertilizer to young seedlings while continuing to grow annual crops between the trees including allowance for green manuring.
- The deliberate incorporation of trees will help improve soil texture, organic content, nutrient cycling, and water infiltration as the roots of savannah tree species will systematically break hardpans, and deciduous leaf fall will once again be incorporated into the soils.

Image 15. Village Growing of Tree Seedlings in Recycled Water Sachets

Source: Joseph Hunwick

4.4 Improving Upstream Efficiencies

4.4.1 Energy issues

Although several reports reference to energy inefficiencies in shea harvesting and processing, only one or two studies have been undertaken which attempt to precisely measure all the steps in the collection and post-harvest processing of the kernel and in the butter extraction. The results of an ICCO-supported study in Ghana clearly showed that the energy cost of the firewood used to cure the kernels and to process the butter were by far the largest sources of carbon emissions in the process prior to packaging finished products. Moreover, these calculations included the use of shea kernel waste as a biofuel, something that not all women use in their traditional butter making operations. Furthermore, the opportunity cost of collecting fuelwood is largely underestimated as it is not a true reflection of its economic value since women collect wood fuel at no cost other than their time and effort. If they had to pay for the wood, not only would the present production process become uneconomic, but the drive to greater efficiency would be more rapid. In some urban areas, wood fuel is being imported from locations over 100km distant, leading to development agencies putting this topic at a higher priority.

Image 16. Roasting Crushed Shea Kernels over Firewood

Source: Joseph Hunwick

It is surprising that despite the number of NGO projects designed to promote sustainable women's shea butter, so little attention has been paid to ways of reducing the use of wood or making the process more efficient. The sludge, shea cake, or residue, which is produced in the process of making butter, can be dried and briquetted. However, this generally only profitable at consolidated processing centers, where large amounts of residue exist.

Naughton et al (2017) colleagues in Mali carefully measured energy input into both the traditional and improved systems of processing shea kernels. Overall, the traditional shea butter production process required the highest amount of human energy at 6100 kJ/kg of shea butter. This was followed by the improved semi-manual process at 5900 kJ/kg. The traditional processes, however, used 40% more firewood (average 11 kg/kg) than the improved processes (average 6.6 kg/kg). Traditional processes also required more human energy for firewood collection. There was not a large difference in the total human energy inputs between the two processes. This is particularly true if we consider time spent and firewood used for the many production steps in shea processing.

4.4.2 Facilitating safer and quicker collection

Making the work easier for women would be extremely beneficial to the development of a traceable and carbon-neutral supply chain. It is highly recommended that women are consulted and involved at every stage in the planning process to identify and develop easier, safer, and more efficient ways in which they are empowered to reduce the use their time. The use of bicycles with paneers and trailers, donkey-carts, nut-pickers, water-rollers, and protective clothing are being considered, as is the stocking of medical centers with appropriate anti-venom kits.

4.5 Fixing the Market

4.5.1 Regulatory reform of nomenclature

There has been much confusion concerning the correct botanical name for shea. There has been frequent use of the name *Butyrospermum parkii* by many official agencies and researchers including US FDA GRAS listing (21CFR184.1702, FDA, 2014), the EU cocoa directive (2000/36/EC, EU, 2000), and the International Nomenclature of Cosmetic Ingredients (INCI) (2006/257/EC, EU, 2006). Although this nomenclature has been used in regulations and on labelling and ingredient lists in personal care products, this is neither the scientifically correct nor taxonomically agreed Latin name for the shea tree, its sub-species (*Vitellaria paradoxa* subsp. *paradoxa* and *nilotica*) and its products. As shea use becomes more and more widespread in edible, cosmetic, pharmaceutical, and additional green chemistry products, it is critical that clear consensus on nomenclature and product origin is established across all sectors and disciplines to promote transparency and consistency.

4.5.2 Rebranding "village-refined" hand-crafted shea butter

The processing of shea kernels into 'whole' shea butter for use in the cosmetic industry is undertaken using hand or semi-mechanized production methods that use water extraction processes and manual labor to obtain the butter. On the other hand, industrial production uses commercial oilseed expellers, often followed by hexane extraction of the foots, or residue. The former process is manually labor intensive, but if the raw material input is good, it can produce butter of excellent quality that can meet the new regional CODEX standards for edible, unrefined shea butter (CXS 325R-2017). The growth in the market for fairly-traded and organic cosmetic ingredients previously favored the use of hand-crafted and semi-mechanized) butter production, and one was synonymous with the other. As industrial extraction plants are getting organically certified, *organic shea butter* is no longer synonymous with hand-crafted production by women. This prompts the need to revive interest in developing a new label for women's crafted butter, and a certification program is needed to protect and preserve this brand exclusively for women home producers in the shea zone.

Image 17. Sales of Traditional Shea Butter for Home Consumption

Source: Joseph Hunwick

4.5.3 International regulations for edible shea

The industrial extraction method uses kernels of any quality, but produces a butter of varying quality, which is later blended, fractionated, and refined to meet the clients' international edible standards. There is, however, a need to expand the GRAS regulatory system in the U.S. to include refined whole butter and other fractions in addition to just shea stearin. Furthermore, the existing CODEX for edible oils and fats for human consumption does not list shea, and there is a need to either revise this to include shea butter and its fractions or develop a new standalone CODEX for this purpose. It is then expected that the opportunity for local food security and international demand for alternative edible fats and oils can be realized, and growth in shea butter demand from the entire Sahel-Savannah zone can be promoted.

Due to the variation in global definitions for legal chocolate, there is also the need to standardize the inclusion of CBAs for use in chocolate into the U.S. FDA regulations. It is expected that this will not only increase demand for shea and other exotic vegetable fats, but also allow for the improvement of chocolate for different climatic conditions to the benefit of consumers and sector. All in all, this will increase the opportunity for women to sell more shea kernels into global markets.

4.5.4 Nutritional demand in SSA & food security opportunity

Dietary patterns are changing across SSA. Shea is now far less likely to be consumed as a cooking fat in urban areas where approximately 50% of the population resides. There is a presumed shift to exotic and refined vegetable oils such as groundnuts, soya, and palm, although reliable statistics on edible oil consumption in the shea zone is scarce, especially for informal local markets. Dietary and other local consumption surveys are urgently required to correct this situation. Increasing, the local supply and use of shea butter should be a priority for nutrition and food security due to Africa's shortfall in available edible oils. Most existing government policies in Africa have totally ignored the existing and potential role of shea oil in the local diet. Even in situations of drought and famine, as in places like South Sudan, aid agencies have turned their backs on projects that suggest the refining of shea to produce cooking oil for local populations including refugees and returnees. With modern refining capacity in place, there would be few reasons to prevent the expanded use of this excellent edible oil in food security use.

4.5.5 Structured market promotion

There is a need to organize a wide range of national, regional, and global promotional campaigns to help build the market for shea products and to draw consumer attention to the need to protect and develop the shea parkland. These campaigns could include:

1. Working with bodies like International Trade Centre (ITC) and export promotion agencies in the region to promote shea not just as a cosmetic ingredient, but a highly nutritious food ingredient;
2. Working with small business development agencies to encourage the retail cosmetic and health food products for sale in African cities;
3. Developing/reviving markets for NTFPs associated with shea parkland systems including parkland honey, medicinal, aromatic, and natural dye plant species;
4. Developing market information systems to promote two-way linkages between producers and consumers of products from the shea parklands; and
5. Using multimedia and online platforms to promote the benefits of shea as a generator of income for rural women and a vital resource for food security and nutrition.

4.6 Fixing the Enabling Environment

4.6.1 Formation of an industry international roundtable & national associations

The GSA was established in April 2011 after a multi-year stakeholder consultation process. It is a non-profit industry association with headquarters in Accra, Ghana, that currently has 525 members from 33 different countries. Membership includes women's groups, small businesses, suppliers, international food and cosmetic brands, retailers, and nongovernmental organizations. The GSA mission is to design, develop, and deliver strategies that drive a competitive and sustainable shea industry worldwide and to improve the livelihoods of rural African women and their communities. With substantial funding support from USAID, the GSA has done much to enhance global awareness of the importance of shea to Africa, to open market opportunities, and to address sustainability in the shea parklands. However, the GSA and its key country partners, the national shea associations, still lack the capacity, skills, and resources to engage with all relevant stakeholders, including those operating outside of the shea sector, to create sustainable change across such a vast, 21-country, 3.5-million-km^2 landscape.

4.6.2 Land reform

There is an urgent need to develop appropriate land tenure and tree usufruct solutions for indigenous people to provide tree planting security and to encourage parkland restoration. The key features of any land reform legislation should include key aspects that increase security for tree planting such as:

- Allowing private ownership of reasonable amounts of land by legitimate local owners;
- Allowing women's group or other forms of cooperative to own land;
- Giving special consideration to women in any reforms;
- Limiting transfer of land to outsiders;
- Protecting communal fallow land through national laws;
- Considering the grazing rights of pastoralists in any land reform laws;
- Empowering local communities to protect and to restore their resources; and
- Benefit-sharing and usufruct rights for tenant farmers in regards trees on-farm.

4.7 Requirements for Success

There are several requirements for reforms to be successful. These include:

- Agricultural and forestry policy revisions with support and empowerment for on-farm trees;
- Improved public sector capacity and capability for extension services, nurseries, the delivery of trainings and planting materials, or management skills for private sector delivery;
- Finance and private sector involvement;
- Appropriately scaled and targeted investments;
- Solutions to parkland landscape land tenure/tree usufruct constraints;
- On-farm research and development recommendations;
- Empowered farmers with appropriate technology, resources, and skills;
- Nurseries, access to water, land security, and appropriate planting materials; and
- An agreement for appropriate access to finance model.

5 Summary and Conclusions

5.1 Differences with Other LEAVES Studies

5.1.1 Shea is not the enemy

While large scale production of cash crops like soya and palm oil has resulted in cutting down of large areas of rainforest and upsetting the ecological balance in their native habitats, it is rather the shea parklands that are being degraded by other drivers. It is therefore NOT the shea trees themselves, and production of shea butter, which threaten the ecology, but rather the lack of understanding by all those involved in its use. Many actors do not understand the vital role shea trees play in the maintenance of the ecosystem and the people who live in it. This means that, unlike the other case studies, fixing the problem requires mobilizing not just the immediate actors in the shea supply chain, but also all of those people involved in competitive and complimentary businesses in the parkland zones.

5.1.2 Misconceptions by Westerners and Africans on shea sector structure and health

Most people assume that the shea parklands are healthy and that the expansion of shea production and export is a fine example of fair and ethical international trade. They see it through the eyes of a few high-profile cosmetic companies, whose direct sourcing models account for just a small percentage of shea trade. Despite this glamorous image, women who collect shea kernels are still some of the poorest in the world, and most development thinking remains focused on fostering cooperative butter processing, which focuses on only extraction. There is an urgent need to focus on sustainable parkland production and less on laborious, but more profitable fruit collection. By contrast, most people understand that the Amazon and the Indonesian rainforests are threatened and that agribusiness interests in the region have a direct responsibility to help fix the problem.

5.1.3 Tight control by a small group of companies

Largely unknown to the general consumer, only about ten companies control the global technology and trade in shea. They control the technology to process exotic fats and to formulate and supply invisible, yet highly functional CBAs to the confectionary sector. Valorizing cheap palm oil and sugar are two key value propositions of this industry and obtaining reliable supplies of fractionated shea stearin is the reason for sourcing in Africa. While the business case for CBAs is to smooth erratic economics and to improve the stability of international chocolate quality, shea's local demand and on-farm production systems are misunderstood and remain unimproved. In contrast, there are a far larger number and far greater diversity of companies operating in the global soya, beef, and palm oil industries, whose traded volumes currently also far exceed that of shea.

5.1.4 Insecurity and isolation

Unlike the other case study zones, large areas of the shea parklands are highly unstable and insecurity levels can result in some areas being too dangerous for Westerners to operate in. As a result, some of our information has had to come from second-hand sources. Few Western consultants, scientists, and businessmen regularly visit these areas, and government rule in many places is tenuous. Such political instability in the region is a significant disincentive to both public and private investment.

5.1.5 Limited knowledge on shea parkland ecology

Only since the mid-1990s have scientists truly recognized the existence, management, and function of agroforestry shea parklands, despite covering an area a third the size of the U.S. There is either no research or incorrect research in many fields, and large parkland expanses have already been heavily, possibly irreversibly, degraded. Extremely limited data exists on critical subjects such as:

1. Land brought under intensive cultivation in last 10 years, including the loss of fallows;
2. Shea and other native tree density trends and impact on parkland biodiversity;
3. Wood fuel demand and production which serve as 80%-90% of the energy source for Africans;
4. Levels and trends of domestic consumption of shea as a foodstuff and other uses; and
5. Trends in the importance of parkland products in African nutrition and food security.

5.1.6 Modernizing shea-based agroforestry systems

Because of the isolation, insecurity, and lack of background information, very little has been done to develop novel systems of production within the shea parklands. Rather, the aim has been to replace them with modern cash-crop, mono-strata, monocultures, and prairie farming methods. The lack of tried and tested remedies means that change here is "a leap into the dark." By contrast, there are a many research and development centers involved in surveying, monitoring, and developing alternative environmentally friendly farming systems for the Amazon and Indonesian rainforests. In addition, few strong, local environmental pressure groups champion the shea parkland cause.

In both Brazil and Indonesia, both national and international NGOs like Greenpeace and WWF are very active in raising awareness of the problems of deforestation and the dangers of intensive farming. Industry associations were established specifically to address these issues. In the shea parklands, however, except for the GSA, few such civil society organization are operating. Those that do exist do not understand the ecology of this ancient agroforestry system or understand that the system is under significant threat.

5.2 Lessons from Other Case Studies – The Way Forward

Despite the fact that there are many special features to the problems suffered by the shea parklands, there are also many common traits and many lessons that can be learned from activities that are being undertaken in other regions to tackle the challenge of meeting increasing food demand for while conserving the tropical forests for future generations. It should still be possible, however, to significantly slow frontier deforestation, to develop mosaics of agroforestry systems, and to rapidly increase tree cover across the landscape.

5.2.1 Importance of public, private, and civil society partnerships

It is clear from the other cases studies that there is a vital need for government, industry, and civil society to sit together and understand each other's position and views on the problem. Without such interactions, no solutions will be found. While the GSA has certainly done much to raise a greater global awareness of the importance of shea as a crop, it does not have the mandate, the resources, or the technical expertise to alone find a way to fix problems across the shea parklands. A multi-donor, multi-lateral conference of stakeholders including representatives of civil society, local trading communities, investors/donors, government, and the shea trade and production industries is urgently needed.

5.2.2 A Sahel-Savannah Parkland Commission?

It is difficult to predict whether such a conference could lead to the set up some form of permanent shea parklands commission along the lines of the Permanent Interstate Committee for Drought Control in the Sahel (French: Comité permanent inter-État de lutte contre la sécheresse au Sahel (CILSS)).[48] Since shea parklands exist in seven major West African shea exporting nations, and there are a further fourteen other 'shea' countries that do not presently play major roles in international shea trade, some form of multi-national agency needs to coordinate efforts.

5.2.3 Land reform in the parklands

Land tenure in the shea parklands has not been substantially modified for hundreds of years. The traditional communal ownership patterns are under great stress throughout the zone. This stress is brought about by changing ideas and morals, legacies of colonialism, population pressure, urbanization, mass migration, and the advent of high technology agroindustry. While land reform has taken place in Asia, Latin America, and much of East Africa, in the shea parkland zone, reform has been practically non-existent. Without land reform, incentives for investment and tree planting are weak. This constrains the development of new sustainable agroforestry systems, wood lots, and tree nurseries. Only governments working closely with civil society and local administrations can undertake this task.

5.2.4 Developing suitable new technologies or transferring technology

The shea parklands are an ancient agroforestry production system that has managed to survive and prosper for hundreds, if not thousands of years. Except for some very recent work by organizations such as The World Agroforestry Centre and several national forestry institutes, neither the public nor private sector have invested significant money in the cultivation, breeding, collection, and immediate post-harvest processing of shea. Almost all investment has been downstream of these stages in the consolidation, processing, and formulation of shea and its derivatives. Therefore, there is an urgent need to encourage both public and private investment upstream into all aspects of shea production. Novel production systems must urgently be developed to better satisfy the urgent need for food, wood fuel, and cash incomes. Bilateral and multinational donor agencies can play a major role in supporting such efforts. However, while shea is simply seen as a minor wild-harvested, non-timber forest product, growing wild in the bush such investment is unlikely.

[48] www.cilss.int

Recommended Reading

Aleman, J. C., Blarquez, O., & Staver, C. A. “Land-Use Change Outweighs Projected Effects of Changing Rainfall on Tree Cover in Sub-Saharan Africa.” *Glob. Chang. Biol.* 2016.

Aleza K, Villamor GB, Nyarko BK, Wala K, Akpagana K (2018) “Shea (*Vitellaria paradoxa* Gaertn C. F.) Fruit Yield assessment and Management by Farm Households in the Atacora District of Benin.” *PLoS ONE* 13(1): e0190234. https://doi.org/10.1371/journal.pone.0190234

Balderas Torres A, Marchant R, Lovett JC, Smart JCR, Tipper R (2010) Analysis of the carbon sequestration costs of afforestation and reforestation agroforestry practices and the use of cost curves to evaluate their potential for implementation of climate change mitigation, Ecological Economics, 69(3): 469-477

Bayala et al. “Parklands for Buffering Climate Risk and Sustaining Agricultural Production in the Sahel of West Africa.” *Current Opinion in Environmental Sustainability.* Volume 6, February 2014: 28-34.

Bello-Bravo, J., Lovett, P. N., & Pittendrigh, B. R. “The Evolution of Shea Butter's" Paradox of *paradoxa*" and the Potential Opportunity for Information and Communication Technology (ICT) to Improve Quality, Market Access and Women's Livelihoods across Rural Africa.” *Sustainability.* 7(5) (2015): 5752-5772.

Boffa J.-M. Agroforestry parklands in sub-Saharan Africa. *FAO Conservation Guide No.* 34. 1999.

Boffa, J.-M. Opportunities and Challenges in the Improvement of the Shea (*Vitellaria paradoxa*) Resource and Its Management. Occasional Paper 24. 2015. Nairobi: World Agroforestry Centre.

Chalfin, B. *Shea Butter Republic: State Power, Global Markets, and the Making of an Indigenous Commodity*. London: Routledge, 2004.

Elias, M. “Gender, Knowledge-Sharing, and Management of Shea (*Vitellaria paradoxa*) Parklands in Central-West Burkina Faso.” *Journal of Rural Studies.* 2015. *38*: 27-38.

Gaisberger H, Kindt R, Loo J, Schmidt M, Bognounou F, Da SS, et al. “Spatially Explicit Multi-threat Assessment of Food Tree Species in Burkina Faso: A Fine-scale Approach.” PLoS ONE. 2017. 12(9): e0184457. https://doi.org/10.1371/journal.pone.0184457pmid:28880962

Glew D, Lovett PN “Life Cycle Analysis of Shea Butter Use in Cosmetics: From Parklands to Product, Low Carbon Opportunities.” *Journal of Cleaner Production*, 68, 2014: 73-80

Hall JB, Aebischer DP, Tomlinson HF, Osei-Amaning E, Hindle JR *Vitellaria paradoxa*: a monograph. School of Agricultural Sciences Publication Number: 8. 1996. University of Wales, Bangor. 105 pp.

ICCO. Pilot Study to Determine Opportunities for Carbon Neutral Shea Production, for the Fair Climate West Africa Program Development. 2014Bamako, Mali: ICCO.

ITC Stratégie Nationale De Développement Durable De La Filière Karité Du Burkina Faso 2015-2019. Le Centre du commerce international (ITC) est l’agence conjointe de l’Organisation mondiale du commerce et des Nations Unies. 2014.

Loh Moong Ming, H. Specialty Fats—How Food Manufacturers Can Get More Out of Them. *Lipid Technol.* 2008, *20*: 35–39.

Lovett PN The Shea Butter Value Chain: Production, Transformation & Marketing in West Africa. *West Africa Trade Hub – USAID, Technical Report No. 2.* 2004.

Lovett PN Sourcing Shea Butter in 2010: A Sustainability Check. SOFW’s Global Ingredients & Formulation Guide. *The Green Book of Cosmetics.* 2010.

Lovett, P. N. Shea Butter: Properties & Processing for Use in Food. In *Specialty Oils and Fats in Food and Nutrition: Properties, Processing and Applications,* G. Talbot (Ed.); Cambridge: Woodhead Publishing, 2015: 125-158.

Naughton CC, Deubel TF, Mihelcic JR. "Household Food Security, Economic Empowerment, and the Social Capital of Women's Shea Butter Production in Mali." *Food Security*, 2017. 9(4): 773–784.

Naughton CC, Lovett PN, Mihelcic JR. "Land Suitability Modeling of Shea (*Vitellaria paradoxa*) Distribution across Sub-Saharan Africa." *Applied Geography*, 58 (2010): 217-227.

Place F, Garrity D, Mohan S, Agostini P (2016) Tree-Based Production Systems for Africa's Drylands (World Bank Studies) (ISBN: 0001464808287).

Pouliot, M. "Contribution of "Women's Gold" to West African Livelihoods: The Case of Shea (*Vitellaria paradoxa*) in Burkina Faso." *Economic Botany* 2012*, 66*(3): 237-248.

Image 16. Young Women Working in a Baobab Processing Center

Source: Joseph Hunwick

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