



Tamarindus indica

Tamarind



Semi-processed and packed tamarind fruits for sale at a market in Mombasa, Kenya

Common name

Tamarind,
Madeira mahogany,
Indian date (English)

Tamarinde,
tamarinier (French)

Scientific name

Tamarindus indica L.

Synonyms

Tamarindus occidentalis Gaertn,
Tamarindus officinalis Hook,
Tamarindus umbrosa Salisb.

Family

Fabaceae

subfamily

Caesalpinioideae

■ Benard O MUOK

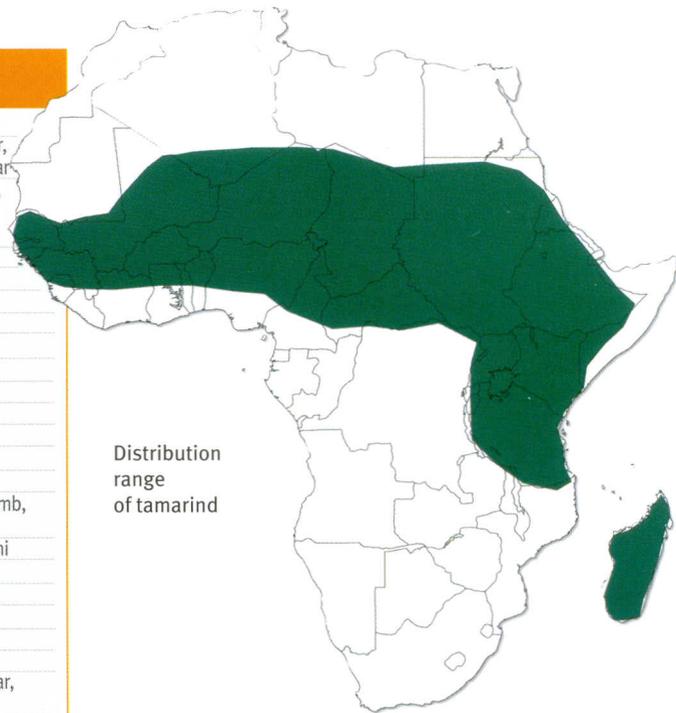
African Centre for Technology Studies (ACTS), PO
Box 45917-00100 GPO Nairobi, Kenya

■ Sheferaw ALEM

Ethiopian Institute of Agricultural Research, Forestry
Research Center, PO Box 30708, Addis Ababa,
Ethiopia

This leaflet highlights the nutritional and socio-economic potential of tamarind and provides information to assist those working with the species. The focus is on conserving genetic diversity and promoting sustainable use of tamarind. 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
Afrikaans	South Africa	Tamarinde
Amharic	Ethiopia	Humer, hemor, homor, humar, komar, tommar
Gamo/Oromo	Ethiopia	Roka, racahu, dereho, dindie, ghroma, gianko,omar
Tigrinya	Ethiopia	Arabeb
Borana	Kenya	Roka
Kamba	Kenya	Rakhai, hamar
Luo	Kenya	Chwa waa
Masai	Kenya, Tanzania	Ol-masamburai
Meru	Kenya	Muthithi
Pokot	Kenya	Oran
Turkana	Kenya	Eopduran
Chichewa	Malawi	Ukwaju, bwemba
Nkonde	Malawi	Nkewesu
Yao	Malawi	Mkewesu
Mandinka	Mali	Tomi, timbingo, timbimb, tombi
Fulbe	Nigeria	Dabe, jammeth, jammi
Guiziga	Cameroon	Mbulam
Toupouri	Cameroon	Baaré, zoulgo, mblar
Kapsiki	Cameroon	Oumbila
Massa	Cameroon	Chitna
Hausa	Nigeria, Niger	Tsamiya
Wolof	Senegal	Daharg, dakah, dakhar, ndakhar
Jola-Fonyi	Senegal	Budahar
Somali	Somalia	Rakhai, hamar
Kiswahili	Somalia, Mozambique	Msisí, mkwaju
Arabic	Sudan	Ardeib, aradeib
Nuba	Sudan	Shekere, kuashi, danufi
Kiswahili	Tanzania	Ukwaju
Acholi	Uganda	Chwa/o
Bari/Ma'di	Uganda	Iti
Kakwa	Uganda	Pitei
Karamojong	Uganda	E/apedura (fruit)
Langi	Uganda	Chwa/o
Luganda	Uganda	Mukoge
Teso	Uganda	Esukuru, esuguguru (leaves)
Bemba	Zambia	Mushishi
Nyanja	Zambia	Mwemba
Tonga	Zambia	Musika



Distribution range of tamarind

hemisphere in more recent times, probably during the early years of the West African slave trade. The capital of Senegal, Dakar, was named after the local word *dakhar* for tamarind.

The species is thought to be native to Burkina Faso, Northern Cameroon, Central African Republic, Chad, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Kenya, Madagascar, Mali, Mozambique, Niger, Nigeria, Senegal, Sudan, Tanzania, Uganda and Zimbabwe.

Geographical distribution

Tamarind is widely distributed in Africa and Asia. Its origin is unknown, although it is commonly believed to be indigenous to the drier savannahs of tropical Africa. However, it has long been naturalized in tropical Asia. Tamarind is now cultivated throughout the tropics and is economically important all over South-East Asia. It was introduced to the tropics in the western

Importance and use

Tamarind is used as a source of food, food preservatives, fodder, drugs, timber and fire wood. Tamarind fruit pulp is very rich in tartaric acid and it is used as a preservative in the pickle industry. The hard green pulp of unripe fruit is too sour to be consumed directly, but is often used as a component of savoury dishes.

Uses	Part of plant
Food	Fruit, leaves
Beverage	Fruit
Preservative	Fruit
Fodder	Pods, leaves
Fuel wood	Stem, branches
Medicines	Leaves, fruit, bark
Fishing	Flowers
Soil protection	Whole tree
Timber, furniture	Wood
Recreation	Whole tree

The ripe fruit is edible and popular, as it is sweeter, but is still very acidic. It is used in desserts such as jam, blended into juices or sweetened drinks or eaten as a snack. It is also consumed as a natural laxative. The species has many traditional uses in different societies in Africa.

Socio-economic value

Tamarind fruit and other products are sold on local markets in Africa as well as on international markets. Trade in tamarind products is an important source of income for farmers in Kenya. The fruits are also commonly marketed in



Retailers selling tamarind fruits in Eastern Kenya



Trade of tamarind fruits in a local market

Karamoja, West Nile and Northern districts of Uganda, and children sell the fruit in Ethiopian towns and coastal towns in Kenya.

Ecology and biology

Tamarind grows well under a wide range of soil and climatic conditions, but prefers semi-arid areas and wooded grasslands. It is commonly found on light clay (especially red clay), loam, sandy and alluvial soils as well as in rocky areas. It prefers well-drained alluvial soil with an average rainfall of 250–1200 mm per annum. It has an altitudinal range of 0–1600 m above sea level. The species is found along rivers in drier regions.

Reproductive biology

The reproductive biology of tamarind has been relatively well-studied compared with other African fruit species. Flowering coincides with the production of new leaves. The flowers are showy and aromatic, hermaphroditic (i.e. both male and female) and likely pollinated by bees.

Flowers are receptive for pollination for almost 48 hours. Self-pollination often results in flower or fruit abortion, indicating partial incompatibility.

Phenology

Trees usually begin to produce fruits at between seven and ten years of age. Humans and other large animals are the primary dispersal agents.

Flowering and fruiting times vary between countries. In Kenya, for example, flowers appear at the same time as new leaves, from April to July. Fruiting occurs from May to August and fruits reach maturity from December to February. In Niger flowering starts in December and ends in May. Fruits reach maturity from December to January.

Related species

Tamarind is the only species in the genus *Tamarindus*.

Morphological traits and their variation

The tamarind tree grows to 14 m in height and has a dense, spreading crown with a clear trunk. It is considered an evergreen but may have a short deciduous phase in some areas. Leaves are compound and long, with 8–18 pairs of leaflets. Flowers are small, yellow with pink streaks and grow in small clusters. The fruit is a pod 5–15 cm long, with up to ten seeds embedded in a sticky pulp. The seeds are dark reddish-brown or black with a hard seed coat.

The species shows a remarkable variation in leaf size, tree form and fruit shape, taste and size. Different varieties have been reported from the areas where the species has been introduced and widely planted.

Tree growth is slow, less than 1 m per year. Trees established from seed generally do not start to produce seed until they are at least seven years old, while trees from



© B. MUIOK



© B. MUIOK

Differences in leaf and fruit size

grafts usually bear fruit within three to four years.

Genetic knowledge

In spite of the species' high value and widespread use, little is known about the genetics of African populations. Early studies established that it is a diploid species with 24 chromosomes. Preliminary results from provenance trials in Burkina Faso, Mali and Senegal indicate that the variation in growth, biomass and fruit production among different seed sources is substantial, but results have not yet been published.

A molecular analysis of genetic diversity showed that populations differ between East and West Africa. The population from Cameroon had the greatest diversity among the 10 populations tested, which included populations

from Guadeloupe, India and Thailand, as well as from Burkina Faso, Kenya, Madagascar, Réunion, Senegal and Tanzania. Relatively high genetic diversity was reported across the range of the species, indicating that there is no immediate cause for concern about genetic erosion as long as conditions allow regeneration of seedlings.

Local practices

Farmers select trees based on fruit taste and other important traits. Management of trees differs between those from which fruit is to be harvested for domestic consumption and those from which fruit is to be sold. For example, in the region of Ishiara, eastern Kenya, a particular tree with exceptionally sweet fruits was communally owned, such that all members of the community could harvest fruit for domestic



A tamarind tree left in cropland

use but not for sale, while other trees, which were less sweet, were allocated to different households, which were allowed to sell the fruit.

Threats

The main threats to tamarind include charcoal production, exploitation for timber, expansion of agricultural activities and overgrazing. Urbanization, climate change (drought) and exploitation for medicinal use pose less immediate threats.

Conservation status

Tamarind is considered endangered in the Lake Victoria region but is locally common in other areas. It is unknown whether tamarind occurs in protected areas such as parks or forest reserves.

Seed is orthodox so *ex situ* conservation in seed banks is feasible, though no seed banks have yet been established. Provenance trials are a form of *ex situ* conservation if they are maintained

properly. Forty-four provenances have been planted in four provenance trials by INERA, Burkina Faso, but each with only one test site. Clonal genebanks have been established at tree seed centres in Burkina Faso (CNSF) and Senegal (PRONASEF) with populations from Burkina Faso, Kenya, Mali, Niger and Senegal.

Trees are generally protected from cutting on farmers' land but the shade they provide is too dense to allow crops to grow beneath the trees. Tamarind suppresses the growth of other species nearby and is thus not as suitable for use in agroforestry systems as other forest fruit trees. In many areas little regeneration is observed, which may be cause for concern.

Management and improvement

Selection and domestication

Tamarind is not planted in the Sahel region but it has high potential for domestication. Plus trees were selected by the World Agroforestry Centre in collaboration with farmers



Tamarind seedlings

in 2004–2005 in Burkina Faso, Kenya, Mali, Niger and Senegal and were cloned for use in tree improvement programmes. The selection criteria were vigour, early fruit set, fruit sweetness, resistance to pests and disease, long straight pods, large round canopy, high number of seeds and of pods, and ease of removal of fibre and shell from the fruit pulp.

In Asia, tamarind has a long history of cultivation and intensive management is practised in some areas. For example, the young trees are pruned so that 3-5 branches form the main structure.

Propagation from seed

Seed must be pretreated to achieve good levels of germination (80%). Pretreatment consists of pouring hot water (80°C) over the seed and then leaving the seed to soak in the cooling water for 24 hours. Alternatively, the seed coat can be nicked to facilitate germination. Pretreated seeds should be sown in germination beds or directly into potting tubes. Germination takes place within a week after sowing. The seed should be covered by 1.5 cm loose, sandy loam or by a mixture of loam and sand. Seedlings should be at least 80 cm tall before they are transplanted into the field at the onset of the rains.

In a pure-stand plantation, tree size can be controlled by close spacing (about 500 trees/ha) and pruning to promote fruit production. The World Agroforestry Centre recommends a spacing of 13 x 13 m when establishing the plantation from seed. Spacing may be reduced if using vegetatively propagated plants, which do not grow as large as trees established from seed.

Vegetative propagation

Tamarind can be vegetatively propagated easily and reliably using grafting and budding techniques. Grafted trees bear fruit within three or four years, compared with at least seven years for trees from seed, so are more appealing to farmers than seedlings.

Guidelines for conservation and use

Effective conservation of tamarind will require action in four main areas: *in situ* conservation, *ex situ* conservation, education and research. In order to ensure that wild populations of vulnerable species are maintained, protected habitats that will allow natural processes to continue undisturbed should be designated and monitored.

Ex-situ conservation involves establishment of plantations, maintenance of living collections in farm fields, home gardens, botanical gardens and arboreta located outside the zone of their natural occurrence.

Research needs

- Determine conservation status of existing populations and threats to their continued existence
- Determine the number of viable populations in protected natural areas such as national parks
- Determine effective population sizes in semi-natural farmland populations and minimum viable populations for conservation and long-term sustainable use
- Determine genetic variation in drought tolerance and location of important sources of variation
- Determine genetic variation in tree growth and fruit production by establishing additional provenance and progeny trials
- Identify pollinator species, investigate effective pollen flow and determine threats to pollinator species
- Investigate effectiveness of seed dispersal and degree of dependence on fauna that are rare or threatened
- Develop seed handling methods to enhance potential for *ex situ* conservation. ■



Tamarindus indica L. Tamarind

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.

Coordination committee:

Dolores Agúndez (INIA, Spain)
Oscar Eyog-Matig (Bioversity International)
Niéyidouba Lamien (INERA, Burkina Faso)
Lolona Ramamonjisoa (SNGF, Madagascar)

Citation:

Muok BO and Alem Sh 2011.
Tamarindus indica, tamarind.
Conservation and Sustainable Use of
Genetic Resources of Priority Food Tree
Species in sub-Saharan Africa.
Bioversity International (Rome, Italy).

Bibliography

- Diallo BO, Hélène I, Joly I and McKey D. 2007. Genetic diversity of *Tamarindus indica* populations: Any clues on the origin from its current distribution? *African Journal of Biotechnology* 6(7):853–860.
- Diallo BO, McKey D, Chevallier M, Hélène I, Joly I and Hossaert-McKey M. 2008. Breeding system and pollination biology of the semi-domesticated fruit tree, *Tamarindus indica* L. (Leguminosae: Caesalpinioideae): Implications for fruit production, selective breeding, and conservation of genetic resources. *African Journal of Biotechnology* 7(22):4068–4075.
- ICRAF. n.d. Agroforestry database [online]. Available at: <http://www.worldagroforestrycentre.org/sites/treedbs/aft.asp>. Accessed 20 February 2010.
- ICUC. 1999. Fruits for the future. Tamarind. Factsheet 1. International Centre for Underutilized Crops, University of Southampton, UK. Available at: <http://www.icuc-iwmi.org/files/News/Resources/Factsheets/tamarind.pdf>. Accessed 20 February 2010.
- Joker D. 2000. *Tamarindus indica* L. Seed Leaflet 45. Forest & Landscape Denmark, Hørsholm, Denmark.
- Kalinginire A, Weber JC, Uwamariya A and Kone B. 2007. Improving rural livelihoods through domestication of indigenous fruit trees in the parklands of the Sahel. In: Akinnefesi FK, Leakey RRB, Ajayi OC, Sileshi G, Tchoundjeu Z, Matalaca P and Kwesiga F, editors. *Indigenous Fruit Trees in the Tropics Domestication, Utilization and Commercialization*. CABI Publishing, Wallingford, Oxon, UK. pp. 186–203.
- Muok BO. 2000. Socioeconomic and ecogeographic survey of *Tamarindus indica* and *Dialium orientale* in Kenya. In: Eyog-matig O, Gaoue OG and Obel-lawson E, editors. *Development of Appropriate Conservation Strategies for African Forest Trees Identified as Priority Species by SAFORGEN Member Countries*. UNEP/IPGRI, Rome, Italy. pp. 51–66.
- Parrotta JA. 1990. *Tamarindus indica* L. Tamarind. Leguminosae (Caesalpinioideae). Legume family. SO-ITF-SM-30. USDA Forest Service, Southern Forest Experiment Station, Institute of Tropical Forestry, Río Piedras, Puerto Rico. 5 pp. Available at: http://www.fs.fed.us/global/iitf/pubs/sm_iitf_29.pdf. Accessed 20 February 2010.

ISBN: 978-84-694-3166-5



GOBIERNO
DE ESPAÑA
MINISTERIO
DE CIENCIA
E INNOVACIÓN

