Chapter 3
Mangroves: The fastest growing forest ecosystem

"Oh these mangroves. I never saw one that looked as if it possessed a decent conscience. Growing always in shallow stagnant waters, filthy black mud, or rank grass, gnarled, twisted, stunted and half bare of foliage, they seem like crowds of withered, trodden-down old criminals, condemned to the punishment of everlasting life. I can't help it if this seems fanciful. Anyone who has seen a mangrove swamp will know what I mean."

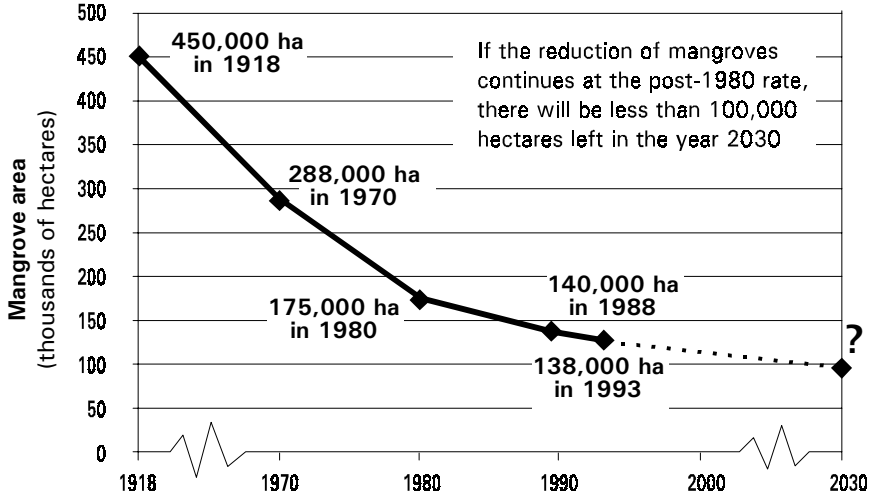
- An early New Zealand novelist[112]

MANGROVE FOREST (EXTENT AND CONDITION)

Mangroves are highly productive forests growing along tropical tidal mudflats and along shallow water coastal areas extending inland along rivers, streams and their tributaries where the water is generally brackish. As an ecosystem, mangroves form a unique association of plants dominated by the mangrove forest as the primary producers interacting with associated fauna and the physical environment. Mangrove plants are unique for being able to get established and survive in a waterlogged and saline soil. Mangrove ecosystems have extremely high natural productivity in terms of plant growth and all the associated organisms. Much of this productivity translates into useful products for people in the form of wood, fish and crustaceans and various other ecological and economic benefits[75, 97].

Some 450,000 ha of mangroves existed in the Philippines in 1918 (Figure 3.1). In 1970, the country's mangrove forest area was pegged at 288,000 ha. By 1988, the mangrove cover sank to 140,000 ha. From 1988 to 1993, the mangrove cover declined to only 138,000 ha. Thus, from 1918 to 1970, an average of 3,100 ha of mangroves were lost every year, increasing to about 8,200 ha annually from 1970 to 1988[40, 124].

Figure 3.1. Mangrove resource decline in the Philippines[40, 132].



This loss is mostly attributed to the conversion to fishponds during the 1960s and 1970s. Other factors which have contributed are reclamation for residential and industrial purposes, overharvesting of mangrove trees for charcoal or fuelwood production, lack of reforestation and physical expansion of coastal communities[74].

At present, 95% of the remaining mangroves are secondary growth and only 5% are old or primary mangroves which are mostly found in Palawan[74]. Most mangrove areas in Luzon and Visayas islands are made up of reproduction brush and young growth. Thus, mangrove forests remaining along Philippine coasts today are of much lower quality than early in the century and they cover less than one-third of their original area. This has occurred because of the lack of consciousness on the substantial economic and ecological contribution of this ecosystem to society.

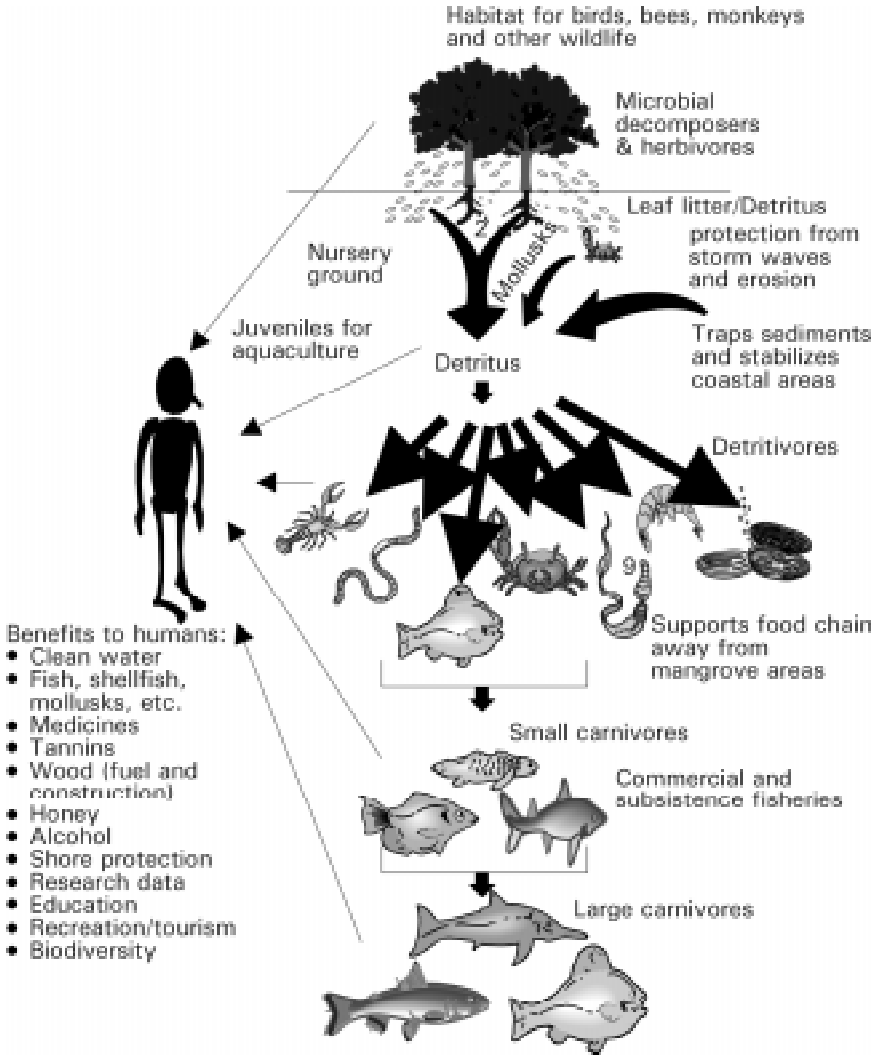
MANY USES OF MANGROVE PRODUCTS AND THEIR VALUES

The depletion of mangroves can be traced to the various types of direct and indirect economic goods that are derived from the ecosystem which ignores the longer-term benefits from their continued existence. The primary ecological and economic benefits and functions of the mangrove ecosystem are (Figure 3.2):

- Provision of nursery grounds for fish, prawns and crabs and support of fisheries production in coastal waters;
- Production of leaf litter and detrital matter which are broken down by bacteria, fungi and other micro-organisms, which in turn provide a valuable source of food for marine animals in estuaries and coastal waters;
- Protection of shore of the lagoons and the estuaries from storm waves and erosion;
- Reduction of some organic pollution in nearshore waters by trapping or absorption;
- Recreational grounds for bird watching and observation of other wildlife; and
- Access to a high diversity of mangrove plants and animals, and their adaptations, making them ideal field laboratories for biology and ecology students and researchers.

In addition, various types of end consumers depend on mangroves. People collect firewood, charcoal and use posts for their fishing traps and housing materials; and from the mudflats are harvested various species of fish, crustaceans and mollusks. Aquaculture and commercial fisheries depend on mangroves for on-site and off-site goods such as juveniles and mature fish species. Meanwhile, the biochemical industry utilizes mangroves for tannin, alcohol and medicinal resources.

Figure 3.2. Mangroves and their ecological and economic benefits[79].



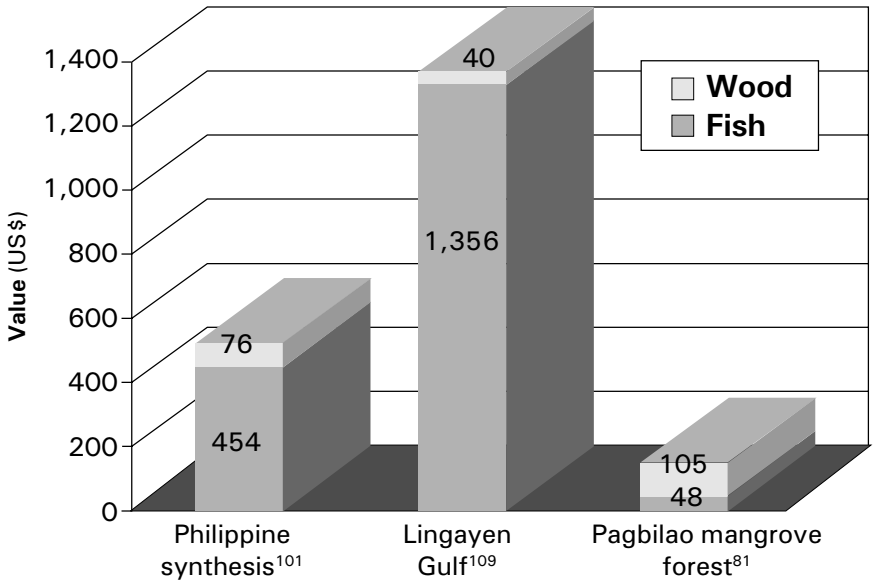
WHAT IS LOST WHEN MANGROVES ARE DESTROYED?

In 1977, researchers compiled data on the correlation between the incidence of mangrove forests and wild commercial shrimp production in Indonesia. The evidence showed that the largest shrimp catches were in areas offshore from sizable mangrove

forest stands[68]. Subsequently, the annual shrimp catch near the coast of southern Java, Indonesia, associated with a 22,000 ha mangrove forest and estuary was valued at US$12 million in 1988 (US$545/ha).

Direct economic values estimated in the Philippines for mangrove wood and fish products combined range from US$153 to 1,396/ha/year (Figure 3.3)[1, 23, 48, 81, 101, 109]. The lower estimate[81] is based on the Pagbilao mangrove forest for which direct observation of occurring species (for both fish and forest) was made in a relatively degraded mangrove area. The estimates of Schatz[101] and Trinidad[109] are indicative figures on a national scale and are updated by using inflation assumptions of 2.5% per year. The estimates do not include revenues generated from aquaculture in the area. Also, a sustainable forestry regime is assumed despite the national prohibition on mangrove cutting; thus, revenues from wood products are generated.

Figure 3.3. Summary of Philippine estimates for mangrove values[81, 101, 109].



Note: The larger figures for Lingayen Gulf reflect a different methodology than those for the others which are more conservative estimates.

The range of values is consistent with a study that estimates the value of a complete mangrove ecosystem to be in the range of US$500-1,550/year[42]. This can be considered to be the minimum valuation of loss when mangroves are converted to other land use forms. Mangroves in Trinidad, Fiji and Puerto Rico were valued at US$500, US$950-1,250 and US$1,550/ha/year, respectively[55]. The value of mangroves in Chanthaburi, Thailand, at US$590/ha/year falls within the range[27]. The mangroves of Bintuni Bay, Indonesia, have been valued for forest and fishery resources at US$1,333/ha/year while that of traditional uses amounted to US$650[92].

It is difficult to maintain a consistent level of economic value from mangroves because of the disparity of study sites, the differences in development conditions, the research techniques used, and the overall scope or focus of studies. Values are often site-specific simply because of variation in the mangrove ecosystem among other factors.

A compilation of information from around the world on the annual value per hectare of mangrove and tidal marsh areas confirms our estimates for the Philippines. These values shown in Table 3.1 also include estimates for "disturbance regulation" and "waste treatment" which have not yet been estimated for Philippine mangrove forests.

Table 3.1. Summary of mangrove ecosystem value averages from around the world[35].

Benefits of ecosystem services	**Value** (US$/ha/year)
Disturbance regulation	1,839*
Waste treatment	6,696*
Habitat/refugia	169
Food production	466**
Raw materials	162**
Recreation	658*
Total benefits	**3,294**

*Disturbance regulation, waste treatment and recreation are generally not economically quantified in the Philippine context because they are indirect services which are difficult to quantify. In other countries, these services are valued more highly and will thus affect management decisions regarding mangroves.
**It is reassuring to note that the combined values for "food production" and "raw materials" (US$628) is very close to the accepted values for Philippine mangroves for fish and wood products and what is being used in this book.

Despite some variation of values, there is definitely a monetary basis for protecting mangroves, even if only to maintain their present economic benefits. Based on the above estimates, US$600/ha/year (US$60,000/km^2/year) is used in this book as the acceptable economic equivalent to indicate what is lost if mangroves are converted to other uses.

ECONOMIC JUSTIFICATION FOR MANGROVE MANAGEMENT

In deciding how to maximize economic gain from mangroves, discussions usually focus on the "economic rent" which should be charged to lessors for alternative uses of the habitat area. In one research effort to determine an optimal system for leasing out mangrove areas for fishpond use, three management scenarios were compared: (i) mangrove plantation, (ii) managed naturally regenerated mangroves, and (iii) unmanaged understocked stands[101]. The value of wood products from mangrove plantation generates more revenues than alternatives (ii) and (iii) but for practical purposes, scenario (ii) was recommended as a basis for economic rent for mangrove habitats converted to fishpond (Table 3.2). The higher value in all three options is not the wood products but the fish products (US$538/ha) dependent on the existence of the ecosystem. This amount can be considered as a minimum economic gain from a healthy mangrove ecosystem.

Table 3.2. Estimated net annual economic value (in US$/ha) of Philippine mangrove areas for different levels of management[102].

Level of management	Wood products (value/ha)	Fish products (value/ha)	Total (value/ha)
Mangrove plantation	156	538	694
Managed naturally regenerated	90	538	628
Unmanaged understocked stands	42	538	580

Note: Wood harvest value based on average price of about US$12/m^3 of wood; fish products based on average annual weight of fish and shrimp/ha associated with mangrove areas and an average price of US$0.80/kg; values based on Philippine pesos. US$1 = 25 pesos in 1991.

Mangroves in Lingayen Gulf have been severely overharvested for wood products; meanwhile, the degraded mangroves have been converted into milkfish ponds. Pond culture continues to be a thriving industry in the area and thus, there is impetus for further conversion of lands. This situation prompted a study using the total economic value (TEV) approach to evaluate land conversion[36]. There are existing patches of mangroves in Lingayen Gulf and for theoretical purposes, the conversion of such was also considered. The study estimated the TEV of mangroves by looking at direct economic benefits (fish and wood), indirect economic benefits (value of agricultural production), foregone benefits (income foregone from agriculture due to salinization of aquifers) and irreversible damage to the ecosystem brought about by conversion. Generally, the results show that maintaining mangroves in their present form, instead of converting them into aquaculture farms, is the superior alternative using a future value and foregone earnings approach. The only exception to this is in a few areas where mangroves are already severely degraded so that the development options may provide more long-term benefits compared to the cost of rehabilitation.

While the studies utilize different approaches for mangrove valuation, a unanimous conclusion is that management and protection result in more and longer-term benefits. Strategies that espouse partial conversion of mangroves are also economically tenable but the bottom line is that the natural productive benefits from mangroves endure over time. Healthy mangrove ecosystems continue to supply fish products, wood and other useful products to people regardless of other factors as long as basic environmental parameters are honored. In contrast, intensive aquaculture is plagued with disease, acid soil, market fluctuations and water quality problems, all of which undermine economic viability. This is why many shrimp farms have closed in the Philippines and elsewhere in Southeast Asia, leaving many abandoned and degraded mangrove habitat areas.

Mangroves also provide benefits which have not yet been measured in monetary terms within the Philippine context. These include disturbance regulation which includes natural processes such

as stabilizing land from erosion, preventing floods and absorbing organic waste. In addition, mangroves provide habitats for animals (estuarine fish and terrestrial mammals) which may be valuable to people and biodiversity in general. Finally, the recreation and tourism value of mangroves is only beginning to be explored. In Bais Bay, Negros, for example, a mangrove park has been established which attracts many visitors. A similar mangrove sanctuary is functioning through community efforts in Kalibo, Aklan, which makes money for the community, educates and entertains visitors. These values have been estimated in other parts of the world and are shown in Table 3.1.

The total gain to the Philippines for protecting its remaining mangrove ecosystem is substantial. Using the conservative estimate of value from direct benefits of only US$600/ha/year, the Philippines gains at least US$83 million/year in fish production and potential sustainable wood harvest from the existing 138,000 ha. If we could increase the area of healthy mangrove forest to 200,000 ha, the annual natural benefits would potentially increase to US$120 million for a gain of about US$37 million/year.