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MANGROVE RESOURCES AND THEIR MANAGEMENT IN THE SOUTH PACIFIC

by

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TOPIC REVIEW

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SOUTH PACIFIC REGIONAL ENVIRONMENT PROGRAMME

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I. THE MANGROVE ECOSYSTEM IN THE SOUTH PACIFIC

The best developed expression of the mangrove ecosystem is as a tidal forest - trees growing from a forest floor which is at times covered by tidal water of varying salinity. However, stands of mangrove trees or shrubs are in places interspersed with areas of muddy sediments on which may grow ferns, grass or barely visible algae. The ecological processes which occur in mangrove areas can only be properly understood if the forested areas are considered in relation to adjacent, treeless intertidal areas.

The nature and extent of the mangrove areas of South Pacific island nations varies a great deal. In the west, Papua New Guinea has vast tracts of mangrove, with individual trees not uncommonly 30-40 metres high. Elsewhere, particularly in the north and the east of the region, are low island groups where isolated, stunted clumps of mangroves may exist but no forests of mangrove.

A basic requirement for optional mangrove tree development is terrestrial water - from streams, land surface runoff or seepage. Regular tidal exchange of mixing fresh and saline water makes possible the best growth of trees. Sediment depth is also an important factor and this tends to be greatest in association with "high" islands. Generally speaking, the best growth of trees produces the best crops of leaves, twigs, bark, flowers and fruits, which, in falling, carry to water and sediments the nutrients and energy which form the basis of a complex web or organism inter-relationships the end results of which are several nutritious forms of food which constitute the mangrove fisheries resources.

Thus, it is only along the sheltered coasts of so-called "high" islands that vigorous mangrove forest development is possible. Papua New Guinea has extensive tracts; the Solomon Islands, Vanuatu and Fiji could be categorized as having moderate development of mangrove forests. Some islands of Micronesia have sufficiently well developed mangrove forests to sustain small scale timber cutting industries. Though countries such as Tonga and Western Samoa have limited stands of mangrove trees, these may be of great local significance (eg. those fringing Tongatapu's main lagoon, an important fish nursery area). The "low" islands of atoll nations such as Kiribati and Tuvalu, while not devoid of mangrove, may have only an occasional clump of stunted representatives of the region's most adaptable and widespread genus, Rhizophora.

Within the mangrove ecosystem of the region, there is considerable variation. Not only does the height and form of mangrove trees vary - in relation to physical factors; there are also different combinations of mangrove tree species in different areas.

In Fiji, there occurs a hybrid mangrove plant which is not known to occur elsewhere. This hybrid results from cross breeding between two species of Rhizophora whose distributions - R. mangle from the east, and R. stylosa from the west - overlap in Fiji.

Mangrove forests are essential habitats for some animals and plants. The secretive mangrove heron (Butorides striatus) is found only among mangroves. Two large and spectacular Fijian Dendrobium orchids grow attached to the trunks of large mangrove trees.

II. USES OF THE MANGROVE ECOSYSTEM

South Pacific islanders have long recognized the mangrove ecosystem as a renewable resource, a source of useful products such as structural timber, canoe logs, firewood, dyes, tannin, drugs and a variety of plant and animal foods. And it is note-worthy that Papua New Guinea is now investigating a possible new product from one of its mangroves - ethanol from sago palm.

Mangrove areas can be allocated an economic value based on market values for these products. But there is also a number of "intangible" values which cannot be expressed in terms of money. These "intangibles" are very important components of a country's natural resources base. They include :

a) prevention of coastal erosion;

b) protection of land and habitation from storm seas;

c) protection of juvenile fish, crabs and prawns from rough weather and predatory animals;

d) protection and food supplies which make mangrove areas particularly suitable as spawning and nursery areas for fish and prawns which may later mature and be captured in adjacent reef or lagoon areas;

e) transfer of energy and nutrients through floating of mangrove leaves to adjacent water masses of river, lagoon and reef for use by food animals in these areas;

f) the trapping of sediments resulting from soil erosion, thus protecting coral reefs from disturbance by sedimentation and enabling sediment - associated nutrients to be repeatedly recycled in the mangrove ecosystem for use by marine animals;

g) the cultural significance fo an ecosystem alongside which some Pacific island communities have evolved and on which many continue to be dependent.

Mangrove areas are believed to have an important role in the production of the small anchovy-type fish which, used as baitfish, are crucial for the region's developing skipjack tuna industry.

Coastal fisheries do exist in island groups which have few or no mangroves. But there can be no doubt that the most productive inshore fisheries of the region are associated with extensive mangrove dominated estuaries; for example, off Fiji's Rewa, Ba and Labasa River deltas.

Nevertheless, scattered small areas of poorly developed mangrove on island coasts devoid of mangrove forests may have a fisheries value out of proportion to their size. These areas should not be dismissed as unimportant until further research has been undertaken to check this possibility.

There is considerable scope for improving the mangrove resource base by planting mangroves in areas where natural mangrove vegetation has been damaged or destroyed or, with establishment assistance, on some mudflats which did not previously carry mangroves. Planted mangroves can also be used to provide money - saving protection for seawalls, jetties, causeways, and coastal roads and buildings.

The most effective use of mangrove areas for national development is, in most cases, as self-renewing mangrove resources, largely for local community use, but, through fisheries, for national needs, too.

A valid development case can sometimes be made for clearance of limited areas of mangrove for fishpond construction, with extensive adjacent areas of mangrove retained. Villaluz (1972) has considered fishpond possibilities in mangrove areas of Fiji, though he promoted and extent of pond construction which evidenced no respect for the considerable value of mangroves for natural fish production.

The removal of mangrove vegetation in order to use its sediments, with appropriate drainage, as agricultural soils is another use option. However, since this involves destruction of the mangrove ecosystem, any benefits which accrue from this reclamation for agriculture must be viewed in relation to costs to the economy resulting from depletion of the mangrove associated fisheries resource base. Except where agricultural land may be in very short supply the case for agricultural reclamation of mangrove areas is not strong, and this appears now to be recognized in Fiji, where roughly 10% of mangrove areas has been reclaimed for agriculture.

There may be a special case for mangrove area reclamation for infrastructural development in and near to some urban areas, e.g. Suva, Apia. Though there is an argument for retention of these urban mangroves to sustain the fisheries resources increasingly needed to sustain urban families with limited access to cash incomes - a contrary fact is that the resources of these mangrove areas are at risk from urban pollution sources, and, thus, may become public health hazards. Nevertheless a physical buffer of mangroves seaward of coastal developments should, wherever practicable, be maintained.

There is a mistaken, but widespread, belief that mangroves represent "wasteland". This is, of course, an imported, colonial, idea, but it has gained some standing among urban communities. Consequently, many South Pacific island rubbish tips, official and otherwise, have been secreted among mangrove forests - with as yet undetermined effects on public health. On a grander scale, a foreign entrepreneur, several years ago, proposed that large mangrove areas of one South Pacific island nation be used as disposal sites for waste from seabed minerals which he proposed to process onshore in that country.

On the basis of studies in Fiji, Nedwell (1974) proposed that the denitrifying potential of mangrove sediment bacteria be exploited to provide tertiary treatment for treated sewage effluent. This idea, which has merit, is being applied in Fiji where oxidation ponds for sewage treatment among mangroves have been constructed at two sites. Nevertheless, mangrove oxidation pond management is imperfectly developed. The Technology is not completely free of problems or of health hazards and the Fijian projects should be carefully monitored for performance and for environmental effects.

III. THREATS TO THE MANGROVE ECOSYSTEM

The mangrove ecosystem and its resources are under potential or actual threat from overexploitation, from pollution, and from reclamation. The overlapping complexity of administrative and legal arrangements for mangrove ecosystems (discussed in section 4) makes these threats particularly difficult to handle.

Overexploitation for timber, for firewood and for fish and crabs has occurred in a number of places, particularly those in close proximity to urban areas. On Fiji's main island, for instance, mature trees of the preferred timber and firewood species, dogo (Bruguiera gymnorrhiza) have become scarce. Concern about the sustainability of small mangrove timber and fuel harvesting industries in some islands of the region's north west led to a recent investigation by a forest ecologist. In his report, Gillison (1981) urged caution on any expansion of harvesting activities in Babelthuap and Ponape, and emphasized a need for better basic resource data.

A gross form of overexploitation will occur where mangrove forests are clear-felled. This destructive approach is most likely where large volumes of mangrove wood are being removed for commercial purposes, often for wood chips for export. Regeneration of mangroves in clear felled areas in South-East Asia has not been demonstrated to be successful. In these circumstances, the mangroves are being "mined", not harvested on a renewable basis, and the cost to associated fisheries must be very great.

Threats from pollution come in a number of forms. Wastes from the processing of sugar cane, oil palm, fish and coconut oil have high levels of organic matter, and, thus, consume large amounts of oxygen where they are dispersed into natural waterbodies to decompose. The disruptive effects of such waste in the mangrove ecosystem can be very marked.

Sediment resulting from soil disturbance caused by careless land clearance or poor agricultural practice can also be a disruptive form of pollution, in spite of the fact that estuarine mangroves usually grow in a muddy environment. Another source of sediment pollution of mangroves is dredging in adjacent waterbodies. An example at Pago Pago has been studied. A proportion of all agricultural chemicals used on land eventually is carried into streams and then to estuaries and the sea. The polluting consequences of these chemicals vary. Considering that there is a relatively low level of fertilizer use in regional agriculture, nutrient enrichment of mangrove fringed waterbodies is probably not a significant problem. However, pesticide chemicals may be. These will not be only of agricultural origin. The casual use of pesticides for domestic purposes means that urban waste tips, not infrequently among mangroves, will act as continuous sources of toxic chemicals, some of which are known to adversely affect the behaviour and breeding of crustaceans, at least.

Industrial wastes also enter the mangrove ecosystem, through stormwater drains or through sewerage systems. Of particular concern with this category of pollutants is the chemical group referred to as "heavy metals". These can become concentrated in the tissues of some mangrove associate animals. Zinc in a mangrove oyster, for instance, could built up to a level which is dangerous for human health.

Oil pollution of mangroves has not yet been shown to be a significant problem in the region, unlike in South East Asia where large spills from leaking ships have caused major damage. Nevertheless, problems of local significance can arise from incompetent management of oil storage terminals, garages and factory plant. The potential for oil pollution damage of mangrove resources should not be underestimated. And it is important to note that the long-term adverse effects may not become apparent until long after a pollution incident. Affected mangrove trees may survive initially, to die suddenly perhaps a year later.

IV. ADMINISTRATION, RESEARCH AND EDUCATION FOR BETTER MANAGEMENT

To most, if not all, indigenous Pacific island communities, land, and all that grows upon it, together with the people who draw their sustenance from that land are, conceptually, one and indivisible. Adjacent mangrove and coral reef ecosystems are seen as integral components of that "land", not as separated from terrestrial ecosystems by an upper tidal water level.

This ecologically sensible perception of resources persists. It is, however, inconsistent with forms of law and administration imposed in the region under foreign rule. These latter prevail, and, where political independence has been achieved, have continued as a basis for mangrove area administration.

According to British tidal law, for instance, as its seaward extent terrestrial land is delimited by a boundary whose position is determined by the mean level of high tides - the mean high water mark (MHWM). Some components of mangrove vegetation - shrub formations of Rhizophora stylosa, for example, or Acrostichum aureum stands - are located largely or wholly landwards of MHWM.

It is not unusual, then, for the mangrove ecosystem to experience split agency jurisdiction. A Lands Department might administer mangrove areas landward of MHWM while a Forestry Department might have some jurisdiction over the intertidal mangrove forest but not over its associated fish and crab resources. This sort of administrative (and legislative) confusion makes rational mangrove resource protection and allocation especially difficult.

A closer approximation of ecological reality is needed for effective administration of the mangrove ecosystem. It needs to be considered as a component of a complex of coastal ecosystems of which it is but an interacting part. Planning for resource use or protection should take account of adjacent reef, lagoon and coastal land ecology. It may not be practicable for governments to arrange single agency responsibility for coastal ecosystems. At the very least, there needs to be active and meaningful co-ordination of coastal resource use and protection, accompanied by a rationalization of agency responsibilities and accompanying legislation.

The complexity and values of the mangrove ecosystem must be better understood by decision makers, planners and managers. Mangrove research requirements formulated for Fiji (Baines, 1979) provide a basis for the following regional listing.

a) the ecology and physiology of mangrove food species;

b) mangrove ecosystem processes, food chains and food webs;

c) primary productivity as a basis for estimating productivity of associated food species;

d) fisheries productivity of large mangrove estuaries;

e) techniques for sustainable production of such mangrove ecosystem components as wwod and crustaceans;

f) technology for the exploitation of mangrove food resources - the selection, improvement and application of effective indigenous and imported technology;

g) mapping, and resoruce classification systems;

h) multiple resource use systems and their management;

i) chemical and microbiological studies of sewage in mangrove areas;

j) establishment, growth and regeneration of mangrove forests.

Administration of the mangrove ecosystem should include provision for "protected areas" which would help to satisfy a need for protection of critical fisheries habitats - as an aid to the maintenance of sustainable fisheries in adjacent waters. "Protected areas" could also provide protection for representative examples of a country's mangrove forest types and safe refuge for uncommon or perhaps endangered plant and animal species.

V. MANGROVE ECOSYSTEM STUDIES

There is a number of activities in mangrove ecosystem research and management with which SPREP might usefully be associated or from which the Programme might obtain useful information.

Under the Commission on Ecology of I.U.C.N. (International Union for Conservation of Nature and Natural Resources) a Mangrove Ecosystem Working Group has been established. Currently, this Group is preparing a report on the status of the world's mangrove areas as a basis for action which IUCN and other agencies may take to assist in establishing optional management and in preserving representative examples of mangrove forests. It is also preparing an audio-visual teaching package on mangrove resource management. Later this Group, possibly in association with a SCOR/UNESCO Working Group on mangroves (which is looking particularly at research aspects of mangrove areas), will produce a much needed mangrove area management handbook.

The proposed East Asian Seas Programme being developed by UNEP in association with a number of other UN agencies and with IUCN includes in recent (October 1980) draft proposals a mangrove ecosystem project which includes surveys of mangrove resources and studies of the effects of pollutants, the effects of utilization on forests and soil and the effects of utilization on fisheries.

Under Unesco, a Training and Research Programme on the Mangrove Ecosystem of Asia and Oceania is to be established. Papua New Guinea and Australia so far are the only countries of Oceania with any association with this Programme. Recommendations, yet to be published, of an "expert group" convened by Unesco's Division of Marine Sciences in July 1980 to consider marine science training and research in Oceania will be of interest to UNEP.

Mangrove ecosystem research in the region is being undertaken at University of the South Pacific, University of Papua New Guinea, Australian Institute for Marine Sciences, University of Queensland and possibly other centres.

BIBLIOGRAPHY

Baines, G.B.K., 1979. Mangroves for National Development : a report on the mangrove resources of Fiji. Publ. of the Inst. of Appl. Soc. Res., Schl of Aust. Environ. Studies, Griffith University, Australia, 29pp.

Baines, G.B.K., in press. Mangrove resource management in a Pacific island nation : Fiji. In Proc. Asian Symp. on Mangrove Environ.: Research and Management, Kuala Lumpur.

Gillison, A.N., 1981. Report on a Management Study of Mangrove Ecosystems in Micronesia. CSIRO Division of Land Use Research, Australia. Tech. Memo. No. 81/23 (in press).

Marshall, C., undated. Yield management of the mangrove salt swamp forest of Fiji. Dept of Forestry, Fiji. 19pp.

Narsey, P.B., 1974. The distribution and reproductive biology of the mangrove oyster. M. Sc. thesis, University of the South Pacific.

Nedwell, D.B., 1974. Sewage treatment and discharge into tropical coastal waters. Search 5(5), 187-190.

Richmond, T. de A., and Ackermann, J.M., 1975. Flora and fauna formations in Viti Levu and Vanua Levu, Fiji. Proc. Int. Symp. Biol. and Mngt of Mangroves, Honolulu, Oct. 8-11, 1974, pp153-159.

Straatmans, W., 1954. Reclamation of Tidal Mud Flats in Tonga. SPC Technical Paper No. 53.

Villaluz, D.K., 1972. Aquaculture possibilities in some islands of the South Pacific. FAO rept. 543/72, Rome.

Wildin, W.F. 1965. The reclaimed mangrove flats of Labasa, pp366-371. In Twyford, E. and Wright, A.C.S., The Soil Resources of Fiji. Government Printer, Suva.