SAFORGEN

Vitellaria paradoxa

Shea butter tree

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Processing shea butter under a shea butter tree in Pereré (Benin)

Common name	Scientific name	Synonyms	Family
Shea butter tree, shea tree, shea nut (English) Karité (French)	*Vitellaria paradoxa* (Gaertn and Hepper)	*Bassia parkii* (Ruyssen); *Butyrospermum parkii* (G. Don); *Butyropermum paradoxum* (Kotshi)	Sapotaceae

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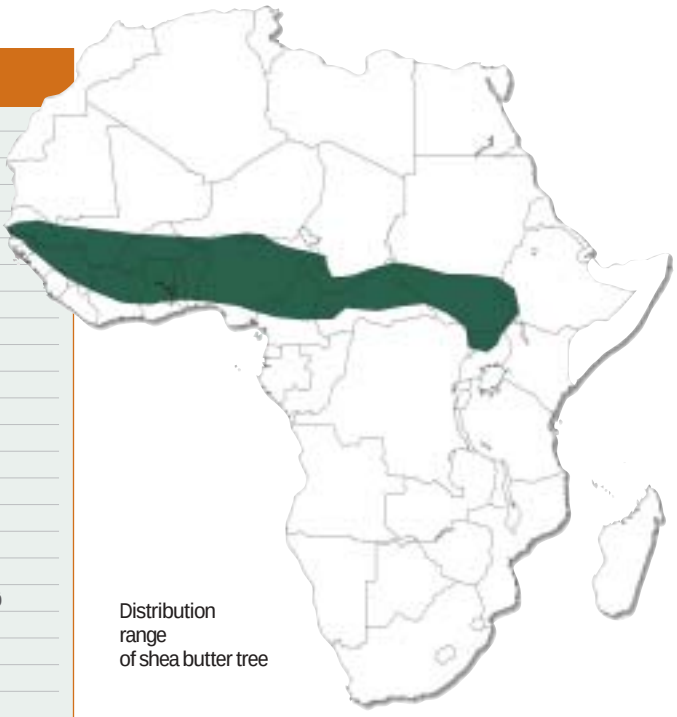
This leaflet highlights the nutritional and socio-economic potential of shea butter tree and provides information to assist those working with the species. The focus is on conserving genetic diversity and promoting sustainable use of shea butter tree. The leaflet presents a synthesis of current knowledge about the species. The recommendations provided should be regarded as a starting point, to be further developed according to local or regional conditions. These guidelines will be updated as new information becomes available.

Socio-cultural group	Country	Vernacular name
Bariba	Benin	Sombu
Dendi	Benin	Bulanga
Fulbe	Benin	Kareegi
Yoruba, Nago	Benin	Emin
Moore	Burkina Faso	Taanga
Arabic	Cameroon	Oum kouroum
Bamoun	Cameroon	Sap
Bangangté	Cameroon	Kekombichop
Baya	Cameroon	Kol
Fulbe	Cameroon	Karehi
Guiziga	Cameroon	Sougoum
Hausa	Cameroon	Kadanya
Koma	Cameroon	Kelé
Mboum	Cameroon	Soro
Moundeng	Cameroon	Kire.
Ga	Ghana	Ngu
Gbe-Vhe	Ghana	Tokuti
Nzema	Ghana	Ngu
Manding-Mandinka	Guinea-Bissau	Bambô, tulô, irô
Bamana	Mali	Si yiri
Kanouri	Nigeria	Tosso
Samba-Daka	Nigeria	Tubbi
Wolof	Senegal	Ghariti
Manding-Mandinka	Sierra Leone	Se, si



Distribution range of shea butter tree

Geographical distribution

The shea butter tree is native to West Africa and was first described by Mungo Park in 1796 in the Ségou region of Mali. It ranges from Senegal to Uganda and is localized between the latitudes 9° and 14°N in West Africa, 7° and 12° N in central Africa and 2° and 8° in East Africa. This zone corresponds to wetter central and southern parts of dry countries such as Burkina Faso, Mali and Niger and the drier northern part of wetter countries (Benin, Cameroon, Côte d'Ivoire, Ghana, Nigeria, Togo and Uganda).

Importance and use

People living in the semi-arid zone of sub-Saharan Africa have traditionally used shea butter in large quantities. The butter is used in cooking and as medicine. It is used for frying and in sauces, for medicinal applications, in lanterns and in ceremonies, such as for births, weddings and funerals. Good quality butter can be sold in international markets. It is estimated that at least 150 000 tonnes of kernels for butter extraction are consumed annually.

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Fruits for pulp consumption

Shea butter in calabash moulds

Shea butter has important therapeutic properties, particularly for the skin. It provides protection from ultra-violet (UV) radiation and has moisturizing, regenerative and anti-wrinkle properties. It is also used in personal care products, such as pomades, soaps and pharmaceuticals.

The pulp is consumed by people of all ages, especially during the rainy season when fruit ripens (May–September). During this period, cereal crops are in short supply in the villages and the pulp of shea fruit becomes a staple food. The pulp is used to make beverages and jam, which are much appreciated in Mali and Burkina Faso.

Shea butter in a local market from Mali

Socio-economic value

The main shea-producing countries are Burkina Faso (70 000 tonnes of dry kernels in 2004), Ghana (65 000 t), Mali (53 000 t) and Nigeria (414 000 t). Of this, Burkina Faso exported 40 000 t, Ghana 60 000 t, Mali 53 000 t and Nigeria 20 000 t.

Uses	Part of plant or tree product
Nutritional	
Consumed raw as jam or beverages	Pulp
Cooking oil	Butter
Nectar converted to honey	Flowers
Cocoa butter substitute in chocolate	Butter
Cosmetics	Butter
Fodder	Leaves
Medicinal	Leaves, bark, butter, roots, latex,
Firewood	Trunk and branches
Lighting	Butter
Fishing	Trunk and branches
Musical instrument	Bark, sap (as glue in instruments)
Glue to capture small animals	Latex and sap
Pesticide	Seed residues from butter extraction
Soil conservation	Leaves
Cultural (protection of newborns)	Butter

Gando women selling shea butter in a local market in Benin

Exports of shea butter have increased dramatically in the past 25 years, largely due to increased demand for vegetable fat from developed countries, where shea butter is now commonly used in the production of cocoa butter equivalents or improvers, other confectionaries and margarines. However, the pharmaceutical market uses as much as 5–10% of total African exports, and the cosmetic industry is an increasing outlet.

Different industries have different requirements for shea butter. The cosmetic industry requires softer butter, while the chocolate industry uses hard butter to compensate for softer cocoa butter or the addition of milk fat. The antioxidant activity of phenolic compounds is an important characteristic of shea butter for the cosmetics industry. Butter characteristics are under both genetic and environmental control. For example, the overall concentration of phenolic compounds in shea kernels may be linked to the level of environmental stress in the source population, with the highest phenolic concentrations occurring in shea trees at the upper and lower temperature limits of the species. Processing conditions can also affect the content and quality of fatty acids present in the butter.

Chemical analysis of shea butter from four African countries (Uganda, Burkina Faso, Mali, Nigeria and Uganda) found considerable differences between countries. The Ugandan sample had a 59% oleic acid content compared with only 39% for that from Burkina Faso. Malian shea butter closely resembles cocoa butter while Ugandan shea butter has more similarities with olive oil. This variability suggests that shea oil from different regions could be targeted towards different niche markets or industrial uses.

Intermediary women in international trade from Benin

Ecology and biology

The shea butter tree is found in wet and dry savannahs where annual rainfall amounts to between 400 mm and 1500 mm. It is adapted to a wide variety of environmental conditions. It can be found in plains and mountains. It forms fairly pure stands in the Sudanian savannahs in association with other species such as false shea (*Lophira lanceolata*), esemi

A shea butter tree flowering

Phenology	Periods
Emergence of young flower buds	November-April
Blooming	December-April
Leaf–fall	November-March
Emergence of young leaves	December-April
Fruiting	December-April
Fruit ripening	March-August
Fruit harvest	April-September

Fruit development

(*Terminalia macroptera and Terminalia avicennioides*) and African locust bean (*Parkia biglobosa*). It is commonly associated with agroforestry systems and benefits from the close care given to it by farmers in the fields.

The tree grows to a height of 10-20 m with parasol, pyramidal or globular shape. The cylindrical trunk of mature trees measures 30-80 cm in diameter. The fruit consist of a berry comprising a nutritious pulp that surrounds a relatively large nut containing an oil-rich kernel from which the shea butter is extracted.

Shea butter tree has two subspecies—*nilotica* from East Africa and *paradoxa* from West Africa—which are differentiated by morphological characters such as flower size.

Reproductive biology

The shea butter tree has hermaphroditic flowers, meaning that each flower is both male and female. The tree is predominantly outcrossing, with little evidence of self-pollination. The main pollinators are bees, flies, ants and wasps. Seed is dispersed primarily by humans, monkeys and birds.

Phenology

Shea butter trees lose their leaves during the dry season, from November to March. Flowering occurs during the dry season, from November to April. New leaves appear immediately after flowering. Fruit ripens from March to August and harvesting is mainly from April to September.

Related species

Vitellaria is considered a monospecific genus, hence the shea butter tree has no related species.

Morphological traits and their variation

The leaves are simple and oblong. When young, they are reddish or greenish and slightly hairy underneath. The hairiness disappears completely in mature leaves in the majority of West African morphotypes while it is conserved in morphotypes from Benin and East Africa.

A study on morphological variation in 41 populations found variation in all tree size, leaf

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Shea butter trees in parklands showing different tree shapes

and fruit characteristics measured, although it was not possible to separate genetic from environmental variation. Results indicated that variation was higher within populations than among populations, as would be expected when variability caused by environmental conditions is included in the within population proportion.

The largest trees are found in northern, drier areas. Trees in the wetter zones of the west of the range have the longest leaves and the largest nuts.

Descriptors for Shea tree (*Vitellaria paradoxa*) have been developed by IPGRI (now Bioversity International) and INIA. See a basic list of minimum discriminating descriptors on this leaflet, pages 10-11.

Genetic knowledge

Genetic diversity is low compared with other tropical trees. Quantitative traits measured on one-year-old seedlings are more variable within populations than among populations, but they showed a greater degree of inter-population differentiation than molecular markers, providing evidence for the influence of selection on genotypic values. Variation in traits was not correlated with environmental variables, meaning that there is not clear evidence for adaptation to different levels of rainfall, for example.

Trees growing in fields have been found to be more diverse than those growing in forests or on fallows. Despite the influence of human activity on the life cycle of shea butter trees growing in parkland systems, the impact on genetic variation appears to be minor, probably due to extensive gene flow between unmanaged and managed populations.

In spite of high gene flow between neighbouring populations, there are distinct differences between populations at the eastern and western ends of the species range.

Local practices

Fruit ripens during the rainy season, when women are very busy in the fields cultivating

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Young girls collecting fruit for shea butter processing

Decorated pot for short-term storage of shea butter, in Monno (Niki, Benin)

food crops or cotton. As a result, women and children harvest the fruit early in the morning and after cooking the meal at noon or even at night. Fruit may be stored in holes in the ground, but this reduces the quality of the butter that can be made from them. Therefore people try to process the fruits immediately after harvesting them, removing the pulp from the nuts.

Men and women prefer trees with different characteristics, reflecting the division of labour between them. Men prefer healthy trees with low competitive effects on crops, large sweet fruit, fast growth and resistance to mistletoe. Most women prefer trees that give a high butter yield. In general, trees with consistent year-to-year yields, sweet pulp and high fat contents are considered ideal. The fat content of large kernels is very low. Women usually prefer small, compact seeds because they get a higher return to their labour extracting butter.

Numerous ethnic groups regard the shea butter tree as sacred, and the species occupies an important place in numerous cultural and religious ceremonies. Gender-related rules and management practices are observed. For example, fruit is harvested by women and children but trees and lands are considered to belong to the men.

Threats

Human pressures—including cutting trees for firewood, burning savannahs and bushland and clearing forest for agriculture—and drought are the main threats to the species. Regeneration is hampered in agricultural areas, especially where cultivation is mechanized. The shea butter tree is most threatened in areas where cotton is grown.

Strong winds at the beginning of the rainy season in March and April can destroy flowers and even topple trees, especially when root systems have been weakened by successive droughts. If climate change results in reduced rainfall, the destructive impact of strong winds may worsen in the future.

Charcoal for sale in a North Benin market

Pollination and reproductive success are reported to be very low; reduced pollinator activity is considered to be a key factor. High temperature and smoke reduce bees' activity, and periods of hot weather and late bush fires in March and April are blamed for reducing pollination and consequently affecting fruit production.

In the parklands, shea butter trees are mostly old (80 to 100 years on average), and hence fruit production is declining. Parasites of the genus *Tapinanthus* and wood-boring beetles weaken the trees over time and reduce fruit production.

Conservation status

The shea butter tree appears to be protected by the forest laws in most of the countries in the species' natural range. Despite this protection, the trees are cut in parklands, for example when clearing land for cotton cultivation and harvesting wood for charcoal. Consequently, the number of trees in the parklands is declining year after year.

Government extension services working on environment preservation, in particular in the Sahel region, encourage farmers to protect and to stimulate natural tree regeneration. Young trees are identified and marked, and are protected from grazing, tillage and fire. Protecting natural regeneration allows enrichment of parklands. In comparison to tree planting, it is technically easy to apply and reproduce; it is also relatively low cost and requires little community organization.

Traditionally protected areas such as sacred groves exist in many villages, allowing seedlings to establish and grow. The shea butter tree is reported to be found in at least one national park in Benin.

The seed of the shea butter tree is considered recalcitrant, and hence cannot be stored for more than a few weeks using conventional methods.

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Nursery grown seedlings at the Sotuba Research Station (Bamako, Mali)

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Wild shea butter tree seedling grafted using the side cleft method

Management and improvement

Shea butter trees have probably been under traditional management for centuries, and are widely grown on cultivated lands and in parklands.

The traditional parkland farming system consists of alternating cycles of cultivation and bush fallows. Natural regeneration of woody plants occurs around established trees in fallows. The shea butter tree is rarely planted and most individuals result from natural regeneration.

Farmers actively select specific trees when woodland is cleared for cultivation, based primarily on fruit productivity and their likely competitive effects on annual crops (determined by crown size, leaf density and spacing). Criteria for selection of immature trees are based on spacing, health and growth rate. In agroforestry systems, farmers maintain a balance between crop and tree productivity. Unwanted mature trees are usually killed by girdling and are allowed to dry before being cut for household uses (poles, mortar and charcoal).

Differences are observed in size class distribution and spatial patterns between forest, field and fallow. Forest trees are usually smaller

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Shea butter young trees after five years grafting, in Burkina Faso

than those found in fields and fallows because competition is much greater in the forest than in fields or fallows. Trees are more scattered in fields than in forests or fallows as a result of thinning and reduction of regeneration by human intervention.

Trees are sometimes pruned to increase fruit production, reduce shading of crops or to harvest wood, fruit or leaves. Agricultural practices have a noticeable impact on flowering phenology. The shea butter tree flowers more abundantly in cultivated fields than in forests or fallows. Human activities also influence fruit parameters: the size (length and width) and the average kernel yield is higher from trees located in agroforestry parklands (around 4 kg/tree) than from trees in natural forests (1.5 kg/tree). Fruit production is very irregular; girdling can be used to increase uniformity but it may have detrimental effects on the health of trees.

Shea butter trees can regenerate in fields and fallows by coppicing to allow regrowth of bushy shoots. This method is used for fuel wood and construction wood.

Propagation from seed

Farmers generally do not plant shea butter tree, hence there is little local experience in seedling production. The seed is recalcitrant, hence cannot be stored using normal methods. Germination rate decreases considerably after three weeks storage under room temperature (30 to 35°C). Germination time varies from seven days to three months. Germination rate, under good conditions, varies between 30–75%.

Vegetative propagation

Trees can be grafted successfully using side cleft, tongue cleft, top cleft and chip budding techniques. Cuttings can be rooted successfully and trees can be propagated vegetatively using the air layering technique.

Guidelines for conservation and use

Given the long-term decline in the numbers of shea butter trees, especially in parklands, and the age of trees found there, there is a need to

Trait variation defining morphological descriptors of fruits, seeds and kernels

conserve the tree in situ and ex situ. This should be done in a participatory manner involving policy-makers, extension services and local populations. Field genebanks should be established.

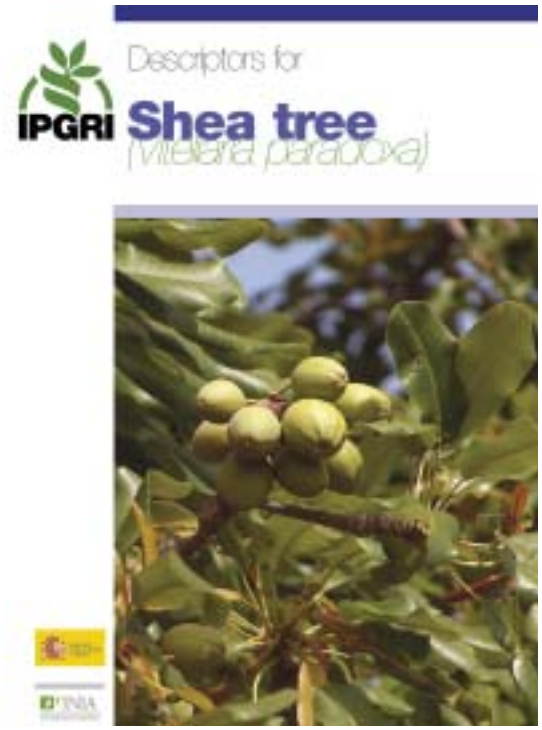
Little genetic variation has been found between populations. Much of the natural genetic variation can be captured by sampling intensively from a relatively small number of populations. Populations for in situ conservation or for collection for breeding purposes should be chosen to cover a range of environments, with special emphasis on sites that receive low rainfall.

Conservation through sustainable use is a viable option for shea butter tree, in combination with other forms of conservation. Breeding programmes that make the species more attractive to farmers to plant and tend would have the added benefit of conserving valuable genetic resources. Phenotypic variability observed for fruit size and quantity indicates that breeding for these characteristics could deliver considerable improvement.

Research needs

- Determine the number of viable populations in protected natural areas such as national parks
- Determine genetic variation in tree growth and fruit production characteristics
- Determine genetic variation in drought tolerance traits and location of important sources of variability
- Determine effective population sizes in semi-natural farmland populations and minimum viable populations for conservation and long-term sustainable use
- Identify pollinator species, investigate effective pollen flow and determine threats to pollinator species, including probable effects of climate change
- Investigate effectiveness of seed dispersal and degree of dependence on fauna that are rare or threatened
- Develop protocols for *ex situ* storage (overcoming the difficulty posed by recalcitrant seed)
- Develop best practices for nursery propagation. ■

Basic list of minimum discriminating descriptors
for Shea tree (*Vitellaria paradoxa*)



Number	Name
7.1.6	Trunk surface
7.1.7	Bark thickness [mm]
7.1.11	Crown shape
7.1.15	Apical dominance
7.2.5	Leaf apex shape
7.2.8	Leaf base angle [°]
7.2.10	Adult leaf colour
7.2.11	Young leaf colour
7.4.4	Fruiting season dates
7.4.7	Fruit shape
7.4.9	Fruit apex shape
7.4.11	Fruit length [cm]
7.4.12	Fruit diameter [cm]
7.4.13	Fruit weight [kg]
7.4.17	Fruit taste
7.5.1	Seed length [cm]
7.5.2	Seed width [cm]
7.5.3	Number of seeds per fruit
7.5.5	Seed shape
7.5.7	Seed coat colour
7.5.16	Melting point for oil produced [°C]
8.2.1.4	Kernel unsaponifiable matter content
8.2.2	Kernel fatty acid

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Vitellaria paradoxa **Shea Butter Tree**

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This leaflet was produced by members of the SAFORGEN Food Tree Species Working Group. The objective of the working group is to encourage collaboration among experts and researchers in order to promote sustainable use and conservation of the valuable food tree species of sub-Saharan Africa.

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Citation:
Sanou H and Lamien N. 2011. *Vitellaria paradoxa*, shea butter tree. Conservation and Sustainable Use of Genetic Resources of Priority Food Tree Species in sub-Saharan Africa. Bioversity International (Rome, Italy).

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ISBN: 978-84-694-3166-5

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