

UTILISATION

Of all the ecosystems of the world, mangrove ecosystem stands second as far as productivity and biodiversity are concern. Apart from the ecological and environmental services, many products can be obtained starting from wood to fisheries to pharmaceutical and natural products. All these are not easy to quantify in economic terms due to difficulties encountered to enumerate every component and various functions that are responsible to maintain ecological balance and sustainability.

The uses and values of the different products obtained from mangroves are many and valuable. Mangroves are also used as a source of food, the tender leaves, fruits, seeds, and seedlings of *Avicennia marina* and tender vegetative parts of other mangrove species are traded and consumed as vegetables.

Traditionally, mangrove bark has been used as a source of tannins, which is used as a dye and to preserve

leather. The pneumatophores of different mangrove species are used in making corks and fishing floats; some are also used in perfumes and condiments. The ash of *Avicennia* and *Rhizophora* spp. is used as a soap substitute. Other mangrove extracts are used to produce synthetic fibers and cosmetics.

Apart from this, mangrove ecosystem provides living space for many epiphytes, invertebrates, vertebrates such as fin fishes, shell fishes, birds, reptiles, mammals etc. In addition, mangrove areas are often converted to salt pans, ponds or to agriculture or aquaculture purposes.

WOOD PRODUCTS

· Firewood

Since ancient times coastal inhabitants of the world were using mangrove as firewood for domestic purpose. Mangrove wood has high specific gravity (0.7 to

Villagers carry the fire wood collected from mangrove area



1.0) and high caloric content of 4000 to 4500 kcal kg⁻¹, *Rhizophoraceae* members such as *Rhizophora*, *Kandelia*, *Ceriops* and *Bruguiera* are preferred for firewood. It has been reported that one ton of *R. mucronata* equals to the caloric value of 2 to 3 tons of coal.

As mangrove grows in the intertidal zone, it comes under CRZ-1 category that means mangroves are under protection; therefore, solar cookers, biogas plants, liberal LPG connections and use of electricity are some of the firewood substitutes used to minimize the pressure on mangroves. However, at many places mangrove wood is continued to be used as fire wood.

· **Wood handicrafts**

Aboriginal communities in Malaysia are well known for their indigenous handicrafts. Sculptures and mask made from wood of *Xylocarpus* spp. are attractive because of colour, appearance and its fine texture. Some local people inhabiting coastal area in India make wood furniture and some house hold items from mangrove wood.

· **Wood vinegar**

Wood vinegar is produced as the by-product of charcoal making in Malaysia. Wood vinegar is traditionally used as sterilizer, deodorizer, fertilizer and antimicrobial and growth promoting agent. It has wide range of industrial, agricultural, medicinal and home application.

· **Timber**

In India, mangrove trees are mostly used for house building, furniture, transmission as well as telephone poles and certain household items. Exploitation of mangrove forest for timber is limited to well managed



forest like Gangetic Sundarbans, Andaman-Nicobar and deltas of Mahanadi, Godavari and Krishna along the east coast of India. Mangroves on the west coast of India are not managed for timber and hence do not produce timber of any significant value.

Mangrove wood is strong, durable and rot-resistant and because of these properties it is well suited for construction purpose. *Heritiera fomes*, *B. gymnorhiza*, *Aeigiceras corniculata* etc. are used for making boat. The ribs and keel of large vessels like traditional dhows are built from *Sonneratia alba*, *Heritiera littoralis* and *A. marina*, and masts, paddles and ores are made from *Rhizophora mucronata*, *Bruguiera gymnorhiza*, *Ceriop stagal*, *Laguncularia racemosa*, *Xylocarpus moluccensis* and *S. alba*. Earlier, fishermen used to paint the surface of canoes and boat with mangrove extract for durability and to prevent wood boring and other insect attack.

· **Wood for fish smoking**

Mangrove wood is preferred for fish smoking because of its high calorific value and its combustion imparts a golden brown colour to the smoked fish, enhancing their marketability. In addition smoke from mangrove wood has antimicrobial properties. The improved smoke system was first developed by FAO and Food Research Institute of the CSIR in Ghana.

· **Charcoal**

The manufacture of charcoal from *Rhizophora* wood remains the most important forest industry in Malaysia. *R. mucronata* and *R. apiculata* are the two species used for commercial charcoal product. The wood of these trees have a high calorific value, meaning it produces high heat when burned, making it the wood of choice in the manufacture of charcoal. Presently, because



Fishing stakes



of over exploitation and depletion of wood resources many charcoal producing units have been closed down in India.

· Fishing stakes/poles

Along the muddy river banks, small fishing stakes are used to support tidal fish nets. In many countries in South East Asia, fishermen cut mangroves and dump them into the shallow coastal waters as a way of creating shade and thus attract fish (fish attraction devices). Some mangroves are used for livestock food, as "green manure" in fish ponds.

· Pulp

Sonneratia caseolaris, *Excoecaria agallocha*, and *Avicennia marina* produce strong sulphate pulps. The chips were exported mainly to Japan for making dissolved pulp and cellulose derivatives such as rayon used in the textile industry. Mangrove trees are also exploited for the lignocellulose for the manufacture of chipboard, pulpwood (newspaper and cardboard) or synthetic materials (e.g., rayon).

· Tannin

Tannin is extracted from the bark, leaf shoot and roots of some mangrove species like *Rhizophora mucronata*, *Bruguiera gymnorrhiza* and *Ceriops tagal*. *Rhizophora* bark produces very fine tannin suitable for leather work. Indian mangrove trees have 35% tannin in their bark which is higher compared to other countries. Indian fishermen were using tannin for curing and dyeing of fishing nets made of natural fiber to make the nets more resistant to biological decay and fouling. The production of tannin from mangroves has declined greatly in recent years, particularly, after the introduction of nylon fishing nets and the use of chrome as the predominant agent for leather curing.

· Mangrove Feed

The Gulf of Kutchh, being arid zone, does not have any other vegetation or source of energy for cooking or as a green fodder for cattle, camels and goats. Large populations of camels regularly graze on the green leaves of *Avicennia marina* and *Porteresia coarctata*. The gathering of leaves of *Suaeda* and *Porteresia* for animal fodder remains widespread activity in Iran and India.

NON-WOOD MANGROVE PRODUCTS

· Thatching material

The uses of *Nypa* palm are many and diverse. It yields an important thatching material, which is used for the roofs and walls of rural houses. The shingles produced are cheap, light to transport, easy to fix and can last several years, particularly when used in houses with open stoves.

· Wrappers Cigarette

The manufacture of cigarette wrappers from young leaves of *Nypa fruticans* remained flourishing industry in Malaysia and in Indonesia where it is the major secondary occupation of many households. Leaves of some mangrove species are used as tea and tobacco.

· Sugar and wine

About 90 % of the households in Thailand derive their livelihood by tapping *Nypa* sap for production of

Women carrying fodder for cattle





beverage and sugar. It has been estimated that one hectare of *Nypa* forest yield 2400 to 3000 liters of sap per month. Another potential of the *Nypa* lies in the sugary sap of the flower stalk, which can be used to produce a sugary fluid.

· **Nira, perfumes, condiments, jelly etc.**

Freshly tapped sap of *Nypa* is a popular drink that is sold in coastal areas of Southeast Asia. The tapping involves slicing off the cut end to sap out flow. The milky white and sweet nira has to be consumed the day it is tapped for it ferments spontaneously becoming alcoholic drink with 6 to 12 % alcohol content. Extracts of the heartwood of *Avicennia alba* and *A. officinalis* have tonic properties. It is reported that some mangrove plants and extracts are used as incense, perfumes, hair preservatives, condiments and aphrodisiacs.

· **Apiculture**

Honeybees, from the genus *Apis*, have been exploited by man for thousands of years. *Apis mellifera*, which is native throughout Africa, most of Europe and the Middle East, is the best known and most widely spread species. Honey collection from the mangrove forest is a promising business in India. It has been estimated that Sundarbans mangrove alone produce 111 tons of honey, annually. Honey collected from *Cynometra ramiflora* and *Aegialitis rotundifolia* has a good market value and is in demand. In the Sundarbans, bees wax and honey are produced by wild bee swarms that build hives on branches, in tree holes and crevices. In Goa mangroves, honey collection is not being done except when it is naturally made by the honey bees. There is a high potential to undertake apiculture in many mangrove areas of Goa.

· **Salt Extraction**

India is the third largest salt producer only after China and USA. The main contribution comes from the



states of Gujarat, Rajasthan and Tamil Nadu, which is about 90% of the country's total production. Salt production methods vary widely among the different salt producing states. Apart from sea water, sub-soil brine, lake brine and rock salt deposits are also being used for salt production.

Goa estuaries' easy access to sea water and favorable climatic conditions makes salt production attractive during summer. Salt produced through this natural evaporation process also played an important role in the economy of Goa even during the Portuguese rule as salt was the chief export commodity.

In the past salt production was concentrated around in 36 villages along the Goa coast. These villages lie on the estuaries of the Terekhol, Chapora, Baga, Mandovi, Zuari and Sal. Currently, the number of salt producing villages has drastically reduced to 9 because of low income, lack of skilled labours, competition from industrially produced salt, losses incurred on the yearly damage of embankments etc.

Private sector plays a major role in salt production, contributing 90.3%. Most of the salt pans have iodization plants located nearby for fortifying the salt with iodine and iron. The major commercial salt extraction sites are present in Gujarat, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Odisha and West Bengal.

· **Fisheries products**

a) It has been estimated that the total fish production of the world's mangroves is around 1 million tons per year for an estimated area of 83 000 km² of open water in mangroves, which is slightly more than 1 percent of estimated total world production in all waters per year.

b) A wide range of commercial and non-commercial fish and shellfish depends on mangrove

forests. Some of the common fishes found in the Indian mangroves are Liza, Mugil, Lactes, Polynemes, Sciana, Hilsa, Metapenaes etc. The species of commercial interest include mullets (*Mugil cephalis*), snappers, milk fish (*Chanos chanos*), sea bass (*Lates calcarifer*), tilapia *Etropolis suratensis*, *Sillago sihama*, etc.

c) In Mondovi and Zuari estuarine complex shellfish was available throughout the year and locals used to harvest for consumption and sell them in the local market. The present dwindling of shell fishery in Goa is attributed mainly to sand mining, over exploitation, ship repair yards along the estuaries, developmental activities etc.

d) Six crab species are commercially important, out of which *Scylla serrata*, *Thalamitta crenata* and *Portunussan guinolentus* are caught in large quantities. *Scylla serrata*, the large edible swimming crab, inhabits the muddy bottom of mangrove estuaries, as well as coastal brackish water of Goa. *Thalassina anomala*, the mud lobster is also found along estuaries.

e) The most common prawns include *Macrobrachium rosenbergii*, *Penaeu indicus*, *P. merguensis*, *P. monodon* and *Metapenaes brevicornis*. Shrimps are usually caught with push nets along shallow creeks within the mangroves.

f) Oyster species like *Crassostrea madrasensis* and *C. cucullata* (Kalva) are found in the mangroves and in the vicinity. The marketable size of oyster is considered to be when the shell height reaches 60 -70 mm. The locals harvest oysters from mangroves regularly and sell in the local market.

g) Other bivalves, *Meretrix casta*, *Velorita cyprinoides*, *Polymesoda erosa* etc. are found in the Mondovi- Cumbarjua Canal- Zuari estuarine system of Goa. *M. casta* are harvested from Ribandar and Banastari in Mondovi and Cumbarjua Canal. *Velorita cyprinoides* (Black clam) beds are found in Zuari and, Mondovi estuaries. *P. erosa* (Mud clam) also grow abundantly in mangroves and are harvested on regular basis. During monsoon season when fishing is banned, these bivalves are in demand in local markets through out Goa.



Pukkali culture

· **Mariculture**

In recent years there has been an increasing shift towards the use of mangrove ponds for rearing milk-fish, prawns, mullets etc. - commonly referred to as aquaculture. This ranges from simple ponds which rely on the movement of the tides to bring in seawater and fresh nutrients, to more elaborate aquaculture systems involving separate hatcheries and nurseries, provision of feeds, and use of pumping to regulate water flows. Even these systems, however, rely to a certain extent on mangrove areas for nutrients as well as fry recruitments.

Conversion of mangrove for aquaculture has been undertaken by both small-scale extensive farms and by larger-scale semi-intensive and intensive farms along the east and west coast of India. Shrimp aquaculture is responsible for about 80 percent of the conversion of mangrove forests. Kerala is well known for brackish water prawn and fish farming known as Pukkali culture. Some aquaculture ponds have also been constructed in the mangrove areas of Goa which now stand abandoned (Chorao Island).

· **Medicine**

Mangroves have great potential for medicinal uses. Materials from different mangrove species can treat toothache, sore throat, constipation, fungal infections, bleeding, fever, kidney stone, rheumatism, dysentery, and malaria. Mangroves also contain toxic substances that have been used for their antifungal, antibacterial, and pesticide properties. Numerous mangrove plants are used in folklore medicine. Extracts from mangroves and mangrove dependent species have proven effective against human, animal and plant pathogens, but only limited investigations have been carried out to identify the metabolites responsible for their bioactivities.

· **Wildlife**

Mangroves shelter various wild life. The wild boar (*Sus scrofa*) is often found marauding in the swamp margin and it is a source of bush meat in Asia. The marine Green turtle (*Chelonia mydas*) grow up to 400 lbs. in weight and 4 to 4.5 feet long. It lays about 100-200 eggs at a time. Crocodiles are present in good numbers. Eating eggs and meat and also killing crocodiles, turtles etc. for skin are banned in India.

· **Vegetables**

The edible fern, *Acrostichum aureum* grows to 1 to 2 m tall, often inhabit soft muddy soil. In Goa and many

other coastal states of India the young tender fronds (Akur) are used in preparing delicious steamed vegetable.

Fruits of *B. gymnorhiza*, *Phoenix paludosa*, *S. alba*, *S. caseolaris* etc. and *Suaeda* are used as vegetable. Leaves of some mangrove associates such as *Salvador persica*, *Finalaysonia obovata* are used in making salad. Fruits of *Avicennia marina* are universally used as vegetables. The fruits of *Kandelia candel* and *Bruguiera gymnorhiza* contain starch when sliced ground to a paste can make excellent cakes or sweetened stuffing for pastry.

The multiple use potential of mangrove ecosystems require an integrated approach to mangrove management and that should cover the full range of products and services which can be obtained from them.

Table 5. Traditional uses of mangroves in medicine and tool making

Mangrove species	Food/ feed use	Medicinal use	Tool use
<i>Acrostichum aurem</i>	Tender shoots eaten after roasting	---	---
<i>Aegiceras corniculatum</i>	Nectar	Smoke for making babies strong, asthma, diabetes, rheumatism, fish poison	Axe handles and digging sticks
<i>Avicennia marina</i>	Fruit eaten after treatment, nectar, fodder for live stock	Sting-ray and stonefish sting, rheumatism, small pox, ulcer	Shields
<i>Avicennia officinalis</i>	Nectar, fodder for live stock	Joint pain, Small pox, Urinary disorder, leprosy bronchial asthma	---
<i>Bruguiera gymnorhiza</i>	Hypocotyls eaten after treatment	---	Shields
<i>Bruguiera cylindrica</i>	Tender propagules are eaten	Treatment of hepatitis	Spear tips, boomerangs
<i>Ceriops tagal</i>	---	Sores, infections, scabies. cure for hepatitis, ulcers	Paddles
<i>Lumnitzera racemosa</i>	Nectar	Antifertility, asthma, diabetes, snakebite	Fishing, spears, sticks for hunting
<i>Nypa fruticans</i>	Unripe seeds eaten	---	Spears, firewood, fire sticks.
<i>Rhizophora apiculata</i>	Mud crabs found at roots.	Skin sores, typhoid, hepatitis, an antiseptic, diarrhea, insecticide, hepatitis	Roof thatching, basket weaving
<i>Rhizophora mucronata</i>	Mud crabs found at roots.	Elephantiasis, hematoma, Hepatitis, Skin sores, ulcers	Armbands, firewood
<i>Sonneratia alba</i>	Nectar	Skin disorders	Spears, firewood, clubs.
<i>Xylocarpus moluccensis</i>	---	All-purpose medicine	Carving wood
<i>Acanthus ilicifolius</i>	---	Snakebite, skin disease, kidney stone, small pox , ulcer	Canoe repairs, fire wood
<i>Excoecaria agalocha</i>	---	Hepatitis, ulcers, conjunctivitis, dermatitis, hematuria	---
<i>Clerodendron inerme</i>	---	Febrifugal and uterine stimulant, arrest bleeding, antiseptic, ringworm	---

Compiled from published reports

Table 6. Uses of mangroves

Sr. No.	Mangrove species	Uses
1.	<i>Rhizophora</i> spp.	Charcoal, tannin, fire wood, building frames.
2.	<i>Sonneratia alba</i>	Fire wood, packing material, boxes, building material
3.	<i>Aegialis rotundifolia</i>	Honey, fuel
4.	<i>Aegiceras corniculatus</i>	Fuel, frame work, best honey
5.	<i>Avecennia</i> spp.	Cattle feed, green manure, good quality charcoal
6.	<i>Bruguiera gymnorhiza</i>	Building construction, bark for adhesive.
7.	<i>Xylocarpus</i> spp.	Building boats, bark as astringent and febrifuge.
8.	<i>Excoecaria agalocha</i>	Fishing floats, boxes, matches, treat marine stings.
9.	<i>Heretiera fomes</i>	Boat building, building construction etc.
10.	<i>Nypa fruticans</i>	Roofing, basket weaving, inflorescences for alcohol
11.	<i>Lumnitzera racemosa</i>	Honey, fuel
12.	<i>Acrostichium aurem</i>	Vegetable
13.	<i>Ceriops tagal</i>	Fuel, tool handles

Compiled from published reports

