6.5 Other ecosystems and the loss of biodiversity

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The driving forces to global changes cause various pressures to wildlife, forests, other ecosystems, and the natural biodiversity. The daily, global rate of deforestation is 430 km², chiefly due to land acclamation to agricultural use. 24% of world's mammal species—and 65% of all freshwater mammals—are under threat of extinction. Biodiversity is one of the key elements of sustainability of the earth's ecological system.

Overview

In terms of their genetic and ecological diversity, both natural and cultivated ecosystems are under various pressures. This is due to many factors including modernization of agriculture, pollution, erosion, poverty and population growth, exploitation of ecosystems, climatic change, changes in land-use patterns, and many more. The loss of biodiversity, genetic erosion of cultivated species, forests and wildlife are discussed below after which freshwater and coastal ecosystems are dealt with.

Loss of biodiversity

According to UNEP's (1995) first global bodiversity assessment, the total number of currently identified species is around 1.7 million. Estimates on the actual number of species range from 3 to 111 million, and the current "best estimate" is 14 million.

50,000 species disappear each year in the world (Flavin 1997). Various other estimates suggest that between 1975-2015, 1-11% of all species will extinct (WRI 1996). Among the most threatened ecosystems are freshwater lakes and streams, coastal mangroves and coral reefs, and temperate rain forests (Wilson 1992). Biological resources of freshwaters are very rich, accounting for 12% of all animal species, 20% of which have already disappeared or are under severe threat (Abramovitz 1996).

The concept of aging of ecosystems was discussed in Chapter 6.3. In the context of biodiversity, it can be used as an illustrative manner: the rate of species extinction has been estimated to range between 100-1,000 times the "natural" rate. In the coming decades, it may still grow with one order of magnitude.

The major causes to biodiversity loss include:

- Pollution and sedimentation
- Species introduction

- Intense overexploitation
- Habitat loss

Loss of biodiversity weakens the capacity of ecosystems to adapt to changing conditions or extreme situations such as climatically exceptional years or periods, constituting a destabilizing factor.

An example of this is the widely distributed damages in Central and Eastern European forests due to acid rain in 1980s and also later. Monoculture forests have shown great sensitivity to combined effects of increased air pollution and dry seasons. In more general terms, it is a very risk prone approach to allow the biodiversity of ecosystems to decrease.

The strategies to the protection of biodiversity include separation of ecosystems species, and genetic resources from human activity by creating protected areas, prohibitions on harvesting threatened species, and the preservation of germ plasm through gene banks or cryogenic storage (UNEP 1995, WRI 1996).

The preservation strategies must include a variety of strategies such as creating controlled environments and policies to minimize the loss of biodiversity of natural environments. This calls for integrated approaches to conservation (for more details, see UNEP 1995 and WRI 1996).

Besides the ecological importance of biodiversity, FAO (1995a) underlines the crucial economic role of wildlife, indigeneous species and varieties, and traditional products and skills in utilizing them. More than 6,000 forest plants have traditionally been used as natural medicines. Many of them form a basis of modern products.

An estimate of US\$ 100 billion each year has been presented as the economic value of this activity. The potential of all the unknown species as herbal plants is immeasurable, and of unquestionable importance.

Genetic erosion of cultivated species

The genetic biodiversity of cultivated plants and domestic animals has been under heavy manipulation during the last decades. Whereas plant and animal breeding—including genetic technology—aims at producing varieties that best meet the criteria of modern agriculture and forestry, an erosion of the genetic diversity follows.

This is because the new varieties push away the traditional, genetically less uniform varieties and species, which typically are less productive but offer great robustness. Since 1900, about 3/4 of the genetic diversity of agricultural crops has been lost (FAO 1995a).

Rhoades (1991) mentions that in Sri Lanka, the farmers grew some 2000 local rice varieties in 1959. Today, only a few principal varieties are grown, and most of the old varieties have extinct. In India, the number of rice varieties has been as high as 30,000, though nowadays most of the production comes from fewer than ten varieties.

Genetically uniform varieties, despite of many highly positive sides, have been the reason to widely distributed disasters due to unexpected epidemics, insect invasions, etc., that keep attacking new varieties. The importance of the conservation of traditional and wild species has been emphasized increasingly.

Forests

Before human influence, over 1/2 of the earth's land area was forested. Now, forests cover around 34 million km², less than 1/3 of the land area (Figures 6.5a, b). In the 1980s, the world's forested area diminished with over one million km², and between 1990-95, 650,000 km² were deforested (Figure 6.5c). The daily rate of deforestation is 430 km² (FAO 1995a).

The causes to these changes are many. Since 1980, the major cause in Africa and Asia has been rural population growth with agricultural expansion. In Latin America, economic development programs have accounted for the greatest forest cover changes.

These pressures will continue. FAO (1997) estimates, that by 2010, around 0.9 million km^2 of land will be added to agricultural use. Around 50% of this will be present-day forest. Other important stresses to forests are due to industrial pollution and firewood use by the poor in many parts of the world.

It is important to realize that the demand for forest products has been and will continue to be in sharp increase. In 1960-1995, the consumption of fuelwood rose 2.5 times, of saw-wood three times, and of paper more than tripled.

Many reverse trends are also to be noted. In some Asian countries, China and South Korea in particular, extensive afforestation programs have been realized.

Figure 6.5a

Forested and unforested area in 2000.

The percentages of forested area of total land area are also shown. Source: World Bank (2004).



Figure 6.5b

World's forests by region in 2000. Source: World Bank (2004).



China has been able to cut down the decreasing trend in deforestation, and been successful in limiting soil erosion by planted forests, which protect the soil from wind and water caused erosion. Almost 60% of these forests have been planted by taking the industrial use of wood into primary consideration. In South Korea, forests were largely destroyed during the war, but today, forests cover again over 2/3 of the land area.

Problems related to biodiversity and wildlife occur in many planted forests due to the selection of species (e.g. eucalyptus-species in Asia that are not indigenous), and 15-20% of China's plant and animal species are under extinction threat. In many N European and N American countries, remarkable areas of marginal agricultural land have been afforested.

Environmental concerns increasingly influence national forest policies and practices, and even the international trade. Still, the markets have still a long way to develop before they would take enough responsibility of all social and environmental problems due to unsustainable forestry practices.

The condition of forests can be measured in many ways, which include (WRI 1996):

- *The degree of degradation:* the extent of fragmentation and biomass removal.
- *The degree of naturalness:* how much human activity has modified the forest structure and species composition.
- *Management intensity:* how much of the (economic) potential of the forest is utilized.
- *Forest health:* the relative health of tree species.

No global assessment exists on these. Forest degradation is a particular concern in the tropics; although not reflected in deforestation statistics directly, degradation is the reason why the state of tropical forests is in many places alarming (FAO 1993). Temperate forests suffer in particular of the loss of undisturbed areas, fragmentation, and declining health.

In relation to the fact that deforested areas are taken continuously into agricultural use, the connections between food security and forests are the following. Forests and wood are an important constituent of livelihood and economy of many farmers: a source of income, fuel, etc., and it offers a protection to the land resource. Trees and forests are an important part of many farming and agroforestry systems such as intercropping practices (FAO 1997).

Deforestation by region

SE Asia is famous due to deforestation and decline of mangroves. Solely in the period of 1990-2000, SE Asia lost 9.9% of its forest cover (FAO 2001). With this rate, it is holding the second position in the world in terms of deforestation after W Africa (Figure 6.5c). Between 1990 and 2000, the annual deforestation rates varied from 0.4% in Lao PDR to 1.4% in Myanmar and the Philippines. Vietnam was the only country in the region which reforested 0.5% per year. The forest area per capita has dropped around one quarter in ten years in SE Asia (Figure 6.5d).

Even if SE Asia is so famous of its dramatic

deforestation, the situation is still worse in the African regions in terms of decreasing forest area per capita (Figure 6.5e). Clearly, the African situation is worsened by the very high population growth. In 2000, SE Asia had lost 24% of its forests since 1990 while in the Nile region the decrease was 28%.

Figure 6.5c

Change in the forest cover area 1990-2000. Regional data from FAO (2001). The percentual

change of total forested area is also shown. Area (km²) -400000 -300000 -200000 -100000 0 100000 200000 China 12,4% S Asia -0,9% SE Asia -9,9% As a other 2,2% Nile -9,3% WAfrica -10,8%



Figure 6.5d

SE Asia used to be rich with forests *Left: Forest per capita in SE Asian countries (World Bank 2004, FAO 2001). Right: The decline of Thailand's mangrove forests (FAO 2000).*



W Africa is richest in forests among the regions. However, the decline in per capita forest area has been dramatic: from over 0.7 ha to 0.5 ha, with an absolute decline of 10.8%.

China and S Asia suffer less from deforestation. Between 1990 and 2000, their forested areas stayed virtually unchanged. The other side of the coin is that they have very limited amount of forest per capita, one order of magnitude less than the other study regions. Pakistan's small forest area declined by 1.5% per year between 1990-2000. In Nepal the figure was 1.8%. Bangladesh and India were able to increase their forest area by 1.3% and 0.1% annually.

Figure 6.5e

China and SE Asia are forest scarce

Forest per capita in the study regions (World Bank 2004, FAO 2001). The data for Central African Republic (CAR) is 8 ha in 1990 and 6 ha in 2000.



Wildlife

As a part of ecosystems wildlife has important roles. Wildlife has a direct value to people who rely on hunting as a source of food, clothing and income. Indirectly diverse wildlife promotes tourism, which is a significant source of income for numerous nations. The recreational value of wildlife cannot be bypassed.

Besides the benefits provided by wildlife, animal species can be used as environmental indicators. Species richness is one useful indicator among others to assess biodiversity. The more animal species a region hosts the more it is biologically diverse. The number of endangered species gives some indicative information on the pressure faced by selected species.

Figure 6.5f

Pressure on declining forests

Deforestation does not stop even if forests get scarce. The situation is alarming in the Nile region and W Africa. Source: FAO (2001).

Deforestation vs. forest area



Forest area per capita 2000 (ha)

World's wildlife is living under increasing pressure. Population growth and agricultural expansion cause habitat loss. Collection and use of firewood together with pollution further destruct the wildlife habitats. In addition illegal trade, overhunting, the effects of climate change and economic development increase the number of threatened and extinct animal species.

Mammals are more vulnerable to environmental changes and other threats, than birds, reptiles, and amphibians. Globally the total number of known mammal species is 4,629 out of which 1,096 or 24% are threatened (Figure 6.5g). Corresponding percentages for birds, reptiles, and amphibians are 11%, 4%, and 3%.

When comparing the number of threatened mammal species to the total number of known mammals by regions it can be noticed that the highest rates are found in the Asian countries (Figure 6.5g).

In SE Asia the situation is most alarming. Out of the 158 mammal species living in the Philippines, 31% are threatened (Figure 6.5h). This is mainly explicable by the loss of habitat due to the high deforestation rate.

Indonesia, which is the richest study region country in number of mammal and bird species, is facing a serious problem too. The country's wildlife is extremely diverse and valuable as nearly half of the mammal species are endemic, thus not found elsewhere. However 28% of the mammals or 128 species are endangered despite the fact that 10% of Indonesia's land area is protected. In spite of the intense deforestation (Figure 6.5c) the percentage of threatened mammals in Thailand and Malaysia has stayed below 15%.

In terms of nationally protected area, Cambodia and Thailand are leading the statistics with 15.8% and 13.8% of protected land area, respectively. The environmental destruction and loss of wildlife habitat in Lao PDR and Myanmar may get alarming as the countries' protected areas are nearly non-existent. From the perspective of wildlife, the situation is neither good in S Asia or China. With 400 species, the latter is the richest in total number of mammals. Although China's forested area has increased and protected areas cover no less than 594,000 km², one fifth of the mammal species are threatened. Figure 6.5g Mammals are the most threatened vertebrates. Data from WRI (2001). Fish species are excluded.



Figure 6.5h

Mammals are facing growing pressure especially in Asia.

Total number of mammals, threatened mammals and nationally protected areas by countries in the study regions. The values above the bars indicate the percentual share of the threatened mammals vs. the total number. Source: WRI (2001).



India's situation is somewhat similar. Wildlife is living under high pressure as 1/4 of the mammals are endangered although forest cover has not decreased. In both cases, the high number of threatened mammals is due to the enormous human population and its activities. In places pollution is extreme as well.

Among the study regions Africa's wildlife is least threatened but diverse. Alone in the Nile region three countries including Tanzania, Uganda, and Kenya (from down to top) have over 300 species of mammals. Cameroon, with its 409 mammal species, is the richest country out of the African study regions. When considering the proportion of endangered mammals and protected areas in the Nile region, Egypt is the first and last, respectively, in the statistics. Out of the mammals 15% are threatened whereas just 0.8% of the land area is protected.

W African wildlife is in a good position. In all the countries excluding Chad and Mauritania, less than 10% of the mammal species are threatened. In Chad the figure is 10%. With sixty-one species Mauritania has the lowest total number of mammals among the countries of the study regions. However, out of these as many as fourteen or 23% are endangered.

Freshwater ecosystems

Aquatic ecosystems can be divided into freshwater and marine ecosystems. The former include lakes, rivers, reservoirs, ponds, and wetlands. Saltwater ecosystems are located either in the coastal zone or open sea. This section focuses on the freshwater ecosystems. The next section discusses coastal zone habitats including i.a. estuaries, coastal wetlands, and coral reefs.

Freshwater ecosystems provide several times higher economic benefits per unit area than terrestrial ecosystems. It is estimated that global wetlands alone are worth about US\$ 4.0 trillion annually (Klaphake et al. 2001). Unfortunately freshwater ecosystems are also more threatened than terrestrial ecosystems.

River and lake ecosystems are essential for human life. Water is needed to satisfy the growing needs of domestic, agricultural and industrial sectors. Freshwater ecosystems are used among other things for water supply, irrigation, hydropower generation, navigation, fisheries and recreation.

Water is equally critical for nature which functions are dependent on freshwater availability. Species richness in relation to habitat extent is extremely high in many freshwater systems although the total number of species is low compared with marine and terrestrial ecosystems. It is estimated that about 40% of the known fish species live in freshwater although just 0.013% of the global annual water quantity is surface water in lakes and rivers (FAO 1995a, Groombridge and Jenkins 1998).

The state of the freshwater ecosystems is of great concern in many places the world over. Pollution is one of the most severe threats to river and lake ecosystems. Water quality is deteriorating (Chapter 6.3) which limits the well-being of populations of aquatic animals and the use of water for human consumption. Another limiting factor is the quantity of water. Water use is increasing sharply while water stress is already facing several countries (Chapters 2.2 and 2.3). Out of the 2465 threatened species worldwide, 25% are related to freshwater ecosystems whereas around 65% of the freshwater mammals are threatened.

Species introduction is a widely recognized threat to freshwater ecosystems. Especially lake ecosystems are vulnerable to exotic species. One well-known example is the Lake Victoria in the upper parts of the Nile region. Half of the lake's cichlid species became extinct due to the introduction of the Nile perch.

The Global 2000 system, developed by WWF, is a science-based global ranking of the Earth's most biologically outstanding terrestrial, freshwater and marine habitats (Olsson et al. 2000). It encompasses the most significant examples of each major habitat type from each continent, which are represented as ecoregions. From the total of thirty-three freshwater ecosystems listed in the Global 2000, sixteen are found in the study regions.

In terms of biodiversity Asia is well represented in the category of river ecosystems considered as ecoregions (Table 6.5a). Mekong River in SE Asia and Yangtze River in China belong to the most outstanding large river ecosystems found in Asia. W Africa is represented with three river ecosystems including the Congo Basin Piedmont Rivers and Streams, the Niger River Delta, and the Upper Guinea Rivers and Streams.

The study regions comprise several unique lake ecosystems in terms of biodiversity (Table 6.5b). SE Asia alone includes three ecoregions out of the seven listed in the category of small lake habitat type; Lake Lanao in the Philippines, Lake Inle in Myanmar, and the Central Sulawesi Lakes in Indonesia. As a large lake habitat, the Rift Valley Lakes found partly in the Nile Region sustain some particularly notable lake biotas.

River ecosystems considered as ecoregions located in the study regions

The table is compiled from Olsson et al. (2000)

ASIA	Large Rivers			
China	Yangtze River and Lakes Features: Numerous fish, mammal, and plant species which are adapted to the dynamic water regime of the rivers and lakes. In winter, a large number of waterbirds are dependent on the lakes. Threats: Construction of dams, inter basin water transfers, fish farming, deforestation, cultivation of surrounding land for farming and grazing, pollution, oil drilling, industrialization, urbanization, and in- troduced diseases from domestic waterfowl.			
SE Asia	 Mekong River (Cambodia, China, Laos, Myanmar, Thailand, and Vietnam) Features: The most diverse and distinctive large river fauna of tropical Asia. The ecoregion provides base for large scale fish migrations. Threats: Deforestation, dams and overfishing. Growing urban, industrial, and agricultural pollution. 			
AFRICA	Large River Headwaters			
W Africa	Congo Basin Piedmont Rivers and Streams Mainly located in Central Africa with parts of W Africa (in Cameroon, CAR, and the Sudan). Features: Africa's richest freshwater fauna is in the Congo basin. 80% of the fauna may be endemic. Threats: Sewage and other pollution from the growing urban centers and few mining operations.			
ASIA	Large River Deltas			
S Asia	Indus River Delta (Pakistan, India) Features: A productive large river delta which is territory to large populations of migratory species. Threats: Dams, water extraction for irrigation, runoff of chemicals, and introduced species.			
AFRICA	Niger River Delta (Nigeria)			
W Africa	Features: Consists of the Niger Delta, which is one the largest delta in the world with 50,000 km ² . The ecoregion is a biogeographical crossroads for African ichthyofauna supporting nearly 200 fish species. Threats: Threatened by oil pollution, coastal urbanization, oil and gas exploitation, industrialization, domestic and industrial waste discharges, the water hyacinth, coastal erosion and aquaculture.			
ASIA	Small Rivers			
SE Asia and China	Xi Jiang (Pearl) Rivers and Streams (Vietnam, China) Features: High richness in fish species (380) in a temperate region with significant endemism. Threats: Dams, changed landscape, and population growth/urbanization in the delta area.			
	Salween River (China, Myanmar, and Thailand) Features: 1/3 of the fish species are endemic. Supports the world's most diverse turtle community. Threats: Intensive agriculture, fishing, mining and the proposed dams.			
SE Asia	Sundaland Rivers and Swamps (Brunei, Malaysia, Indonesia, and Singapore) Features: Likely the richest freshwater faunas in Asia with much island and local endemism. Borneo has 149 endemic fish species. Threats: Deforestation, agriculture, overfishing, exotics, aquaculture industry, and mining pollution.			
S Asia	Western Ghats Rivers and Streams (India) Features: Isolated, and characterized by small coastal drainages. Over 100 endemic fish species. Threats: Deforestation which causes sedimentation, deteriorate water quality and alter the flow re- gimes. Other threats include over fishing, urbanization, water diversions and dam construction.			
AFRICA	Upper Guinea Rivers and Streams (Côte D'Ivoire, Guinea, Liberia, and Sierra Leone)			
W Africa	Features: The Upper Guinea rivers contain high fish richness including many endemic species. Threats: Deforestation, mining of iron ore and diamonds and political instability which weakens the management of the natural resources in the area.			

Wetlands are the third type of freshwater ecosystems to be discussed here. Wetlands provide several functions, services and benefits to people including:

- groundwater recharge and discharge
- flood control
- water quality and quantity
- water purification

• sediment, toxicant and nutrient retention

The water purification capacity of wetlands can be significant. Folke and Jansson (2000) indicated that the existing wetlands of the Baltic Sea basin create a nitrogen sink corresponding to nearly 15% of the total nitrogen load to the Baltic Sea. The figure is eminent when considering that over 60% of the basin's wetlands have already been drained.

Common benefits and attributes provided by wetlands include:

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- medicinal and biomedical products
- water supply
- pollution clean-up
- fish nurseries and fisheries products

Table 6.5b

Lake ecosystems considered as ecoregions located in the study regions The table is compiled from Olsson et al. (2000).

AFRICA	Large Lakes			
Nile Region	Rift Valley Lakes Located in East-central Africa and include parts of the Nile region (parts of Burundi, Ethiopia, Kenya, Rwanda, Tanzania, and Uganda) Features: The ecoregion encompasses i.a. Lake Malawi, Tanganyika, and Victoria. Globally outstanding adaptive radiations of fish in tropical lakes. Extraordinary levels of endemism. Threats: The introduction of exotic fish, overfishing, urban runoff, industrial pollution, deforestation.			
ASIA	Small Lakes			
SE Asia	Central Sulawesi Lakes (Indonesia) Features: Encompasses distinctive and highly endemic biota of tropical lakes. Significant radia- tions of species occur. Threats: Lakeshore nickel mining, commercial fishery, species introductions, population growth. Philippines Freshwater (Philippines) Features: The ecoregion has high levels of endemism. In addition one of the most remarkable ra- diations of tropical lake fish in Asia exists. Threats: Introduction of exotic species, logging and erosion. Mining, and agriculture are consid- ered as minor threats. Lake Inle (Mvanmar)			
	Features: Outstanding levels of endemism for lake fauna of Indochina Threats: Land reclamation has significantly modified the lake. Runoff of pesticides and fertilizers from the floating gardens, sedimentation from cattle grazing, and sewage from surrounding lands.			
China	Yunnan Lakes and Streams Features: There is an unusual level of endemism for subtropical lakes in Southern Asia. Threats: Silt and fertilizer from rice fields, domestic and industrial waste, aquaculture and fisheries.			
AFRICA	Cameroon Crater Lakes (Cameroon)			
W Africa	Features: Over 3/4 of the fish species and one third of the aquatic insects are endemic. Threats: Lake Barombi Mbo is threatened by overfishing, deforestation, and excessive water extraction. Others remain relatively undisturbed.			

In addition to the functions, services and benefits the wetlands provide to human beings, these ecosystems are essential to the nature. Wetlands sustain diverse populations of wildlife being breeding grounds and habitats for waterfowls and other wildlife.

Few global assessments of wetlands exist. Estimates of the surface area of wetlands are diverging and vary from 5.6 million km^2 to 9.7 million km^2 . The variability of the estimates is due to the different definitions of wetlands used and the lack of data. According to Finlayson and Spiers (1999) most of the world's wetlands are located in the Latin America and Caribbean while just one tenth is in Africa (Figure 6.5i).

Since 1900, half of the world's wetlands have been destroyed. In the early 20^{th} century the degradation of wetlands focused in the northern temperate zone.

Since the 1950s tropical and sub-tropical wetlands have increasingly been lost.

Agriculture is considered the principal cause for wetland loss. By 1985 it was estimated that 56–65% of available wetland had been drained for intensive agriculture in Europe and N America. For Asia, S America and Africa the figures are 27%, 6% and 2% respectively (Finlayson and Spiers 1999). Water management activities, water allocation and distribution, are linked with the wetland losses. In particular largescale irrigation schemes and large dams, which alter the natural flow regime of rivers are destructive for the vulnerable wetlands.

Figure 6.5i World's wetlands by continent Source: Finlayson and Spiers (1999).

- forage products
- agricultural products
- transport

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The protection of wetlands took a long step when the Ramsar Convention on Wetlands, an intergovernmental treaty, was signed in 1971. It provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. At present the number of contracting parties is 152. The Ramsar List of Wetlands of International Importance includes 1,346,933 km² of wetlands (Ramsar 2006). Ramsar is the only global environmental treaty, which deals with a particular ecosystem.

Nations' attitudes toward wetland protection can be assessed by contemplating the countries which have not contracted with the Ramsar Convention. In total there are two countries in the study regions which have not signed the treaty. These are Lao PDR in SE Asia, and Ethiopia in the Nile region.

Coastal ecosystems

Coastal zone is defined as inter-tidal and subtidal areas on and above the continental shelf to a depth of 200 meters and immediately adjacent lands (Burke et al. 2001). As a consequence coastal ecosystems comprise a very diverse array of habitats including among others coral reefs, mangroves, estuaries, tidal wetlands, seagrass beds, barrier islands, and peat swamps. These ecosystems are important in many ways to humans and animals. Primary goods and services provided by coastal ecosystems are summarized in Table 6.5d.

As critical transition zones (CTZs) coastal ecosystems link land, freshwater habitats and sea. Due to this unique role, coastal wetlands and estuaries provide, besides the above-mentioned goods and services, sub stantial ecological functions, which include decomposition, nutrient cycling and nutrient production. In addition the CTZs regulate the fluxes of nutrients, water particles, and organisms flowing from the land and rivers to the ocean. Although coastal wetlands and estuaries are very productive in terms of higher plant and animal biomass, they are characterized by low species richness and particular sensitivity to hydrologic modifications (Levin et al. 2001).

Table 6.5d

Coastal ecosystems provide diverse goods and services

Source: WRI (2000).

Goods		Services	
•	Fish and shellfish Fishmeal (animal feed)	•	Moderate storm im- pacts (mangroves, barrier islands)
•	Seaweeds for food and industrial use	•	Provide marine and terrestrial wildlife habitat
	Salt Genetic resources	•	Maintain biodiversity
			Dilute and treat wastes
		•	Provide harbors and transportation routes
		•	Provide human habi- tat
		•	Provide employment
		•	Provide esthetic and recreational values

Coastal ecosystems are under severe pressure. In the middle of 90s, 39% of the world's population lived within 100 km of coast, an area which covers just 20% of the global land area. The population in the coastal area is further increasing along the migration and population growth.

Although coral reefs cover less than 0.2% of the total area of oceans they contribute one quarter of the total fish catch in developing countries. Besides seafood coral reefs provide new medicines and services including tourism and coastal protection. It is estimated that the overall economic value of coral reefs is about US\$ 375 billion each year (Bryant et al. 1998).

Over one half of the world's coral reefs are potentially threatened by human activities. The situation is most alarming in Southeast Asia where the most diverse coral reefs in the world, located in the Philippines and Indonesia, contain at least 2,500 species of fish. Over 80% of the SE Asian reefs are under medium or high threat. The coral reefs of Pacific are least threatened. The major causes to coral reef degradation from the most severe are over exploitation and destructive fishing practices, coastal development, inland pollution and erosion, and marine pollution.