1995

Aqua Farm News Volume 13(04) July - August 1995

Aquaculture Department, Southeast Asian Fisheries Development Center

SEAFDEC

AQUA FARM NEWS

ISSN 0116-6573

A publication of SEAFDEC Aquaculture Department, Iloilo, Philippines

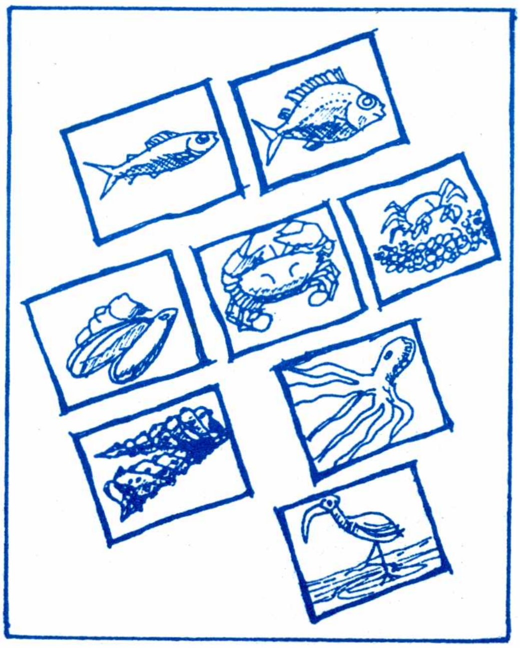
Vol. XIII No. 4 July-August 1995

Mangroves support life

Mangrove as a vital resource which serve as sanctuary for fish and other marine animals have long been exploited and neglected. That is indeed a reason for us to be alarmed and thus give us the responsibility to do something.

The vast areas which were once considered the most productive tidal forests in the world are continuously being destroyed and is now fast becoming a history. To date, the Philippines has a little over 100,000 hectares of mangroves left from the 0.5-1 M hectares in 1918.

The Philippines has been importing milkfish fry from Taiwan to augment the present supply. The shortage could be attributed to the extensive destruction and degradation of our mangroves which could substantially reduce the supply of the fry.



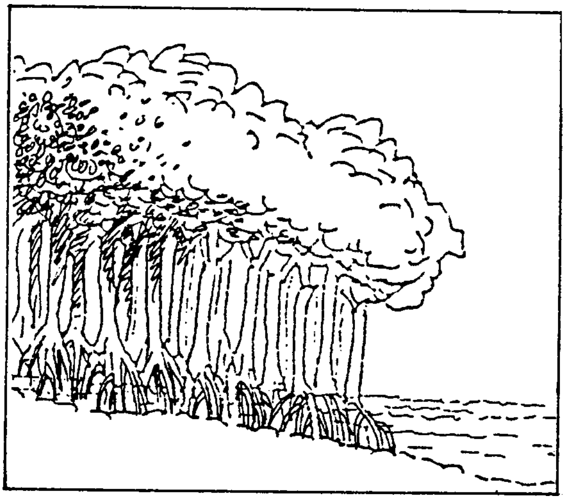
The decline of mangroves is the consequence of its undervalued assessment. For a time they were considered as wastelands and was believed to be more productive and profitable if converted into fishponds or to other industrial advancement.

Studies by ecologists, however, reveal that mangroves are very important ecosystem and their destruction are detrimental to the varied forms of living things including humans.

What happened to our mangroves? How important are they to our ecosystem? What are we supposed to do to save the country's remaining mangroves?

The next pages will discuss the importance of mangroves (focusing on the Indo-Pacific region), effects of its destruction and impact to both marine and human life. Let us save what is left of our mangroves and yes ... restore where possible.

What are mangroves?



The term "mangrove" refers to a number of species of trees and shrubs that are adapted to the conditions of the intertidal zone. They are much more than collection of plants. Mangroves are important to people because they form the basis of highly complex and productive intertidal ecosystem. As major contributors to the system, they directly support local and offshore fisheries by providing physical protection to the coastal fringe from erosion and a habitat for wildlife.

Mangroves include mangrove swamps, mangrove forests or manglares. They are found along coastal waters, tidal flats, extending along rivers, streams and its tributaries where the water is brackish.

Mangrove areas are considered as one of the most productive ecosystems. They have a net primary productivity twice of the tropical grasslands. Mangroves are found in Asia, Oceania, West and East coasts of Africa, Northern Australia, New Zealand and Gulf of Aquaba in the Middle East.

Mangrove species

There are as much as 93 higher plant species; 43 mostly small to medium-sized trees, 9 shrubs and undershrubs, 13 vines, 3 palms, 12 herbs and 1 grass mangrove species growing and most of which are of economic and commercial value.

There are about 26 true mangrove species in the Philippines which are classified into the following major and minor elements:

Major elements:

A. Rhizophoraceae
1. *Rhizophora apiculata (Bakawan-lalaki)*
2. *R. mucronata (Bakauan-babae)*
3. *Bruguiera cylindrica (Pototan-lalaki)*
4. *B. gymnorrhiza (Busain)*
5. *B. Parviflora (Langai)*
6. *B. sexangula (Pototan)*
7. *Ceriops decandra (Malatangal)*
8. *C. tagal (Tangal)*

B.Avicenniaceae
9. *Avicennia alba (Api-api)*
10. *A. officinalis (Api-api)*
11. *A. marina (Bungalon)*

C. Sonneratiaceae
12. *Sonneratia alba (Pedada)*
13. *S. caseolaris (Pagatpat)*

D. Combretaceae
14. *Lumnitzera littorea (Tabau)*
15. *L. racemosa (Kulasi)*

E. Meliaceae
16. *Xylocarpus granatum (Tabigi)*
17. X. moluccensis (Piagau)

F. Palmae
18. *Nipa fruticans (Nipa)*

Minor Elements

G. Aegicerataceae
19. *Aegiceras floridum (Tinduk-tindkukan)*

H. Euphorbiaceae
20. *Excoecaria agallocha (Buta-buta)*

I. Rubiaceae
21. *Scyphiphora hydrophyllacea (Nilad)*

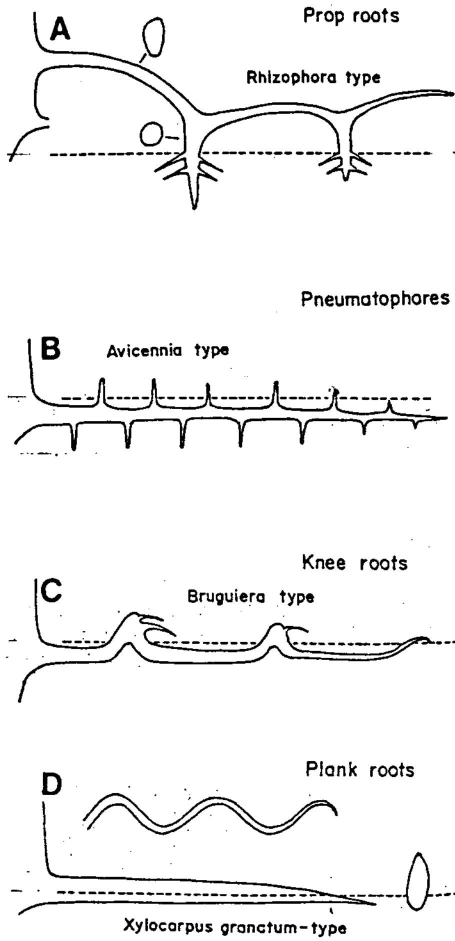
J. Myrataceae
22. *Osbornia octodonta (Tualis)*

K. Bombacaeae
23. *Camptostemon philippinensis (Gapas-gapas)*

L. Lythraceae
24. *Pemphis acidula (Bantigi)*

M. Pteridaceae
25. *Acrostichum aureum (Lagolo)*

N. Sterculiaceae
26. *Heritiera littoralis (Dungon-late)*



The aereal roots (top left) which serve as tube allow passage of air to the roots in the soil and development of seedlings from the fruit while still attached to the parent tree (left), are mangroves' remarkable adaptations to intertidal conditions. Above right are types of aereal roots, dotted lines are substrate level (based on Tomlinson, 1986. The botany of mangroves. Cambridge University Press.)

How do mangroves cope with their environment?

Mangroves have developed certain features to adapt to the intertidal zone. Many mangroves do not actually require intertidal conditions for growth, and will flourish if provided with freshwater. However, all mangroves species occur in the intertidal zone.

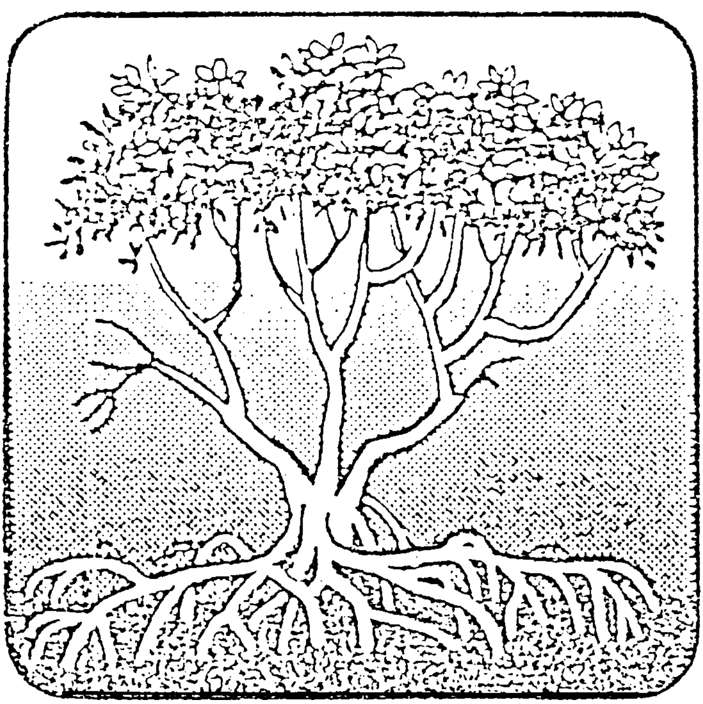
Saline Conditions. Mangroves are subject to tidal coverage of seawater which varies in salinity, temperature, frequency, height and duration. Depending on rainfall, varying quantities of freshwater enter the mangrove area from surrounding land. Salt levels in the soil are usually higher in drier areas and also vary according to the structure, drainage and nutrient content of the soil.

High salt levels in the environment are dealt with by the mangrove plant in several ways. One or more techniques may be employed by the same species. Most mangroves can tolerate high salt levels in the sap. Some mangroves excrete salt from special pores in the leaves or accumulate salt in older tissues. The majority of mangrove species also actively exclude salt when absorbing water through special tissues in the lower stem and roots.

Aeration and support. Soils in mangrove areas are sometimes rocky and poorly drained with very low oxygen but are usually fine silts and rich in nutrients and organic matter. The soil is usually shallow, limiting the depth available for root growth. In some areas, water currents through the mangroves change in direction and strength with changes in the tide. To counteract water movement and the poor support given by the soft, silty soils, many mangroves have aerial or prop roots and buttressed trunks for support. To make up for lack of root penetration, many plants have pneumatophores and shallow but extensive root system. Oxygen diffuses into the root system when exposed to the air.

Propagation. Many of the conditions in mangrove areas - the waterlogged soil, low oxygen levels and changing current flows - are unsuitable for the germination of seeds adapted to land conditions. Such seeds may be eaten, rot or be washed away before taking root.

One mangrove adaptation to intertidal conditions is the development of seedlings from the fruit while still attached to the parent tree. The seedlings when in contact with the soil, can deal with the adverse environmental conditions. After detachment, the seedlings either lodge in the soil nearby to grow or remain dormant and are carried by water currents to other places until suitable conditions arise. This seed development process in plants is unique to mangroves.

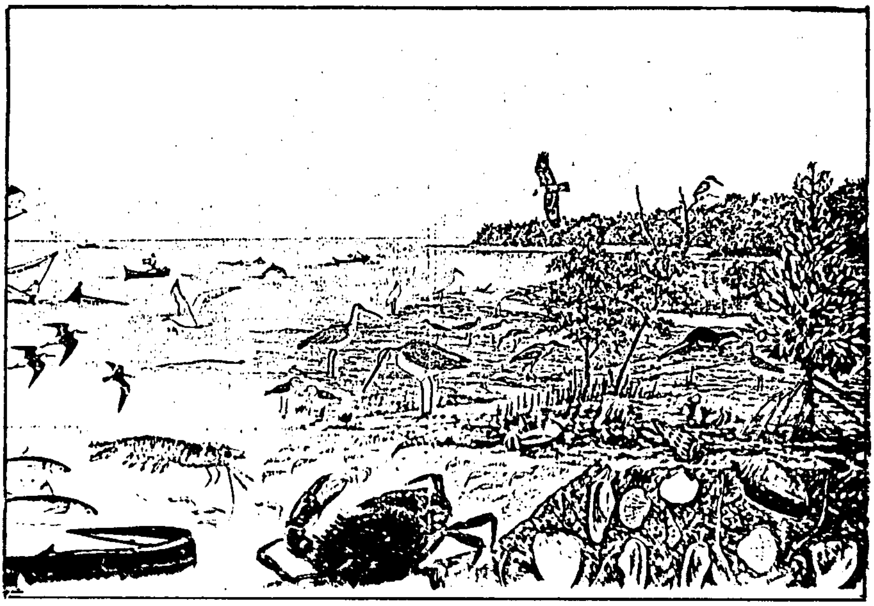


Zonation. This is a vital guide in mangrove reforestation to determine the suitability of a particular species to a particular site. Other factors affecting zonation are shades tolerance, seedling dispersal methods and selective predation of seedling by crabs.

Sources: (1)Lustica, AL.1990. Guide in Mangrove Reforestation.Techno Transfer Series. Mar-April 1990. Vol. 1 No. 2. DENR-ERDS, Region VI, Iloilo City. (2) Our Mangroves. Queensland Department of Primary Industries. 1989. 20 pp. (3) Primavera, JH.1995. Mangroves and brackishwater pond culture in the Philippines. Hydrobiologia 295:303-309. Wong YS and Lam BFY (eds.). Asia-Pacific symposium on mangrove ecosystems. 303 p.

The leathery and thick leaves of mangroves excrete salt from special pores (left) while aereal or prop roots (below) and buttressed trunks (inset) counteract water movement.

The state of our mangroves



"If only we can have this back". **From a full color poster "A Mangrove Must Live" by the ASEAN-US-CRM/ICLARM.**

Like corals, mangroves thrive in the Tropics. They grow abundantly in Pakistan, India, Burma, Malaysia, Thailand, Indonesia, Korea, and the Philippines. The total area of mangrove forests in the whole of Asia is about 2.5 million hectares.

The mangrove forest is one of the most important and productive ecosystems found along coastal zones and islands. Ecologically, mangrove swamps are beneficial to coastal dwellers in various ways. Exporting detritus and nutrients which contribute to nearshore and offshore productivity, they serve as feeding and/or nursery grounds for many economically important fish, shellfish and crustaceans. They protect valuable properties from storm surges and strong winds associated with tropical typhoons. They perform a flood reduction function in estuarine flood plains which may be lost if the mangrove swamp is converted into other uses.

For centuries, mangrove swamps have been beneficial to the socioeconomic well-being of coastal communities in the ASEAN region.

In Southeast Asia, mangroves are often converted into aquaculture ponds inspite of the many benefits they provide. In Malaysia, shrimp farms have encroached onto mangrove reserves. In Indonesia, most of the estimated 200,000 hectares of shrimp ponds have been converted from former mangrove forests. Their conversion to milkfish and shrimp culture ponds have contributed to a very significant denudation in Java, Sulawesi and Sumatra. In the Philippines, a combination of milkfish and shrimp culture is responsible for reducing the mangrove area from 448,000 hectares in 1968 to 139,000 hectares in 1988, with 60% of this decrease thought to be due to conversion to milkfish ponds. The Philippine Fisheries Code which disallowed private ownership of mangrove forests and placed them under the joint administration of the fisheries and forestry bureaus slowed down the conversion but shrimp culture during the 1980's removed an additional 30,000 hectares for new ponds.

In Thailand, 38.8% of mangrove areas lost between 1979 to 1986 were used for aquaculture; this means 38,000 hectares or 13% of the 287,000 hectares of mangrove resource in 1979. Prior to 1961, mangrove exploitation was generally for charcoal-making. In the Mekong Delta in Vietnam, clearance of mangroves for timber and shrimp farming has been serious, estimated at 60,000 between 1985 and 1988 and still continuing, adding to the catastrophic loss of mangrove forests during the Viet Nam war.

Conversion of mangrove forest into aquaculture and other uses means loss of habitat of many mangrove-dependent species of fish and shrimps. This will further compound stock recruitment and production problems in many overexploited fishing grounds.

Mangrove destruction consequently affects coastal areas depending on prevailing local conditions. In typhoon-prone areas, it increases the risk of coastal erosion from storm surges. Along estuarine systems, it accelerates the erosion of river banks. When large areas of mangroves have been converted to fishponds, acid sulfate are exposed leading to poor production and mass mortality of stocks, as well as the discharge of toxic substances to nearby waters.

Destruction of mangroves for coastal development (residential, industrial) affects freshwater supply through salt intrusion upstream, particularly under low-rainfal conditions. On the other hand, flooding occurs under high-rainfal condition. Conversion into salt ponds also changes soil structures and increases salt content, thereby rendering the area difficult to reclaim for agriculture and silviculture. Conversion into mining areas not only affects coastal waters, beaches, coral reefs, and fisheries, but could also render the areas irreversibly damaged, if not costly to reclaim for more productive purposes.

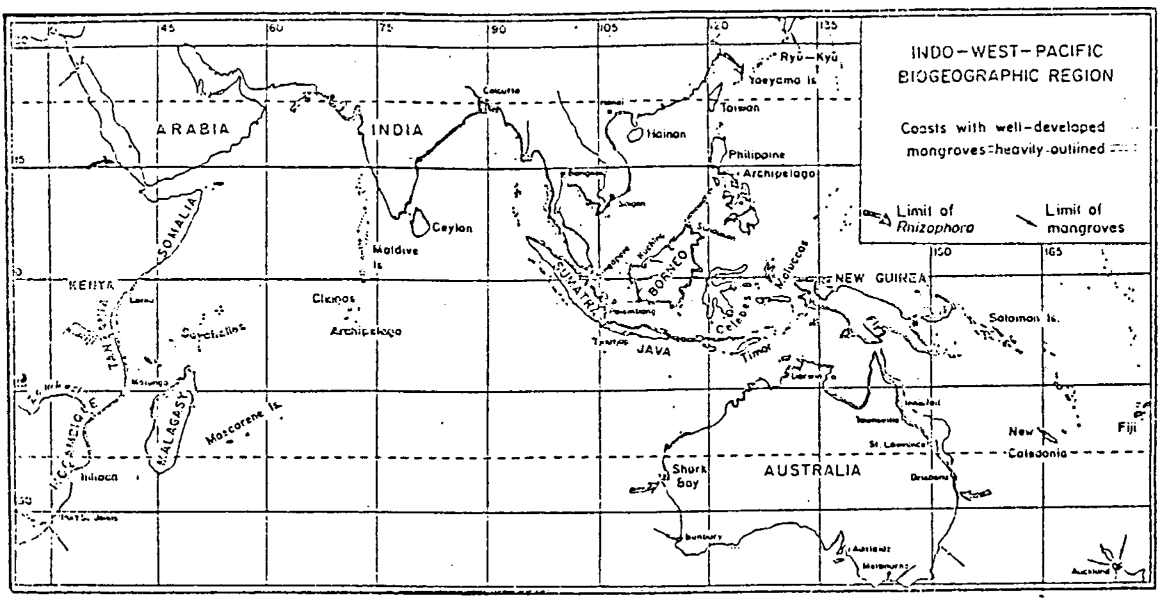
Inspite of their rapid destruction, large tracts of mangrove forests still exist in Southeast Asia: Brunei Darussalam, Sabah, Sarawak, Indonesia, the Upper south of Thailand and Peninsular Malaysia. Except for Peninsular Malaysia, where a mangrove reserve has been instituted in 1904 in Perak, most countries in the ASEAN region established some mangrove management measures only in 1960.

In the Philippines, since 1970, numerous decrees, proclamation and orders have been issued to preserve the country's remaining mangrove forests but enforcement has been wanting. This has been due to several factors: ineffective and inefficient implementation of programs among others.

In 1989, the Department of Environment and Natural Resources (DENR) adopted a conservation method derived from the successful practice of contractual reforestation in the upland communities. Called the "Mangrove Stewardship Agreement", rural families, qualified individuals, or communities were granted the privilege of developing and maintaining their mangrove forest areas. In return, they gain the exlusive right to utilize the stewardship area and enjoy all its produce on a sustainable level.

In 1990, the DENR issued Order No. 15, banning the conversion of mangrove areas into fishponds, allowing only community-based sustainable activities within these areas. Under this

to page 21...

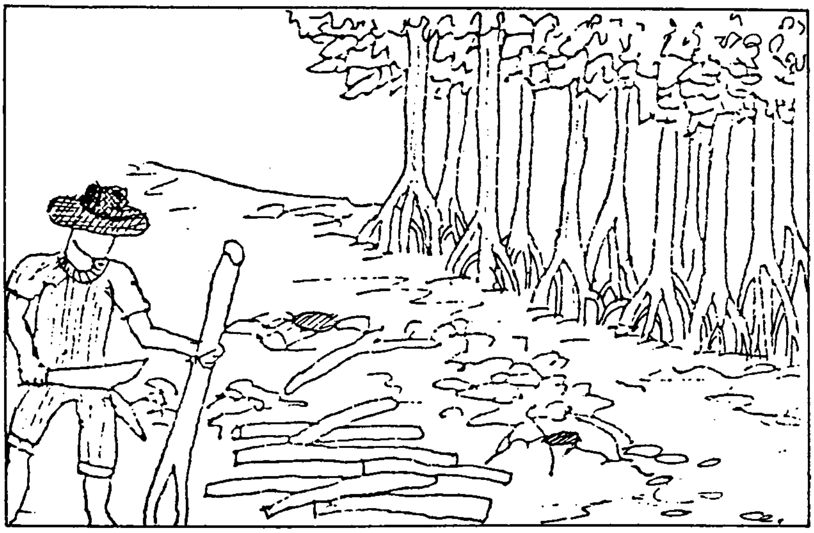


Map of the Indo-west-Pacific biographic region. Coastline where mangroves occur have been heavily outlined in Mcnae W. 1986. A general account of the fauna and flora of mangrove swamps and forests in the Indo-West Pacific Region. Adv. Mar. Biol., 6:73-270.

The value of mangroves

Before one could think of converting mangrove areas into another resource, the values should first be considered. The following values of mangroves make it among one of the most productive resources of the aquatic system:

• **Forestry values.** Mangrove species offer benefits similar to those derived from upland forests like wood which are ideal for house materials because they are hard and durable. Families of timber-producing mangrove are *Rhizophoraceae, Sterculiaceae, Sonneratiaceae, Combretaceae,* and *Avicenniaceae.* Many other



non-timber products are also derived from the mangrove forest. Among these are resin for plywood adhesive manufacture, fuelwood and high grade charcoal, tea from leaves of some species, tanning for dyeing; viscose rayon for textile fabric manufacture, livestock feed supplement, medicine and wine (*lambanog*), and vinegar from nipa. Nipa shingles, a popular product from nipa palm find their use in the construction of nipa hut.

• **Fishery values**. Mangrove forests support the fishery resources within the ecosystem, while mangrove swamps serve as a nursery ground or as a permanent habitat for some species. In some mangrove areas, most fishes feed on mangrove detrital material. Other groups of aquatic organism depend on planktonic or benthic organisms - a food supply generated within the mangrove creeks, rivers and estuaries comprise fish, crustaceans, and mollusks. It was reported that the influence of the mangrove ecosystem also extends beyond the mangrove forests limits into the coastal waters. Large quantities of organic detritus are produced in the mangrove and are exported into the coastal zone to support the productivity or organism in the coastal waters.

• **Ecological values.** Mangrove aside from minimizing soil erosion also minimizes pollution of sea water. Its extensive air root system traps eroded soil and industrial pollutants especially during strong rains. Mangrove also aids in reclaiming considerable land area - eroded soil is trapped in the root thickets and later, soil stabilizes and becomes a permanent land area.

Mangrove forests can hardly be uprooted because of their extensive root system. These, therefore, serve as strong shelterbelt against tidal waves, typhoons, and strong winds.

Mangrove forests also serve as habitat of some wildlife such as, birds, rodents, reptiles, amphibians, mammals, and insects. This faunal component helps maintain ecological balance within the mangrove ecosystem.

Values of commodities are determined by the market just as some of the products that can be extracted from a mangrove forest: so many dollars per hundred poles or per kilogram of crabs. Unfortunately, the directly marketed goods (or services) produced by a mangrove ecosystem represent only a fraction of the total array of goods and services that yield benefits to individuals and societies. Mangroves because they are considered as low-value ecosystems becomes prime candidates for conversion to other uses such as aquaculture ponds, infrastructure (e.g., ports, marinas, coastal roads, etc.), agriculture, housing and even garbage dumps.

Direct and indirect costs and expected benefits should be considered when assesing the "development" alternatives being proposed for mangrove areas.

The magnitudes of expected benefits from mangrove conversion can be calculated. For some uses, particularly infrastructure such as ports, industrial sites or housing, the conversion is permanent and the economic benefits from use of the mangrove area is the difference between the costs of conversion (e.g., ports); the value of such uses is very large and the conversion is clearly justified.

In Singapore, for example, the major industrial estate and port of Jurong is partially built on reclaimed mangrove areas. In Malaysia, the new port at Kelang is also built on reclaimed mangrove forest. The justification for other infrastructure developments many not always be as clear because in some areas the final costs of creating dry land from mangrove have been higher than initially projected. In Kelang, for example, a large area of mangrove adjacent to the new port was also converted for industrial development and housing. Due to a variety of economic, locational and engineering factors, this land, reclaimed at considerable expense, lies largely unused; traditional mangrove ecosystem products have also been lost, thereby compounding the economic costs of the project.

For other types of conversion, however, the benefits may be both smaller than anticipated and less permanent. Mangrove soils have proved difficult to manage in some areas on a sustained basis, both for agriculture and aquaculture. In some places, this has led to what was earlier referred to as "shifting aquaculture". Acid sulfate soils are common in mangrove areas and are a major cause of these problems for human-made structures, property damage may be caused by storm surges or typhoons. In either case, the net benefits from conversion are smaller than expected.

Expected benefits are usually documented in any proposal for mangrove conversion . What are often not documented at all , are the opportunity costs of achieving those benefits. Man-

next page ...

Resource or product	Location	Year	US$/ha/yr
Complete mangrove ecosystem	Puerto Rico	1973	1,550
	Trinidad	1974	500
	Fiji	1976	950-1,250
	India	1985	11,314
Fishery products	Trinidad	1974	125
	Fiji	1976	640
	Various	1977-1990	538
	Indonesia	1978	50
	Thailand	1982	30-100 (fish) 200-2,000 (shrimp)
Forestry products	Trinidad	1974	70
	Indonesia	1978	10-20 (charcoal, wood chips)
	Thailand	1982	30-400
	Malaysia	1980	25 (charcoal, firewood, poles)
		1986	11,561 (sustained harvest)
Matang Forest Reserve	Malaysia		
Fisheries			750
Forestry			225
		Total	975

Values placed on mangrove systems. From "Mangrove conversion and brackishwater pond culture in the Philippines. JH Primavera. 1992. Phil. Wetland Workshop Proceedings. p. 82.

grove-derived goods and services that would be lost by conversion should be assessed in full range.. This is the true "opportunity cost" of conversion, that, what society must give up to use the mangrove for a port, an aquaculture pond or a housing estate. Measuring this opportunity cost, however, has proved very difficult.

Measuring Economic Values

The difficulty in measuring the true economic value of a mangrove stems from two factors: (1) some products or services do not have market prices; and (2) the goods and services produced occur both within the mangrove and outside of it. To a large extent, the within-mangrove, on-site goods and services are land-based, while the off-site effects are usually aquatic or coastal, reflecting the mangroves' role as a bridge between the sea and the land. The wide variety of goods and services produced by a mangrove ecosystem, from the tangible production of poles or crabs to less tangible aspects like nutrient flows or breeding habitat. The production of goods and services and the interaction of both fresh- and saltwater result in dispersed locations for mangrove products.

When the value of an existing mangrove forest is assessed, the analysis traditionally has included only those marketed items like poles, charcoal, woodchips and mangrove crabs.The value of these products is frequently small compared to the expected benefits from conversion; consequently, extensive mangrove areas are converted each year in the name of "economic efficiency." As knowledge has been gained of the ecosystem interactions in mangroves, greater attention has been paid to those that occur off-site but are marketed. These largely consist of fish and shellfish caught in adjacent waters.

Goods and services without market prices are usually ignored. For some of these goods and services, the valuation problem is due to its subsistence role in the local economy (e.g., traditional medicine, minor mangrove forest product). For others, identification and quantification of the effect are sometimes a problem (e.g., storm surge protection) and placing monetary values may therefore be difficult. Nevertheless, these contributions of the mangrove may be quite important in terms of the total benefits produced by the mangrove system.

Thailand. A case study in Chanthaburi Province in southeast Thailand examined a traditional mangrove-based economy and presented annual values for a variety of products including forest products, nipa thatch, fisheries, oyster culture, shrimp farming and agriculture.

Values were estimated for each of the mangrove-dependent products, both for present productivity levels and for potential levels with improved management. The shrimp farming val-

	Location of goods and services	
	On-site	Off-site
Marketed	1 Usually included in an economic analysis (e.g., poles, charcoal, woodchips, mangrove crabs)	2 May be included (e.g., fish or shellfish caught in adjacent waters)
Nonmarketed	3 Seldom included (e.g., medicinal uses of mangrove, domestic fuelwood, food in times of famine, nursery area for juvenile fish, feeding ground for estuarine fish and shrimp, viewing and studying wildlife)	4 Usually ignored (e.g., nutrient flows to estuaries, buffer to storm damage)

Relation between location and type of mangrove goods and services and traditional economic analysis.

ues are large, ranging from $200 to $2,000/ha/year. These values are for commercial shrimp farms on converted land that are partially dependent on the remaining mangrove as a source of shrimp fry. Still, the total value per hectare from forest and fishery products from an intact mangrove ecosystem is substantial for over $160/ha at present to a potential of over $500/ha. When compared to one alternative use like rice farming, one sees why a broader economic analysis is needed. The expected return from agriculture ($165/ha/year) is large compared to the annual per hectare value from charcoal production ($30). However, when one adds in the present value of fishery products caught within and outside the estuary, the two uses are equivalent in value. When future increases in potential income is considered and the contribution of mangroves to shrimp farming is also included, the *in situ* value of mangrove becomes very substantial. In addition, forestry and fishery production are fairly labor-intensive and have important employment generation potential. In the Thai case, one potential production system, based on intensified management of the natural mangrove (particularly utilizing nipa palm), was about equal to shrimp cultivation in creating jobs and better than rice farming.

The estimate only included a limited number of the goods and services. As such, they are minimum estimates of the yearly value of mangrove products. And yet, the decision as to whether or not mangroves should be converted (destroyed) is made by comparing this minimum partial estimate with the total expected benefit from conversion. No wonder mangroves are being lost at such a rapid pace.

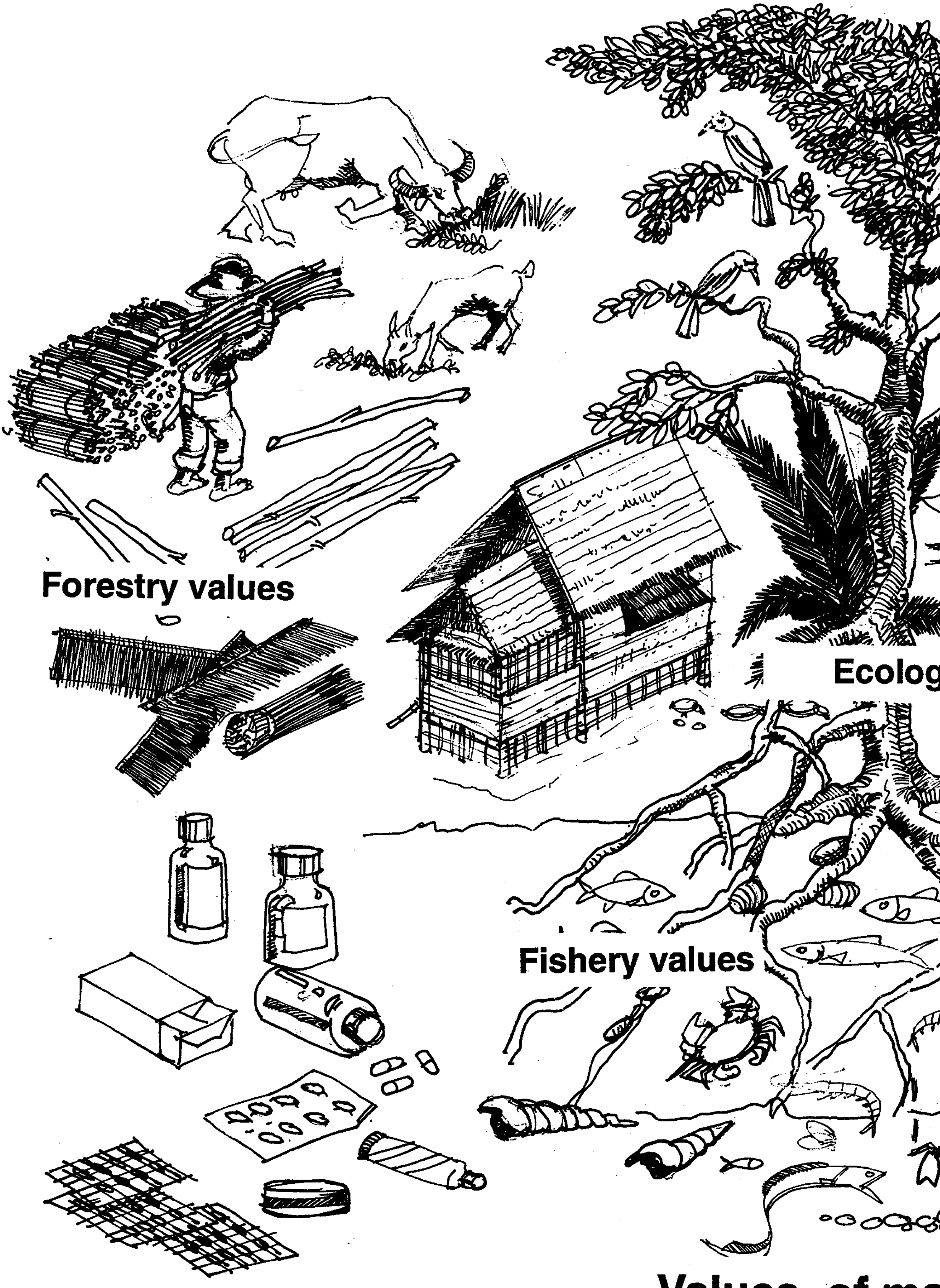
Indonesia. Similar issues to Thailand were raised in a recent report on coastal resources management (CRM) in Indonesia . Indonesia has the largest mangrove area in the world and, conversion, both to dry-land agriculture and to *tambak* (fishpond culture), is widespread. Indonesian mangroves are highly productive and diverse and are under severe pressure from overharvesting of forest products and conversion. Inspite of an official policy against further tambak extensification, the potential for sustainable production from mangrove areas was largely ignored and that "a prevailing but erroneous view among many advocates of mangrove conversion is that the swamps are wastelands with little value in comparison to 'higher' uses such as *tambak* and rice culture."

Ecuador. Large areas of mangrove forest have been converted to shrimp grow-out ponds in Ecuador. This development has been particularly rapid in the southern Gulf of Guayaquil — 16% of the mangrove forest has been lost between 1966 and 1982. In addition to the physical loss of mangrove forest, researchers believe that this has also resulted in the decline of shrimp postlarvae in Ecuadorean estuaries. This is a major concern of shrimp pond owners who rely on wild postlarvae as a stock source for their grow-out ponds. As a result, productivity falls and shrimp farmers may have to use more expensive hatchery operations to produce shrimp larvae.

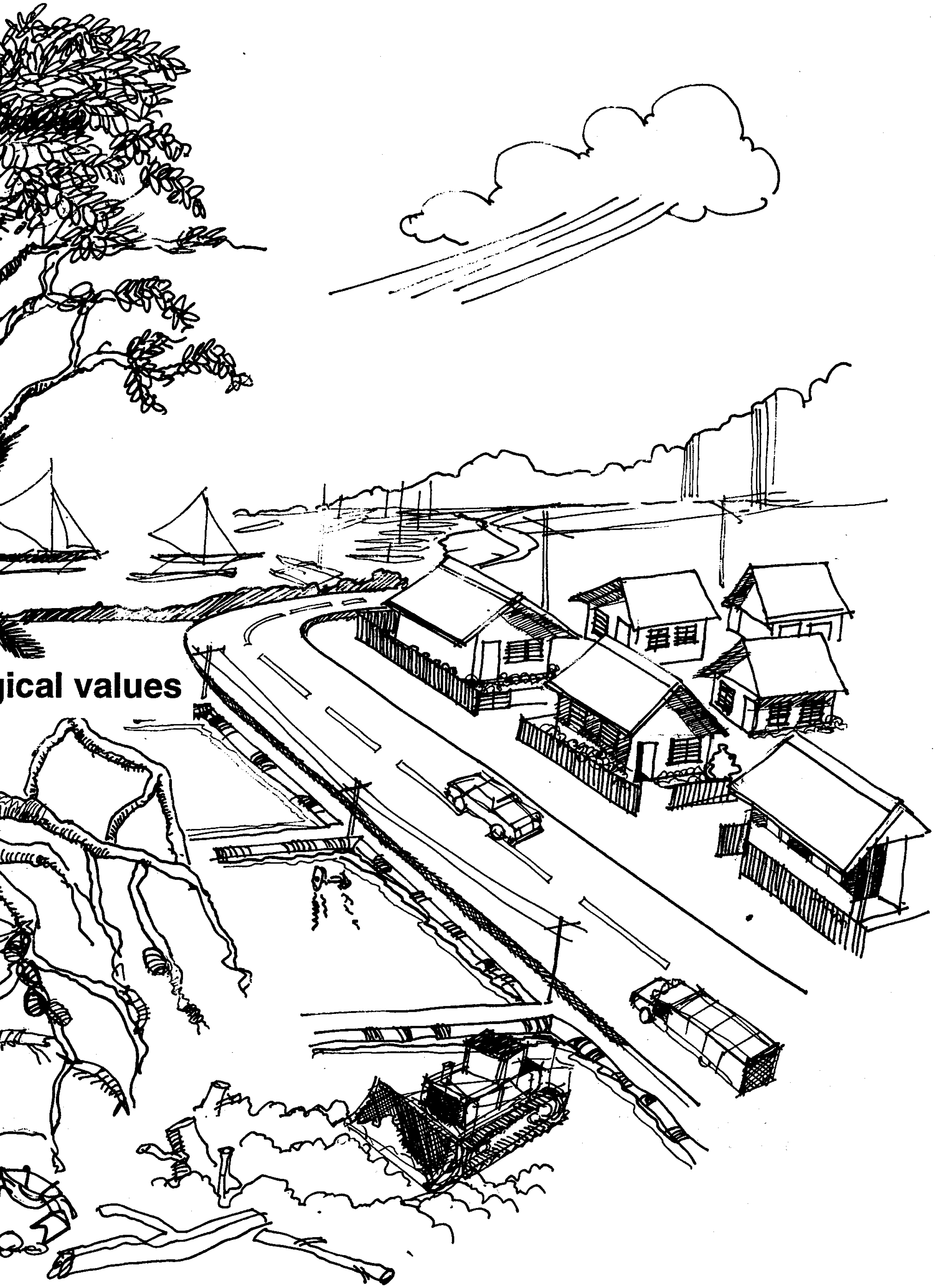
Although much more detailed analysis of the economics of mangrove ecosystems is needed, the following general conclusions can be drawn from the above cases:

- Decisions on whether or not to convert mangroves to other uses are frequently based on the value of marketable forestry products produced by the natural unmanaged mangrove. These values may be quite low. Fishery and marine products, both within the mangrove and in nearby waters, are frequently much more valuable than forest products.
- A natural mangrove is a self-sustaining, productive ecosystem, many conversion-based alternative uses have proved to be expensive to construct and maintain, or have produced disappointing economic results due to low and declining productivity. Nevertheless, normal market forces will almost always favor conversion of mangroves to other uses. This is a direct result of the dispersed nature of the products of, or dependent on, the mangrove and the problem of assigning monetary values to some goods and services. Because of this "market failure," government intervention is essential if mangroves are to be used in a socially optimal manner.
- The linked land-ocean system of mangroves create complicated ecosystem linkages affecting the production of a wide range of socially valuable goods and services.

Sources: Serrano RC and Fortes M. 1989. Perspective on World and Philippine Mangrove Resources. In: *State of the Art: Mangrove Research. (2) Dixon JA.1989. Valuation of Mangroves. Tropical coastal area management. Vol. 4, No. 3. December.*



Values of ma



gical values

angroves

Impact of mangrove conversion

The mangrove forest contributes to both terrestrial and aquatic productivity, especially on the detritic energy pathway through leaf litter. Many productive fishing grounds are found adjacent to mangrove areas which has numerous ecological functions and are seriously affected when denudation takes place.

Impact on fisheries. The mangrove areas which serve as nursery grounds for important species of fish and crustaceans are also rich feeding ground for many species from various trophic levels. An analysis of the 1981 landings in Malaysia shows that 32% may be associated with mangroves while in the Philippines, 71.9% of the total catch from 1982 to 1986 has some close association with mangroves.

Mangal (mangrove forest) mollusks and some species of oysters and cockles are associated with mangroves. Several species of shrimp, notably penaeids, also depend on mangroves from their larval to juvenile stages. Like crustaceans and mollusks, many species of fish are closely associated with mangroves but very few species are truly mangal residents. Numerous studies have been conducted on the fish composition of mangrove areas worldwide. In Florida, USA, about 80% of the marine commercial and recreational catch are dependent on mangroves for at least some critical stages of the species life cycles. In Fiji, 60% of commercial landings are from mangrove areas.

In the ASEAN region, the impact of mangrove conversion on fisheries has not been assessed qualitatively and quantitatively. However, many aquaculture operations rely on the collection of naturally occurring seed stock of penaeid shrimp and fish like milkfish, groupers, snappers and sea bass. Although the commercial hatchery production of penaeid shrimp and sea bass has been attained, many hatcheries still depend on their wild broodstock. Thus, the destruction of mangroves could affect the availability of fry and broodstock and, consequently, aquaculture production and capture fisheries. Low recruitment will consequently affect production. With many overexploited fishing grounds in the region, the loss of habitat through mangrove destruction will further compound stock recruitment and production.

Economic impact will most likely be localized. The decrease or subsequent depletion of seed stock of penaeid shrimp and milkfish can displace fishermen and fry gatherers who depend on the fisheries for sustenance. Mollusk culture beds will also be directly and indirectly affected. The decrease in aquatic productivity as a result of mangrove destruction directly affects the settling and growth of mollusks like oysters and cockles. Indirectly, it affects the

A former mangrove area converted into fishpond in Barotac Nuevo, Iloilo Phil.

The destruction of mangroves accelerates the erosion of riverbanks especially where water traffic is heavy.

culture beds through high sedimentation resulting from shoreline erosion and terrestrial runoff since there will be no barriers against these forces.

Shrimp catch, especially the penaeid species, has been correlated significantly with existing mangrove areas.

The evaluation of mangroves is very difficult because many goods and services derived from the mangrove ecosystem are not easily monetized and are considered economic externalities. Financial analysis of mangrove conversion considers only its profitability from the investor's point of view. The social benefits are almost always ignored and that many mangrove areas in the region are privately owned. Many of the coastal communities dependent on coastal resources tend to be politically and economically marginal.

Shrimp farming has dramatically increased since the 1970s because of the high profitability of such a venture although few people or groups of people benefit from it.

Impact on coastal areas. The impact of mangrove conversion on coastal areas varies from place to place, depending on the prevailing local conditions. In typhoon-prone areas, the destruction of mangroves increased the risk of coastal erosion from storm surges and winds. Along estuarine systems, their denudation accelerates the erosion of riverbanks, especially where water traffic is heavy. When large areas of mangroves have been converted to shrimp ponds, the process results in the following: acid sulfate soils are exposed, leading to poor production and mass mortality of stocks as well as the discharge of toxic substances into nearby waters.

The destruction of mangroves for coastal development (i.e., residential and industrial sites), will affect the freshwater supply through salt intrusion upstream, particularly under low-rainfall conditions; on the other hand, flooding will occur under high-rainfall conditions. In Jakarta, the construction of *tambak* resulted in the diversion of stream channels, causing major channels in hydrologic regime and siltation, thereby altering the coastal sedimentation process. Conversion to salt ponds also alters soil structure and increases salt content, thereby rendering the area difficult to reclaim, especially for agriculture or silviculture. Some *Artemia* ponds in Thailand and the numerous salt ponds in the region can become unproductive should these areas be abandoned for various reasons. Conversion of mangroves to mining areas — as in Indonesia and Thailand — not only affects other resources (i.e., coral reefs, coastal waters, beaches, fisheries) but could also render the areas irreversibly damaged, if not costly to reclaim for more productive purposes.

Source: Paw JN. and Chua TE. 1991. An assessmentof the ecological and economic impact of mangrove conversion in Southeast Asia. p. 201-202. In: LM Chou et al (eds.). Towards an integrated management of tropical coastal resources. ICLARM Conf. Proc. 22. 455.p.

SEAFDEC appeals - Save the mangroves!

Mangoves, the intertidal trees and bushes that grow in the tr0pics and subtropics require salt water, protection from wave action, a suitable substrate, and regular tidal flushing. There are seven from the 26 true species of mangroves in the Philippines. They are bakawan babae, bakawan lalake, api-api, bungalon, pagatpat, pototan, and tangal (refer to p. 2.) Another 60-70 species of vines, shrubs, palms, and trees are associated with mangroves.

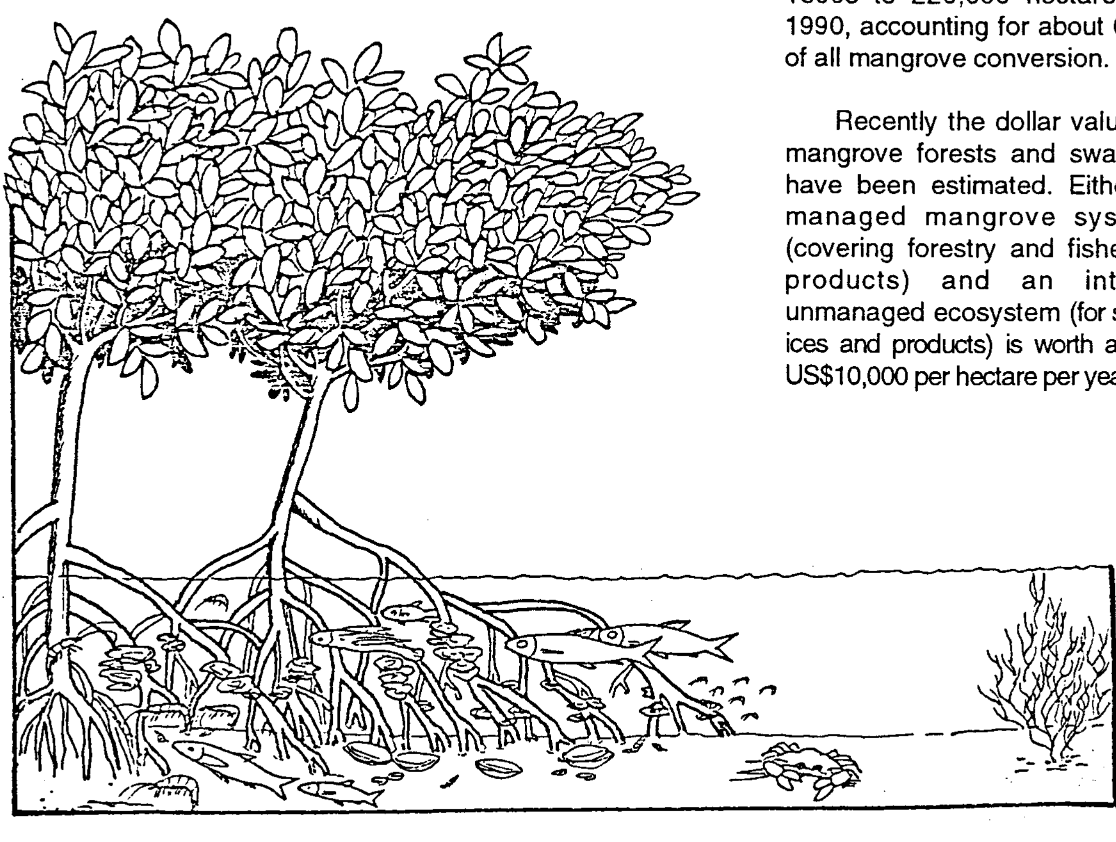
Mangroves have contributed to the ecological and economic well-being of coastal communities for centuries. Mangrove forests prevent river bank and shoreline erosion by trapping and stabilizing sediments, and reduce flooding.

Mangrove areas export nutrients and detritus to nearshore waters and serve as nurseries and feeding grounds for many commercially important species. Milkfish, mullet, rabbitfish, snapper, gobies, shrimps, crabs, oysters, mussels, clams, and some seaweeds are found in mangroves.

Aside from fisheries, mangroves also provide many forestry products - fuel (firewood, charcoal); construction (roof shingles, timber, beams, poles); fishing (poles, floats); paper production; drugs and beverages (vinegar, alcohol, medicines); household items (furniture, glue); textile and leather products (dyes, tannins); and forage for livestock.

Mangroves (and other wetlands) regarded as wastelands have been cut down for fuel or converted to other uses. In the Philippines, mangrove forests and swamps had its own serious slump in area and remarkably reduced which gave irreversible ecological and economic consequence Fishponds increased from a few hectares in the late 1800s to 220,000 hectares in 1990, accounting for about 60% of all mangrove conversion.

Recently the dollar value of mangrove forests and swamps have been estimated. Either a managed mangrove system (covering forestry and fisheries products) and an intact, unmanaged ecosystem (for services and products) is worth about US$10,000 per hectare per year.



What can be done?

To stop and prevent further degradation of the mangrove ecosystem, three major action plans are necessary:

Conservation

To conserve remaining mangroves, existing legistlation designed to protect them must be implemented. For example, the ban on clear-cutting of mangroves should be strictly enforced by the Bureau of Forest Development of the DENR. Only regulated, selective harvesting of fuelwood and other mangrove products may be allowed.

Similarly, the Bureau of Fisheries and Aquatic Resources should require pond owners to retain or plant a mangrove greenbelt 20-100 meters wide around the ponds as specified in Presidential decree 705 (1975 Revised Forestry Code), P.D. 950, and other similar laws. Abandoned fihsponds should be allowed to revert to mangrove forest by breaking the dikes and restoring tidal flow.

Mangrove Reforestation

Considering that around 300,000 hectares of mangroves have been lost since 1920, equal effort should be given to reforestration or planting of denuded mangrove areas. As early as 1964, community residents, school officials, and students in Bohol planted mangroves primarily for protection against monsoon winds and typhoons. Similar mangrove reforestation projects can be undertaken in other places in the country.

Ecologically Sound Aquaculture

Mangroves and aquaculture systems may not be entirely incompatible. When culture systems imitate natural ecosystem functions, they require less resource inputs and produce less harmful ecological effects. Examples of environment-friendly aquaculture technologies are:

- Seaweed culture - Gracilaria
- Cage culture of fishes
- Culture of oysters, mussels, clams, cockles
- Crab fattening
- Amatong - rocks or branches placed in excavations in the intertidal area to provide shelter for groupers and other fishes which are then harvested regularly
- Indonesian *tumpang sari* - integrates forestry and fisheries with aquaculture or agriculture and retains the multiple uses of given mangrove areas

Source: Bagarinao, T. et al. Towards a viable environment: What individuals can do. SEAFDEC/AQD. (in press).

Mangrove reforestation is being done in Dumangas, Iloilo as a project of Iloilo State College of Fisheries (ISCOF).

Management of mangrove areas

The rapid conversion of mangrove forests to alternative economic uses inevitably reduced the fish catch in the nearby coastal waters.

Baseline information on the mangrove ecosystem is still insufficient, especially on its relationship with other ecosystems and resources within the coastal zone.

In managing mangrove forest they must be allocated for conservation purposes to protect the mangrove ecosystem, conserve genetic biodiversity and provide areas for scientific research and aesthetic considerations.

Areas for the sustainable management of mangroves have been established in many countries to ensure the ecological balance of the ecosystem.

Population and economic development pressures is partly responsible for the conversion of mangroves to various land uses.The indiscriminate clear-cutting of mangroves for aquaculture, salt ponds and other uses - especially those within privately owned lands - must be minimized. The conversion should be restricted to areas that do not adversely affect the environment like flooding, salt intrusion in aquifers, erosion and others.

To prevent further negative effects of mangrove depletion on the income of coastal fishers, the conversion of mangrove areas should be regulated by means of land lease. The fishpond lease fee depending on whether one wants to encourage or discourage conversion. If it is set high, this may compel the producer to employ better technology rather than converting additional mangrove areas to fishpond. This pricing policy would lead to induced-innovation and greater resource use efficiency.

The basis for the lease fee is resource rent, which is the surplus value over and above the opportunity cost of all factors of production. The rent will be the basis in setting the lease fee for mangrove areas converted to fishponds.

The rent is important to the local authorities regulating the use of mangrove areas to sustain the productivity of the ecosystem (i.e., the fishpond production and coastal fisheries).

The residual method is the resource rent which is the total revenue minus all costs excluding the fishpond lease fee. Total revenue includes normal profits as farmers will sell at a price that incorporates the profit mark-up.

To determine the annual rent per hectare, the present value (PV) of the stream of rents for the period of the fishpond lease are divided by the lease period. The rationale behind the net present value (NPV) is to incorporate society's valuation of the opportunity cost of money or their preference between present and future consumption.

The rents calculated are based on a technology using low levels of chemical inputs and low stocking density of about 2,000 fingerlings/ha/crop and 5,000 milkfish fry and shrimp, respectively. This technology results in low yields. In the aquaculture industry, high stocking density and heavy dosage of chemical inputs results in high yields and better profits.

The annual discounted rent using 10 and 5% social rates of discount using three types of cropping system: milkfish-milkfish, milkfish-shrimp and shrimp-shrimp. Each type uses a combination of species grown in a pond sequentially in a given year, e.g., milkfish is grown in the first half of the year followed by shrimp in the second half. The rents are highest with the shrimp-shrimp system. These rents are much higher than the fishpond lease agreement (FLA) fee of ₱50/ha/year (US$2). The size of the

to page 21...

Economic rent (discounted) of mangrove areas by period of lease, discount rate and cropping system.

	Item	Cropping System: Milkfish-milkfish	Milkfish-shrimp	Shrimp-shrimp
		Pesos/ha/year		
10%				
	5 years	1,247	1,195	3,296
	10 years	1,011	968	2,672
	20 years	700	671	1,851
15%				
	5 years	1,103	1,056	2,916
	10 years	825	791	2,182
	20 years	515	493	1,362

The Genetic Garden

Over the years, the mangrove forests have undergone tremendous pressures due to the demands of growing human population. A great number of people lives in the coastal mangrove areas and derived their livelihood from mangrove products aside from fishing and farming. Immediate action is needed to prevent further damage of the remaining mangroves and its sustainable management is the establishment of the mangrove genetic garden where species could be maintained. The prime functions of the mangrove germplasm garden is for protection and conservation for sustainable use.

Selection of Site. The principal concern of designing a mangrove genetic garden is the conservation of biodiversity in mangrove ecosystem. The sites should be selected not intended to serve as national park but as a pool to enhance genetic diversity. The identification of sites will be based on the following criteria:

- accessibility
- close proximity to research ecosystems and/or habitats with rich diversity (large number of endemic, threatened and/or rare species);
- legal status (possibly reserved or protected areas); and
- institutional/social (social, political, economic, and human aspects).

Site Characterization. Boundaries should be delineated and characterized showing land use patterns, anthropogenic features using Geographical Information Systems (GIS). Baseline inventories through ecogeographical survey should be conducted to assess the needs for research and monitoring, and management intervention. Ecological zoning and/or stratification of mangrove zones into homogenous strata will be undertaken to identify intraspecific genetic variation.

Socio demographic information, economic condition, awareness perception and attitudes of coastal mangrove dwellers toward mangrove conservation will be initiated.

Sampling Technique and Selection. The method of sampling will depend on the status of the area. A priority knowledge of patterns and structural complexity of genetic variation within and between species as well as at ecosystem level is necessary. Breeding systems, reproductive biology and mode of occurrence are fundamental to conserving and managing genetic resources.

next page ...

Conservation Strategies. Genetic conservation efforts can be carried out in two ways: *in situ* and *ex situ. In situ* depends on ecogeographical surveys and monitoring of important habitats to determine the number, size, and extent of resources needed to provide range of species. *Ex situ* management include the managed or living stand where the seeds will be collected and maintained for observation. This involves collection, storage and regeneration, documentation and information systems development, evaluation, enhancement and exchange.

A combined *in situ* and *ex situ* conservation techniques is ideal to conserve and manage the genetic variation of mangrove trees.

Research and Monitoring. A long-term research program should be initiated to gain scientific understanding of the ecological process that maintains mangrove biodiversity. Researches are best addressed in an inter-disciplinary approach in assessing the different natural and socio-economic process in mangrove ecosystems. Monitoring on the other hand, should be an integral part of any conservation activity. Biological indicators at all levels of ecosystems, species populations, and genetic diversity must be identified and selected. Appropriate assessment should provide a baseline information on the conservation status of biodiversity.

Development of Management Plan. A comprehensive management plan will be drawn from the physical, socioeconomic, and ecogeographical surveys. The plan should provide an overview of the steps to be undertaken essential in the establishment of a mangrove genetic garden. This should be based on the distribution of genetic variability as determined by surveys and include as many genetically local population as possible. The plan should also specify directives for coordination and involvement of coastal communities to integrate them in the conservation and management of the mangrove resources.

Policy and Management Recommendations

The government laid down management action-oriented policies, rules, and regulations related to mangroves through Presidential Decrees, Letters of Instruction, Special Orders, and Administrative Orders. However, these rules and laws need effective and efficient implementation.

The conservation of natural resources like mangrove forests is the joint responsibility of both the government and the citizens. The following are recommendations for some key forms of action towards the protection of our mangroves. They are addressed to individuals or community groups, environmental groups and the government sector.

Individuals or Community Groups

- Monitor aquatic resources in the area, particularly mangrove forests, and raise community awareness by organizing the community for the protection of these resources.
- Dispose garbage and other waste properly to avoid polluting mangrove swamps.
- Initiate or join activities to replace or replant more mangrove trees, specially in areas where reforestation of mangroves are badly needed.
- Adopt aquaculture methods which entail minimal modification of mangrove areas, e.g., oyster culture in aerial roots, mussel culture, clam culture, seaweed farming, etc.

Environmental Groups

- Strengthen information dissemination campaign on all aspects of mangrove forests as an ecosystem, through both mass media and school curricula incorporation.
- Establish closer linkages with other environmental groups and government institutions that work for the protection of mangrove resources, and participate in their activities.

Government

- Delineate the areal extent and zone of mangrove areas. This will involve a review of the present zonification and classification guidelines.
- Formulate steps to halt uncontrolled and unnecessary alteration of mangrove areas.
- Installation of data/information bank on mangrove forests as a natural resource and as an ecosystem.
- Reevaluation and assessment of the relevance of the following in mangrove area management planning: a.) *ownership/common property value;* b.) *conditions of open access;* c.) *establishment of social welfare value;* d.) *international value judgment;* e.) *existing alternative resource policy;* f.) *irreversibility and* g.) *policy and allocation of mangrove forests*

Sources: (1) Roman EB. Designing a Genetic Garden for mangrove Germplasm Conservation. Canopy International. Sept-Oct 1993.

"It is not intensive shrimp farming per se but the widespread conversion of mangroves to brackishwater culture ponds that has had the greatest impact on the ecology and economy of the Philippines" -J.H. Primavera, SEAFDEC/AQD Scientist

from p. 18 ... Management of....

rents indicates that the fishpond owners have the capacity to pay higher fees, which could be ploughed back into the fisheries to rehabilitate the mangrove areas and hence, the ecosystem of both inland and capture fisheries.

It is possible to calculate a whole schedule of rents by varying the assumptions on technology and prices. Rents can be calculated assuming the best technology available and given input-output prices and this will result, theoretically to higher values than those shown in the table. The major causes of mangrove depletion are cutting of mangroves for fuelwood and charcoal and clearing for fishpond development.

The economic rent is significantly greater than the current FLA fee of ₱50. There is then justification for the government to increase the fee which could be used to rehabilitate the inland-coastal fisheries to improve productivity and ensure sustainability of the ecosystem.

The government could charge ₱3,296/ha/year (US$130). This rent corresponds to the shrimp-shrimp system for a five-year lease and a 10% discount. This would compel the fishpond owners to shift to the more profitable cropping system or may motivate them to use better technology to improve productivity and income.

One important consideration in the implementation of a revised FLA fee is that the rent should be location-specific. Although the technology may be applicable from one place to another, environmental conditions and input-output prices are likely to differ from one region to another.

Sources: (1) Paw JN and Chua TE. 1991. An assess ment of ecological and economic impact of mangrove conversion in Southeast Asia. p. 201-202. In: LM Chou et al. (eds.). Towards an integrated management of tropical coastal resources. ICLARM Conf. Proc. (2) Evangelista LD. 1992. Management of Mangrove Areas in Calauag Bay, Quezon Province, Philippines. AFSSRNews Section. April 1992.

from page 7.... The State of ...

policy, the government stopped issuing permits and immediately set out to convert abandoned and unused mangrove swamps back to their forest land classification.

The order also allows the establishment of mangrove plantation in sparsely vegetated mangrove forest lands and in alienable and disposable forest areas. As of 1990, 8,705 ha. of mangroves have been replanted throughout the country with funding from the World Bank, Asian Development Bank, Overseas Economic Cooperation Fund of Japan, and the national government.

Inspite of these measures, however, the conservation of the country's remaining mangrove appears to be a losing battle because of ineffective law enforcement and the entry of powerful political and business interests in the pond industry.

Environment-friendly fisheries methods can be another solution to the problem of mangrove forest depletion. Culture ponds may not necessarily preclude the presence of mangroves. Dikes and tidal flats fronting early Indonesia *tambak* (fishponds) were planted with *Avicenna, Rhizophora* and other species for firewood, fertilizer (from decaying leaves), and protection from wave action. **Alfredo Nathaniel L. Marte**

Sources: Paw, JN and Chua, TE.. 1991. An assessment of the ecological and economic impact of mangrove conversion in Southeast Asia. pp. 201-205. In: LM Chou et al. (eds.). Towards an integrated management of tropical coastal resources. ICLARM Conf. Proc. (2) Zamora, P.M.1989. Philippine Mangroves: Their depletion, conversion, and decreasing productivity. (3) Primavera, JH. 1995. Mangroves and brackishwater pond culture in the Philippines. Hydrobiologia. 295 Wong YS & Lam BFY (eds.). Asia-Pacific symposium on mangrove ecosystems. pp 303. (4) Primavera, JH. 1994. A critical review of shrimp pond culture in the Philippines. Reviews in Fisheries Science 1(2):151-201. (5) Philipps, MV. 1995. Shrimp culture and the environment. Towards sustainable aquaculture in Southeast Asia and Japan. pp. 39-40.

Aquaculture clinic

Q: Are mangroves nurseries?

A: Yes, depending on:

a) type/setting of mangroves
b) species of shrimp
c) larval supply (presence of spawning adults)
d) larval transport (by advection)

As nurseries, mangrove are postulated to provide food and/or shelter to shrimp juveniles during the early stage of their life cycle.

Source: Primavera, JH. 1995. Mangroves Habitats as Nurseries for Shrimps (Penaeidae) in Guimaras, Philippines. Unpub. Ph.D. thesis, University of the Philippines, Diliman, Quezon City, Philippines.

D0 YOU KNOW?

1. In 1760, the Portuguese King D. Jose, passed an ordinance regulating the exploitation of the red mangrove (*Rhizophora mangle)* and forbidding the ringing or cutting down of trees as a management practice?
2. It is incorrect that the term mangrove came from a combination of the Portuguese word *'mange*' for trees and the English word '*grove*' which means a stand or group of trees'." The word for tree in Portuguese, like in all Latin languages, derives from the Latin '*arbor*' and is *'arvore*' not '*mange*' (in Portuguese)"
3. The mangroves of Oman was once the biggest mangrove forest in the Arabian Gulf. Many ancient references describe Arabian mangroves, some dating back 3580 BC.
4. Red mangrove in the tropics may reach approximately 30 m (100 ft) tall, with trunks up to 1 m (3 ft) in diameter.
5. Philippines' premier city of Manila owes its name to the mangrove species *Scyphiphora hydrophyllacea* or *nilad* in local dialect. The Spanish in 1570 called the swampy area in Manila Bay "Maynilad" meaning "there's nilad" in reference to the abundance of *S. hydrophyllacea* with its small, white flowers and aniline products used for cleansing and whitening laundry agent.

Sources: *1 & 2. Vanucci, Marta . Why mangroves? Bakawan 5(2) 1987*
3. D'Souza, Fermin. Arabia's ancient mangroves. Bakawan 5(1):11, 15. 1986.
4. Tomlimson, P.B. The Botany of Mangroves. 1986.
5. Primavera, J.H. Mangroves and brackishwater pond culture in the Phil. 1995.

DOST Secretary to AQD Scientists - Help achieve NIChood

Department of Science and Technology Secretary, Dr. William G. Padolina in his keynote address at the SEAFDEC/AQD 22nd Anniversary convocation on July 7 exhorts AQD scientists to help the government in achieving NIChood (Newly industrialized country). Some scientists work for knowledge for its own sake, but this should be justified by connecting it to national goals to strengthen our national well-being. He challenged the researchers to use a fast track approaches in science and technology to enable the Philippines to address its current problems.

It is imperative to strive for excellence, whether in research, administration and training. Padolina recognized the need for efficient administration to make research programs viable to effect good research acitivities. He also identified the national goals as: exports, food security, and environmental integrity.Scientists then should look for approaches that make research palpable to catalyze and initiate activity in the private sector.

Padolina's assessment is that the Philippines now is on the verge of becoming the next 'economic miracle' in SE Asia. And this can be achieved if we:

- Focus on intellectual capital. Information becomes valuable when delivered at the moment it is needed.
- Develop, improve infrastructure. Modernize and upgrade existing facilities.
- Develop R & D themes to identify the right problem and address it at the right time. Set national programs to build national capability which has to be assessed and strategically placed.
- Partnership, linkages and collaborations must be forged with varying groups for technological development.

"A science organization must be flexible and decentralized. Its manpower should focus on demand-oriented programs and must enhance a culture of excellence."

Other activities included:

- Ground-breaking ceremony by the Chief and Deputy Chief on the quadruplex site.
- Mass/blessing of hatchery complex
- Villaluz Memorial Lecture by Dr. Gavino Trono
- Lecture and industry consultation
- Video showing on environment
- Exhibit/Open house
- Free medical/dental consultation
- Convocation during which certificates of appreciation/recognition were given to outstanding researchers.

Mangroves - target of aquaculture expansion, says AQD researcher

"The mad scramble for more profits through production intensification and expansion of production areas through conversion of mangroves into fishponds have contributed to the further degradation of the already fragile coastal environment", laments AQD researcher Renato Agbayani. This was said to the 28 trainees from 11 countries during the opening ceremonies of the Aquaculture Management Training Course. Uncontrolled aquaculture production system have further marginalized the small-scale fishers whose main source of income comes from coastal water. "Sustainable development"- the buzzword in the aquaculture industry encompasses the development of appropriate technology, financial and economic viability, environmental soundness and social acceptability.

The fast growth of the aquaculture industry during the last two decades was primarily due to the increase in demand for fish as a protein source. Agbayani hopes that aquaculture will fill-up the widening supply-demand gap for fish and other aquatic products because of population growth and dwindling fish resources.

The four-week training course aims to develop skills of project managers in aquaculture planning and implementation, monitoring and evaluation. It is designed for middle to top level government planners, executives, bankers, aquaculturists and decision makers. It covers lectures in seed production, grow-out techniques, nutrition and diseases as part of the technical module. Some of the lectures include laboratory sessions. The management module includes production, marketing, finance, business and government policies.

Entered as second class mail matter at PPC, Tigbauan, Iloilo on 21 July 1995

Vol. XIII, No. 4 July-August 1995

Aqua Farm News is published bimonthly by the Aquaculture Department of the Southeast Asian Fisheries Development Center P.O. Box 256 Iloilo City 5000 Philippines

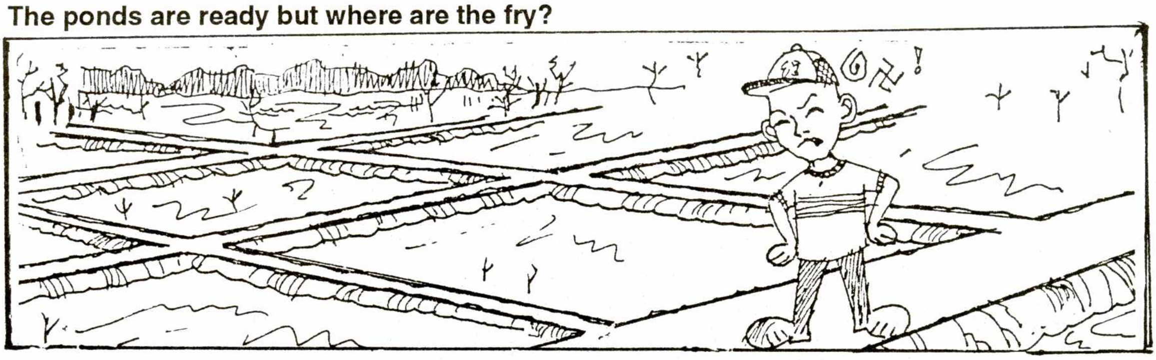
AFN is a production guide for fishfarmers and extension workers. It discusses the technology for cultured species and other recent information excerpted from various sources.

In citing information from AFN, please cite the institutional source which is not necessarily SEAFDEC/AQD. Mention of trade names in this publication is not an endorsement.

Editor this issue: E. T. Aldon; Production: D. Badilles, R. Buendia, E. Ledesma, L. Plondaya, J. Requintina, I. Tendencia; Circulation: R. Tenedero, L. Tabigo-on, Jr.

Subscription rate: ₱40 per year (local), US$ 15 per year including air mail postage (foreign). Please make remittances in postal money order, bank draft, or demand draft payable to SEAFDEC/AQD.

The ponds are ready but where are the fry?



by E. LEDESMA

SEAFDEC *Better life through aquaculture*