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Environmental Challenges to Bangladesh

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BANGLADESH INSTITUTE OF INTERNATIONAL AND STRATEGIC STUDIES

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INTRODUCTION

The delicate balance between man and environment maintained through millennia is being distorted rapidly and severely because of unrestrained and unplanned exploitation of the nature by man. The consequence of this distortion is disastrous environmental degradation. In the broader perspective, the unchecked exploitation of natural resources through various short term and unplanned developmental activities result into desertification, deforestation, soil erosion, air and water pollution and a number of other forms of environmental degradation. The combined fall-out of all these are : the rise of mean temperature of the world, changed weather pattern, melting of polar ice cap, rise of sea level, depletion of ozone layer, etc., whereby the entire human race faces extinction. Every country in the world will have to share this burden in varying degrees no matter whether they are responsible for such degradation or not. On the other hand, disputes arising out of scarce natural resources as well as the transborder implications of environmental degradation resulting out of various developmental activities can be a source of conflict between or among nations. Thus, even the security of the nations is threatened in the limited sense at least.

Although global environmental concern has been noticed since the 1960s it is not till the 1980s that the subject received attention from the standpoint of security of states. The Oslo Workshop on the linkage between Environmental and Security in 1986 emphasized that "theorist

must move beyond traditional thinking about security concepts and begin considering a series of environmental factors underpinning the material welfare. These factors include such natural resources as soil, water, forests, grassland and fisheries, all prime components of a nation's natural resource base. They also include climatic patterns and physio-biotic cycles that maintain the life support systems of all nations. If a nation's environmental foundations are depleted, the idea goes, its economy may well decline, its social fabric may deteriorate and its political structure may become destabilized. The outcome all too likely is conflict whether in the form of disorder and insurrection within the nation or tension and hostilities with other nations".¹

The burden of environmental degradation befalls more on the third world developing countries even though the liability of such degradation lies more with the developed countries. Being economically and technologically backward, the developing countries are largely dependent on the nature for their livelihood and are helpless in facing the disturbance in the balance of the nature. Instead of attaining the conventional tasks of socio-economic development and political stability, the challenge facing a number of them in the 1990s and early twenty first century is likely to be one of ensuring mere physical survival.²

Agriculture is the backbone of developing economies, yet throughout the Third World farmers have been forced by financial

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1. Norman Myers, "Linking Environment and Security", *Bulletin of Atomic Scientists*, June, 1987, p. 46; cited in . M. G. Kabir, "Environmental Challenges to the Security of Bangladesh" *BISS Journal*, Vol. 10, No. 1, 1984, p. 64.
 2. Yezid Sayigh, "Confronting the 1990s : Security in the Developing Countries", *Adelphi Papers*, No. 151, Summer, 1990, p. 42.

and population pressures to adopt short-cut methods that are leading to long term land degradation.³ By interfering with important natural cycles and overusing fragile and barely stable ecosystem, they are creating a self-reinforcing cycle of land deterioration.⁴ When domestic production fails to support the population of a given land, it has no choice but to borrow from developed countries and developmental activities become increasingly dependent on loan and aid. To pay the loan back these countries draw more heavily on the natural resources hence further damage the prospect of long-term economic development. In a highly competitive world market the developing countries start from an in-built disadvantage of underdevelopment and technological backwardness.⁵ To compensate this they exhaust resources at even faster pace. Deforestation in Brazil and Nepal, desertification in Africa, soil erosion in the Caribbean and Latin American countries, drug production in Peru, Columbia, Bolivia and Pakistan, acceptance of nuclear and chemical wastes by some west African states—West Guinea, Guinea-Bissau and Benin—are all viewed central either to feed people and achieve growth or to debt servicing. Thus, the Third world countries are caught in a vicious circle the end result of which is the downward spiral of the supporting capacity of the environment, the never ending march of environmental refugees in search of fertile soil or employment, the increase of slums and shanty towns, extra pressure on the food and employment of the migrated land, increase of crime, conflict between various interest groups and finally socio-economic and political instability both at the national and regional level.

3. Jodi L. Jacobson, "Environmental Refugees : A Yardstick of Habitability", *Worldwatch Paper*, No. 86, November 1988, p. 16.

4. *Ibid.*

5. Yezid Sayigh, *op. cit.*, p. 42.

Only a few states are faced with environmental challenges that could be compared with the one faced by Bangladesh. It is exposed to environmental degradation at all levels, viz., global, regional and national. Bangladesh is one of the few countries which will be among the first victims of sea level rise. Today global warming or green house effects are no longer hypothetical predictions. Most scientists are in agreement that a global warming is under way caused by the accumulation of greenhouse gases primarily due to fossil fuel use in industrialised countries. Recent estimates predict that a global temperature increase of 1.5 to 4.5 degrees celcius can be expected as early as 2030. This will raise the average temperature of the oceans and will cause the polar ice to melt raising the sea level. The low lying delta regions like Bangladesh are threatened to be inundated creating millions of environmental refugees.

At the regional level too Bangladesh is exposed to severe challenges because of its geographical location which is very much vulnerable to any imbalance in the nature which may come about as a deliberate policy decision. At the regional level, Bangladesh is suffering from annual flood and alternate drought because of the various activities undertaken by other countries of the region specially deforestation in India and Nepal and construction of numerous dams and barrages on the common rivers by India. Situated in the belt of Himalyan ecosystem, the countries of the region share more or less the same river system originating mostly from the Himalyas. Bangladesh, the lower riparian, is geographically situated in a position to bear the most severe burdens of any disturbance in the nature of this region created by the indiscriminated and uncoordinate developmental activities of the upper riparians. This surely strain the relationship between neighbours. Moreover, problems of environmental

pollution and degradation in this region are closely interwoven with such issues as over population, poverty and underdevelopment on the one hand and politico-strategic dimension of inter-state relations on the other which has for long been characterized by historical mistrust, endemic tension and occasional hostilities.

At the national level also environmental degradation is taking place in the form of massive deforestation to meet the need for fuel consumption of the increasing population, soil erosion because of unsustainable land-use practices to receive quick return, water pollution because of unawareness of general mass regarding proper sanitation and throwing of industrial and chemical wastes to name a few. Underdevelopment and population pressure are the main causes of environmental degradation within the country. Such degradation may in the long run result in the further weakening of already fragile socio-political and economic structure of the country leaving it even more vulnerable.

In this paper an attempt is made to identify the major ecological concerns and environmental challenges facing Bangladesh and suggest possible measures to combat them. The first part deals with the sources of the major ecological concerns, on-going process of environmental degradation and its broader implications. The second part of the paper is aimed at finding out means and ways in order to face the challenges. This part is also divided into three levels, viz., combating global challenges, regional challenges and national challenges.

I

DIMENSIONS OF THE PROBLEM

I. A. Challenge at the Global Level

The Earth's ecosystem maintains a fragile equilibrium. For example, a pre-historic decrease of less than five degrees in the

global mean temperature once ushered in a series of ice ages. We are now experiencing a temperature change of just a few degrees in the opposite direction, a gradual warming of the earth's atmosphere that could lead to a dangerous rise in the sea level, more severe hurricanes and cyclones, and dramatic shifts in precipitation, that could disrupt present day agriculture. Scientists termed this the "Green House Effect".⁶ Carbon dioxide and other gases that are accumulating in the lower atmosphere allow the sun's ray to enter, but trap the excess heat like a gigantic greenhouse. Recent analyses with advanced general circulation models of the atmosphere suggest that if emission trends continue, the atmosphere build up of these gases will significantly change global weather patterns in the near future.

Today there is no doubt as to the warming of the world. The process has already started but the uncertainties lie in just how much higher the earth's average temperature will go, and how quickly the increase will take place. General estimate predicts that it is happening quickly, over tens of years, instead of tens of thousands of years that led to the ice age. As 1980 dawned, it was confirmed that the decade just ended had recorded a net rise in mean air temperature of 0.25°C. Collaterally, the area of sea ice had contracted by two million square kilometers in each polar region.⁷ Moreover, the new trend has continued to this decade. According to a recent study at the Climate Research Unit at the University of East Anglia in the UK, the six warmest years on the global record are (in ascending order) 1986,

6. Mohiuddin Ahmed, "Bangladesh : An Easy Prey to Greenhouse Monster", *Holiday*, May 24, 1991.

7. Naville Brown, "Climate, Ecology and International Security, " *Survival*, Nov/Dec. 1989, p. 534.

1980, 1981, 1983, 1987 and 1988.⁸ Global average temperature is now about 0.6 degree celcius warmer than they were 100 year ago. Even sea-level has also risen 10-15 cm. during last one hundred years. In short, the greenhouse warming is now coming through quite steadily.

According to the report presented by the scientists of the UN commissioned IPCC (Inter-governmental Panel on Climate Change), among the principal sources of greenhouse gases, carbon dioxide (55%, annual increase 0.5%) tops the list originating from fossil fuel burning and deforestation. This is followed by chlorofluorocarbons (CFC) and related gases, viz. HFCS and HCFCs (24%, annual increase 4%) which originates from various industrial uses, methane (15%, annual increase 0.9%) which originates from rice, enteric fermentation and gas leakage and the rest is by nitrous oxide (6%, annual increase 0.8%) which originates from biomass burning, fertilizer use and fossil fuel combustion.⁹ On the basis of computer simulations of climate, the scientists predicted that if greenhouse gas emissions continue at their present rates, average temperature in the world will rise by a full degree celcius within the next thirty years.¹⁰ Another estimate predicts that a global temperature increase of 1.5 to 4.5 degrees celcius can be expected as early as 2030.¹¹ A warming of this magnitude will directly affect many physical aspects of the earth's global systems.

8. *Ibid.*

9. Mohiuddin Ahmed, *op. cit.*

10. *Ibid.*

11. Robert C. Cowen, "Man Made Gases Increase the Chance of Major Weather Change," *Christian Science Monitor*, June 30, 1988 see. Also, "Changing Climate", *Report of the Carbon Dioxide Warming Projection from U. S. National Academy of Science, Assessment Committee*, Washington D. C., National Academy Press, 1983.

Sea level will rise worldwide due to thermal expansion of the oceans and the melting of small, land-based glaciers. A warming of 1.5 to 4.5 degrees centigrade would cause a rise in global sea level of 40 to 120 centimetres.¹² The IPCC scientists have made prediction on the basis of climate models that in the absence of efforts to cut greenhouse gas emissions, sea level will rise between 10 to 30 cm. (with the best guess of 20 cm.) by the year 2030 and by 30 to 100 cm. (with the best guess of 65 cm.) by the end of the next century.¹³ Such a sea level rise would have the following immediate impacts : (a) loss of land by inundation of low lying coastal areas and river deltas or by erosion or flooding of coastal areas; (b) increase in the frequency of storm damages to lagoons, estuaries and coral reefs, coastal structures, dikes, dams, and change in morphology and ecology; (c) increase saline water intrusions into aquifers, inundate vital wetlands and destroy commercially important spawning grounds.

Another important impact of global warming is that the warming will not be uniform everywhere. Warming at the poles is likely to be two to three times the global average, while warming in the tropics may be only 50% to 100% of the average. This increased warming at the poles will reduce thermal gradient between the equator and the high latitude regions decreasing the energy available to the heat engine that drives the global weather machine.¹⁴ As the thermal gradient is reduced, global pattern of winds and ocean currents as well as the timing and distribution of rainfall will change. Global rainfall will probably increase but the timing and distribution of regional rainfall

12. Irving Mintzer, "A Warming World : Challenges for Policy Analysis," *Economic Impact*, No. 65, 1988/4, p. 6.

13. Mohiuddin Ahmed, *op. cit.*, May 31, 1991.

14. Irving Mintzer, *op. cit.*, p. 8.

is likely to change substantially. Some areas will become wetter and others drier.¹⁵

The low lying developing countries are most vulnerable to such threats of which Bangladesh would be among the worst victims. The Bengal delta, resting at the confluence of the Ganges, Brahmaputra and Meghna rivers, is the world's largest such coastal plain and comprises about 80% of the country's total area. Bangladesh is subject to annual floods both from the rivers and from oceanic storm surges. The average height of the country is estimated to be only 7.6 meters above the present sea level. A three feet rise in sea level would inundate 11.5 percent of the country's land area, displace 9 percent of the 110.8 million people and threaten 8 percent of the annual GDP.¹⁶ Approximately 8.5 percent of Bangladesh's agricultural output comes from the areas that would be flooded. The loss of land to inundation would also reduce the fish catch, which now supplies 80 percent of the animal protein. Approximately 7.5 percent of the major fishing centers would be flooded out.¹⁷

Bangladesh will suffer further from the likely destruction of coastal mangrove forests upon which 30% of its population depends to some extent. Extensive river diversions markedly decreased the amount of freshwater discharge into this coastal environment while higher sea levels will increase saltwater, thus, reducing mangrove forest cover and disrupting major fisheries within this fragile ecosystem. Reduction in river outflow may also accelerate the intrusion of brackish waters into aquifers, a problem that already extends 240 kilometers inland.¹⁸

15. *Ibid.*

16. David A Wirth, "Climate Chaos", *Foreign Policy*, No. 74, Spring 1989, p. 9.

17. Irving Mintzer, *op. cit.*, p. 7.

18. John D. Milliman *et. al.*, "Environmental and Economic Impact", cited in Jodi L. Jacobson, *op. cit.*, p. 35.

A study made by a group of researchers headed by John D Milliman at the Woods Hole Oceanographic Institute, developed three possible scenarios under two estimates of sea level rise : a maximum of 13 centimetres by 2050 and 28 centimetres by 2100 which they termed as 'best case scenario' and a maximum of 97 centimetres by 2050 and 217 centimetres by 2100 which they termed as 'worst case' and 'really worst case' respectively. Under the 'best case scenario', the researchers assume the minimum rise in global sea level and a delta region in equilibrium. The second scenario, called the 'worst case', assumes the maximum rate of sea level rise and the complete damming or diversion of the river system draining into the delta. In this case, the rate of subsidence must then be added to the absolute rise in sea level.¹⁹

The 'third scenario' is referred to as the 'really worst' case. It assumes that excessive groundwater pumping from irrigation and other uses accelerate natural subsidence. To calculate the economic implications of these cases on both Egypt and Bangladesh, Milliman and his colleagues assumed present day conditions, such as the estimated share of the total population now living in areas that would be inundated and share of economic activities that are derived from them.²⁰

Just how severely sea level rise will affect Bangladesh depends in part on the pace at which damming and channeling of rivers proceed and the rate of ground water withdrawal. Although annual flooding is severe and can damage up to one third of the crops grown on the flood plains, large areas of the delta region suffer rain deficit for the rest of

19. *Ibid.* p. 32.

20. *Ibid.*

the year, thus, creating a large incentive to divert river water for agriculture. Such diversion would impact heavily on the amount of the sediment available to offset natural subsidence.²¹

Under natural conditions, deltas are in a state of dynamic equilibrium, forming and breaking down in a continuous pattern of accretion and subsidence. Over time, these sediments accumulate. But regional and local tectonic effects along with compaction cause the land created to subside. Local subsidence alone can be as great as 10 cm. per year. Local rates of sea level rise, then depend on the sum of global sea level rise and local subsidence.²²

Over-population and decreased river flows have increased the rate of groundwater withdrawal almost six times over the last two decades which has affected subsidence rates. Sediment sample suggest that ground water withdrawal may have raised subsidence to at least twice the natural rate.²³

Taking these factors into account, Milliman and his colleagues estimated that the sea level will rise 209 cm along the Bangladesh coasts by 2050. Half the country lies at elevations of less than 5 meters. Loss of land under 13 centimeter rise in the 'best case' scenario is minimal - less than 1 percent of the country's total. In the 144-centimeter rise in the 'worst case', however, 16 percent of the nations land would be lost. In the 'really worst case', local sea level rise would be 209 centimeters and 18 percent of the habitable land would be under water. Figure 1 shows estimates of loss of land as a

21. *Ibid.* p. 33.

22. *Ibid.* p. 31.

23. *Ibid.* p. 33.

result of 1 and 3 meters rise in sea level. As a result, more than 17 million people would become environmental refugees.²⁴ By the year 2100, the 'really worst case' scenario shows that 35 percent of the nation's population will be forced to relocate. The economic effects will be widespread, because 31 percent of Bangladesh's gross national product is realized within the land area that will be lost. An already poor country will have to accommodate its people on a far smaller economic base.²⁵

Table 1. Effects of Sea Level Rise on the Bengal Delta Under Two Scenarios

	Global Sea Level Rise	Local Land Subsidence	Local Sea Level Rise	Loss of Habitable Land	Popula- tion Displa- ced	Loss of Gross National Product
	(centimetres)			(percent)		
Bangladesh 2050						
Worst case	79	65	144	16	13	10
Really worst case	79	130	209	18	15	13
Bangladesh 2100						
Worst case	217	115	332	26	27	22
Really worst case	217	230	447	34	35	31

Source : John D. Milliman, *et al.* "Environmental and Economic Impact of Rising Sea Level and Subsiding Deltas. The Nile and Bengal Examples", Woods Hole Oceanographic Institute, Woods Hole, Massachusetts, unpublished paper, 1988, Cited in Jodi L. Jacobson, "Environmental Refugees : A Yardstick of Habitability", *World Watch Paper*, No. 86, Nov/1988, p. 34.

24. *Ibid.*

25. *Ibid.* p. 34.

Sea level rise will enhance the process of shoreline erosion. Per Bruun of Technical University of Norway in a study showed that shoreline erosions are of the order of 0.3 meter per year. If sea level rises 1.5 meter by the year 2100, shoreline recession will be about 150 meters. Vast amount of low lying areas of Bangladesh will be flooded. This will add to the existing process of erosion due to tidal action which is the general reason of erosion in the coastal region of Bangladesh. It may be mentioned that during 1940-1963 the island of Sandwip suffered erosion in the order of 138 km, Hatia 96km, Bhola 213 km and Chittagong coast 68 km. A rising sea level will definitely intensify the process of coastal erosion in Bangladesh.²⁶ According to the survey made in 1780, the island of Sandwip was of 417 sq miles. But its size reduced to 222 sq miles in 1916 and in 1984 it became 92 sq miles. During the last 200 years about 325 sq miles area of the island have been submerged.²⁷ From 1940 to 1963 about 3.5 kilometers area of the island of Bhola eroded. It was 3 kilometre during 1963 to 1984. An average 150 metre area of land eroded per year from 1940 in Bhola.²⁸ The island of Hatia consisted of an area of 394 square miles in 1640 and according to the map of 1684 it was of an area of 184 square miles. Today the size of the old Hatia is only 8 square miles.²⁹

The combined effect of warmer climate and higher seas will make tropical storms more frequent and more destructive world wide, raising the toll in lives and further decreasing the habitability of coastal areas. Milliman notes that cyclones originating in the Bay of Bengal

26. Mohiuddin Ahmed, *Holiday*, May 31, 1991, p. 5.

27. Manirul Qader Mirza, *Robbar*, September 15, 1985, p. 18.

28. *Ibid.*

29. *Ibid.*

before and after the rainy season already devastated the southern part of Bangladesh on a regular basis. An average of 1.5 severe cyclones now hit the country each year. Phillip L. Woodworth of the Institute of Oceanographic Sciences (UK) observed that the major effect of a sea level rise in Bangladesh region is the increased likelihood of storm surge damage rather than simple flooding.³⁰ Generally, cyclones develop in the southern Bay of Bengal where depressions develop and move north to the coasts of India, Bangladesh and Burma mainly during April-June and October-November. The damaging effects of cyclones are caused by the increased water level due to wind set up and low barometric pressure in combination with strong winds. In comparison with the neighbouring countries, cyclones approaching the coast of Bangladesh are more harmful. The reason is the funnel shape of the Bay of Bengal with Bangladesh at the bottom of the funnel where the waters are piling up. In addition, the near sea level in the eastern estuary increases during the monsoon by about 1 metre as a result of upland discharge, strong wind from the south-west and a low barometric pressure.³¹ Therefore, it can easily be concluded from these situations that a rising sea (global rise + local rise due to local subsidence and coastal erosion) and a warmer climate would increase the frequency and intensity of cyclones and storm surges in Bangladesh.

It is even observed by experts that one of the reasons of the cyclone of April, 1991 which took catastrophic turn in terms of unprecedented loss of life and property, is the rising sea and warmer climate. Usually storm surges as much as 6 meters higher than

30. Mohiuddin Ahmed, *op. cit.*

31. F. G. Koch, *Delft Hydraulics*, 1988; cited in Mohiuddin Ahmed, *op. cit.*

normal can reach as far as 200 kilometers inland. But the height of the surge was 15 to 20 meters this time. Total property loss from the storm surges in the region between 1945 and 1975 has been estimated at \$ 7 billion, and some 300,000 lives were lost in 1970 when surge covered an estimated 35% of Bangladesh's land area.³² In the 1991 cyclone alone about 125,500 people died according to government assessment, while the non-government assessment is about 500,000.³³ About 15 million people were affected of which 1 million people became homeless and 10,000 fishermen went missing.³⁴ The financial loss were of such an extent that it was not possible to ascertain the exact amount. However World Bank's estimate is about \$ 2.4 billion.³⁵

Thus political, social and economic fallout of global environmental change can be one of enormous importance to Bangladesh. Severe cyclonic storms, inundation, changed weather pattern, disruption of various sectors of economy would definitely displace thousands of people. The question is where will these people go? Moving further inland, millions of environmental refugees will have to compete with the local people for scarce food and water. A large number of these people will have to move beyond the border which would perhaps spur the regional clashes, heightening the existing tensions. The combined effect of all these would be so devastating for Bangladesh that the very survival of the country could be at stake.

I. B. Challenge at the Regional Level

At the regional level too, Bangladesh is exposed to environmental challenges. Bangladesh is the lower riparian of the common rivers

32. Jodi L. Jacobson, *op. cit.*, p. 35.

33. *Monthly Bikas*, (in Bangla, Dhaka, May 11, 1991), p. 62.

34. *The Bangladesh Observer*, May 7, 1991, p. 1.

35. *Daily Star*, December 3, 1991, p. 1.

shared by the Himalayan basin states. Development activities in the upper reaches, like, various flood control and irrigation projects on the common rivers as much as the continued deforestation process in the Himalayas and their impact on the environment, agriculture and the economy of Bangladesh significantly influence the relationship among the co-riparian states.

The Ganges river collects water from the southern slopes of the Himalayas, the Brahmaputra river drains the northern slopes of the Himalayas and the Meghna river arises in the north eastern hills of India bordering Bangladesh. These three rivers together with numerous other small rivers combine to carry the world's largest sediment load of 1-2.4 billion tons per annum to form the deltaic plain of Bangladesh. Because of this flat terrain the country is very much prone to annual flood. Main sources of flooding are spillover from rivers, drainage congestion of local run off due to this extremely flat nature of topography, storm surges and tidal blockage. Deforestation in the water shed areas further intensify the problem already existing.

The problem of flood in Bangladesh begins high up in the Himalayan watershed i.e. 200 kilometer upstream. There population pressure, energy crises, overgrazing and unsustainable farming practices have decimated forests. Forests play a vital role in maintaining ecological balance. These stabilize soils, conserve nutrients and moderate water supply. In general forests help anchor soils. Thus the loss of tree cover specially from steeply slopping hillsides can lead to loss of top soil. Beside diminishing upland productivity, such erosion transfers sediment to river channels which aggravates local flooding and can contribute to the premature silting of reservoir downstream.

Available data suggest that by 1950, the Himalayan forests have been halved and from one half to three fourth of the middle mountain range in Nepal has been deforested in the last 40 years. R. F. Bista, the chief spokesman of the government of Nepal said that due to embargo imposed by India on Nepal's trade and transit, about 33,600 hectares of land had been deforested from the end of March to mid August of 1989 alone to meet the need of fuel consumption.³⁶ According to a survey made in 1961, it was revealed that in Nepal there was about 32,000 square miles of land which was under forest. By 1982, the forest area in Nepal was reduced to the size of about 12,000 square miles.³⁷

The situation is just as bad right across the border in India. According to the Centre for Science and the Environment in New Delhi, India has lost 40% of forest cover in the last 30 years. The fallout is that the increase in flood prone areas has almost tripped in the last 25 years despite an enormous increase in flood control.³⁸ About 190 acres of forest is disappearing in India per minute.³⁹ Landsat data released by the National Remote Sensing Agency of India reveal that India's forest cover declined from 16.9% in the early seventies to 14.1% in the early eighties, an average loss of 1.3 million hectares per year. Recent data show that in less than a decade forest coverage within 100 kilometers of India's major cities dropped by 15% or more.⁴⁰

36. *Ittefak*, August 19, 1984.

37. Shafiqul Haque, *Bichitra*, September 23, 1988, p. 20.

38. Peri Batliwala, "Bangladesh Flood", *Bangladesh Observer*, October 15, 1988.

39. Shafiqul Haque, *op. cit.*

40. Sandra Postel and Lori Hoise, "Reforestation the Earth", *Worldwatch Paper*, No. 83, April, 1988, p. 9.

Stripped of forest cover, the Himalyas are no longer able to buffer the powerful monsoon, because the sponge effect of soil to absorb certain amount of water is lost. Hard rain flow more quickly off mountain sides, taking with them that soil that are left unprotected. The increased erosion further compromises the soils ability to retain water. Narrow mountain rivers and streams that receive huge volumes of rain over a short period of time swell beyond their banks sending torrents of water full of silt to the low lands. Upland soils and silts eventually settle on the beds of broader, shallower deltaic rivers, decreasing their depth and increasing the likelihood of flooding in the next surge. Only 25% of the silt carried by the rivers are disposed into the Bay and the rest into the river beds.

Flood is a yearly phenomenon in Bangladesh but in recent time, its frequency and intensity have increased to a great extent. Previously, flood waters used to increase slowly giving people time to move but in recent time flush floods are taking place because of the fast flow of rain water and melting of ice in the Himalya as well as rising river bed due to siltation. Figure number 2 shows the different types of floods to which the country is subjected annually. In the past, massive flood used to hit Bangladesh only once in every 50 years and so. Since the middle of the present century, the number and severity of large scale flood has increased markedly together with the suffering of people and economy. In the seventies there has been a flood in every four years. Since 1980 there have been five floods, each one worse in terms of unprecedented damage to life and property. In the 1988 flood, about 80% of the country was submerged, 25 million people were displaced and 1,200 people died.⁴¹

41. Jodi L. Jacobson, "Flood : An Unnatural Disaster" *Bangladesh Observer*, December 8.

From this trend it can be assumed that the future floods are likely to be more disastrous. The common scenarios following floods are disrupting agriculture, communication, rising food prices, outbreak of diarrhoea in the epidemic form, influx of displaced people from rural to urban areas, dramatic increases of slums, corruption and crimes. In short one flood in a densely populated poor country like Bangladesh is enough to shake the infrastructure of the country through social disintegration and politico-economic instability.

I. B. 1. *The Ganges Water : a Case*

Another challenge at the regional level is associated with the management of common rivers which totals 54, of which Ganges is the most important. In this paper Ganges has been taken as a case study to show the close relation between environmental, social, and economic problem on the one hand and security on the other.

The Ganges river problem between India and Bangladesh centers around the question of an equitable share of its water for their respective needs and that of the best means of augmentation of its flow to meet the inadequacies in the supply of water during the dry season.

The river Ganges has highly seasonable flows. Eighty percent of its annual flow takes place during the four months of July to October. Nearly 82% of the rainfall in the Ganges plain also occurs from June to September. Therefore, the monsoon flow is enough to meet the requirements of both the riparians. Even the overflow often results in flood. More acute problem is faced during the dry season when the flow is insufficient to meet the need of both the countries. Hence any major harnessing of the Ganges water during dry season upsets

its natural equilibrium and brings about a whole chain of important and inter-related repercussions.⁴² Unilateral undertaking of projects and plans has resulted in conflict of national interest. The problem has become critical after the diversion of its water by India from Farakka.⁴³

Although the then Pakistani government made immediate protest against the introduction of a barrage to be constructed on the Ganges sanctioned by the Indian government in 1960, India went ahead with the construction work even after the liberation of Bangladesh in 1971. In April, 1975, India and Bangladesh entered into an interim agreement whereby provisional operation of the barrage for a period of 41 days was agreed upon and it was decided that continuous operation was conditional on their arriving at a mutually acceptable solution. India continued the operation even after the expiry of this period. The assassination of President Sheikh Mujibur Rahman in August 15, 1975 strained the relationship between the two countries. The period from 1975 to 1977 witnessed protracted series of protests, negotiation, exchange of technical team and goodwill team, internationalisation of the issue, etc., but all these were futile attempts.⁴⁴ In 1977, after the coming of Janata Party in power, the countries entered into an interim agreement for the first time as to the sharing of water to the Ganges. It was agreed that of the total availability of 55,000 cusecs of water at Farakka, Bangladesh would get 34,500 cusecs and India 20,500 cusecs during the leanest period (last 10 days of April). The significance of the agreement is the 'guarantee clause' inserted at the initiative of Bangladesh that if during

42. M. Rafiqul Islam, *The Ganges Water Dispute : Its International Legal Aspects*, UPL, Dhaka, 1982, p. 2.

43. See for details, B. M. Abbas, *op. cit.* pp. 10-11.

44. See for details, B. M. Abbas, *op. cit.*, pp. 29-66. M. Rafiqul Islam, *op. cit.*, pp. 102-129.

particular 10-day period the flow at Farakka came down to such a level that the share of Bangladesh was lower than 80% of the stipulated share, the release to Bangladesh during that 10-day period shall not be below 80% of the quantum shown in the schedule.⁴⁵ Meanwhile, it was agreed upon that in the course of three years of this interim agreement, the Joint River Commission would conduct a study and report on the techno-economic feasibility of a suitable scheme or schemes which could be implemented for augmentation of Ganges dry season flow at Farakka to satisfy the requirements of both the countries as a long term solution to the dispute.⁴⁶

The 1977 agreement expired on November 1982. In October 1982, a Memorandum of Understanding (MOU) was signed between the two countries as an interim arrangement for the sharing of the Ganges water for the next two dry seasons instead of renewing the 1977 agreement. Under the MOU the 80% guarantee clause for Bangladesh was dropped which meant that India could now withdraw any amount of water from the Ganges. The MOU also expired in May 1984.

The present position is that there has been a deadlock. Both India and Bangladesh came up with their respective versions of long term solution of the problem, neither of which is acceptable to the other side. Bangladesh proposes to augment the dry season flow of the Ganges by conserving a part of its monsoon flow through construction of storage dams in the upper reaches of the river system lying in India and Nepal whereas India proposes to divert the water of the Brahmaputra into the Ganges above Farakka through a

45. B. M. Abbas, *op. cit.*, p. 7.

46. M. Rafiqul Islam, *op. cit.*, p. 7.

link canal across Bangladesh. Bangladesh rejected India's proposal on the ground that the link canal would divide Bangladesh, it would take away much of her precious land and also cause a damage to the ecological balance of the country.⁴⁷ A huge chunk of the land will be isolated from the main land since both the ends of the link canal will be within the territory of India which would give India added military advantages over Bangladesh in case of an exigency. It would also push the line of defence of Bangladesh more inside her territory. On the other hand India rejected the Bangladesh proposal on the ground that India, as a matter of policy, would not accept the inclusion of the third party, Nepal.⁴⁸ Moreover, it would open the door for the involvement of external funding agencies like the World Bank which was not acceptable to India.

Adverse effect of unilateral conduct of the upper riparian has fallen on Bangladesh to an extent which cannot be measured in terms of compensation. Abrupt changes are marked on the physical features, economy and social life of Bangladesh,⁴⁹ which are posing enormous threats to the country. We now turn into these impacts.

I. B. 2. *Impact of the Ganges Water Problem*

a. Change in Hydrology

Due to the diversion of the Ganges water there has been a change in hydrology in Bangladesh. The water level at Hardinge Bridge

47. Nurul Islam Nazem and Mohammad Humayun Kabir, "Indo-Bangladesh Common Rivers and Water Diplomacy", *BISS Papers*, No. 5, December, 1986, p. 11.

48. *Ibid.*

49. *Ibid.*

has fallen below the minimum ever recorded, i.e., 23,000 cusecs as compared to a historical average of 64,430 cusecs.⁵⁰ The water level registered at 17 feet compared to 22 feet while the ground water level has been has been fell by 5 feet.⁵¹ The off-take of river Gorai, the main distributary of the Ganges is at the point of extinction due to heavy siltation.⁵²

The consequence of hydrology change due to upstream diversion are as follows :

1. Siltation and rise of river beds leading to flood, demolition of river embankment, changed river course;
2. Decreased soil moisture and salinity leading to desertification;
3. Decreased water level leading to problem of agriculture, industry, navigation, fishery and domestic use ;
4. Decreasing upstream flow leading to saline intrusion in the coastal areas and damages to the mangrove forest;
5. The overall effect in the changed weather pattern.

a. i) Flood

Apart from deforestation and melting of ice in the upper region, the barrage contributed to a great extent to the flood in Bangladesh. Diversion of the silt free water into the upstream pushes a large volume of silt into the rivers downstream and thereby decreases the carrying capacity of the rivers. It has been shown in a study that 30%

50. Khurshida Begum, *Tension over the Farakka Barrage : a Techno-political Tangle in South Asia*, UPL, Dhaka, 1987, p. 131.

51. *Ibid.*

52. See for details, Khursida Begum, *op. cit.*, pp. 131-135.

of the country is subject to flood due to spillover from major rivers while the flood from small rivers cover about 40% area of the country.⁵³ The major rivers carry about 2.4 billion tons of sediments annually resulting in gradual deterioration of morphological characteristic of the rivers.⁵⁴ More than 80% of the flood run off is brought from outside the country of which 90% is contributed by the major rivers.⁵⁵ According to a conservative estimate the damage due to flood is well over \$ 158 million a year on an average (in terms of damage to crops and properties)⁵⁶. The loss of life and human suffering is beyond any measurement.

a. ii) Desertification

The process of desertification in the northern part of the country has been initiated largely by depleting soil moisture and increasing salinity. After the cessation of the monsoon rain, the occasional rainfall is not sufficient for agriculture and irrigation is entirely dependent on surface flow of water which reach to its lowest due to upstream diversion. It has increased the soil salinity in 21 districts of the country by 40%.⁵⁷ As a result, the experts apprehend more than 1.20 crore acres of cultivable area in as many as 21 south-western and northern districts of the country may turn into vast expanse of desolate arid land.⁵⁸ The lowering moisture context of soil is a sure

53. Md. N. Huda and J. U. Chowdhury, "Flood and Erosion", Paper presented at a Regional Conference on Floods and Erosion, Dhaka, 7-10, September, 1989. p. 9.

54. Manirul Qader Mirza, *Holiday*, July 4, 1986, cited in *BIISS Papers*, *op. cit.*, p. 31.

55. Amjad H. Khan, "Flood : Problems and Prospect—A Regional Overview", Keynote Address on a Regional Conference on Flood and Erosion; cited in *BIISS Paper*, *op. cit.*, p. 31.

56. Manirul Qader Mirza, *op. cit.*, cited in, *BIISS Paper*, *op. cit.*, p. 31.

57. *Bangladesh Observer*, November 7, 1989.

58. *Ibid.*

sign of desertification. The timing of the critical point of moisture (lowest percentage of moisture in the soil), usually recorded in April or May before 1975 has come forward over the last few years to February.⁵⁹ It has squeezed the land and the volume of Robi crop production in the greater Rajshahi, Pabna, Kushtia, Faridpur, Jessore, Khulna and Barisal districts. Rise in the surface water salinity and soil intrusion salinity in the districts served by Padma will force a change in the usual cropping pattern in those districts.⁶⁰ The course of the four rivers of Padma, Mohananda, Punarbhaba and Pagla consists of 123 miles of which 27 miles are now closed due to shoals.⁶¹ Sometimes local boats become inoperative in some areas. The people of the Rajshahi district often experience such dust storm that totally disrupt normal life, which is a most unusual occurrence in a riverine country.

a. iii) Salinity

Intrusion of salinity in the coastal area is another adverse effect of Farakka. The most affected are those areas which are subject to the tides of the Bay of Bengal that occur twice a day. The saline intrusion is normally ousted by strong upland flow. Due to upstream withdrawal in the dry season flow of the Ganges, Gorai-Madhumati receives very insignificant flow to check salinity. As a result salinity front penetrates further inland in the region.⁶² In 1968 the minimum discharge of water at the Hardinge Bridge was 58,800 cusecs and the salinity of the Passur river was 1000 micromhos per centimeter. In 1976 the water level of the bridge came down to 23,200 cusecs whereas the salinity of the river increased to 1,36,000 micromhos.

59. *Ibid.*

60. *Ibid.*

61. *The Shangbad*, (in Bengali), April 25, 1988.

62. Nazem and Kabir, *op. cit.*, p. 33.

In 1982 the water discharge was 31,400 cusecs and the salinity decreased to 11500 micromhos/cm.⁶³ This shows the relationship between the flow of water from Ganges and the level of salinity. To keep the salinity to a permissible limit (below 500 micromhos/cm), the minimum Ganges flow at Hardinge Bridge should be about 78,000 cubic feet per second (cfs.), which is very close to the pre diversion average minimum flow in the Ganges.⁶⁴ Salinity in the Passur and Sibsa estuaries reaches the maximum during the months of April and May. The 500 micromphos line engulfed an area of about 27,600

Table 2. Area Engulfed by Salinity of Different Concentration

Salinity Concentra- tion Micro mhos/cm	Prior to 1971 Max Area in 10 ² sq/km.	Area Engulfed During the Year in 10 ² sq/km.							
		1983	1982	1981	1980	1979	1978	1977	1976
500	186	276	246	227	243	223	215	238	263
1000	163	195	187	167	186	184	183	184	223
2000	135	170	158	149	168	163	161	153	202

Source : Ainun Nishat and Shahjahan Kabir Chowdhury "Water Quality : Problems and Needs for Integrated Control in Bangladesh", a paper presented at the Regional Symposium on Water Resources Policy in Agro-Socio-Economic Development, Dhaka, 4-8 August 1985.

63. Z. Karim, S. M. Shaheed, *et. al.*, *Coastal Saline Soils and Their Management In Bangladesh*, Bangladesh Agricultural Research Council, Dhaka, p. 2.

64. A. Hannan, *op. cit.*, cited in *BISS Paper op. cit.*, p. 33.

square km during 1983 which has surpassed all the line of same concentration in other years.⁶⁵ In 1983, the 500 micromphos line reached about 13 km north of Kamarkhali and penetrated upto 300 km inside from the Passur mouth.⁶⁶ Salinity obvserved at Khulna topped all past records, reaching 17,100 micromphos in April, 1983.⁶⁷ Figure 3 illustrates the situation.

a. iv) Forest

The world's largest single tract of mangrove called the Sundarban forest is located in the extreme southwest portion of the Ganges basin. With the withdrawal of Ganges water, the Sundarban also fell a victim to process of desertification due to increasing rate of salinity and frequent drought which hampered the generation process of the local flora.⁶⁸ Sundari trees, after which the forest was named, are now in the process of extinction.

a. v) Water Pollution

Apart from increased salinity, another major source of water pollution is the unprocessed wastes thrown in the Indian part of the Ganges. The huge amount of waste of the four thousand towns of India through the Ganges is having an adverse effect on the environment of Bangladesh and is contributing to the health hazards. Corps, dead animals and factory wastes are all thrown in the Ganges. By the side of the river there are about 150 large factories of which 81 are Jute mills, 18 cotton mills, 7 tanaries, 5 paper mills, 4 fertilizer factories, 8 distilleries and 8 thermal power stations.⁶⁹ Apart from

65. Ainun Nishat and Shahjahan Kabir Chowdhury, "Water Resources Policy for Asia", a paper presented at a Regional Symposium on Water Resources Policy in Agro-Socio-Economic Development, Dhaka, 4-8 August, 1985.

66. *Ibid.*

67. *Ibid.*

68. *Bangladesh Observer*, November 7, 1989.

69. *Desh*, (Monthly Journal, Calcutta), June 18, 1988, p. 34.

these there are many small factories producing colour, rayon, acid and drugs. The wastes thrown from all these factories⁷⁰ are having an adverse effect on the marine life and people living by the side of the river in the downstream. The amount of waste from melted inorganic carbon was 12.6 million tons and from organic carbon about 2 million tons in the meeting point of Ganga and Brahmaputra which increased to 15 million and 2 million tons respectively in 1984.⁷¹

b. On the Economy

The combined effect of siltation, soil erosion, decreased level of surface water and increased salinity is so grave for Bangladesh that stability of the country is at risk. Sectors like agriculture, industry, navigation, aquaculture of the northern as well as south-western part of Bangladesh has been suffering serious setbacks.

Of the total net cropped area of 6.85 million acres, 1.57 million acres are partially or fully affected. This amounts to 22.92% of the net cropped area.⁷² During the dry season of 1976 alone, over four hundred acres of land were affected due to soil moisture deficiency and increase of salinity and approximately 33% of the irrigation facilities could not operate because of the decreased availability of water. Rice production alone fell short by 236,000 tons or 20% of Bangladesh's food import.⁷³

Irrigated crops usually suffer more from shortage of water. The area damaged due to water shortages in the year 1988-89 was 38,449

70. *Ibid.*

71. *Daily Inquilab*, (Bengali Daily, Dhaka), August 6, 1988.

72. A. Hannan, "Impact of Reduced Low Flow of the Ganges" a paper presented at a seminar organised by the Department of Water Resources Engineering. BUET, August 23, 1980, p. 11.

73. Government of Bangladesh, *White Paper on the Ganges Dispute*, September, 1976, p. 8.

hectares as against 11,215 hectares of the year 1987-88.⁷⁴ The total area affected due to moisture depletion was 59,129 ha. which was 13,216 ha. more than the previous year. B. Aus variety of rice was the worst affected crop and sustained yield loss was about 37%.⁷⁵ Intrusion of salinity in the soil imposes limitation on the cultivation of crops. Vast areas remain fallow during dry season. The area affected in the year 1988-89 due to salinity was 43,254 ha. against 8218 ha. of the previous year.⁷⁶ The value of the total production loss of the Ganges dependent area has been estimated as Tk. 2895 million or US\$ 85 million in the year 1988-89.⁷⁷ Therefore, it is clear that the production as well as financial loss is increasing day by day.

Apart from decrease of surface water, agriculture is also disrupted due to alternate flood and drought. The main sources of flooding in Bangladesh are spill over from rivers, drainage congestion of local run off due to extremely flat nature of topography, storm surge and tidal blockage.⁷⁸ The major rivers carry about 2.4 billion tons of sediments annually resulting in gradual deterioration of morphological characteristic of the rivers.⁷⁹ Since the water of Ganges enter into Bangladesh after flushing the Calcutta port, large volume of silt enter through the river and the river beds of the south western region are rising gradually making the area prone to flush floods. In the Ganges

74. Information received from a concerned office under Bangladesh Water Development Board.

75. *Ibid.*

76. *Ibid.*

77. *Ibid.*

78. M. N. Huda and J. U. Chowdhury, *op. cit.*, cited in *BISS Papers*, No. 5, *op. cit.*, p. 30.

79. Manirul Qader Mirza, *op. cit.*, cited in *BISS Papers*, *op. cit.*, p. 33.

dependent area about 240,929 hectares of land has been affected due to 1988 flood.⁸⁰ The crops damaged are mainly B. Aman and T. Aman types of rice and Sugercane, etc. Yield loss varies from 100% to 39% in case of T. Aman. The most seriously affected districts are Faridpur, Madaripur, Gopalganj and Rajbari.⁸¹ It is worth noting that 10 years ago the Ganges had only one entry point into Bangladesh, but now it enters at two different points having a curved course of about 12 km in the Indian territory.⁸² Experts view that it is mainly due to diversion of silt free waters in the upstream and pushing a large quantity of silts into the Ganges in Bangladesh.

The drought situation is critical in the south-western region because after the cessation of monsoon rain usually by October, occasional rainfall are not sufficient to eradicate soil moisture deficit. The possible measure against drought is supply of water from surface flow. But due to upstream withdrawal river flow dwindles down in the dry months. As a result aridity increases and the lands become parched.

Due to low water level resulting from reduced flow of water, irrigation pump lifts have significantly been increased at the Ganges-Kobadak pumping station at Bheramara during 1988-89. Dredging of the intake channel was required for which an amount of about Tk. 10 million was incurred for the said purpose.⁸³

The offtake of Gorai closes every year and repeated dreading of Gorai is required every year. An amount of Tk. 15 million (including Tk. 5 million for Food for Work Programme) was spent for

80. BWDB source, *op. cit.*

81. *Ibid.*

82. *Bangladesh Times*, April 30, 1985.

83. BWDB source.

the clearance of the silt during 1988-89.⁸⁴ The command area of the G. K. project is about 141,700 ha. of which 16200 ha. of land could not be provided with irrigation for which an amount of Tk. 405 million has been estimated to be lost in terms of food production.⁸⁵

The reduced water availability significantly limited the landing of fish probably because of disturbance of the historic food chain and inability of the fish to tolerate shallow depth and unprecedented level of salinity. After completion of the Farakka Barrage in India, fish landings (Hilsa specially) in upstream were reduced more than 90%.⁸⁶

The Government of Bangladesh claimed that the forest of Sundarbans which provides raw materials for newsprint mills, paper mills, match factories, furniture factories and all varieties of construction activities is affected by salinity causing a heavy loss which would be in fact irreparable.⁸⁷ The White Paper states, "the forest is graded on a three tier quality standard with the quality and yield directly correlated with the soil salinity. The yield difference over a 20 year growing cycle between quality 1, the bulk of the Sundari (the principal tree of the forest), and quality 3 is 740 cubic feet per acre. Such a reduction in yields would naturally affect 45,000 people directly employed in clearing the forest as well as existing and future industries which are and will be dependent on the forest products."⁸⁸

84. *Ibid.*

85. *Ibid.*

86. U.N. ESCAP, ST/ESCAP 618 : 'Coastal Environment Management Plan for Bangladesh', Vol. 2, *Final Report*, Bangkok.

87. Khurshida Begum, *op. cit.*, p. 143.

88. *White Paper*, *op. cit.*, p. 9.

According to a study by a concerned office under BWDB, in April and May, salinity in certain areas of the forest reaches its peak and ranges from 4000 to 8000 micromhos/cm.⁸⁹ Reduced water level and subsequent increased salinity have adversely affected the industrial sectors specially the thermal power stations and the paper mills situated in the south-western region of the country. After the commissioning of the Farakka Barrage, the Goalpara thermal power station had to be closed and though became operative after some time, the cost of running the station became much higher.⁹⁰

According to a concerned office of the BWDB, the financial loss of power generation due to reduced water level and increased salinity is about Tk. 30 million. The Khulna newsprint mill operated at half the capacity as the Chloride content of the water used for the mill increased by more than 20 times. Other industries also suffered equally.⁹¹ Although India contends that salinity level is always high in Khulna region and the increased level may occur due to human activities, the type of abrupt change that has appeared would result only when a massive human activity would have taken place in that area. But the fact is that no such unusual human activities took place in that area to make such a change in salinity level.⁹²

Navigation of this region also is affected seriously due to upstream withdrawal. According to the survey made by the

89. BWDB source.

90. "The Farakka Barrage", External Publicity Division, Ministry of External Affairs, Government of India, New Delhi, cited in Khurshida Begum, *op. cit.*, p. 143.

91. Government of Bangladesh, "Deadlock on the Ganges", p. 3, cited in Khurshida Begum, *op. cit.* p. 143.

92. See for details, Khurshida Begum, *op. cit.*, p. 145.

Bangladesh Inland Water Transport Authority (BIWTA), the sections of waterways most seriously affected are :⁹³

a) Ganges River : Upstream of the confluence of the Ganges with Jamuna River;

b) Gorai River : at and also from its off-take point from Ganges-Kumarkhali, and

c) Madhumati River : downstream of Kumarkhali.

Immediately after the commissioning of the Barrage, Bangladesh Government pointed out the critical condition of navigation : Ninety miles of navigation routes on the Ganga (from Godagari to Aricha) went out of commission, (so also) 45 miles on the Gorai and 15 miles on the Padma. In addition to these three specific reaches, navigation throughout the entire region was hampered.⁹⁴ Although India contends that the route is negligible in transportation and a little dredging will solve the problem⁹⁵ the real picture is totally different. Water route in the south-western region is very important in the economy of the country. At certain point like Barisal, no railway system is possible because of numerous water outlets. Moreover, dredging on the river Padma where siltation is very high, is costly, time consuming and not feasible at all. River Padma, on which the entire south-western region is dependent is becoming dry at an incredibly fast rate. The livelihood of thousands of fishermen and boatmen are at stake. BIWTA source reveals the most seriously affected areas as below.⁹⁶

93. BWDB source.

94. *White Paper on Ganges*, *op. cit.*, p. 9.

95. Khurshida Begum, *op. cit.* p. 145.

96. BWDB source.

Table 3. Areas Most Seriously Affected by Farakka

Draught level measured in metres

River	Reaches	Indicated draught	Minimum draught available in 1987-88	Minimum draught available in 1988-89
Ganges	Godagari to Paksey	1.37	Closed (draught in less than 0.91)	Closed (draught is less than 0.91)
	Paksey to Aricha	1.83	Closed (draught in less than 0.91)	Closed (draught is less than 0.91)
Padma	Daulatdia to Tapura-kandi (Now C&B Ghat).	-do-	-do-	-do-
Gorai Madhumati	Off-take to Bardia	1.37	-do-	-do-
	Bardia to Khulna	1.83	Open to vessels with draught at 0.91 or less.	Open to vessels with draught at 0.76

The routes in the Ganges-Jamuna confluence have deteriorated in particular and caused difficulties in the operation of the ferry services linking the east and west zones of Bangladesh due to extra fall in water levels and consequent development of shoals. For main-

tenance of Ferry services, BIWTA had to carry out extensive dredging and frequent construction of ferry terminals involving a huge cost.

Table 4. Dredging cost for the year 1988-89 :⁹⁷

Sl.	Name of Shoal	Name of river	Area/000m	Cost (million taka)
1.	Daulatdia Ferryghat Basin/Channel	Padma	459	13.71
2.	Khapura	Jamuna	138	3.55
3	Aricha	Jamuna	157	5.38
4.	Char Safulla	Jamuna	114	3.37
5.	Nagarbari	Jamuna	35	0.64
6.	Bhuapur	Jamuna	301	8.33

Table 5. Cost for construction and maintenance of ferry terminals due to frequent shifting of terminals for the years 1988-89 :⁹⁸

Sl. No.	Name of ferry terminals	Cost in million taka
1.	Aricha	1.66
2.	Nagarbari	.74
3	Daulatdia	.82

From the above picture it is apparent that the economic life of the south-western and north-western regions of the country as well as the entire country is disrupted largely due to unilateral diversion of

^{97.} *Ibid.*

^{98.} *Ibid.*

the historical flow in the downstream area. It has become more pronounced from 1987 because from that period there is no agreement on water sharing between the two countries which allowed the upstream country to divert as much water as it wants. Experts believe that almost 91% of the Ganges flow have been diverted by India leaving only 9% for the lower riparian. Due to the decrease of surface water flow in this region by 85%, the irrigation is dependent on the ground water but that has also reached to the saturation point. The consolidated loss on different sectors for withdrawal of water of the Ganges is estimated to be about Tk. 300 million per year.⁹⁹

c. Impact on Socio-political Life

Ganges issue always played an important role in socio-political life of Bangladesh. The fluctuating and decreasing river flow has not only disrupted the environment and economy of the south-western as well as north-western regions but also disrupted the social stability. Land degradation of millions of acres have made thousands of people unemployed. Apart from agriculture, industry, navigation, fisheries and various other sectors, large number of people who depend for their survival on these sectors have also been affected very seriously. Growing food deficit, rising food prices, increasing unemployment as well as inflation are associated with the problem. The economy as a whole is deprived of the possibility to take a course of stable growth. Being subject to social injustice and maltreatment, the people carry with them a feeling of antagonism against the source of their misfortune, i.e., the developmental activities undertaken by the neighbouring countries.

99. Information received from a concerned expert in an interview.

The issue has political implications too. Government's failure to resolve the problem with India is always a matter of public resentment. The politicians of Bangladesh knowing very well the prevalence of this feeling among the general mass, tried to capitalize on this. "Solution of Farakka barrage problem" is one of the common issues in the political activities in Bangladesh. But the irony is that for any government in power, effort to solve the problem is constrained by Indian principled position of bilateral rather than regional and comprehensive approach. As a result anti-Indianism continues to grow among general mass which instead of solving the problem further complicates it.

Another side of the picture is that for any government in power in Bangladesh, Farakka Barrage issue is most sensitive in its relationship with India. Since the amount of water of Ganges to be flown in Bangladesh is absolutely within the control of the upper riparian, i.e., India, it gives her a leverage over Bangladesh. The water sharing problem made Bangladesh very much vulnerable which in turn provides the imperatives for her to live with India rather than annoying her. Therefore, the geographical location of the country and transborder implications of environmental degradation are not only affecting the security of the country by disrupting economic and social life but also by increasing her vulnerability to the giant neighbour.

I. C. Challenges at the National level

Within the boundary of the country too Bangladesh is exposed to various challenges because of fast rate of environmental degradation. The booming population and chronic poverty of the country are seriously affecting the limited natural resources as well as the ecological balance. Overuse and improper use of the limited natural resources have already had their impact on the welfare of millions

of people, threatening their food security and quality of life¹⁰⁰ and impeding the developmental process.

Thus, while population pressure has contributed to the overuse of natural resources, poverty has induced to address short term needs even if such action contribute to the long term depletion and degradation of the resources. The combined effect of these two factors are going to be so serious on the fragile eco-system that the existence of the country could be threatened. Over half of the forest land of Bangladesh has been cleared in the past 20 years and tree cover now amounts to only less than 6% of the total land area. A majority of the households are already without sufficient arable land to raise enough food to meet their needs; the fallowed stocks have been depleted and diminished to the point where over 84% of the total domestic energy requirements must be met by drop residues and particularly when one considers the projected population level of the year 2000 and beyond, it does appear that population density has clearly outstripped the potential for sustained production of fuelwood for domestic energy consumption from existing sources of supply.¹⁰¹ Fishery production have declined by 20% in the recent years.¹⁰² Large scale deforestation on the one hand is denying the opportunity of regeneration of forest, on the other, reducing the ground water level, destroying the moderating effect of weather and increasing soil erosion. In short, eco-system is crossing the sustainable level at a high rate. Figure 4 shows the major areas of environmental concerns within the

100. "Bangladesh Environment and Natural Resources Assesment", Final Report prepared by the World Resources Institute, Centre for International Development and Environment, Washington, U.S.A., 1990, p. 2.

101. *Ibid.*

102. *Ibid.*

national boundary and Annex 1 illustrates the situation. The various domestic factors contributing to environmental degradation are discussed in details as follows :

I. C. 1. *Population and Socio-economic Factors*

Population is the most important factor in determining the ecological balance in the developing countries like Bangladesh. Growing population means growing demand on natural resources. High population density has contributed to the overuse of land, forest, fisheries, energy, water, etc. From 1951 to 1981, the population of Bangladesh doubled from 44.2 million to 89.9 million. Present population is estimated to about 110 million with projections of 140 million by the year 2000. A population growth rate of 2.17% is putting tremendous pressure on already limited resources.

Agriculture and fisheries are the main source of livelihood of the people (60.4%), followed by manufacturing (9.8%) and construction (3.1%). But there is sharp and continuous decline of the most vital economic sector, i.e., agriculture. Growing fragmentation of land tenancy, share cropping, unscientific farming system, uncertain and inadequate rainfall, lowering ground water level etc., have contributed to the reduction in per acre yield as well as profit from this sector.

Education is very important in sound resource development but in Bangladesh literacy rate is one of the lowest in the world averaging 29.2% of the population. Moreover, there is disparity between urban literacy rate (34.8%) and rural rate (17.0) and between male (39.7%) and female rate (18.8%).¹⁰³ Low level of literacy is very detrimental

103. BARC/IUCN-1989; cited in P. B. Dean and Wit Treygo, "The Environment and Development in Bangladesh; An Overview and Strategy for the Future", report prepared for Asia Branch, CIDA, October, 1989, p. 5.

to successful implementation of social programmes like family planning, health and nutrition. Under these conditions awareness of the people on environmental issue is low and public participation in, or contribution to conservation is limited.

Most health problems that relate to the environment arise from contaminated water, either ground water or surface water. In urban areas only 26% of the households have access to tap water and the rest depend on canal, pond, river, etc., which are highly polluted. Supply of drinking water from tubewells is 53% in rural areas and the rest is from river, pond, canals whose water quality is far below drinking standard. All the solid wastes in the urban areas are thrown on the water bodies in an untreated form, so also the toxic chemical wastes and organic wastes.

Both in urban and rural areas, water bodies are the natural toilet to people because of acute shortage of sanitation system. As a result diarrhoea, malaria and other water-borne diseases are spread very rapidly. This becomes further intensified during flood and other natural disasters.

Urbanization has various environmental as well as socio-economic consequences. The census of 1981 revealed that 15.5% of Bangladesh's population was urban i.e. 15 million people in 500 urban centers. But this number is increasing at the rate of 6.5% which is putting additional stress upon an already strained system.¹⁰⁴ It also signified a tremendous increase for a country that had less than 3% urban population at the beginning of the present century. During 1950s, Bangladesh experienced a 45% increase in its urban population and in 1974-81 an increase of 115% with the projection

104. "Bangladesh Environment and Natural Resource Assessment", *op. cit.*, p. 22.

of 35-40 million people by the year 2000, i.e., an increase of over 20 million people.¹⁰⁵ Providing space for the newly emerging urban centers has already put pressure on agricultural land. Forest resources and fisheries in the vicinity of the urban centers are becoming over-exploited. Housing shortages cause urban dwellers to live in high density units often without proper municipal facilities. The density of population in Bangladesh is 700 per sq. km. but the number is 1300 in case of Dhaka. Living conditions among the urban poor are directly linked to their deteriorating health and nutritional states. Housing for migrants to urban slums consists of the barest necessities only. There is acute shortage of drinking water, proper sanitation and air circulation. These are closely linked to the spread of water-borne diseases. Continued filling of canal and ponds in the urban areas to create more land is also reducing access of the urban poor to water for washing and other uses. The incidence of diseases among them is high. The overall infant mortality rate in a central slum area of Dhaka is 152 per 1000, compared to the national average of 124 per 1000.¹⁰⁶

I. C. 2. *Water*

Water is highly important in maintaining ecological balance. The rain water and the flood water seep into the soil to enrich the underground aquifers. *Haors and beels* apart from providing spawning ground for fish and winter habitat for the migratory birds, act as a 'sponge' to absorb the water and slowly release it during dry season recharging reservoir and groundwater level. The river waters carry a huge volume of sediments which during the flood are spread

105. *Ibid.*, p. 23.

106. *Ibid.*

by the side of the river and settles down after the flood water subsides, thus fertilize the soil. Another important function of water, both on the surface and underground is to push back the intrusion of saline water inland.

Bangladesh is generally known as an area of abundance of water. However, due to seasonal variation in hydrological conditions there is too much water during monsoon whereas too little during winter. Usually 18% of the country is submerged during normal flood, while 36% of the country, equivalent to 60% of the net cultivable area, are submerged during severe flood years.¹⁰⁷ On the other hand, during dry season the water becomes scarce not only on the surface but also in the ground. Peak discharge during monsoon season for the Brahmaputra, for example, is 121,000 cubic meters per second which drops to 3,650 in the winter.¹⁰⁸

Due to the increased demand for foodgrain production, domestic and industrial water supply and better living environment, the utilization and control of water for irrigation, water supply and drainage and flood protection has drastically increased in recent years. These have consisted of many highly dispersed, self-contained small projects designed to meet urgent local demands without a cohesive planning based on overall national requirements, hence likely to result in undesirable and even disastrous impact on the river system.¹⁰⁹ Moreover, embankments, road construction, drainage channel, etc., have all changed the normal flow pattern affecting fish reproduction. The direct loss of fish harvest has been estimated at 37 kg/ha.¹¹⁰

107. BARC/IUCN - 1987; cited in P.B. Dean and Wit Treygo, *op. cit.*, p. 8.

108. P. B. Dean and Wit Treygo, *op. cit.*, p. 10.

109. Ainun Nishat and Shahjahan Kabir Chowdhury, *op. cit.*,

110. ESCAP, ST/ESCAP 618; Cited in P. B. Dean and Wit Treygo, *op. cit.*, p. 9.

Forest vegetation in the Barind tract in the north-west and in the Modhupur Tract in north of Dhaka, has been greatly reduced thereby decreasing the amount of water held by the surface soil and reduced percolation in the aquifer. *Haor* and *beel* areas of the Ganga-Brahmaputra floodplain are being converted into agricultural land. In the absence of these water pockets and due to deforestation, ground water level has gone lower and there is continuous evidence of dug wells to go dry specially in the north-west, north-east and further south in the Meghna delta. Moreover, due to reduced ground water level, regeneration of natural vegetation is becoming very difficult. The roots of the natural vegetation in this area were adapted to a groundwater level of a particular depth. If the level parmanently goes deeper and if the vegetation can not adapt to that new level, it will die and be replaced by a different community of plants.¹¹¹

Reduced water flow, both on surface and groundwater, allowed saline water to intrude inland. Presently, over 10,000 square miles of agricultural land, i.e., 2.8 million hectares are affected by salinity. Saline intrusion in the north-western region which is mostly dominated by Ganges system has been shown in the previous chapter. Salinity in the Meghna estuary is not a problem at the moment but it is feared that the salinity limit may advance further inland if fresh water supply is reduced.

Another major source of water pollution is the disposal of wastes in the water bodies in untreated form. The large volume of effluent generated daily by polluting industries in urban areas such as Dhaka, Chittagong, etc, contain both degradable and persistent organic

111. P. B. Dean and Wit Treygo, *op. cit.*, p. 10.

and inorganic wastes and toxic metallic compounds and chemicals. Most of the country's rivers are affected by this type of pollution.¹¹² Pollution by toxic chemicals and industrial wastes further aggravate during floods.¹¹³

Oil is another major pollutant of the marine system. Nearly 1,000 ships, including 50 oil tankers ply the water of Chittagong harbor every year, not to mention countless small crafts. All these ships are permitted to discharge ballast water and bilge washings, a policy which makes Bangladesh an exception to world maritime practices.¹¹⁴ The ports do not provide any facilities, to dump those wastes. The country also does not possess adequate petrolling system. As a result, toxic wastes from developed countries could be dumped in the Bay of Bengal without notice.¹¹⁵ Another dimension of the problem is that since Bangladesh has not ratified most of the Conventions and Protocols dealing with pollution she cannot take any action even if any accident or spillage of oil occurs within her territorial limit.¹¹⁶

I. C. 3. *Land use and Agriculture*

Unsustainable land use practice and unscientific cultivation methods are having their impacts on the environment negatively, through soil erosion and reducing soil fertility.

Agriculture is the major land use activity. Rain deficiency and unpredictability have made agriculture largely dependent on irrigation.

112. Ainun Nishat and Shahjahan Kabir Chowdhury, *op. cit.*

113. Nahid Islam, "Marine Pollution : Effect and Management", *BIJSS Journal*, Vol. 11, No. 3, 1990, pp. 411-412.

114. "Bangladesh Environment and Natural Resources Assessment", *op. cit.*, p. 24.

115. Nahid Islam, *op. cit.*, p. 412.

116. *Ibid.* pp. 413-414.

Various flood control, drainage and irrigation projects are affecting other sectors like fisheries. During dry season, surface water flow reduces and numerous deep tubewells are sunk in an attempt to ensure year round irrigation but this has contributed to the lowering of ground water level.

In many areas, where ground water have lowered greatly, agriculture has to depend on rain water during monsoon. As a result, the land is left exposed for the other half of the year. The top soil of this dry land is blown away by wind together with the nutrition of the soil. When rain water flows on such exposed land, it not only washes away the top soil but also helps the minute soil particles to enter inside the land and create an inaccessible layer sealing off all the gaps. Since the rain water cannot enter that inaccessible layer, all the rain water flows over it very quickly taking away all the top soil. In this way, vast areas of the Barind region are facing soil erosion at an incredibly fast rate. Weather in that area has also become extreme as in desert, i.e., dry and hot during daytime and cold at night. Dust storms have also been reported.

Slash and burn agriculture is being practiced in the Chittagong Hill Tracts. However, the long time required between cultivation to allow the forest to regenerate is no longer possible because of growing population pressure and need for land. The exposed slopes are subject to increased soil erosion.

Fragmentation of land is another contributing factor to soil erosion as well as declining soil fertility. Side by side with fragmentation, increasing landlessness is inducing people to destroy forests, wild habitats and to get hold of the marginal land.

To meet the short term needs of the growing population, the lands have been deprived of the foodgrain gap or alternate cropping to retain soil fertility. Continuous rice cropping is depleting organic matters and is leading to sulphur and Zinc deficiencies.

Another important factor that is declining the productivity and soil fertility is absence or low rate of fertilizer use in the agricultural land. Poor farmers often cannot afford to buy agrochemicals, or if they do, often fail to use it properly. As a result, it goes into the water bodies and pollute the water. A natural alternative to chemical fertilizers is organic and animal residues. Because of severe fuel shortage, cow dung is collected, dried and used at home or sold for fuel. A World Bank study estimated that only about 50% of animal dung was used as fertilizer.¹¹⁷ Straw is fed to livestock. In short, very little natural organic matter or nutrient finds its way back to the soil. According to the 1986 UNDP/ADB report, agricultural residues, wood and tree litter and dried cow dung provided 66%, 18% and 16% respectively of the energy derived from traditional biomass fuels in 1981.¹¹⁸ Another reason of declining soil fertility is that various flood control projects are denying the land of the flood water required to submerge the land for the limited period to allow the alluvium to settle. Flood control projects should be planned in such a way that normal flooding is allowed.

I. C. 4. *Forest*

Forest is very important in maintaining the balance of nature. Forest provides valuable wild -life habitat, controls erosion, and is

117. "Bangladesh Environment and Natural Resources Assessment", *op. cit.*, p. 21.

118. *Ibid.*

the primary source of fuelwood for domestic energy. It also provides protection from storm surge and cyclons on the coast.

To maintain the balance of the nature there should be at least 15% to 20% area of forest land of the total land area of a country. But in Bangladesh as already mentioned actual forest cover is approximately 1 million hectares i.e. 6% of the total land area. With a population of some 110 million people, Bangladesh has less than 0.02 ha. of forest land per person, one of the lowest such ratios in the world.¹¹⁹ It is primarily the result of dramatic increase in population and their need for land and fuel.

Hill forests are very important for the protection of watershed areas. The Kaptai hydropower project has dammed the river Karnaphuli to create Kaptai lake. The forest conserves the hydrologic cycle maintaining water flow for the dam and preventing soil erosion from silting in the reservoir. But the creation of dam opened the area to the settlers and forced the villagers to move up the hillsides. Over the years, forest areas have been shrinking and degrading due to shifting cultivation, encroachments, land alleviation, fire and logging. As a result, Kaptai lake is silting up. It is believed that one of the reasons for the recent cyclone and the storm surge to cause so much damage is the large scale deforestation in the Cox's Bazar and Hill Tracts areas.

The Sundarbans in Bangladesh together with the adjacent Indian Sundarbans form the largest mangrove ecosystem in the world. The importance of an intact Sundarbans ecosystem is considerable as it

119. *Ibid.* p. 19.

protects human settlements in adjacent areas from the ravages of cyclones. The Sundarbans ecosystem is also important in protecting adjacent inland groundwater from salinization. This is vital to agricultural production and drinking water supplies in these areas.¹²⁰ Moreover it is a huge reservoir of oxygen, consumes pollutants of the air, acts as a moderator of climate and protect the coastal area from erosion. It is a wonderful assemblage of flora and fauna, home to the world's largest populatin of Royal Bengal Tiger and the globally endangered estuarine crocodile.

Decreased freshwater inflow and increased salinity as well as water pollution on the one hand, and over-exploitation of the forest resources on the other, have produced such serious consequences that this delicate ecosystem is threatened to destruction. Unless appropriate measures are taken this may totally imbalance the ecological equilibrium of the country as well as the region together with extinction of a large number of rare and endangered species and their habitats.

All these factors are denying the development of the country on the one hand and making the country exposed to all sorts of natural calamities on the other which destabilize the infrastructure of the country. Hence the country is subject to greater insecurity stemming from within the boundary of the country itself. Successive governments have met immediate needs, often overlooking long standing consequences. Every sector is linked with several other sectors which requires a comprehensive development planning and this has to a great extent been lacking in Bangladesh. It frustrates the development objectives and further damages the environment.

120. *Ibid.* pp. 27-28.

II

POLICY IMPLICATIONS: TOWARDS SUSTAINABILITY

Responding to the environmental challenges facing Bangladesh requires policy formulation not only within the national boundary of the country but also at the regional and global levels. Ecological concerns cannot be compartmentalized within sectors like energy, agriculture, trade or within broader areas of concern like environment, economy, security etc. These are all interlocking concerns and one cannot be dealt with in isolation from the others.

The inherent objective behind all environment programme and policies should also be sustainable development i.e., "to meet the need of the present without compromising the ability of future generations to meet their own need".¹²¹ Moreover, such development requires meeting the basic needs of all and extending to all the opportunity to fulfil their aspirations for a better life. That will require not only a new era of economic growth, but an assurance that everyone gets his share of the resources required to sustain that growth which is possible by the political system that would secure effective citizen participation in decision making, equal participation of all in international decision making, sacrifice by the rich nations to adopt life style with planets ecological means and so on.¹²²

121. *Our Common Future*, the report of the World Commission on Environment and Development, Oxford University Press, Oxford, New York, 1987, p. 8,

122. *Ibid.*

II. A. Global Measures

Since Bangladesh is going to be one of the first victims of global warming and sea-level rise, policies regarding the methods of slowing global warming is very much relevant to her.

The straight way to eliminate the greenhouse problem completely would be to return the world to its pre-industrial state. Since this is impossible, researchers are concentrating their efforts on slowing down the process of warming which will buy time for adapting to the changed climate. There are two aspects of such efforts : (1) to slow down the warming; and (2) to adapt to the changed climate.

II. A. 1. *Slow Down The Warming*

This may be done in the following ways :¹²³

- a. Reduction of Carbon-dioxide emission through using less coal by :
 - Finding more efficient ways to use clearer burning fossil fuel;
 - Manufacturing of more fuel efficient vehicles;
 - Shifting the mix of energy supply option away from such carbon intensive sources as coal and
 - Taking a new look at non-fossil alternatives, e.g., solar, hydropower, nuclear, etc.

123. See for details, Irving Mintzer, "A Warming World : Challenges for Policy Analysis", *Economic Impact*, No. 65, 1988/4, pp. 8-10; David A. Wirth, 'Climate Chaos', *Foreign Policy*, No. 74, Spring 1989, pp. 13-16.

b. Reduction of emission of other green house gases like methane, nitrous oxide and CFCs.¹²⁴

Greenhouse impacts should be an explicit part of all future decision making process in the energy sector. Traingular development of energy, viz., energy conservation, efficient technologies and renewable energy efficiency shall help reduce the emission of the greenhouse gases to a much lesser extent even though major economic growth are achieved.

c. Another method of slowing global warming is reduction of deforestation and mobilization for reforestation. Forests absorb greenhouse gases and contribute to climate stabilization. Policy formulation in this area shall require the following steps :¹²⁵

- Creation of general awareness as to the importance of forest and mobilize the people to reforestation;
- Evaluation of the developmental priorities of the government as well as the local government and to adopt a more responsible role towards forest preservation and reforestation;
- Taking initiative for high yielding food production and alternate energy source so that pressure to expand agricultural land or fuelwood demand is reduced;
- Providing assistance to the developing countries in achieving alternative energy, high yielding food production and so on;

124. *Ibid.*

125. See for detail, David A. Wirth, *op. cit.*, p. 16-19; also Sandra Postel and Lori Hoise, 'Resforesting the Earth', *Economic Impact*, No. 65, 1988/4, pp. 13-19.

- Bringing a change in the trade policies of the developed countries which will discourage import of tropical woods; and
- Adoption of policies like 'debt for nature swap'¹²⁶ by the donor agencies, financial institutions which will mobilize reforestation as well as preservation of forests.

d. Another approach towards slowing the global warming will require a multilateral treaty with standards binding under international law that would require each country to take prescribed actions to reduce and halve greenhouse warming.¹²⁷

II. A. 2. *Adapting to Climatic Change*

Undoubtedly, energy conservation, energy efficiency, reforestation and legal provision or multilateral treaties can slow the rate of climate change. Nonetheless, since climate change appears to be inevitable, it is important to explore the opportunities for adapting to unavoidable changes. Such adaptation cannot be universal but regional since warming will affect the various region differently.

a. One of the most likely impacts of global warming will be changes in the timing and distribution of regional precipitation, which in combination with changes in regional temperatures will cause reductions or increase in surface run-off, evapotranspiration (the evaporation of water from plants by way of the holes of leaf surfaces) and soil moisture.¹²⁸ To prepare for such changes, policy makers must modify water management practices and improve the

126. David A. Wirth, *op. cit.*, p. 20; also S. Fuller, "Debt For Nature Swaps : A New Conservation Tool", *Economic Imapct*, No. 65, 1988/4, pp. 39-44.

127. David A. Wirth, *op. cit.*, p. 20.

128. Irving Mintzer, *op. cit.*, p. 10.

efficiency of water use. Climate impact studies suggest that where demand for water is likely to increase in the future, less water will be available for agriculture and municipal uses. In the circumstances, increasing water storage capability and reducing seepage and evaporation losses may be critically important.¹²⁹

b. Another promising but equally difficult opportunity is to improve agricultural and forest management. Policies to spur the early development of heat and drought resistant seed varieties of major cultivar could reduce the risk of future losses from climate change. The challenge of course is to develop varieties that can withstand a broader range of environmental conditions without sacrificing current yield.¹³⁰

c. Until such advanced varieties can be achieved, alternative cropping patterns should be explored.

d. Another approach involves altering irrigation practices to improve the efficiency of water delivery systems. By increasing local storage capacity and shifting from flood or field type irrigation techniques to drip irrigation system (which deliver water to individual plants) farmers can minimize seepage and evaporation losses.¹³¹

e. Since the sea level rise will not be uniform everywhere, its monitoring will be important in concentrating efforts to minimize local damages. Additional detailed data collected with remote sensing techniques from existing satellites could be crucially important for identifying areas vulnerable to sea level rise. Once the location of new

129. *Ibid.*

130. *Ibid.*

131. *Ibid.*

flood plains have been established it is important to guide local planning and zoning decisions.¹³²

f. Cyclone preparedness system needs to be strengthened which would involve not only installation of satellites for correct weather forecasting but also to establish shelters in the areas more vulnerable to cyclones and storm surges.

II. B. Regional Measures

The contention over Ganges issue and other rivers as well as the impact of deforestation on Bangladesh have reached a delicate state. India's endeavour to take some calculated steps with a view to serving her own need is posing severe threat to Bangladesh including disturbance in the balance of nature. Bangladesh is geographically in a disadvantageous position which forced her to bear almost the sole burden of that disturbance in such a helpless way that her survival is at stake. The dispute on the Ganges as well as all other common rivers between the two countries are to be viewed in the context of implications for the socio-economic and environmental equilibrium. The political aspect of the problem has made it more and more complicated. The political primacy needs to be stressed while there is no denying that if political goodwill prevails on both sides a mutually acceptable solution can be achieved.

Complex tasks of conserving ecological balance, like afforestation, flood control, proper use of common rivers, etc., cannot be resolved in isolation from each other nor by any individual state alone. It should be realized by India that since the rivers of the region

132. *Ibid.*

are part of the same ecological belt, developmental activities done in one part of that belt are bound to cause repercussions in another. Every programme needs to be undertaken keeping in mind this ecological unity. Moreover, it is by now widely recognized that there is immense potentiality for development through cooperation in such areas as the unutilized energy reservoir of Nepal from which the entire region can be developed.

A jointly coordinated policy should be formulated for collaboration of the environment related organizations of the countries of the region and there should be exchange of materials and information among them. A regional coordination body within or outside the South Asian Association for Regional Cooperation (SAARC) may be established for continued monitoring of the situation resulting from the environmental changes that are taking place. The objectives of such coordination policy should include things of regional priority. It may be useful to jointly exercise the relative priority of flushing of Hooghly river, for example, as against the acute problem faced by Bangladesh due to diversion of water.

Steps should be taken to afforest Himalaya and for this purpose the upland countries should be provided with alternative energy source. There is enough potential for improving hydroelectric power in Nepal and upper reaches of India which can be the best source of alternate energy. This will not only slow deforestation but also balance the environment of the entire region. This is again a regional problem and all concerned states need to formulate a joint comprehensive long term project for which external financial assistance may be obtained from appropriate sources.

Regional cooperation is the most practical approach for development of common natural resources of this region and resolution of most of the related problems including water sharing. However, Bangladesh should also recognize the fact that India, which has the upper hand, is yet to fully adopt this regional approach. Hence it may be counterproductive to bank too much on a regional solution. Parallel with Bangladesh's efforts for a regional solution, Bangladesh also needs to strengthen its relation with India with a view to reaching a bilateral agreement for long term sharing of the common-water resources.

II. C. National Measures

Until recently, the need to cope with periodic disaster, preoccupation with increasing food production and reducing poverty in the face of continued population growth have overshadowed efforts to conserve and manage the natural resources within national boundary of Bangladesh. Environment policies in government plans and priorities are conspicuous by their absence and when they exist, they are inadequate, outdated or unenforceable. If the issue of environmental degradation is not addressed immediately, it could significantly undermine Bangladesh's long term economic development and be the reason of greater insecurity.

Various efforts are needed not only to check the further decline in land productivity, fisheries, water quality, forest resources and so on but also to improve the quality, biological diversity and efficiency of the natural resources. It should require not only effective regulation, monitoring and enforcement mechanism but also large scale advance studies and research aimed at restoring, maintaining and improving the quality as well as biological diversity of natural resources.

Another important aspect that must be taken into consideration is that economic development and improved natural resources management are inextricably linked and success in one area cannot be achieved without success in another. Therefore, these two goals must be addressed in an integrated fashion. A concern for environmental conservation and improved natural resource management must be an integral part of development strategies.

Another challenge facing development planning in our country like many other countries is the institutional constraints. Intersectoral coordination of development planning is hampered by a multitude of specific agencies and frequently overlapping jurisdictions or conflicting mandates.

Legal framework in many instances needs to be further updated and better adapted to cope with current problems and projected demands. Most of the environmental laws of Bangladesh were promulgated before independence and are only recently being revised and updated or have yet to be updated. Urban planning laws of the 1950s and 1960s were passed when the population was half the present size. The Factories Act of 1965 was enacted before industrial pollution or hazardous substance became a serious concern. The Forestry Act of 1927 was adopted when enforcement against deforestation was manageable. Although the Motor Vehicle Ordinance 1939 was updated in 1983 and the Pesticide Ordinance of 1971 was updated in 1980, the provisions are largely unenforceable.

A particularly critical issue is the strengthening of environmental monitoring capabilities and environmental impact assessment (EIA) procedures. The newly established Environment Department under

the Ministry of Environment and Forest is likely to play an important role in EIA. Its institutional capacity and procedures need to be strengthened. Within the Ministry of Planning, the Environment cell can also be a forum for assessing economic trade-offs and environmental threats originating from sectoral development programmes. Another problem of EIA is the compartmentalized developmental activities. Various Ministries need to take joint initiatives in examining the anticipated impact of proposed project of the environment and on the development objectives of other sectors which may be adversely impacted.

Another problem facing successful environment management is that there is want of cooperation between public agencies and the private sector including both private enterprises and independent voluntary non-governmental organisations (NGOs). Not only the government will be benefited by the experiences and informations gathered by the NGOs, the NGOs will also be benefited through access to information about past or ongoing development activities of the government.

But the most important factor that is posing the greatest challenge to environment management is the lack of public awareness. Success of all programmes ultimately depends upon those who use the resource on a daily basis.

In order to address the critical needs and important issues related to the environment and natural resources, short, medium and long term approach is needed. But these are preconditioned by a firm and sustained commitment to a steady reduction in population growth rates and to population stabilization.

In the short term a number of initiative should be taken by the Government of Bangladesh, in concert with donors and other

interested agencies, to reduce further environmental degradation and to develop the technical skills, information base and institutional capacity needed to move forward with a sustainable developmental agenda.

Medium and long term objective should be to continue to build up efforts aimed at institution strengthening and programm support for critical areas of natural resource management and environment conservation. This shall include not only extended support for research and advance studies in resource management, EIA etc., but also to implement the various reports made on environment, viz, the National Water Plan, Coastal Zone Management Plan or Action Plan for Flood Control, etc. There should be a coordination cell to make every department aware of the past, present and future development activities. This cell can again be the centre for assessment of trade-offs and resolution of inter-sectoral conflicts.

Although in the past environment management did not get that much attention from the government, a number of recent development and natural resource issue is steadily growing. By declaring the year 1990 as the Environment Year and the 1990s as the Environment Decade, the Government of Bangladesh has reaffirmed its commitment to focus increasing attention to this growing problem.

Ministry of Planning can play a key role in environment management since it is charged not only with the preparation of Five Year Plans but also controls the allocation of funds to individual Ministries. Moreover, it has the authority to supervise and coordinate cross-sectoral and inter-ministerial activities, affecting the use of natural resources and environment. With a view to utilizing

this opportunity and evaluating the environmental impacts of proposed development projects, a new "Environment Cell" is being established within the Planning Commission. The Local Government Institutions formed under the Local Government Ordinance of 1982 can also play important role. The Upazila Council or Parishad can carry out various delegated powers, including building regulations, and implementation of projects related to infrastructural development and environment management. Municipal Corporation which has the authority of land use planning (except for the national laws and regulations affecting forest, land tenures and coastal resources) can be a potential source for environment development. These local bodies can also play effective role in creating greater public awareness.

The private industrial enterprises will have to assume a growing responsibility to utilize resource sustainability and mitigate environmental damage resulting from industrial process whereby they will have an important role to play in improving natural resource management. Press and media is a very significant source to reach the message to the people, hence generate public awareness.

If the existing policy research and coordinating institution can be properly utilized by the government it could form the basis of sound environment related research as well as development planning.

Public awareness, as already mentioned, is very important for the successful implementation of the environmental programmes. In recent period, at the initiative of public and non-governmental organisations, people's awareness of the problem is growing. If this trend can be sustained and if the government can utilize and coordinate the work of all the related institutions, the country may be able to cross the borderline from vulnerability to sustainability.

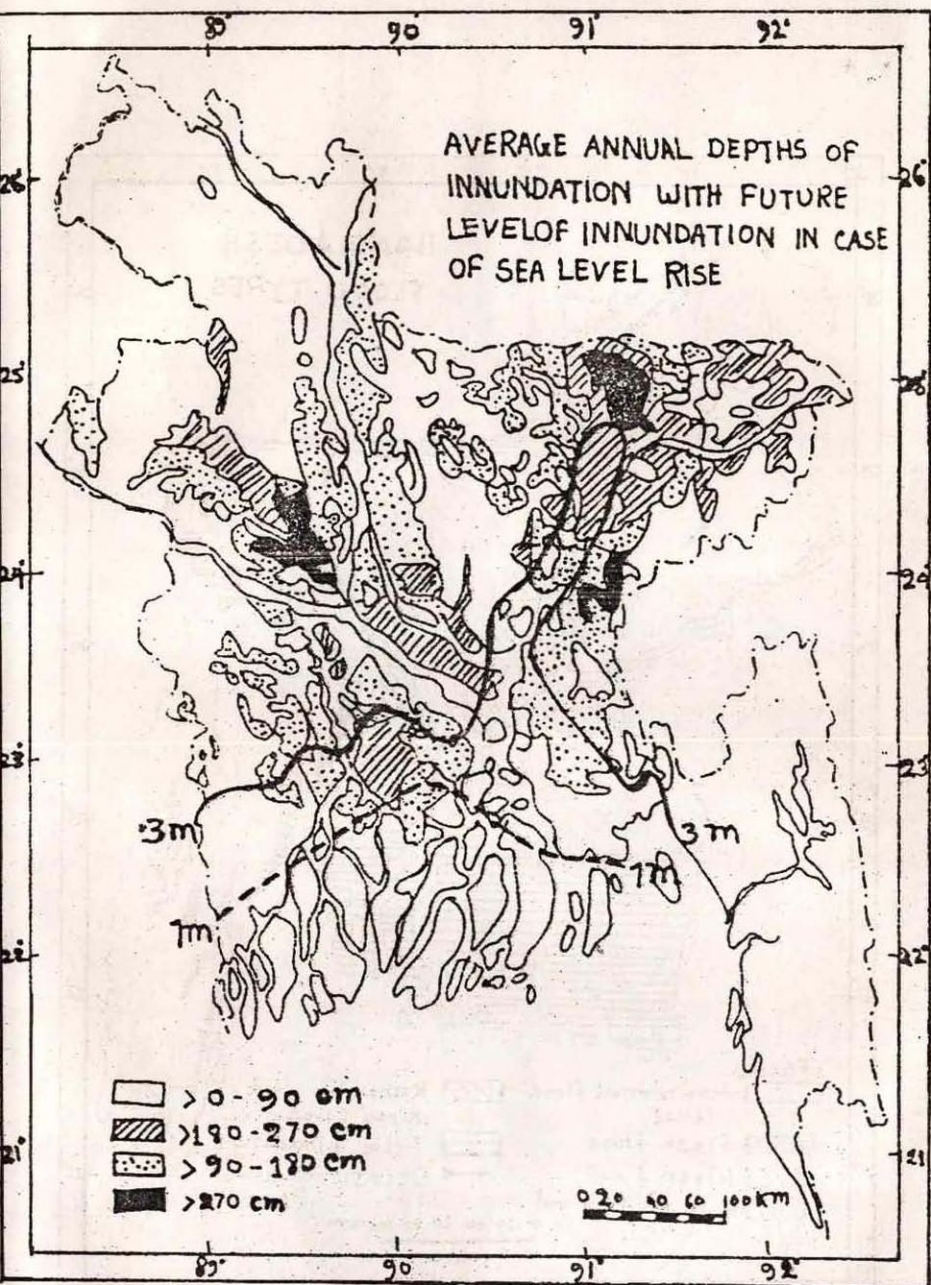


Fig. No. 1

Source : Department of Environment, Ministry of Environment and Forests,
Bangladesh.

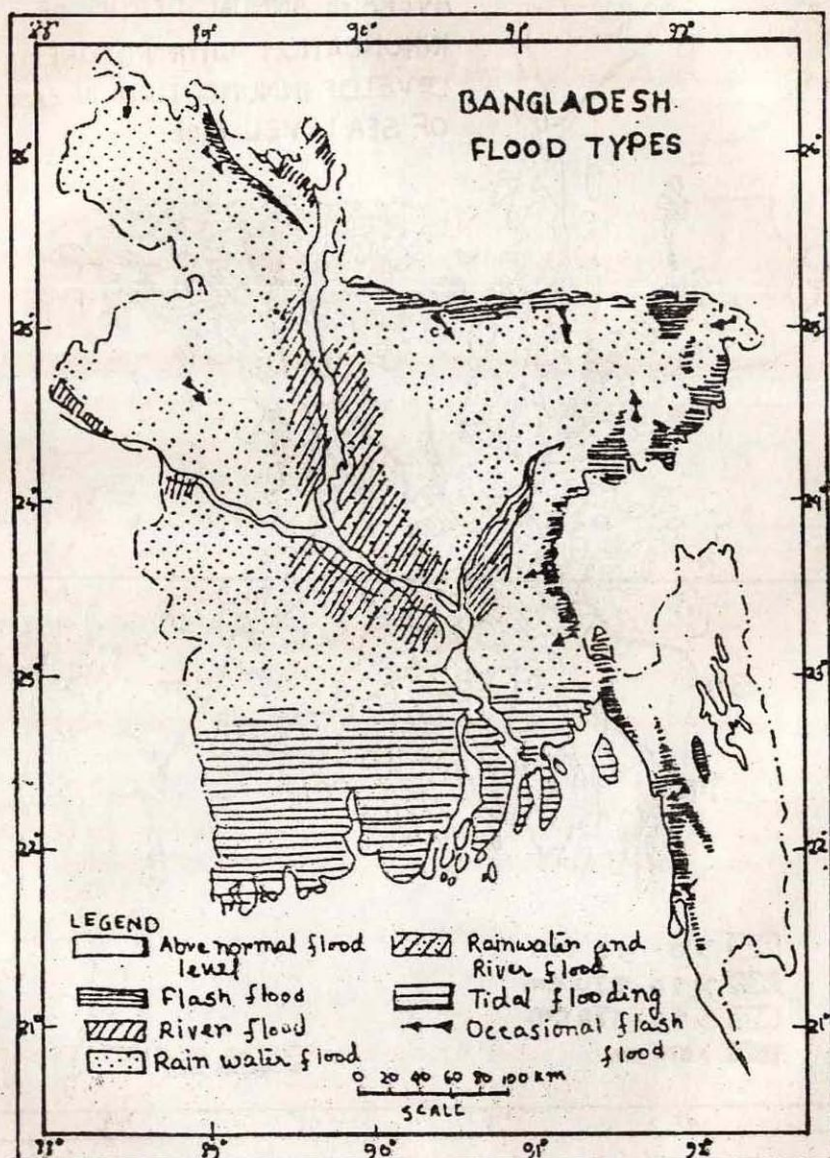


Fig. No. 2

Source : Master Plan Organisation

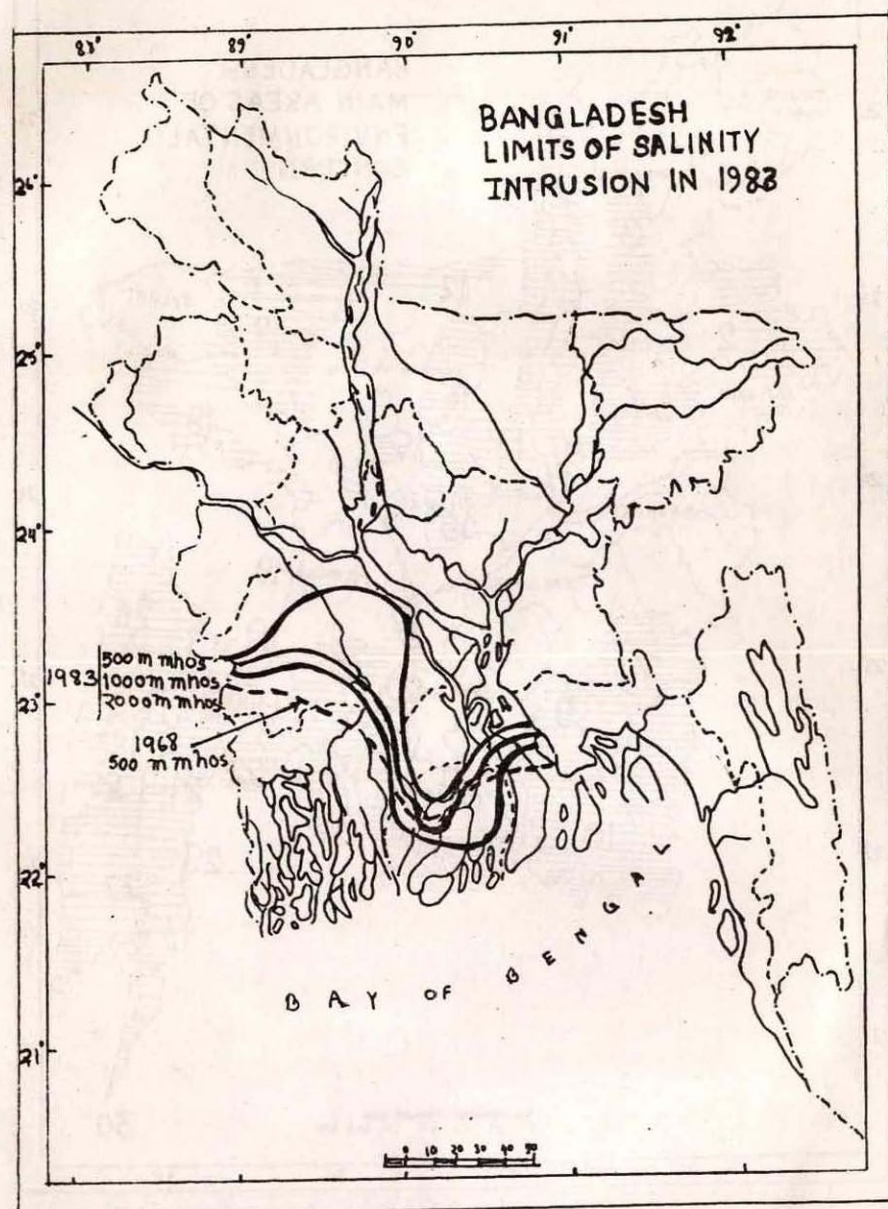


Fig. No. 3

Source : ST/ESCAP/618 P. 91 : After BWDB, 1984

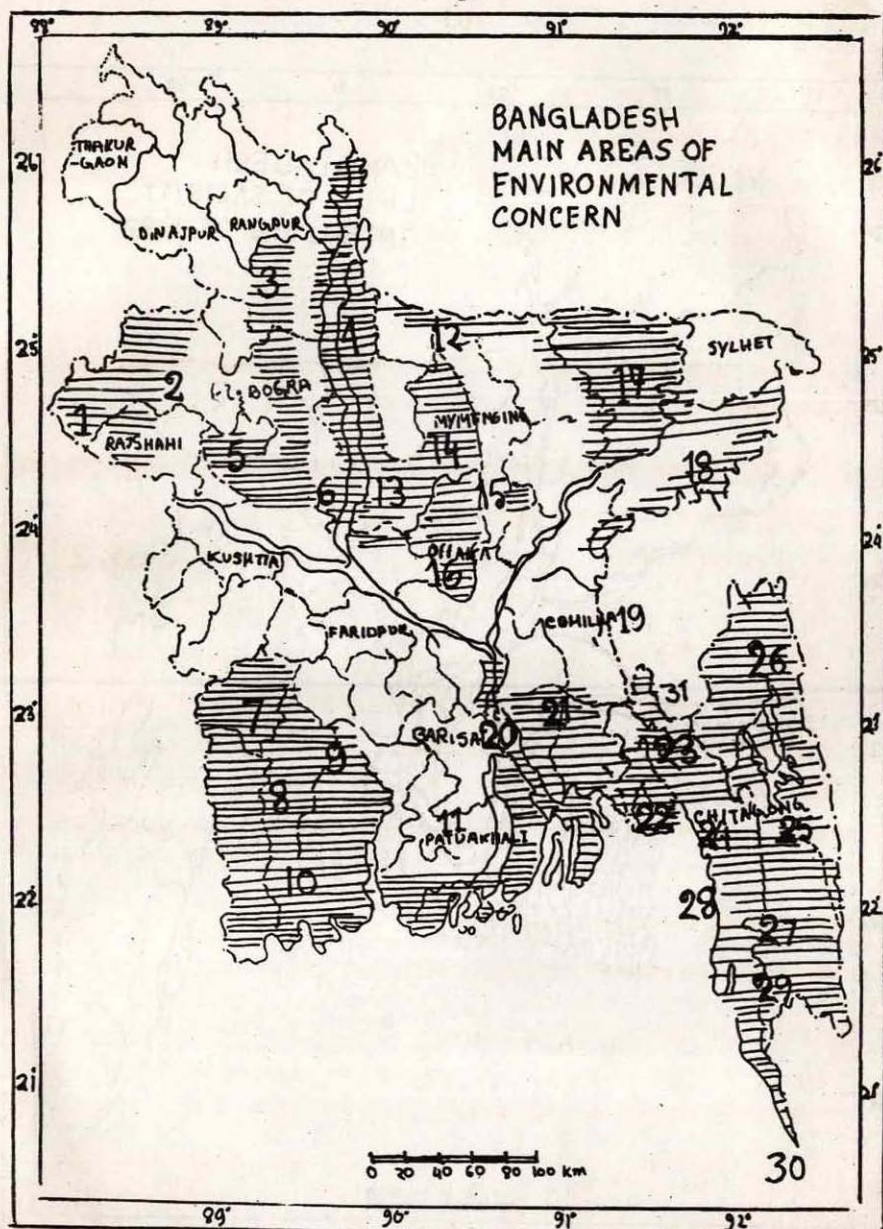


Fig. No. 4

Source : Ministry of Environment and Forests, Reproduced in Ainun Nishat, "Environmental Consideration for Sustainable Development in Bangladesh", paper presented in BISS on 17-19 September 1991.

MAIN AREAS OF ENVIRONMENTAL CONCERN AND THEIR MAJOR PROBLEMS

1. Mahananda Basin : Frequently flooded, and also subject to droughts.
2. West-Central Barind : Being desiccated through improper landuse. Low water-table and poor soils affect crop agriculture.
3. Middle Karatoa Floodplain : affected by drying-up of Karatoa river. Double-cropping of HYV Rice has led to severe Sulfur and Zinc deficiencies.
4. Brahmaputra-Jamuna Floodplain : entire stretch affected by Brahmaputra Right Bank embankment which was breached in 4 out of the last 5 years. The main river may be shifting westwards, large floating population in the *char* lands. Sand deposit after floods often ruin cultivable land.
5. Chalan Beel : Once one of the largest permanent wetland areas of Bangladesh, now seriously degraded by FCDI projects.
6. Atrai-Hurasagar drainage basin : Due to construction of ill-conceived embankment and regulators drainage has been impeded and water-logging has become a serious problem.
7. South-west Jessore : This area is climatically subject to wide variations in rainfall and temperature. Due to reduced flow in the Ganges in the dry season salinity has increased and freshwater flow has decreased.

8. Northern Khulna : Large-scale shrimp farming has increased salinity and farmer conflicts and reduced rice production.
9. Khulna City and Mongla town : Problem area due to industrial pollution, oil spills from ships and urban congestion.
10. Sunderban : Increased salinity, increasing amounts of ship oil, industrial chemicals etc. has led to the top-dying of several species of trees. There has also been overcutting of the forest for industrial use.
11. Patuakhali-Bhola-Noakhali Char areas : Affected by water-logging, salinity, and diluvium.
12. Garo Hills Piedmont : Erosion, flush floods, and loss of tree cover has led to decreasing agricultural productivity.
13. Tangail : Affected by silting of rivers, increase in sudden flooding.
14. Modhupur Tract : Deforestation and improper use of sloping land has led to topsoil erosion. This in turn has silted rivers all around this important watershed area.
15. Sitalakhya River : Industrial plants at Ghorashal, Palash and Demra discharge toxic chemicals into this river leading to suspected loss of fisheries and creation of hazard for public health.
16. Dhaka city : Industrial and traffic pollution creates serious health hazard; urban expansion is destroying class 1 agricultural land and some of the best horticultural land in the country.
17. Haor Basin : Reduction in fish spawning areas due to embankments which cut out fish migration routes, and to because of

increase in boro cultivation, which increase the use of pesticides.

18. South Sylhet : Affected by deforestation, flush floods, and soil erosion.
19. Lalmai Range : Deforestation, erosion and soil removal have reduced productivity and may reduce future potential.
20. Lower Meghna : Affected by floods, riverbank erosion, stagnant productivity, loss of fisheries and population pressure.
21. Central Noakhali : Affected by water logging in the wet season due to impeded drainage and lack of irrigation supply in dry season due to saline groundwater. This has led to decreasing agricultural productivity.
22. Sandwip : Thickly populated island being eroded rapidly. New land formations not consolidated. Frequently affected by cyclones and surges.
23. Sitakunda Range : Affected by deforestation and sheet erosion with consequent loss of productivity. This area is a major source of thatching grass and, therefore, urgently requires Land Use Planning.
24. Chittagong City and Port : Industrial pollution, oil spills, and cutting down of hills leading to increasing erosion and consequent silting of rivers have degraded the environment.
25. Chandraghona : Industrial units discharge large quantities of chemicals into Karnafuli river, destroying fisheries and posing health hazards.

26. Hill Tract : Slash and burn cultivation (*jhoom*) and improper use of hill slopes by immigrants have greatly increased erosion on the hill slopes and flooding of valleys, with consequent loss of productivity. There has been a serious decline in tree-cover.
27. Chakaria Sunderban : A forest area totally destroyed for use as shrimp farms. Now yield are declining and soils are becoming highly acidic.
28. Chittagong Coast-Kutubdia island : Severe bank erosion, loss of land and increase in salinity has led to environmental degradation.
29. Cox's Bazar : Tropical moist forest with unique bio-diversity is being destroyed through clear-felling and planting operations, unchecked encroachment and illicit felling of trees.
30. Jinjira island and reef : Coral reef being destroyed through over-exploitation of corals and mollusks.
31. Muhuri Basin : Successful agricultural project utilizing surface water irrigation, has in turn led to excessive use of fertilizers and pesticides and pollution of important fishing areas in lower Big Feni river and Sandwip channel.