MANGROVE MANAGEMENT AND DEVELOPMENT IN THE PHILIPPINES[1]

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INTRODUCTION

Filipinos, whose main daily diet consists of fish and rice, are highly dependent on the coastal resources. Traditionally in the Philippines, the development of coastal resources, including mangroves, has been exploitative in nature. Government policies, which dictated development in both the uplands and coastal areas, have been based mainly on abundant available resources without due consideration for sustainable options for future generations.

In the 1950's, vast tracts of mangroves were awarded to concessionaires and logged over for firewood and tanbarks. Mangrove firewood was the preferred fuel source in coastal villages and most bakeries because of its high heating value, but a greater volume was exported to Japan as firewood, which reportedly became the source of rayon.

In the 1960's, the government adopted a policy aimed at increasing fish production by converting large areas of mangroves into fishponds for the culture of milkfish (Chanos chanos) and prawns. Such policy was promoted by a government program, which classified and released mangrove timberland for fishpond development and opened loan windows in most government banks to finance fishpond development.

It was only towards the end of the 1970's when the government realized the fishery value of mangroves. A National Mangrove Committee was formed in the then Ministry of Natural Resources, and a Mangrove Forest Research Center was created under the Forest Research Institute of the Philippines. The former was charged with the formulation of policies/recommendations for the conservation and sustainable management of the remaining mangrove forests in the country, while the latter worked for the generation of technology for the rehabilitation, production and sustainable management of mangroves. Not surprisingly, this "decade of awakening" was also significantly marked with an alarming decline in fish catch.

The government then opened loans to fisher folks for the purchase of motorized boats and improved fishing gears. The program ended with most fishers unable to pay back their loans as their fish harvests and incomes continued to decline.

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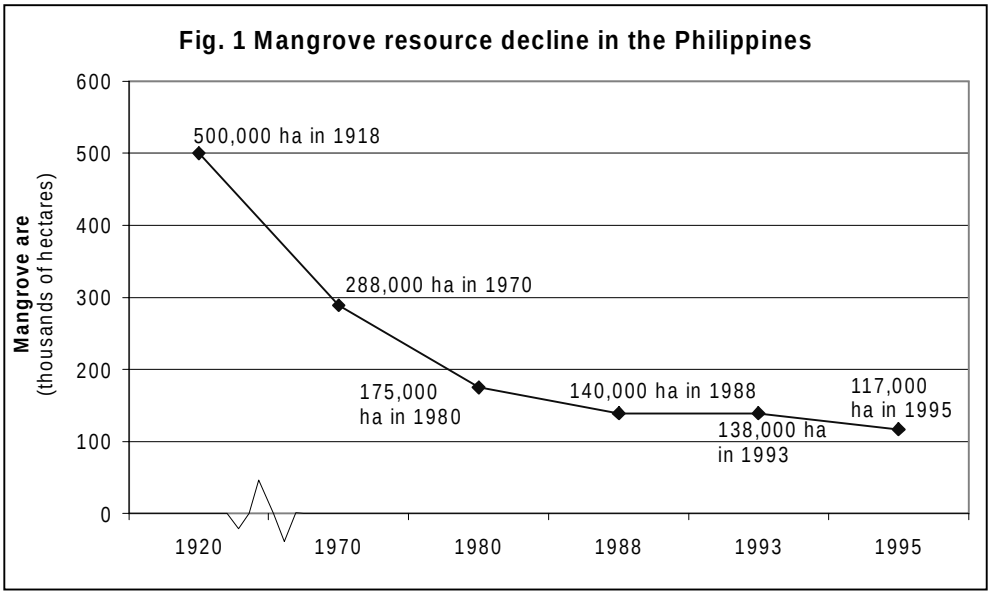
The 1980's and 1990's were marked with significant efforts to rehabilitate destroyed mangroves and related coastal resources. In 1981, small islands indented by mangroves containing an aggregate area of about 4,326 hectares were declared Wilderness Areas under Presidential Proclamation No. 2151. Also in the same year, Presidential Proclamation No. 2152 was issued declaring the entire island of Palawan and some parcels of mangroves in the country containing an aggregate area of 74,267 hectares as Mangrove Swamp Forest Reserves. In 1987, the Mangrove Forest Research Center was expanded in its concerns and coverage, becoming nationwide in scope under the Freshwater and Coastal Ecosystems Section of the Ecosystems Research and Development Service of every regional office of the present Department of Environment and Natural Resources.

Not long after, the Coastal Environment Program (CEP) and the Coastal Resource Management Project (CRMP) were launched in the regional offices of DENR in 1993 and in 1996, respectively, expanding the environment department's concerns over all coastal ecosystems. These programs promote community-based approaches to coastal resource management, making direct stakeholders partners of government in the sustainable development and management of mangroves, seagrass beds, coral reefs, and other coastal resources.

HISTORY OF MAJOR MANGROVE HABITAT USES AND CHANGES IN THE PHILIPPINES

The Philippines has about 7,100 islands surrounding the mainland of Luzon in the north, Visayas in the middle and Mindanao in the south. The country has about 18, 000 km of shorelines and vast areas of mangroves totaling about 500,000 hectares in the early 1900s (Brown and Fisher, 1920). But overexploitation, conversion of areas to various uses, and the simultaneous logging of watersheds in the uplands, the country's remaining mangrove area was only about 117,700 hectares in 1995 (DENR Statistics (1998).

Fig. 1 Mangrove resource decline in the Philippines



With the destruction of mangrove areas, seagrass and coral reef ecosystems have also deteriorated. About 70 % of the Philippines' coral cover has been destroyed, with about 25% still in good condition and only about 5% in excellent condition. As a result, the productivity of coastal fisheries measured in term s of fish catch also suffered a serious decline. It is estimated that there is a reduction of 670 kg in fish catch for every hectare of mangrove forest that is clear-cut. (CRMP, 1998).

ENVIRONMENTAL AND SOCIAL IMPACTS OF MANGROVE HABITAT CHANGES

A. Environmental Impacts

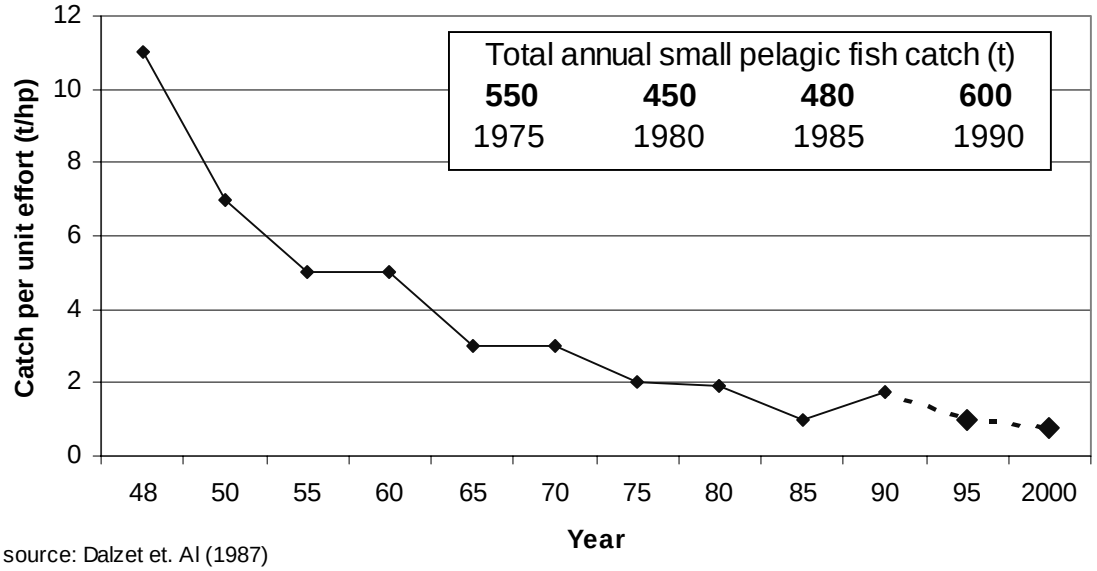
- Shoreline erosion especially in most of the typhoon prone areas
- Decline in forest structure and diversity of plant species in most of the remaining mangrove stand. Mangrove vegetation has been generally reduced to narrow strips and patches indenting the coastlines consisting of usually less than half a dozen species of trees and associated plants. Early works such as that of Brown and Fisher in 1920 reported 25 dicotyledonous tree species in Philippine mangrove swamps. Salvoza (1976 and Quimbo (1971) reported 22 and 29 species, respectively. Most of the remaining mangrove strips and patches are dominated by stunted Sonneratia alba and Avicennia marina which are adapted to sandy coralline shorelines and survive cuttings because of their inherent sprouting ability.

  Original mangrove species were said to be comparable to commercial forests of the land (Brown and Fisher, 1920). Reportedly, mangrove forests included trees of 1.35 meters in diameter and stocks of 650 cu. m. per hectare. Such figures have been drastically reduced to 95.80 cu. m. per hectare for old-growth and 32.81 cu. m. per hectare for young-growth mangrove swamps in Mindanao and 190.70 cu. m. per hectare for old-growth and 146.69 cu. m. per hectare for young-growth mangroves in Palawan (Francia, 1971).
- Decline in fishery

  The degraded forest structure of Philippine mangroves that consequently brought decline in its ecosystem functions (including fisheries) is aggravated by a parallel destruction of equally important coastal ecosystems.

  The decline of catch per unit of fishing effort since 1948 (Figure 2) has run parallel with the decline of mangrove resources in the Philippines (Figure 1). Such trend supports Odum's (1982) estimate that about 50-75 % of the world's commercial species are dependent on mangrove swamps, marshes, seagrass meadows, mudflats and coral reefs for habitat and his further report on fish biomass in mangrove swamps to be 6.8 to 11.5 times that in adjacent open waters.

Figure 2. Trend of catch per unit effort since 1948



source: Dalzet et. Al (1987)

- Negative impacts of mangrove conversion to fishponds

  The decline of mangroves due to conversion to other uses brings about a consequent decline of the following ecological functions of mangroves:

  - Nursery grounds for fishes, prawns, crabs and shellfishes
  - Production of leaf litter and detritus material which provides a valuable source of food for marine animals
  - Protection of shore and estuaries from storm waves and erosion
  - Pollution sink for nearshore waters
  - Wildlife habitat, and
  - Biodiversity

  The conversion of mangrove swamps into fishponds simply means a substitution of a formerly highly diverse and naturally productive ecosystem into simplified and highly input-dependent ponds that are economically and ecologically unstable. Fishponds are plagued with problems such as diseases, acid soil, deteriorating water quality, seepage of water through dikes, and market fluctuations resulting to low production. Many shrimp farms have been abandoned in the Philippines and elsewhere in Southeast Asia because of low productivity (White & Trinidad, 1998). A recent study found that 20% of the fishponds in Negros Oriental and 40% in Bohol, all in the Philippines, are unproductive (Alcala, 1982)
- Rising incidence of "fish kill" and "red tide" have been attributed to either total lost or insignificant functions of the remaining degraded and adversely altered mangrove habitats aggravated by high chemical and fertilizer inputs from agro-ecosystems and developed fishponds plus other types of pollutants from industries and domestic waste waters.

B. Social Impacts

Direct economic values estimated in the Philippines for mangrove wood and fish products combined range from USD253 to USD1,396 per hectare per year (Padilla et al, 1996; Schatz 1991 & Trinidad, 1994).

Figure 3. Summary of Philippine estimates for mangrove values

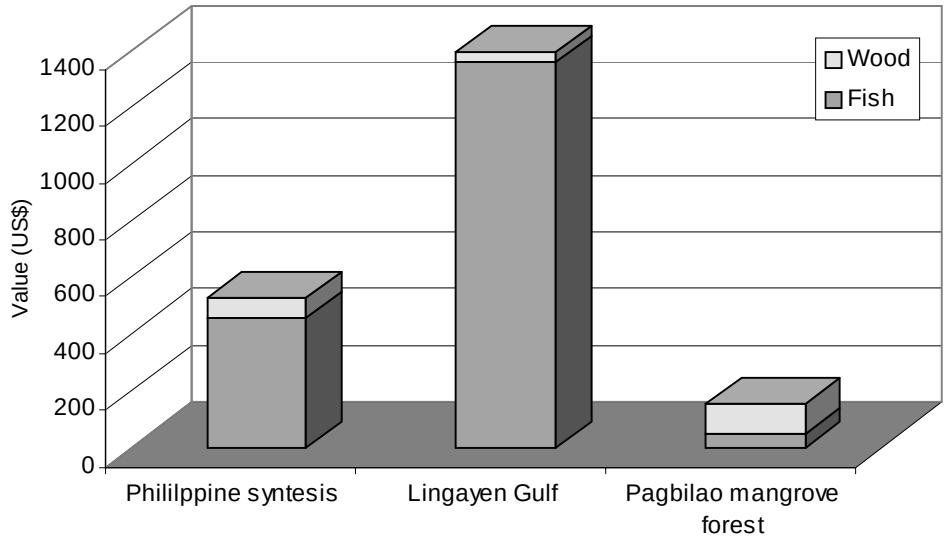
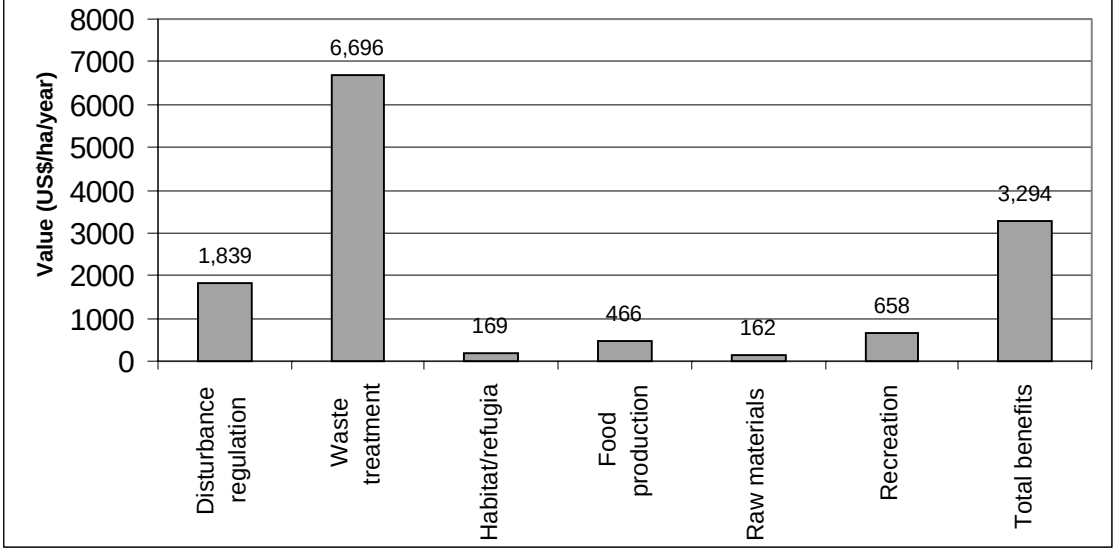


Figure 4 presents a summary of mangrove ecosystem value averages from around the world, which sum up to USD3,294 per hectare per year (Costanza et. al., 1997).

Figure 4. Summary of mangrove ecosystem value averages from around the world



White and Trinidad (1998) estimated the mangrove ecosystem value at USD600/ha/year, a conservative estimate that considers only food production and raw materials.

But while variations in economic values attributed to mangrove ecosystems may be wide, there is no doubting that the conversion to fishponds and other uses result in significant monetary losses.

And who are most affected by such economic loss? Surely, the municipal fisher folks are affected most because they do not have the capital to develop fishponds nor do they have the capital and fishing gears to engage in commercial fishing. Because of this, they are confined to nearshore fishery covering 0-50 meters depth range of the shelf area or to the 10- to 15-km limits of municipal waters as provided for under the Local Government Code of the Philippines.

The significant destruction of coastal habitats (mangroves, seagrass beds and coral reefs), overfishing (more than 70 fishers per sq. km), illegal fishing practices (cyanide, blast fishing, trawl and fine mesh nets) and the encroachment of commercial fishers have cause a significant decline in fish catch and fish quality of municipal fisherfolks.

The municipal fishing sector comprises the majority (68%) of the one million people engaged in the fishing industry (roughly 5% of the country's labor force) in the Philippines, but it contributes only about 30% of the total fish catch, while the 28% engaged in aquaculture and only 4% in commercial fishing contribute 60% of the national fish catch (BFAR 1997).

Fisheries associated with mangrove forests, much of it collected by the poorest of the poor, constitute some 0.67 tons per hectare per year to total fisheries (CRMP, 1998). Alcala (1982) cited one case of mangroves being a substantial source of livelihood for our coastal population - in South and North Bais Bay 20-30 families were wholly dependent on the edible mollusks, sea cucumbers, fishes and crustaceans harvested from surrounding mangrove areas. Some 979 per hectare per year of 26 species of edible shells, 297.1 kg per hectare per year of 16 species of sea cucumbers and an unknown yield of fishes and crustaceans were harvested by the families. This provided an estimated income of at least Php76.36 per hectare per year from shells and Php92.20 per hectare per year from sea cucumber.

MANGROVE MANAGEMENT AND DEVELOPMENT EFFORTS

◆ Self-help Community-Based Mangrove Plantation of Banacon island, Getafe, Bohol

Banacon is one of several islands of Getafe, Bohol surrounded by bakauan (*Rhizophora spp*) plantations established through community-based management since 1957. The existing plantation (more than 400 hectares) attracts many local and foreign visitors, who come to appreciate the monumental success that the islanders have achieved in mangrove rehabilitation.

With the plantations, the islanders have been earning through time out of the following:

- Propagules

  Harvesting and selling of propagules provide additional income to the community. Conservative estimates put production from a 5- to 20-year-old bakauan-bato *(R. stylosa)* plantation at about 100,000 to 320,000 propagules per hectare per year as shown below:

Age of plantation(in years)	Quantity of Production per ha per year ('000)	Gross sale per year at Php 0.20/piece
5-7	100	32,000
8-10	320	64,000
11-20	320	64,000

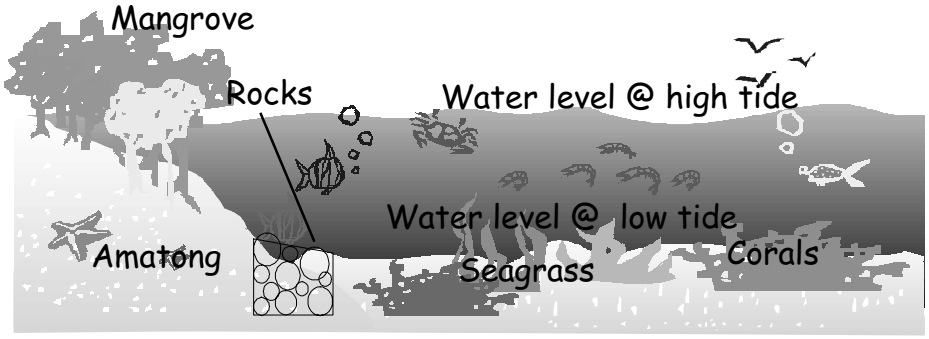
- Firewood/charcoal, piles and Posts

  Allowing 20% mortality, a hectare of bakauan-bato plantation planted at 0.5 m x. 0.5 m spacing will yield 32,000 trees. Through progressive partial thinning operations of up to 50% carried on from the 5th up to the 10th year, a hectare of plantation yields 16,000 poles. This gives a gross return of Php80,000 at a price of Php5.00/ pole measuring 3-6 cm in diameter and 4-5 m in length.

  At the end of the 20th year, the crops will be good for wood piles and posts. A hectare of this plantation can yield 14-16 cm diameter and 10 m long poles.

- Other livelihood
  - Amatong

  Amatong is a cheap, environment -friendly, indigenous, yet lucrative fish-aggregating device that originated in Banacon Island, Getafe, Bohol. Amatong is also known as "miracle hole" because it can provide shelter and food to various kinds of fish, crustaceans and other organisms, making amatong fishing an economically viable livelihood. The site suitable for this method of fishing should be protected from any form of disturbance, shallow (no more than knee-deep) and cleared inter-tidal areas with sandy rocky substrate within a mangrove forest and near seagrass beds and coral reefs as shown below:



The Amatong can range in size from 2 to 4 meters in diameter or 2m x 4m in area and 0.5-1.5 meters deep. It may be circular, rectangular, or funnel-shaped. The distance between two amatong should be at least 50 meters. Harvesting is done after every 3-5 months by installing a net around the boulders and then removing the boulders one after another and piling them outside the Amatong. From 10 to 20 kg of the following fishes harvested from each amatong:

1. Kitong (Siganus sp)
2. Dannggit (siganus spp.)
3. Lapu-lapu *(Epinephelus sp.)*
4. Mangagat *(Lutjanus sp.)*
5. Bunog *(Glossogobius sp.)*
6. Alimasag *(Portunus sp.)*

- Seaweeds

Eucheuma spinosum farming is a viable livelihood for beneficiaries of the Coastal Environment Program in Mahanay and Banacon Islands, Getafe, Bohol. Using mono-lines, these *Eucheuma* farms are extensively spread along tidal flats areas and reach the edge of mangrove plantations.

- **Contract reforestation project**

A contract reforestation project was implemented in several Philippine mangrove areas. Contracts were awarded in four ways - to families, to communities, to local government units, and to non-governmental organizations. This project was successful in some regions, particularly the Central Visayas Region where about 1,700 hectares of mangrove plantations were turned over to the government. Additionally, these plantations impacted fisheries production in terms of a gradual increase in fish catch to about 5-10 percent above baseline. However, in many areas in the Visayas and Mindanao, survival was low, sometimes plunging to 0% compared to the national average of about 54%. Monitoring and evaluation reports pointed to the following as the problems and issues contributing to very low survival:

1. Poor site selection
2. Lack of acceptance by the community or local leaders
3. Barnacles and other infestations
4. Lack of preparation in project implementation
5. Poor understanding and appreciation of the importance of mangroves
6. Conflicting interests of various users/stakeholders
7. General lack of information and actual experience in mangrove rehabilitation and management
8. Contract reforestation benefited only few contractors

- **Mangrove tenurial instruments**
  - Nipa-Bakauan Special Use Permit

The Nipa-Bakauan Permit was issued to individuals or groups who are interested in managing and maintaining Nipa (Nypa fruticans) and bakauan (Rhizopora spp.) stands, after satisfying the documentary requirements and payment of corresponding fees. Because of the government's present total ban on the cutting of mangroves (Republic Act No 7161), this has been reduced to Nipa Special use Permit.

- Community-Based Forest Management program (CBFMP)

The CBFMA is the most recent community-based program of government of the Philip-

pines. The program covers mangrove as well as upland forest areas. It is a national strategy designed to ensure sustainable forestry and social justice.

The DENR and concerned local government units work together with the communities in and near public forests or areas of interests. The main intention is to protect, rehabilitate, manage, conserve and maintain the mangrove resources. For this, it has adopted the theme "people first and sustainable mangrove forest management will follow," meaning that the needs of the people (improved well-being, strengthened capability for sustainable forest management) should be met first before we can solve the country's forest management problems.

The program also aims to develop and strengthen partnership among community, local government, DENR and other groups or organizations. It is applicable in all areas classified as forestlands and allowable zones in protected areas without prior vested rights.

The government, through the DENR, issues a tenurial instrument called " Community-Based Forest Management Agreement (CBFMA) to the organized participating community. The CBFMA is a production-sharing agreement between organized communities and the government to develop, conserve, utilize and manage a specific portion of the forestland, consistent with the principles of sustainable development and pursuant to a Community Resource Management Framework Plan (CRMF). The CRMF defines the terms and conditions for access, use and protection of the resources within the CBFMA areas.

The CBFMA as a land tenure is good for 25 years renewable for another 25 years.

To date, only a few CBFMAs on mangroves have been issued. Under the DENR's Coastal resources Management Project (CRMP) assisted by the United States Agency for International Development (USAID) and managed by the Tetra Tech EM Inc., seven CBFMAs have been issued and another is being processed. These areas agreements, which CRMP regards as "Best CRM Practices," cover 3,352 ha, 414 members and about 23 km of shoreline

- Integration of aquaculture in mangrove management
  - Aqua-silvi-pasture experience: A Case of Failure

    Aquasilvipasture is a management strategy that combines and harmonizes fish production and mangrove development. It is a favorable livelihood opportunity to sustainably augment the fisherman's income and at the same time reforest the coastal ecosystem.

    The Project Site. The site is situated in the mangrove timberland area in Barangay Hunan, Buenavista, Bohol located between 10 degrees 05 minutes and 10 degrees 06 minutes North latitude and 124 degrees 07 minutes and 124 degrees 08 minutes East longitude. The pond site lies some 12 km south of the Northeastern side of Bohol Island, Philippines. It is about 200 meters north of Barangay Hunan. South of the pond site is an illegally developed fishpond associated with a patch of natural mangrove stand. To the west is Cebu Strait and a narrow strip of mangrove forest. To the north is a nipa stand and to the east is a portion of another illegally developed fishpond bordered easterly by an elevated ground planted with coconut.

    For reasons of accessibility, legality and ease of developing, an abandoned 4.0-hectare fishpond was chosen for the project by the DENR. After the site was identified, actual foot survey was made to determine the extent of the pond area. Coordination with the local government units was then carried out and a public consultation was scheduled and conducted. The mangrove occupants were organized and briefed on the objectives, scope and limitations of the project. An organization was created and the officers were elected from among the members. The fishpond was under litigation in the Municipal Trial Court, which decided in favor of the government/DENR. The project started in 1990.

Aquasilvipasture Pond Preparation. The old and damaged dikes were repaired and reinforced with coral boulders. A single sluice gate was constructed on the southern section of the western dike. Close to the gate, was a bunkhouse. Immediately after the entrance to the project is the goat pen. The old nursery pond on the northeastern corner of the pond was repaired. In middle, a portion of the production pond was designated for the silviculture component where the mangrove plantation of Bakauan-bato (Rhizpora apiculata) was established with a spacing of 1.0 m x 1.0 m. The plantation has a total of 2.4 ha, an area equivalent to 60% of the total area of the fishpond.

Forming the pasture component were 1 mature male and 5 female goats. These goats were herded daily in the nearby grassland area and at night brought back to the pen. At times, these goats were allowed to roam along dikes planted with grasses (mostly Chloris spp) and Dampalit (Sesuvium portulacastrum). Leaves of Pagatpat (Sonneratia alba) and Bungalon (Avicennia marina) were also harvested and fed to the goats.

For the Aquaculture component, nursery and production ponds were provided. The fry were stocked first in the nursery pond until they reached fingerling stage. They were then transferred to the production pond for rearing to harvestable size. While in the nursery pond, the fry were fed raw eggs. The production pond was first drained and then fertilized with complete fertilizers and chicken dung to promote the growth of green algae. In rearing the prawns, cooked cassava tubers were used as feeds. The Aquaculture component has an area of 1.60 ha equivalent to 40% of the total pond area.

The Experience. Prior to the implementation of the project, a very well attended consultation with the local government and the community was carried out to determine public sentiment for the project. Most of the local officials were present, some were in favor of the project, but others were against it. Since a majority was for the project, it was decided that Hunan be the project site.

The villagers who attended the forum and were in favor of the project formed the nucleus of the organization that was to manage the project for five years from 1990 to 1994. A total of 52 mangrove forest occupants applied for membership to the organization aptly named "Nagkahiusang Lumulupyo sa Katunggan sa Barangay Hunan" (United Mangrove Settlers in Barangay Hunan). The officers were then elected. At first many of the members were active in rendering labor services but after sometime the number of workers became fewer and fewer until only one family was left to attend to the project. On the third year when the collapse of the organization became evident, a meeting was called and a community organizer was invited to help revitalize the project and its participants. During the meeting expectations and apprehensions were solicited, and a hope for a successful project implementation was shared with everybody. There was a rekindling of the involvement of the members but it was very brief. Not much later, only the family of the president really stuck it out with the project.

Initial pond stocking started in June 1991 with some 5,000 milkfish fry purchased at a price of 350.00/thousand. The first harvest yielded only 100 kg, a total disappointment not only because it fell short of expectations but also because the fish were very small in size (about four inches). The observed mortality of the stock was 41%. After the first harvest the pond was again prepared for the second stocking. Prawn fry were procured and directly seeded in the production pond. Eight months later in June 1992 the stock was harvested. The stock grew to a very expensive size but the mortality was very high at 92%. Only 480 pieces of prawn were harvested. Four months after the second harvest the pond was again stocked with 5,000 milkfish fry, which were harvested nine months after stocking. The

survival was only 2.1% but the milkfish grew to a very expensive size. Stocking was then discontinued because of successive failures.

Pasture Component. This project started with one buck and five does. The goats were herded daily in the vicinity of the project and at times were allowed to graze along the dikes where Dampalit was planted. After a time the Dampalit was completely grazed and herding was made outside dikes. By the fourth quarter of 1991 all four does gave birth to six young goats but only four survived. In the early part of 1992 a total of nine goats were being herded. One was sold for P500.00 and the money went to the family of the project caretaker. Before December 1993, 25 months after project implementation, the number of goats reached a total of 16 heads. During this time, the caretaker decided to sell the mature bucks, but retain the does. But on December 26, 1993, Typhoon Ruping hit the Visayas with strong winds and rains in the wee hours of the morning. All 16 goats were then inside the pen, which was blown down. The pond waters rose when tidal waves came in. The whole area became flooded and the goats drowned. Only one buck and one doe survived.

Silviculture component. Bakauan-lalaki (R. apiculata) was planted in the designated silviculture component area in the pond equivalent to 60% of the total area. The area was partly enclosed by the production pond in the north, south and western sides. The seeds were planted at a spacing of 1.0 m X 1.0 m. The plants had a mean survival of 83.33% and the plants showed excellent growth. By December 1995 the plants had attained a mean diameter of 37.33 mm, and a mean height of 145.51 cm, and developed a mean of 240.03 leaves and a mean of 15.35 roots.

Learnings. The project site was under litigation and all legal problems were solved before the project started. But like any misinformed constituent, the village folks of Hunan remained apprehensive and reluctant to cooperate with the project for fear of retaliation from the losing claimant. No amount of social and community organizing could persuade them to join the project. Instead, the family participants started losing contact with the project leader until only one family remained.

The ponds were not stocked right away because of the non-availability of fry in the market due to the El Niño and the typhoon that hit the country.

The forage demand of the increasing number of goats could not be met by merely planting of blocks of grass and Dampalit (Sesuvium portulacastrum) along the dikes. The pond supply of forage was just insufficient for the goats so that it was necessary to herd the goats outside the ponds in the nearby foraging area.

The pond is located a few meters from the foot of the hillock and the dikes enclosing the pond were so located that the rainwater from the hillside flowed into the ponds. This then diluted the pond waters and melted the green algae.

The dikes, although rock-reinforced, were frequently washed out by flood and strong waves. Closer inspection of the dikes revealed that the soil was sandy clay and therefore prone to collapsing.

The participation of the community waned so that at the end of the project only one family was left. During the construction of the dikes and pond excavation, several families participated in the activities because there was a minimal remuneration for the services rendered. But in the last three years, when their services became voluntary, members shied away shied away from the project and their involvement became minimal.

- **Aquasilviculture for Marginal Farmers: A Case of Success**

Aquasilviculture is a management strategy that combines and harmonizes fish produc-

tion and mangrove development. The strategy has become a favorable livelihood opportunity to sustainably augment fishers income and, at the same time, reforest the mangrove. This was implemented in Catanauan, Quezon and Camarines Norte of Southern Luzon on areas of 0.8 hectare and 0.25 hectare, respectively.

Unlike the aquasilvipasture in Hunan, Bohol, this mangrove friendly aquaculture attained a certain degree of success. The success can be attributed to the following:

- Careful selection of site
- Appropriate selection of aquaculture species
- Careful handling of seeds and fingerlings
- Appropriate selection of mangrove mother trees
- Proper timing and establishment of aquaculture ponds
- Careful pond preparation and adequate stocking, and regular maintenance and monitoring

An analysis of the economic benefits of this project is shown below:

Economic Criterion	PHP at 15% Interest Rate	PHP at 20% Interest Rate
Net Present Value	207,336	108,850
Benefit -Cost Ratio	2.27	1.97

SUMMARY, CONCLUSION AND RECOMMENDATION

Conversion of mangroves to fishponds has been the major cause of the decrease and degradation of Philippine mangroves and accounted for about 175,000 hectares (35%) of mangrove forests lost.

The government's objective to increase fish production out of mangrove conversion to fishponds was not realized. Instead, it created adverse impacts, such as the loss of significant habitats and biodiversity, loss of fishery value resulting from the decline of the protective and ecological functions of mangroves as an ecosystem, and problems of unequal resource access.

To remedy these adverse impacts, government efforts to bring back the lost resources through mangrove reforestation, proclamation of an aggregate of 83,593 hectares of mangrove wilderness and mangrove swamp forest as reserve areas, and the launching of community-based programs focusing on the coastal environment and coastal resources management have since been vigorously pursued.

Nevertheless, fish catch and fishery resources have continued to decline. There are other important coastal ecosystem such as seagrass beds, algal beds and coral reefs that are less visible than mangroves but are equally important to maintaining the productivity of fisheries. Based on the above scenario, the following are recommended;

- Vigorously pursue efforts to bring back the lost productivity of denuded mangroves through sustained mangrove reforestation activities and protection of the remaining mangrove forests;
- Generation of technology to address gaps in mangrove friendly aquaculture;
- Rehabilitation and protection of other equally important coastal ecosystems;
- Strong political will among local leaders to implement fishery laws and institutionalize coastal resources management within their area of jurisdiction;
- Implementation of the Joint Memorandum Circular between the Department of Agriculture-Bureau of Fisheries and Aquatic Resources and the Department of Environment and Natural resources on the reversion of abandoned and undeveloped fishponds back to mangrove forests;
- Harnessing coastal communities as partners in coastal resources management to include the mangroves, seagrass, algal, soft bottom and coral reef ecosystems.

REFERENCES

Alcala, E.P. 1982. Why Conserve Philippine Mangroves: Economics & ecology. Paper presented during the National mangrove Research Coordination sympo sium/Workshop at Covelandia Resort, kawit, Cavite on December 8-10, 1982.

Bureau of forest Development. 1971.Philippine forest Statistics.

Bureau of fisheries and Aquatic Resources. 1997. 1996 Philippine Profile, Department of Agriculture-Bureau of Fisheries and Aquatic Resources. Manila.

Brown, W.H. and A.F. Fisher. 1920. Philippine Mangrove Swamps. Minor Products of Philippine Forests Vol. I, 22, DANR, Bureau of Forestry Bul. No. 17.

Coastal Resource Management Project (CRMP). 1998. Our seas Our Life: A Guide to understanding Ocean life and Its importance to Us. Published by CRMP, Cebu, Philippines.

Costancia, R., S.C. Farber & J. Maxwell. 1989. Valuation & Management of Wetland Ecosystems. Ecol. Econ. 1:335-361.

Francia, P.C. et. al. May, 1971. Proximate Technical composition of Philippine Mangrove Woods. The Philippine Lumberman.

Melana, D. M. 1982. Research and Development Status of Philippine Mangroves. Proceedings: Symposium on Mangrove Forest Ecosystem Productivity in South-east Asia. BIOTROP Special publication No. 17, BIOTROP, Indonesia.

Odum, E.P. 1982. Fundamentals of Ecology. 3rd Ed. W.B. Sanders Company, Philadelphia.

Padilla. J.E.. & R. Janssen. 1996. Valuation & Evaluation of Management Alternative for the Pagbilao Mangrove Forest. Collaborative Research in Economics of Environment & Development (CREED) Working Paper Series No. 9.

Quimbo, L. 1971. Key to the Species of Mangrove Swamps. College of forestry, University of the Philippines at Los Baños, Laguna.

Salvoza, F.M. 1936. Study on Mangrove Vegetation in Pagbilao, Tayabas. Makiling Echo. 15(2): 96-105'

Schatz, R.E. 1991. Economic Rent Study for the Philippine fisheries Sector Program. Asian Development Bank Technical Assistance 1208-Philippines, Manila. 42pp.

Trinidad, A.C. 1994. Modifying domestic Resorce Cost to Reflect Environmental cost of shrimp farming in the philippines, P.1o79-1082 in the 3rd Asian Fisheries Forum. Asian Fisheries Society, Manila

White, A. T 7 A.C. Trinidad (1998). The Values of Philippine Coastal Resources: Why Protection and Management are Critical. Published by the Coastal Resource Management Project of DENR, Cebu City. Philippines.