Forestry resources in Tanzania's wetlands: concepts and potentials

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Summary

Forestry resources include land occupied by, or proclaimed to be forest; the produce found in such land; and human resources capable of fostering the development of such resources. The following landscape units constitute Tanzania's wetlands: estuaries, open coasts, wetlands in coastal forests, floodplains, freshwater marshes, lakes, peatlands, swamp forests, and ground water forests.

Wetlands are sources of food and forest produce, contain plants potentially suitable for agro-forestry and phyto-reclamation, reduce beach erosion, and arc sources of genetic material. Most wetlands face intensive utilisation pressure which endangers their continued existence. Given the multi-utility of wetlands and their diversity in structure, it is not possible to adopt a single conservation strategy. The ecosystem approach to conservation, incorporating the preservation of genetic and ecological diversity alongside scientific research, environmental monitoring, education and training, is advocated in preference to traditional conservation.

Public awareness of the uniqueness of Tanzania's flora and fauna needs to be strengthened as this should guarantee the long term protection of wetlands.

Introduction

Forestry resources are, in essence, forestry assets. Economists define an asset as that which is owned and has a monetary value. Assets may be fixed (buildings and machinery), liquid (cash), intangible (goodwill) or current (goods in stock, cash and bills) (Ford-Robertson, 1971). Extending this definition to forestry, assets include land occupied by, or proclaimed to be forest, the produce found in such land, and the incommensurable human resources capable of fostering the development of such resources.

Wetlands ofTanzan;a

In Tanzania, forest produce (Forest Ordinance No. 30 of 1957, Cap. 389) includes:

- trees, timber, firewood, charcoal, sawdust, withies, bark, roots, fibres, resins, gums, latex, sap, galls, leaves, fruits and seeds; and
- within forest reserves only; vegetation of any kind, litter, soil, peat, honey, wax and wild silk; and
- such other things as the Governor may from time to time by notice published in the gazette declare to be forest produce, either generally or within any forest reserve.

In forestry law, the term tree includes: palms, bamboos, canes, shrubs, bushes, plants, poles, climbers, seedlings, saplings, and regrowth of all kinds. It follows that forestry resources encompass a wide range of items.

Wetlands cover a range of inland, coastal and marine habitats which share a number of common features. The range of wetland habitats which come under the mandate of the Ramsar Convention on Wetlands of International Importance especially as Wildfowl Habitat is impressive. Crude grouping of habitat types according to their basic biological and physical characteristics gives 30 categories of natural and 9 of man-made wetlands. In this paper, only landscape units which are wetlands, or where wetlands form an important component, are considered; these are estuaries, open coasts, coastal forest wetlands, floodplains, lakes, freshwater marshes, peatlands, swamp forests, and groundwater forests.

Importance of Tanzanian wetlands

Wetlands have standing water for at least part of the year. This leads to the view that they are wastelands and that they should be filled in or drained so that they could be put to better use. Recently, informed public opinion and land and water management agencies of governments, notably in the United States, have taken the view that the world's remaining wetlands are more useful in preventing floods, recharging groundwater, controlling pollution and providing habitats and breeding grounds for fish and wildlife (Botts, 1982).

A significant amount of Tanzania's rice is obtained from the floodplains located in Mwanza, Shinyanga, Tabora, Mbeya, Morogoro and Coast Regions. The Wembere, Bahi and Malagarasi Swamps are important sources of fish. Estuaries, such as those of the Rufiji, Wami and Ruvuma Rivers and other coastal wetlands, are among the most productive environments in the world, acting as nurseries for valuable fisheries. Mangrove roots and branches diminish the effects of ocean waves and reduce beach erosion. The Kilombero and Kagera Swamps produce a significant proportion of Tanzania's sugar. In Iringa Region, Mbuga Swamps mitigate floods by retaining water and allowing groundwater recharge. The trapping of sediment by wetlands influences the output of hydroelectricity and the maintenance of riparian ecosystems downstream.

The swamps bordering the Malagarasi River playa significant role in the maintenance of biodiversity within Lake Tanganyika which contains one of the largest

faunas (in terms of species) of any lake in the world. Over 1,300 species of invertebrates have been described from Lake Tanganyika, of which well over 500 are endemic. Distinct and diverse communities exist in the pelagic, benthic, and littoral biotopes (Cohen, 1991; Coulter, 1991). Lake Tanganyika is a rare natural laboratory where ecological, biological, behavioural and evolutionary mechanisms can be studied (Lowe-McConnell, 1991). The trapping of sediment resulting from deforestation of the lake's catchment, is a significant contribution of wetlands to the maintenance of the lake's biodiversity.

The shores of the Rift Valley lakes provide excellent habitats for birds; flamingos are found in Lake Manyara, which is a major attraction to bird watchers in Tanzania. Mangrove vegetation, found in estuaries, provides feeding, roosting and breeding sites for birds.

It is difficult to assign a monetary value to the wetland attributes outlined above. As a part of an ecosystem, a wetland provides many functions that act together to increase its value. Tanzanian wetlands have value for agriculture, fisheries, wildlife, maintenance of biodiversity, and flood control. Considered as a biological system, rather than in terms of separate benefits, the ecosystem approach must be pursued in an effort to secure understanding of the complex interrelationships found in wetlands.

The vegetation of Tanzania's wetlands

The potentials of Tanzanian wetlands are presented under the nine landscape units mentioned above.

Estuaries

An estuaries is a body of water where a river mouth widens into a marine ecosystem, where the salinity alternates between salt and fresh water, and where tidal action is an important bio-physical regulator. Estuaries and inshore marine waters are among the most naturally fertile ecosystems in the world. This high productivity supports a food web which permits rapid growth of the juvenile fish which use estuaries as nursery areas.

Tropical and sub-tropical estuaries support mangrove vegetation and occasionally palms in higher latitudes (Chapman, 1976). Physiographic features that favour the development of mangroves include protected shallow bays; protected or unprotected estuaries; lagoons; the leeward side of peninsulas and islands; protected seaways; protected areas on offshore shell or shingle islands (Banyikwa, 1986). Tn Tanzania, there are around 115,500 ha of mangroves with the majority (53,255 ha) occurring in the Rufiji Delta; of the 40.8 million hectares classified as forests in Tanzania, mangrove forests occupy less than] %.

A review of mangrove distribution in East Africa is given by Banyikwa (1986). Different mangrove community structures occurring in Tanzania have been described

Table 1 Potential economic uses of mangroves

Uses	*A. marina*	*B. gymnorrhiza*	*C.tagal*	*H.littoralis*	*R.mucronata*	*S.alba*	*X.granatum*
Beams	+	+	+	-	-	-	+
Boat building	-	+	+	-	-	+	+
Poles	+	+	+	+	+	+	+
Carving	-	-	-	-	-	-	+
Charcoal	-	+	-	+	-	-	+
Chipboard	+	+	-	-	+	-	-
Jetty beams	-	-	-	+	+	+	-
Dye	-	-	+	+	+	+	+
Fence posts	-	+	-	+	+	+	+
Firewood	+	+	+	+	+	+	+
Floats	-	-	-	-	+	+	+
Fodder	-	-	-	-	-	+	-
Furniture	-	+	-	+	+	+	+
Green manure	+	-	-	-	+	+	-
Hats	-	-	-	-	-	+	-
Medicines	-	+	+	-	+	-	+
Mine props	-	+	+	+	+	-	-
Fish traps	-	-	-	-	+	+	+
Rail ties	-	-	+	+	+	-	-
Scaffolds	-	+	+	+	+	+	+
Tanning	-	+	+	-	+	-	-
Preservative	-	+	+	+	+	-	-
Timber	-	+	+	+	+	-	+
Tool handles	-	+	-	+	-	-	+
Fish smoking	+	+	-	-	-	-	-

by Semesi (1986). The commonly reported species of mangrove trees in coastal Tanzania are *Sonneratia alba, Rhizophora mucronata, Ceriops tagal, Bruguiera gymnorrhiza, Avicennia marina, Xylocarpus granatum, Heritiera littoralis* and *Lumnitzera racemosa. A. marina, R. mucronata* and S. *alba* are the most widespread species in Tanzania (McCusker, 1971).

Commercial and traditional products from the mangrove ecosystems arc listed in Table 1 by species of mangrove. In India, leaves of *Avicennia* spp. are used as fodder for cattle and camels (Kukarni and Junagard, 1959). In Bangladesh, 177 t of honey and 49 t of beeswax are produced annually from *Execoecaria* spp., *Avicennia* spp. and other mangrove species (Macnae, 1974). Other products harvested in mangroves include crustaceans (prawns, lobsters and crabs), molluscs, and finfish (MacIntosh, 1983).

R. mucronata, B. gymnorrhiza, X. *granatum, H. littoralis,* S. *alba,* C. *tagal,* and *A. marina* face utilisation pressure in a decreasing order of intensity and resource management should respond to this intensity. In Tanzania, mangroves are used for firewood, charcoal, building poles and bark tannin (Mainoya, 1985) and *R. mucronata,* and *B. gymnorrhiza* are the most exploited species (Table 1). Attempts were made to introduce *R. mucronata* and C. *ragal* to the Rufiji Delta to replace the less useful *A. marina* and S. *alba* but it was not technically feasible.

The pioneer species *A. marina* colonises sandy-muddy sheltered areas and S. *alba* colonises muddy banks. Much of the literature supports the classic successional view of mangrove dynamics (Chapman, 1970, 1976) which explains zonation as a result of biotic processes which induce soil accumulation and plant community change from pioneer through to climax stage (Semesi, 1986). On the other hand, Thom (1982) suggested that mangrove patterns are ecological responses to external conditions of sedimentation, microtopography, estuarine hydrology and geochemistry. In order to understand the dynamics of mangrove distribution patterns, it is necessary to examine habitat change as a function of those processess which induce environmental change. This would in turn form the basis of a regeneration programme, for each species dominates the zone to which it is best adapted. In this respect, the Rufiji Delta forms a rare laboratory for regeneration studies of the mangroves. *RhizopllOra mucronafa,* the commonest species, is found either as extensive pure stands or in mixed vegetation. Withirt the main delta, the mangrove communities tend to be monospecific over appreciable areas, while mixed stands usually occur in the inner edge of mangroves (Semesi, 1986). Such zonations could easily be exploited for the successful regeneration of mangroves both in the delta and other parts of Tanzania.

Equally important in the management of mangroves is the organised exploitation of mature communities. Important felling and collection depots for poles and bark on the Rufiji Delta were Simha Ulanda, Dima, Urange, Mdae, Utikiti, Mohoro, Salale and Kikale. Others areas in Tanzania were Kisiju, Bagamoyo, Pangani, Mkindani, Idindi and Kilwa Masoko. In 1959, four cooperative societies were formed to take over the exploitation of mangroves in the Rufiji Delta. The societies operated under the umbrella of the Coast Region Co-operative Union Ltd. When cooperative unions were dissolved, disorganised harvesting, processing or mar

keting of mangrove products resulted despite significant local and export demand for poles. Reconstruction of organised systems for harvesting of mangroves is an important aspect of mangrove management programmes.

Open coasts

Tanzania's coastline extends 1,000 km from the Umba River in the north to the Ruvuma River in the south. The coastal zone is of varying width, 20 km to 70 km, gradually rising to a plateau.

Many wetlands of this formation have been modified by human activity, particularly rice cultivation. Coastal, riverine forests found in this area have a number of interesting plants, such as the endemic and monotypic genus of *Stuhlmannia* in the Pangani area. Flat sandy expanses on Mafia Island arc dominated by *Philippia mafiensis* (Polhill, 1968). The fan palm *(/30rassus aethiopiu11l)* is also widespread. As its wood is resistant to termites, it is ideal for fencing posts and rafters; hollowed stems are sometimes used as water pipes, and fans, thatch, m_ts and baskets are made from its leaves. In central Tanzania, where this palm is also found, there are well established mat weaving activities supplying mats for clove drying in Zanzibar. The fruits are edible; root buds are used as vegetables and toddy is obtained from flowering stalks. *Borassus* is also used as an ornamental tree.

Wetlands in coastal forests

It is becoming increasingly clear that although evergreen and semi-green forests cover between 1-2% of Tanzania (887,000 km2), these forests have a biological importance that is greater than their physical extent. This significance has been widely recognised for the 'Eastern Arc' montane forests, but many of the smaller forests of Tanzania are revealing remarkable biodiversity (Sheil and Burgess, 1990). In particular, the coastal forests have been highlighted as requiring further investigation (Lovett, 1985). There arc 92 endemic trees in Tanzania's coastal forests (White, 1983). This high level of endemism is remarkable when compared with more extensive Tanzanian habitats. Coastal forests that attract considerable interest are Tanga limestone forests, GendaGenda Forest, Msungwe Forest, KionoZaranginge Forest, Pan de Forest, Pugu Hills forests, Kazimzubwi Forest, Vikindu Forest, Kisiju Forest, forests in the Rufiji Delta (Mchungu and Kikale), Ngarama and Pindiro forest reserves in Kilwa District, Rondo Forest; Chitoa, Ndiba, Ruawa, Matapwa, Litipo forest reserves in Lindi Region; Chilanga and Mahuta forest reserves in Mtwara Region; Jozani Forest in Zanzibar and the Ngezi forest reserve in Pemba.

The rare *Saintpaulia ionantha* (African Violet) has been found in abundance in the Kierengoma forest (Matumbi hills) (Johansson, 1978). This light sensitive species needs protection from unregulated logging operations in the riverine forest.

A study on nodulating legumes in the vicinity of Kierengoma (Sheil and Burgess, 1990) indicates some promising species which may lead to sustainable agrofore

stry systems. One variety of *Mimosa pudica* (sensitive plant) collected from a waterlogged area, showed abundant nodules on the roots and, more remarkably, on the stem (10-20 em from the ground), suggesting that the plant may be adapted to nitrogen fixation in a waterlogged environment. If nitrogenase activity is confirmcd in thc stcm nodulcs, thcn thc potcntial for using such species in waterlogged environments, such as rice fields, could be investigated. The tree 'mtanga' (Caesalpinoidae) stimulates increased yields in the crops grown underneath it and could have potential use in more formalised cultivation systems. Discoveries of this kind demonstrate the practical value of coastal areas as a genetic resource (Sheil and Burgess, 1990).

Two hundred species of woody plants and herbs have been collected from the Pande and Zaraninge Forests for testing for anti-cancer activity by thc National Cancer Institute in the USA (Burgess, 1990). Although these forests cover a total area of less than 250 km2, their biological importance is such that they should be fully protected. Presently, all coastal forests are being threatened by unsustainable human actions including logging of canopy trees for timber and fuel; removal of Iwrdwood poles to build houses; burning of woody plants to produce charcoal; and wholesale removal of woody vegetation for conversion of the land to agriculture. At the present rate of destruction, these remnant forest patches, with their globally important flora and fauna, could be decimated in the near future (B urgess, 1990).

Floodplains

Some floodplains occur in lowlands and terminate in estuarine deltas. Many of the larger rivers have floodplains which extend far inland with grassy marshes, flooded forests and ox-bow lakes. Floodplains are a conspicuous feature in the extensive Masai and Wcmbcre Steppe, the Usangu Plains and the Rukwa and middle Malagarasi Basins. *EchinochLoa pyramidaLis* is characteristic of the main part of floodplains, with *llyparrhenia rllfa* found towards thc margin; woodcd areas are characterised by *Acacia* spp. or palm stands of *Hyphaene* and *Borassus* (Polhill,] 968).

Floodplains are mainly used for agriculture, notably rice cultivation. Clearing of land for agriculture and woodfuel is likely to lead to the removal of a number of plant species, in particular somc *Acacia* species. *TrichiLia emetica* is potentially an important soap industry tree in the Kyela and similar floodplains (Maro, 1984); *Khaya* spp. (mahogany) are important timber trees. In central Tanzania, *Tamarix* sp., a halophytic plant, forms part of the evergreen vegetation along the brackish Kigwe creek and floodplain. Such trees could he used to check soil salinisation and alkalinisation, a common feature of some irrigation projects, particularly in semi-arid environments (Nshubemuki, 1990).

Freshwater marshes

Freshwater marshes are common whenever groundwater, surface springs, streams or runoff cause frequent flooding or semi-permanent shallow water. Larger

marshes, dominated by *Cyperus papyrus,* cattail *(Typha* spp.) and reed *(Phragmites),* with standing water most of the year are commonly termed swamps.
In Tanzania, freshwater swamps dominated by C. *papyrus* or *Phragmites* are extensive around Lakes Victoria and Tanganyika and also in scattered riverine localities, such as the middle reaches of the Malagarasi River (Usinge Swamps). Grassland swamp, with *Leersia* spp., *Pennisetum macrourU11l, Vossia cuspidata* and *Echinochloa stagnina* associated with Cyperaceae, is well developed in some of the interior drainage basins such as the Wembere, Bahi, Rukwa, Usangu and Usinge Swamps (Polhill, 1968).
Generally, most of the extensive swamps in Tanzania face no danger of destructive development, possibly because of the difficulties involved in reclamation.

lakes

Lakes and ponds develop from several geomorphological processes including faulting, folding and stream action. Wave action land changes in seasonal water levels influence the kind of wetland vegetation that grows on lake and swamp margins. *Cyperus papyrus,* and occasionally *Phragmites,* typically form lake edge vegetation.
Woody vegetation associated with lakes includes *Vi/ex* spp., *Ficus* spp., *Albizzia* spp., *Cassia sangeulla* and *Sapium ellipticum.*
The surrounding vegetation traps runoff and stream flow, thus moderating the amount of nutrients and sediment that enters the lake. Such vegetation also forms important fish, bird and mammal habitats.

Peatlands

Under normal conditions, dead plant matter decomposes, eventually hecoming carbon dioxide and water. Under conditions or low temperature, high acidity, low nutrient supply, waterlogging and oxygen deficiency, the decomposition process is retarded and dead plant matter accumulates as peat. Peatlands occur in all continents and latitudes, including the tropics where thick deposits can form in marshes and swamps, particularly in lake margins.
There is great diversity of peatlands worldwide, the pattern being governed by hydrology, acidity and climate. Some peatlands are highly acidic and nutrient-de
ficient, while others are neutral and nutrient-rich. Therefore, they include some of the least, as well as the most, productive wetlands.
In Tanzania, localised peatlands are found in the Southern Highlands, particularly Sao Hill (German Geological Mission in Tanzania, 1971), and in Ukinga (Geological Survey Department, 1958). Following a recent discovery of peatlands in Burundi, it is widely thought that parts of Kigoma Region, particularly the Kibondo and Kasulu Districts, could be extensions of the Burundi peatlands. Peat can be used as fuel and could alleviate the pressure on wood fuel. In addition, peatlands store carbon and they may have an important role as biogeochemical regulators, especially in relation to the Greenhouse Effect.

Swamp forests

Swamp forests develop in still water areas around lake margins, and in parts of floodplains, such as ox-bows, where water remains for long periods. Their precise character varies according to geographical location and environment.

In Tanzania, only semi-swamp forests occur. The Minziro Forest, which adjoins the Tanzania-Uganda border, is a semi-swamp forest covering 265 km2. The forest has a variety of species usually found to the northwest or rarely found in other parts of Tanzania (e.g. *Heywoodia lucens, Podocarpus usambarensis vaT dawei, Mussaenda erythrophylla, Cassipourea ruwensorensis, Citropsis articulata, Mani/kara obvata, Baikiaea insignis* and *Uncaria africal/a).*

Podocarpus spp. is commercially exploited and it is likely that the less marketable timber species found in this forest will gradually begin to be felled as *Podocarplls* stands dwindle.

The Jozani Forest in Zanzibar has the introduced oil palm *(Elaeis guineensis)* and *Pandanus,* as well as *Phoenix,* and *Anthocleis/a.* Another semi-swamp forest in Tanzania is found on Pemba Island; plant genera commonly found include *Chrysalidocarpus, Phoenix, Elaeis, Tabernaemontana,* and *Oliyendea* (Polhill, 1986).

The semi-swamp forests in Zanzibar and Pemba have several rare and threatened species which could be conserved by translocation to nature reserves. Such species include *Ipomoea zanzibarica, Vanilla zanzibarica; Chrysalidocarpus pembanus* is the sole representative of this palm genus in East Africa; and *Typhodorum lindleyanum,* a native of Madagascar, occurs on Pemba (Polhill, 1968).

Phoenix reelinata, Ipomoea zanzibarica, and the wild yam *(Dioscorea)* can be used as disease resistant gene pools for genetic engineering of related cultivated species. *Vanilla zanzibarica* is of considerable interest to orchid collectors and for perfumery. Consumer demands are likely to require natural substances in consumer sensitive issues such as food and, to a lesser extent, perfumes.

Groundwater forests

The Rau Forest Reserve near Moshi is a groundwater forest. This Forest Reserve covers 25 kn/ and is of a lowland groundwater type. It contains a number of extremely interesting associates including *Oxystigma msoo* (Caesalpinioideae), unkown elsewhere and the only East African representative of a genus otherwise restricted to the Guinea-Congo forests. It is in association with *Milicia exec/sa, Diospyros, Ficus, Lecaniodiscus, Acacia usambarensis* and *Tapura fischeri* (Polhill, 1968).

Much of this forest is no longer in its natural condition as timber is removed to supply poles and firewood to the adjoining Moshi townships. *Oxystigma msoo* trials were initiated at the Lushoto Silviculture Rcsearch Centre in the late] 970s.

The future of Tanzania's wetlands

The following functions are attributed to Tanzania's wetlands:

1. The wetlands on water catchments are involved in flood prevention, recharging ground water, controlling sedimentation and pollution and maintaining biodiversity.
2. Wetlands are important food sources (rice, sugar), breeding grounds for fish, wildlife and commercially important invertebrates.
3. A majority of landscape units serve as sources of forest products many of which lead to small scale industries such as soap making, carpentry, mat making, wine tapping.
4. They may be sources of plants useful for agroforestry and phytoreclamation, such as *Mimosa pudica,* 'Mtanga', and *Tamarix* sp.
5. Certain wetland vegetation types, such as the mangroves, are effective in the prevention of shore and beach erosion.
6. Wetlands are genetic warehouses; wild relatives of domesticated plants may be used in conferring resistance against disease.

The list is by no means exhaustive. Resource conservation in some of the wetlands needs improvement. Given the multi-utility perspective of wetlands and their diversity in structure, it is not possible to adopt a single conservation strategy. The only safeguard seems to be to prepare a list of uses and functions of wetlands and then let each use form the basis of a conservation programme. It is also important to solicit public goodwill in such programmes by conservation education through seminars and campaigns leading to public participation (Nshubemuki, 1990). What is advocated here is the ecosystem approach to conservation incorporating the preservation of genetic and ecological diversity with scientific research, environmental monitoring, education and training (di Castri and Robertson, 1982). Most of the facets of Tanzania's flora and fauna have unique characteristics but these are not widely known by the Tanzanian community. Increasing public awareness of such characteristics needs to be strengthened so that this may guarantee their long term protection.

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