

Ecological Consequences from Growing Population in the Coastal Regions of Asia and the Pacific

Kinji MAGARA

Introduction

The Asia and the Pacific region is predominantly oceanic, but also includes the Asian, Indian and Australian land masses. According to the World Resources Institute's estimate (1994), the number of people in coastal urban districts of this region is estimated to be about 477 million (see Table 1). Because the coastal cities offer both the economic and employment prospects, large numbers of people have moved, particularly in People's Republic of China, from the inland rural areas to the special economic zones on the coast in the last few decades.

Nearly one half of the 75 largest cities in the world are in the Asia and the Pacific region, and more than half of these Asian cities are situated on or near the coast. The developments in the last few decades have contributed to the regional as well as national economic expansion. Unfortunately, however, the same developments have caused environmental costs.

In such Asian countries as China, Bangladesh, Indonesia, Malaysia, Pakistan, Philippines and Thailand, massive movements of their people have occurred from rural to urban since 1980's (Table 2), commonly suggesting the internal migration from the interior to coastal parts of most of these countries. However, population growth of the urban districts may be caused by a combined effect of three elements, namely 1) natural population increase, 2) inward migration toward urban districts, and 3) city boundary expansion and re-classification of rural settlements.

Table 1 Characteristics of coastal districts of selected countries of Asia and the Pacific

Country	Coastline length (thousand km)	Shelf to 200m depth (million km ²)	Coastal population (millions)
Australia	25.76	2.26	13.90
Bangladesh	0.05	0.05	5.05
PR China	14.50	0.86	66.51
Fiji	1.12	0.02	0.42
India	12.70	0.45	78.25
Indonesia	54.71	2.77	58.30
Iran	3.18	0.10	1.48
Japan	13.68	0.48	88.79
Malaysia	4.65	0.37	9.15
Myanmar	3.06	0.22	7.69
New Zealand	15.13	0.24	2.83
Pakistan	1.04	0.05	12.35
Philippines	22.54	0.17	37.18
Sri Lanka	1.34	0.02	3.49
Thailand	3.21	0.25	13.54
Viet Nam	3.44	0.32	14.31
Others	—	—	64.06
Total	—	—	477.30

Source: World Resources Institute, 1994

The movement of a large number of people to the coastal cities has inevitably increased pressure on the coastal environment and its resources. The factors involved are such as 1) increased volumes of both domestic and industrial waste, 2) increased dredging, 3) increased discharges of agricultural chemicals, 4) increased sediment loads, 5) extended and widespread clearance of mangrove, and 6) erosion of coastal sediment and thus coastlines.

Population-related problems in China and India

With respect to the environmental problems as a result of large populations, no one would ignore two of the most populous nations in the

Table 2 Urban population trends in selected countries of Asia and the Pacific

Country	Population In 1990 (million)	Urban population as % of total			% change	
		1980	1990	2000	1980/1990	1990/2000
Australia	17	85.8	85.2	85.5	-0.6	+0.3
Bangladesh	114	11.3	16.4	22.9	+5.1	+6.5
PR China	1153	19.6	26.2	34.5	+6.6	+8.3
Fiji	<1	37.8	39.3	42.7	+0.5	+4.4
India	844	23.1	25.5	28.6	+2.4	+3.1
Indonesia	184	22.2	28.8	36.5	+6.6	+7.7
Iran	58	49.6	56.9	63.7	+8.3	+6.8
Japan	124	76.2	77.2	79.0	+1.0	+1.8
Malaysia	18	34.6	43.0	51.2	+8.4	+8.2
Myanmar	42	24.0	24.8	28.4	+0.8	+3.6
New Zealand	3	83.4	83.9	84.9	+0.5	+1.0
Pakistan	118	28.1	32.0	37.9	+3.9	+5.9
Philippines	62	37.4	42.7	48.9	+5.3	+6.2
Sri Lanka	17	21.6	21.4	24.2	-0.2	+2.8
Thailand	55	17.1	22.2	28.9	+5.1	+6.7
Viet Nam	67	19.2	19.9	22.3	+0.7	+2.4

Source: ESCAP (1995)

Table 3 China's share of world population, economic output, natural resources and some pollutants

Category	Share of world total (%)
Population	22
Economic Output (PPP)	7
Cropland	7
Irrigated Land	19
Forests and Woodlands	3
Fresh Water	7
Oil Reserves	2
Coal Reserves	11
Carbon Emissions	11
Sulfur Emissions	16

Source: State of the World, 1995 (Lester R. Brown)
 PPP: Purchasing power parity

world, namely China and India. It may not be overstated that the fates of China and India in this century depend on the paces of their population growths and their ability to stabilize them.

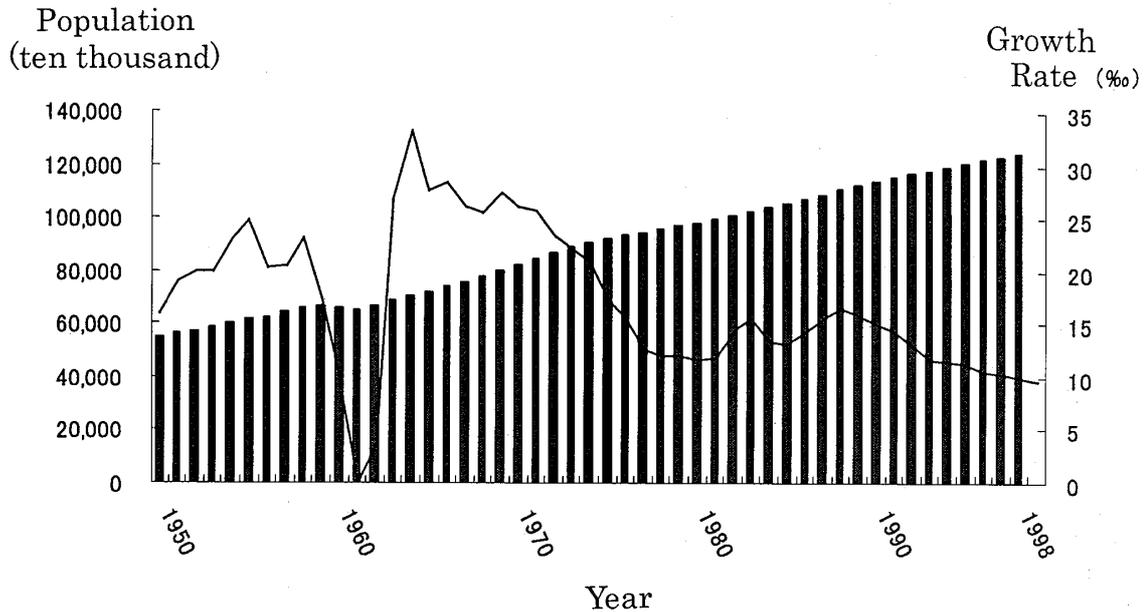
According to the fifth census conducted in November, 2000, the Chinese population, excluding those of Hong Kong, Macao and Taiwan, is about 1 billion 266 million (Chinese Statistics Yearbook, 2001). This number is more than 2.3 times of the population of 540 million at the time of the founding of People's Republic of China in 1949. In other words, an increase of some 720 million people has taken place in the last half century.

China's dilemma is that it has not only a huge population, but has a smaller slice of the world's natural resources. The country with roughly the same size as the USA has four and a half times as many people. With about 22 percent of the world population, China produces only 7 percent of economic output, and has only 7 percent of the cropland, 3 percent of the forest and 7 percent of fresh water (Table 3). While it has only 2 percent of oil and 11 percent of coal reserves, China produces some 16 percent of sulfur and 11 percent of carbon emissions.

Between 1950 and 1999, both the birth and death rates decreased from 37 to 15 people per thousand, and 18 to 6 people per thousand, respectively. This means that the natural population growth rate also declined from about 19 to 9 people per thousand. Even if the growth rate continuously decreases in coming years, it is expected that China's population may reach 1.47 billion by 2025 before being stabilized (United Nations, 2000). The demographic face of China is changing or aging with time; number of people, 65 or older, was only about 26 million in 1953 and 89 million in 2000, respectively, but will increase to about 167 million by 2020 (United Nations, 1993).

No other country has experienced the turbulence and pain that China had in the first half of the 20th century. The nation was devastated by a stream of famine, flooding, civil war, and foreign invasion during the same period. The turbulent aftermath of forced economic development under the Great Leap

Figure 1 Graph showing changes of both population and growth rate of China between 1950 and 1999.



Source: Chinese Population Yearbook, 1999

Forward and natural catastrophes between 1959 and 1961 caused a famine that killed some 30 million people (see Fig.1). No event in history, other than World War II, has taken a greater toll on human life (World Resources Institute, 1994). The Great Leap Forward was followed by the chaos of the Cultural Revolution, that lasted from 1966 to 1976. In the 1960's, forestlands were converted in large scales into croplands to achieve Mao Zedong's goal to increase grain production. Large scale tree-cutting caused soil erosion and desertification.

In the 1970s, China finally recognized its environmental consequences after the actions as a result of the Cultural Revolution. In 1972, the Chinese delegation went to Stockholm and attended the United Nations Conference on the Human Environment, where severity of environmental problems in China became obvious. In the following year, the first National Environmental Protection Conference was held, providing a forum for creation of environmental protection agencies at both local as well as of central levels. In addition, Mao's death in 1976 seemed to have advanced the

policy reassessment for years to come. The state finally undertook a massive and new tree planting campaign to help protect eroding soil and thus cropland. At the same time, the government tried to spread awareness among citizens of the adverse health and environmental impacts of highly polluting industry.

In 1978, when China opened its door to free trading world, initiated by Deng Xiaoping, agricultural reforms were undertaken to promote free-marketing operations. From 1979 to 1984, collectives were gradually disbanded and many farmers successfully leased land for a period of 15 to 25 years after agreeing to return a percentage of their output to the state. Both the increase of agricultural price by 25% and other reforms boosted the production and thus the farmers' cash savings substantially. Because the incentive to channel the savings into new industry, the production of consumer goods, which were formerly overlooked by the state-run, has increased drastically.

Although the situation is far from uniformity, China's overall economic performance since 1978 has been impressive. Not only the productivity gains average 3 to 4 % a year, the share of trade increased from about 10% in 1978 to more than 30 % in 1990. Because the prime areas for industrial production are located along the coast, there has been demographic movements from the interior to the coastal regions, or from the rural to urban districts. In China, the urban population in 1990 was estimated at about 297 million, an increase of some 90 million since 1982. The same trend from rural to urban will most likely continue in the next few decades (World Resources Institute, 1994). From 1982 to 1990, Shanghai's population increased by 13%, out of which 8% increase was due to in-migration, reflecting large scale population shifts as the result of the economic reforms of the 1980's and the de-collectivization of agriculture (ESCAP, 1995).

India's population-related problems differ from those of China. Population growth as the result of internal migration from rural to urban dropped from

about 40% in the 1970's to about 33% in the 1980's (Mathur, 1993). Reproduction now accounts for approximately 60% of the urban population growth. The number of cities over one million has risen from 12 in 1981 to 23 in 1991. Many of these large cities are located along the Ganges River that pours the polluted water and sediments into the Bay of Bengal.

India's census conducted in 1991 shows its population at 844 million, 160 million more people than in 1981 (United Nations, 1993). Early in this century, it is expected to surpass China as the most populous country in the world. Although the growth rate has not yet under control in India, the number of people living under the poverty line decreased from about 52% of the population in 1972-73 to 30% in 1987-88 (World Resources Institute, 1995). Roughly 80% of India's poor live in rural areas. Even if the rural poor own land, it is usually unproductive and thus is hardly an income source. The poorest households tend to have many children. While poor men often take temporary agricultural jobs, most women do not have such options. It has been known that problems of poverty in India are closely linked to the women's social status. The literacy rate for the entire country is estimated at some 52% in 1992, but the rate for women alone is only 39%.

State of the Coastal and Marine Environment in Asia

There are three separate threats that are currently being faced in the coastal and ocean districts of the Asia and Pacific region; 1) pollution from primarily land-based sources which causes direct damages to marine ecosystems, such as coral reefs, mangroves and sea grasses, 2) damages to the biomass and ecological balance of the marine environment caused by over-fishing and unsustainable extraction of marine resources, and 3) more direct physical damages to the coastal and marine ecosystem due to urban and tourist related developments.

Because of both the domestic and industrial effluent discharges, atmospheric deposition, oil spills and other contaminants from shipping,

coastal and marine pollution has become very serious in this region. Most of the pollutants which are composed of sand/silt, nutrients, toxic chemicals and oil came from land. UNEP (1999) estimated that, due to the combined effect of active tectonics, heavy monsoon rain falls, steep slopes and erodible soils of the region, more than a half of the world's total sediment transport takes place in the Asia and the Pacific. These sediments impact not only on the shallow inshore habitat but also on the deeper/wider oceanic ecosystem. Rivers running through Viet Nam, Cambodia, Thailand, Malaysia, and China deliver some 600,000 ton of nitrogen per year to coastal waters of the South China Sea (Talaue-McManus, 2000).

A range of development activities have caused direct damages to coastal habitats, particularly of the estuarine and coastal systems. They include dredging of harbors and shipping channels, construction of harbors and marinas, and reclamation of coastal wetlands for development. The effect is so wide spread in the region and it is difficult to point out one or two areas. According to the ESCAP's report in 2000, the coastal erosion has affected every state of Malaysia and a total shoreline of some 1,400 km², or about 29% of the entire shoreline of about 4,800 km² was eroded.

Flow of natural materials is being contaminated by a wide range of wastes that include organic pesticides, heavy metals such as mercury and lead, plastics, various hazardous chemicals, produced by industrial, commercial and agricultural activities. Pollution by oil spills is also serious in many parts. Out of China's four sea areas, the East China Sea was most polluted, followed by the Bohai, the Yellow and the South China seas (Government of China, 1997 and 1999). It was found that only about 19% of the coastal waters of China met Grade I quality standard in 1997, but this has dropped to 15% by 1999.

Coral Reefs

In 1998, Langdon et al. (1999) discovered that the increased atmospheric

CO₂ seems to have elevated CO₂ content dissolved in sea water and thus acidity of sea water. It is known that the increased acidity slows down calcium carbonate deposition in coral communities. Coral reefs occupy only one quarter of one percent of the earth's ocean surface, but it is known that they are home to approximately a quarter of the known marine fish species. This is the principal reason why they are called the "rain forests of the marine world" (Bryant, et al., 1998). Approximately four fifths of the coral reefs in the world exist in the Asian and the Pacific region, and they with their associated plants and animals provide humans with seafood, medicine and other useful products for living. However, such human activities as coastal development, over exploitation and destructive fishing practices, in addition to both land- and marine-based pollution, have damaged the conditions of coral reefs in the region.

Mangroves

According to ESCAP (2000), South and Southeast Asia region has more than 40% of the world's 18 million mangrove forest, with the highest diversity of mangrove species. Mangrove is a tree growing in tropical salty/ocean water. As the mangrove tree grows, it sends down roots directly from branches and forms thickets. Mangrove thickets commonly grow in quiet ocean water and catch silts, which pile up often to form dry land. In the area near the river mouths, the mangrove roots slow down the current and help settle sands and silts.

Unfortunately, as the result of growing population in the region, large areas of mangrove have been removed for industrial, residential and leisure developments. Most serious of all are due to the establishments of ponds for fish and prawn aquaculture. According to ESCAP's (2000) estimate, more than 60% of Asia's mangrove forests have been converted to aquaculture ponds.

Sea grasses

Sea grasses in the tropical and temperate coastal waters and deeper waters in the region are often associated with mangrove habitats and coral reefs. They perform the ecological function of trapping sands and silts. In other words, sea grasses provide a mechanism for clearing waters with sediments — quite important to the survival of coral reefs. They are, of course, the essential parts of marine habitats in generating oxygen through photosynthetic reactions in the ocean. According to Heck and McCoy (1978), diversity of sea-grass species is highest in the area surrounded by Indonesia, Borneo, Papua New Guinea and northern Australia. Out of the 50 recorded species worldwide, Northeast and Southeast Asia regions have some 20 species (Sudara, et al., 1994).

According to some estimate, more than 20% of the sea grass areas of Indonesia, Malaysia, Philippines and Thailand have been damaged by a combination of coastal development, high sedimentation rate, destructive fishing, pollution from land, spills of petroleum products, dredge and fill operations (ESCAP, 2000).

Coastal Management by Asian Countries

Most of the Asian countries started the coastal zone management programs in the mid to late 1980's, beginning with the formation of committees and the preparation of reports of recommendations. Such management programs commonly resulted in the legislations in such countries as Bangladesh, Sri Lanka, Pakistan, Philippines, Tonga, Indonesia, Singapore, Thailand and Malaysia (ESCAP, 2000).

It seems that such management plans can be successfully implemented if the participations of the local communities are demonstrated, as exemplified in Philippines.

The City of Puerto Princesa on the Palawan Island developed a program

to protect, conserve and rehabilitate the city's forests and marine resources in an attempt to improve the peoples' quality of life and also to use marine resources in ecologically sustainable ways, socially equitable and economically viable. Because of the active participations by the local communities, the program was proved to be very successful in slowing the forest destruction and coastal resource degradation. The concept behind these programs is rather simple in that 1) to protect what is there, 2) to rehabilitate what has been damaged or destroyed, and 3) to plan the management for resource utilization that is environmentally sustainable.

In Sabah, Sarawak and Pulau Pinang States of Malaysia, the coastal zone management program to formulate integrated environmental protection and rehabilitation plans was implemented at the central government level (ESCAP, 2000). In New Caledonia, remote sensing images are being used to detect changes of coral reefs in a ten-year interval, to help assess the impact of the local development activities (Bour, 1990). Both in India and Japan, on the contrary, satellite information has been used to provide data for fishers the best spots for fishing and also to help enforce fishing agreements in offshore waters.

Japan has experienced mass movements of people from rural to urban, commonly coastal, centers since the end of the World War II, resulting in strong environmental pressures on its coastal and marine resources. To combat such environmental pressures, the government has been encouraging the local communities and industries to establish marine parks under the Natural Park Law. As of 1995, there are 58 marine parks in Japan. A marine park consists of a core area of up to one km radius which is environmentally protected, surrounded by ordinary marine areas with such facilities as underwater observatories, glass-bottomed boats and diving sites which are usually managed by non-profit organizations (ESCAP, 1995).

The most important aspect of the marine park operations is the involvement of local fishermen. The park managements employ staff from

the nearby fishing communities and also purchase fish from local fishermen who also operate souvenir shops and rental businesses of glass-bottomed boats. In many countries, traditional fishing rights are protected, and the establishment, of such a marine park is perceived as strong restrictions against fishing rights, thus against preserving their incomes. The marine park management adopted in Japan is, however, such that the economic interests of the local fishermen are linked with the management practices. This helps ensure the sustainability of the parks and their surrounding environment as well.

Conclusions

Because of the economic expansions which have taken place in the last several decades, coastal and marine environments in and near the Asian countries have severely deteriorated. The concept behind the environmental conservation is rather simple, although its implementation is often difficult: 1) to preserve what is remaining, 2) to rehabilitate what has been damaged, and 3) to plan the management for utilization of resources in environmentally sustainable ways. Because the Asian seas contain large percentages of the earth's marine ecosystems such as coral reefs, mangrove forests and sea grasses, it is essential to improve the coastal and marine environments of Asia in order to improve the situation of the entire world. The steps to be followed may be as follows;

- 1) To monitor the marine and coastal environment probably using the remote sensing method, aerial photographs and on-site observations,
- 2) To combat the environmental deterioration with the support of the local community,
- 3) To bring up what has been discovered either to the state or national level for legislation of environmental protection and management, and
- 4) Finally to try to get the international cooperation among the nations involved.

Land-based pollution is commonly caused by poor practice of human and industrial waste disposal, dredging, developments of industrial, residential and amusement sites, etc. Because of the tectonics of the Asian continent represented by high mountains such as the Himalayas and heavy rain falls by both monsoon rain and typhoon/cyclone storms, the amount of sediments transported from land and deposited in the sea is very large. Those sediments also carry a large quantity of polluted materials, because river waters in this region are contaminated by municipal sewage, industrial effluent and sediments. Although this region constitutes only about 17% of the world's total drainage area, Asian rivers carry some 50% of the sediments carried to and deposited in the oceans of the world (UNEP, 1992). Sea-based pollution is primarily originated from oil tankers, offshore oil/gas fields, and ships.

Acknowledgements :

I wish to thank Dr. Yin Hao, Director of the Institute of Population at Jilin University, P. R. China, for his valuable advice on the Chinese population statistics.

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Figure 1 Graph showing changes of both population and growth rate of China between 1950 and 1999. Source: Chinese Population Yearbook, 1999.

Key words : Asia and the Pacific, Population, Coastal Regions, China, India, free market, coral reefs, mangroves, sea grasses, ESCAP
UNEP

(Kinji MAGARA)