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# THE DISTRIBUTION AND ECONOMIC IMPORTANCE OF THE MANGROVE FORESTS OF KENYA

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## ABSTRACT

The mangroves form a group of higher plants which form a unique ecosystem, in that they grow in that part of land which is neither in demand for human settlement nor for agricultural use. They are also unique in their adaptation to both soil and water conditions. They are useful as a source of timber, for building poles, fuel, dyes, tannins, and are also known to provide both shelter and food for part of the marine fauna. Their value to the country, therefore, calls for proper utilization and conservation of all the available mangrove forests along the coast. The demand for forest products, including those from the mangroves in Kenya, is greater than the available resources from the forests, and unless proper and prompt planning for their protection is implemented our mangroves will soon be among the endangered ecosystems in the country.

## INTRODUCTION

The Kenyan coast runs from the Somalian border at 1°40' S southwest to 4°40'S at the border with Tanzania (Map 1). It lies in that hot tropical region where the weather is primarily controlled by the great monsoon air currents of the Indian Ocean. It is the southeast monsoon which brings the long rains from April to June, when most of the annual precipitation is received. The short rains begin around October or November, and both long and short rains occur mainly in the morning or mid-day hours.

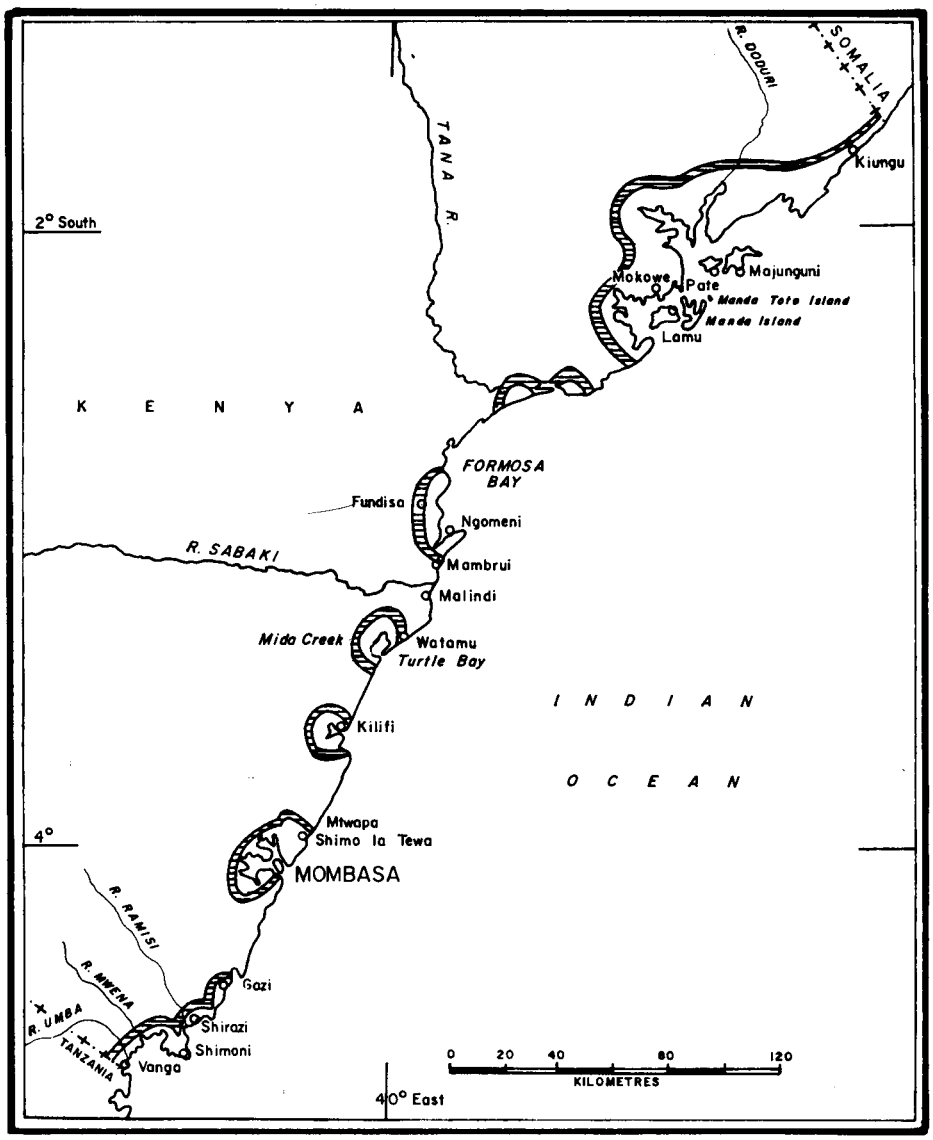
The mangroves form the type of vegetation collectively referred to as mangrove swamps, mangrove forests or mangrove thickets. They are a common feature of tropical shores and are usually formed around the mouths of rivers and creeks where there is a gradual slope of the land towards the sea as well as a large tidal range resulting in a broad inter-tidal zone, consisting of a mixture of sand and silt. These communities are generally confined to tidal estuaries and lagoons, as they are protected from the force of the open sea in these localities. The supporting soil is primarily heavy mud which is mostly saline, though frequently influenced by freshwater streams and rivers. Though the mangroves can withstand seawater with high salinity, their communities are usually most prolific in areas not far from the mouths of coastal streams.

## ADAPTATION TO A UNIQUE ENVIRONMENT

Lagoons behind tropical shores as well as creeks influenced by freshwater streams contain brackish water, and their shores are mostly muddy. Such shores may support a growth of mangroves, which are adapted to this habitat —an environment which is unique due to the following factors:

(1) **Fluctuating salt content.** The mangrove swamp is essentially tidal, receiving water of low salinity from the river and water of high salinity from the sea at different times each day. The plants and animals in the mangrove system will thus have to be adapted to withstand such changes in salinity.
(2) **Aeration.** The soil in the mangrove swamp is saturated by water and hence almost completely lacks the oxygen required by the plants for root respiration.
(3) **Mobility of the soil.** The soil level is unstable, as the streams bring down alluvial soil which is deposited, only to be washed away again by sea currents. This makes it difficult for seedlings to establish themselves.

To be able to withstand the fluctuations in salt content most plants of the mangrove swamps are halophytes, i.e. plants with high osmotic pressure in their cell-solutions. In order to obtain oxygen for respiration some of the plants have pneumatophores (breathing roots or aerial roots); and by means of stilt roots they are able to withstand the mobility of the soil.




MAP 1

Distribution of Mangrove forests along the Kenya Coast line

## DISTRIBUTION

The mangrove swamps along the Kenyan coast cover approximately 52.980 hectares (Table 1). The largest stands occur in the Lamu area including the islands of Manda and Patta, and also along the Vanga-Funzi system near the Kenya-Tanzania border. The former area receives its low-salinity water from the Doduri and Tana rivers, while the latter receives this from the Ramisi, Mwena and Umba rivers.

Other areas along the coast with less extensive mangrove stands are Mtwapa, Kilifi and Mida creeks to the north of Mombasa; the Mombasa-Port Reitz area; Gazi to the south of Mombasa; and the Ngomeni-Fundi Isa area to the north of Malindi (Map 1). The border between the mangroves and the non-halophytic vegetation is found to be well-defined everywhere along the coast, except where fresh-water from the rivers comes into the ocean. Where natural vegetation is disturbed, an impenetrable, evergreen, usually thorny bush dominated by Baobab trees *(Adansonia digitata)* is found. However, since most land adjacent to the mangroves is cultivated, plantations, especially of coconut, are prevalent.

TABLE 1:

*Distribution of the Mangroves*
(from Doute et al. 1981)

| LOCALITY | DISTRICT | AREA IN HECTARES |
|---|---|---|
| Kiunga | Lamu | 3,025 |
| Lamu | Lamu | 30,475 |
| Kipini (Witu) | Tana River | 1,595 |
| Mto Tana (Witu) | Tana River | 250 |
| Mto Kilifi (Formosa Bay) | Kilifi (1,515), Tana River (820) | 2,335 |
| Mto Fundisa (Formosa Bay) | Kilifi | 330 |
| Ngomeni | Kilifi | 1,815 |
| Mida Creek (Malindi) | Kilifi | 1,600 |
| Takaungu (Malindi) | Kilifi | 30 |
| Kilifi Creek | Kilifi | 360 |
| Mtwapa Creek | Kilifi (410), Mombasa (115) | 525 |
| Tudor Creek | Mombasa | 1,465 |
| Port Reitz | Mombasa (380), Kwale (1195) | 1,575 |
| Maftaha Bay | Kwale | 615 |
| Ras Mwachema | Kwale | 5 |
| Funzi Bay | Kwale | 2,715 |
| Vanga | Kwale | 4,265 |
| *Distribution by districts:* | Lamu District | 33,500 |
| | Tana River District | 2,665 |
| | Kilifi District | 6,060 |
| | Mombasa District | 1,960 |
| | Kwale District | 8,795 |
| | | Total 52,980 |

## ECONOMIC IMPORTANCE

Small trees and shrubs are the most important plants of the mangrove swamps. There are five important genera of widely distributed woody plants in the mangrove vegetation of the Kenyan coast, each genus containing one species. *Bruguiera gymnorrhiza, Ceriops tagal* and *Rhizophora mucronata* belong to the family *Rhizophoraceae, Sonneratia alba* to the *Sonneratiaceae* and *Avicennia marina* to the *Verbenaceae*. They are all viviparous except *Sonneratia,* and often have stilt roots and pneumatophores (breathing roots). *Avicennia* and *Sonneratia* are the first colonizers of the swamps. Once established, mud can accumulate among their breathing roots, producing conditions favourable for *Ceriops* and *Rhizophora. Rhizophora* is the commonest and most important constituent of the mangrove swamps. It usually occupies the most favourable sites between *Sonneratia* and *Avicennia* on the creek edge, and *Ceriops* on the landward side. *Bruguiera* is normally found scattered in *Rhizophora* stands.

For a long time, the Coastal Kenyans have exploited the rich natural products of the mangroves to supplement their marginal producing agricultural land. They use the mangrove plants in many ways, and these are discussed below and listed in Table 2.

*Poles*

The most important product of the mangroves is poles for export and for local house-building. Annually, half a million poles were exported from Kenya during the 1930s. About 300.000 headloads of withies were obtained from the mangrove forest annually during the same period (Rawlins 1957). The majority of poles and withies are from *Rhizophora mucronata.*

*Vegetable Tannins*

These are generally considered as minor forest products in Kenya. However, during the mid-1950s, the mangroves were yielding tan bark exported at the rate of 3,500 tons per annum (Rawlins 1957). In many ways the mangrove bark is a unique tanning material, the supply of which is virtually inexhaustible. There is no need for planting or weeding, as the mangrove trees propagate themselves and no other trees are able to establish themselves in this special environment. The common tannin-yielding genera of the mangroves are *Avicennia, Bruguiera, Ceriops, Heritiera, Rhizophora, Sonneratia* and *Xylocarpus.* Of all these, *Rhizophora mucronata* is the easiest to strip and prepare for both local use and for export, and the tannin content of its bark (12-50 %) is among the highest. There are several reasons why tannin from mangroves has not come to the forefront in Kenya as a tanning material. Firstly, the mangrove forests of Kenya are not very extensive, compared to those of Tanzania. The second reason is the difficulty in collecting the bark from the swamps. Finally, the differences in tannin content between the various genera precludes indiscriminate felling of trees if a product of consistent quality is to be obtained. A possible additional disadvantage is that of the unwillingness of leather-buyers to use dark-coloured sole leather — and mangrove tannin is dark red. Research aimed at removing or bleaching the coloured components of the mangrove tannins will definitely increase their use and consequentially the commercial value of Kenyan mangroves.

*Fuel*

Coastal Kenyans have for a long time used different mangrove species as a source of fuel. We find that the kind of raw material used in traditional fuel depends more on accessibility than on the quality of the plants used. Those who live close to the mangrove forests therefore have the tendency to use the wood, frequently as firewood and occasionally for charcoal production. Charcoal produced along the coast is generally exported to the Middle East and was an extremely lucrative trade until the late 1970s when the Kenya Government had to intervene to prevent the complete destruction of forests, including the mangroves. It was estimated that the charcoal export from Kenya to Kuwait alone was at a rate of 35.000 tons a year (East African Standard 08.03.1971). The bulk of charcoal for export is still produced from the coastal forests.

Apart from *Bruguiera gymnorrhiza* and *Rhizophora mucronata* whose poles (boriti) and bark (for tanning) are of high value commercially, the rest of the mangrove species are utilized in one way or another as a source of fuel. Both firewood and charcoal are obtained from *Avicennia, Ceriops, Heritiera, Lumnitzera, Sonneratia* and *Xylocarpus* species, and most of these yield high quality fuel since they have hard and compact wood.

For the coastal people, charcoal is a major source of income whenever they can produce and export it, as the Middle Eastern demand for Kenyan charcoal is ever present; charcoal, even when imported, is cheaper than oil as a source of energy, and certain industrial work is better done by using charcoal as fuel than by electric or oil energy. Fortunately, the rate of regeneration of the mangroves is high when they have been harvested, since most of the species produce fruits and seeds which easily establish themselves. In Malaya, mangrove seedlings are collected as they drop, and planted in rows after the trees have been harvested and the swamps cleared. Proper planting has the advantages of ensuring that the seedlings are not washed away by the sea currents; of making harvesting easier, since the trees grow in lines; and of making increases in production possible as required.

It is clear that the demand for charcoal will continue to rise in Kenya. It is therefore the responsibility of the Forestry Department to encourage plantation of mangroves for the production of tannin, building poles, charcoal and firewood for both local consumption and export. It should be noted that most mangroves do not coppice when felled; this in itself will create some employment in fields like tanning, charcoal production and timber, primarily for export. The production of charcoal can be carried out by using modern and more economical methods such as the CUSAB charcoal kiln.

TABLE 2:

*Summary of Economic Use of Mangroves*

| *SPECIES* | LOCAL NAMES | POLES (BORITI) | TANNIN/ DYE | DHOW MASTS, ETC. | VARIOUS | FUEL | MEDICINAL, ETC. |
|---|---|---|---|---|---|---|---|
| 1. *Avicennia marina* | Mchu, Mtu | | Dye, 6% Tannin | Dhow ribs canoes, drums, carts, beds | | | Aphrodisiac, contraceptive |
| 2. *Bruguiera gymnorhiza* | Muia, Mchofi, Mkifu, Msindi | Boriti, nguzo, telephone poles | Dye, 53% Tannin | | | Firewood | |
| 3. *Ceriops tagal* | Mkandaa | Fito, mapau, nguzo | 24-42% Tannin | | | High quality firewood & charcoal | |
| 4. *Heritiera littoralis* | Msikundazi Mkokoshi, Mkukushu | | 14-15% Tannin | | | Good firewood & charcoal | |
| 5. *Lumnitzera racemosa* | Kikandaa, Mkandaa-mwitu, Muyanywa, Mtuitui | Building poles | | | | Good firewood | |
| 6. *Rhizophora mucronata* | Mkoko | Majority of the building poles | Dye, 12-50% Tannin | | | | |
| 7. *Sonneratia alba* | Mlilana, Mpia, Mkoko-mpia | | 15% Tannin | Boat ribs | Carpentry | | Camel/fodder condiments medicaments |
| 8. *Xylocarpus granatum* | Mkomafi, Mtonga | Poor quality building poles | 33% Tannin | Dhow masts, carts | | Firewood | Fruit infusion aphrodisiac |
| 9. *Xylocarpus moluccensis* | Mkomafi | | | Dhow masts | Joinery, Sandals. | | |

*Feeding ground for fishes*

Mangrove swamps are of great importance as feeding grounds for marine fishes. Most prawns, lobsters and crabs especially the juvelines use the mangrove swamps as their feeding ground. Breeding ponds as part of the mariculture programme has been set up at Ngomeni mangrove swamps for the breeding of prawns. They are also favourable habitats for various other kinds of marine fauna.

## USES OF INDIVIDUAL PLANT SPECIES

*Avicennia marina* (Forssk.) Vierh. *(Verbenaceae)* PLATE 1

Mchu (Standard name, Swahili); Mtu (Vanga Swahili); Mutu (Bajun); Mtswi (Giriama).

A spreading willow-like tree with a wide-spreading root system which sends up numerous asparagus-shaped pneumatophores to ca. 45 cm long.

A brown dye is produced by pounding and mashing the bark in cold water. Both the bark and the leaves contain up to 6% tannin, which is considered low.

The timber is used for making ribs of dhows, small dugout canoes, chairs, drums, carts and bedsteads. A bitter and somewhat aromatic resin which oozes from the bark is claimed to be both an aphrodisiac and a contraceptive. The roots are also claimed to have aphrodisiac properties.

*Bruguiera gymnorrhiza* (L.) Lam. *(Rhizophoraceae)* PLATE 2

Muia (Standard name); Msindi, Muia or Mkifu (Swahili); Mchofi (Digo & Gazi-Swahili).

A slender glabrous tree to 25 m high, with buttresses and knee-like roots acting as pneumatophores arising from near the base of the trunk.

The bark contains up to 53% tannin and also yields a black dye which, when processed, turns orange-red, brown or violet. The dye is prepared by pounding the bark in a mortar and mixing it with cold water; the fabric or leather is soaked in this liquid for 3 days and then hung in the shade to dry.

Poles are used locally as boriti and nguzo for building and construction, for telephone poles or as firewood. The wood is seasoned by leaving the poles in seaswater for some weeks, and thereafter becomes very hard and durable.

*Ceriops tagal* (Perr.) C.B. Robinson *(Rhizophoraceae)*

Mkandaa (Standard name, Swahili).

A shrub or mediumsize tree, with buttresses and knee-like roots acting as pneumatophores. Thos is the real Mkandaa although the name is sometimes loosely applied to mangroves in general.

The bark contains 24-42% tannin. The poles are used for building local houses and are called fito, mapau or nguzo. The wood is widely used as firewood and for charcoal production, and yields a high-quality fuel.

*Heritiera littoralis* Dryand. in Ait. *(Sterculiaceae)*

Msikundazi (Swahili); Mkokoshi or Mkukushu (Vanga-Swahili).

An evergreen tree up to 25 m high, boles often with plank buttresses. Normally grows at the site in the mangrove swamp where fresh water intermingles with seawater, and the best stands in Kenya occur on the Ramisi River. It also used to be common on the Tana River below Kau, but the amount has dwindled due to heavy utilization and other factors.

The bark yields 14-15% tannin. The wood is used for dhow masts, and is reported to be good for firewood and for charcoal production.

*Lumnitzera racemosa* Willd. *(Combretaceae)*

Kikandaa (Standard name, Swahili); Mkandaa-mwitu, Mtuitui (Swahili); Mnyanywa (Vanga-Swahili)

Shrub or tree to 9 m high with dark rough bark, although red and smooth when young. Roots bending to form 'knees'.

Poles are used in building or as firewood, producing good fuel.

*Rhizophora mucronata* Lam. *(Rhizophoraceae)* PLATE 3

Mkono (Standard name, Swahili)

The commonest and most important mangrove, growing up to 25 m high, and developing stilt roots adventitiously from the upper stem nodes.

Plate 1: *Avicennia marina (Verbenaceae)*
Note the numerous breathing roots (pneumatophores) (Photo: J.O. Kokwaro, Vanga, 1969).

Plate 2: *Bruguiera gymnorhiza (Rhizophorace)*
Msindi, Muia, Mkifu (Swahili). Note that the pneumatophores are distinctly kneed or knee-shaped. (Photo: J.O. Kokwaro, Gazi, 1969).

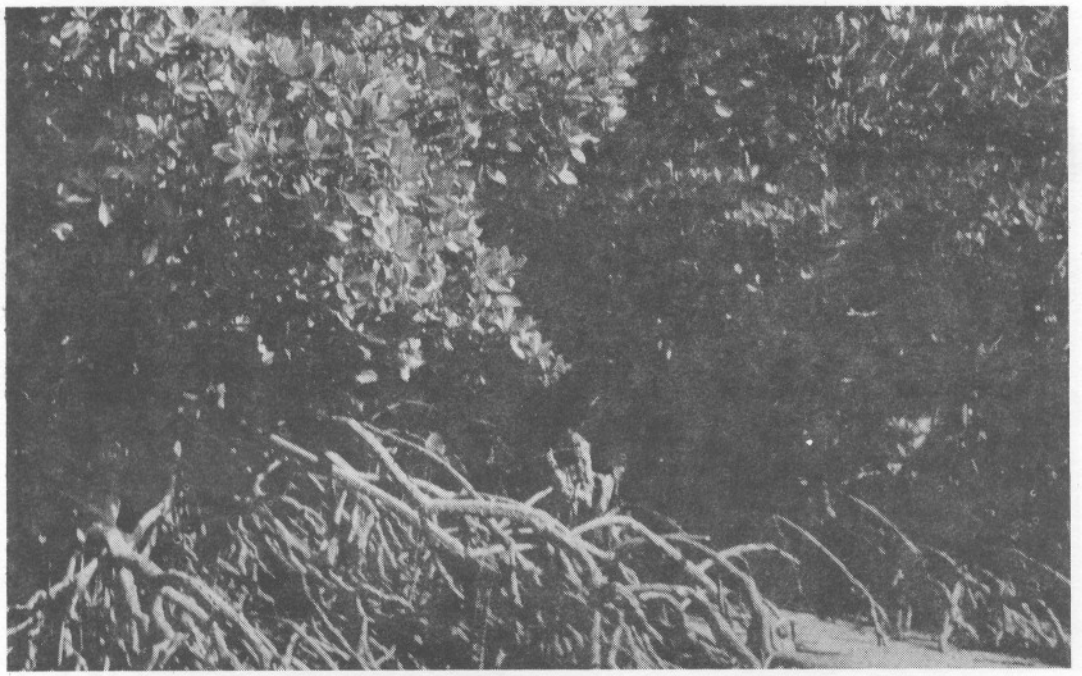


Plate 3: *Rhizophora mucronata (Rhizophoraceae)*
Mkoko (Swahili). Note the numerous branched stilt-roots with root caps at the end, tap root abortive. The leaves are fairly similar to those of *Bruguira.* (Photo: J.O. Kokwaro, Gazi, 1969).

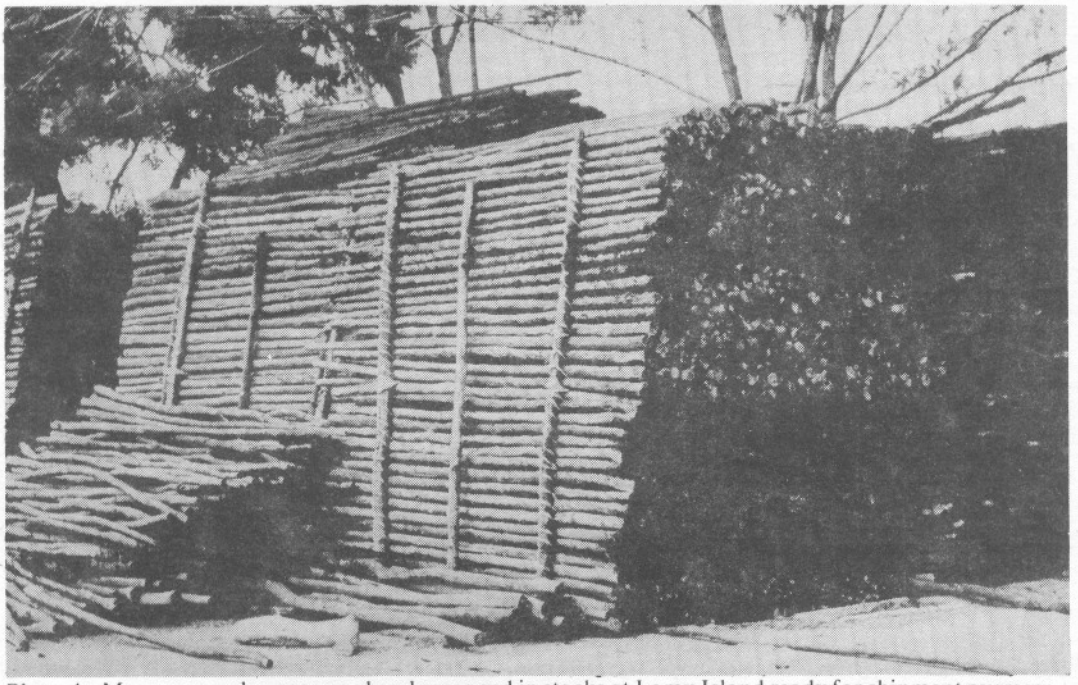


Plate 4: Mangrove poles, seasoned and arranged in stacks at Lamu Island ready for shipment overseas. (Photo: J.O. Kokwaro, Lamu, 1978)

The bark contains 12-50% tannin and is much used. The bark is pounded in a mortar until soft and mixed with cold water. The fabric or leather to be treated is soaked in the infusion for three days and then hung in the shade to dry; the resulting colour is reddish brown. This species provides the majority of building poles for export as well as for local use.

*Sonneratia alba* Sm. *(Sonneratiaceae)*
Mlilana, Mkoko-mpia or Mpia (Swahili)

Evergreen shrub or tree 3-15 m high, occasionally to 20 m. The roots are wide-spreading, sending up many finger-like pneumatophores which are up to 75 cm high.

The light wood is used in carpentry work, for building native huts, to support fishing nets and to make boat ribs. The bark contains up to 15% tannin. The leaves are used, mainly by the Bajun and the Boni, as camel fodder. The fruits are edible and yield both condiments and medicaments. "Mpia" comes from "pia", a top, as the fruit somewhat resembles this.

*Xylocarpus granatum* Koen. *(Meliaceae)*
Mkomafi (Swahili); Mtonga (Vanga-Swahili)

A tree up to 6 m high, with green or brown smooth or flaking bark. This tree does not possess "breathing" roots, and is common on creek banks and in pure saltwater creeks.

The bark contains up to 33% tannin, and the timber is known to make good masts for dhows although the trunks are seldom of the right shape. The wood is also used for making handcarts, in building construction and for firewood. The grapefruit-sized fruits are crushed in water and the infusion drunk as an aphrodisiac.

*Xylocarpus moluccensis* (Lam.) M.J. Roem. *(Meliaceae)*
Mkomafi or Msikundazi (Swahili)

A spreading tree up to 12 m high, without "breathing" roots. Common in sits only occasionally wetted by seawater.

The timber is used for dhow masts, in joinery, for making sandals and for firewood.

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