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MANAGEMENT OF ENVIRONMENTAL DISASTER IN SOUTH ASIA : A REGIONAL APPROACH

South Asia is exposed to almost every type of disaster—natural or man made. At least five out of ten major natural disasters in the world occur in this region. The peculiar natural setting of South Asia is the source of not only the life giving monsoon but also of the catastrophic ravages of tropical cyclones, floods, droughts, norwesters, tornados and tidal waves. The Bay of Bengal is considered to be an 'ideal breeding ground' for tropical cyclones. Human activities, on the other hand, mainly due to extreme pressure of population and irrational use of natural resources cause rapid deterioration of environment in terms of erosion, pollution, industrial hazards, etc. The consequences of all these disasters in the economic and social life of this region is quite apparent. Exact estimate of the damage due to such calamities is not possible, but a good guess could be several hundred million dollars every year only in Bangladesh, the worst hit in the region on an average basis.

A couple of centuries ago infactious diseases were considered inevitable natural disasters. But in the changing world of scientific and technological advancement what were once seen as 'acts of God' are most often controllable natural phenomena. Natural disasters of the type refered here are however yet to be prevented by human endeavour. But, despite that their effects can always be mitigated if considered properly from planning and management point of view. The basic idea of disaster management is to minimize

effects of disaster through prevention, preparedness and mitigation.¹ Prevention concerns the formulation of long range policies and programmes to prevent, reduce and control the occurrences and incidences of disaster. Man cannot prevent natural disaster itself but can prevent to some extent, natural and other phenomena from causing disaster. Preparedness is an action designed to minimize loss of life and damage of property and to organize and facilitate timely relief and rehabilitation. Preparedness also concerns forecasting and warning, education and training of the population for successful management of natural disaster.

Two observations on the problems of disasters in the context of South Asia seem critical. First, most of the disasters — floods, cyclones, droughts, and other ecological and environmental degradation— have a basically regional dimension in the sense that such events in one country are linked to that in another. And the linkage pervades causes, dimensions and effects. This of course is the result of the geographic-ecological unity of the countries so that the vulnerability is more of regional rather than national nature. Second, because of financial, technological and resource constraints on the one hand, and more importantly because of the regional dimension of the problems on the other, no single country is fully capable at its own, to manage the disasters. It is obvious, therefore, that any viable disaster management programme in the region should be a regional effort. Belated though, the countries of the region within the scope of its newly emergent association for regional cooperation (SAARC) have recognized that natural disasters and degradation of environment were severely undermining their development process and prospects. They have therefore decided to intensify regional cooperation with a view to strengthening their disaster management capabilities. They also decided to commission a study for the protection and preservation

1. United Nations, *Disaster Prevention and Mitigation : Compendium of Current Knowledge: Social and Sociological Aspects*, Vol. 12, New York, UNDRO, 1986, p. VIII.

of the environment and on the causes and consequences of disaster in a well planned comprehensive framework.

The present paper aims at elaborating the causes and consequences of natural disasters with particular reference to Bangladesh which occur at the extreme interface of natural phenomena. The objective is to highlight the networking nature of disasters in the South Asian countries. Attempt is also made to focus on the aspects of management of natural disaster with a regional approach.

Environmental Disaster : Roots and Dimensions

South Asia is a land of great diversity, having the highest mountain range on its northern boundary and surrounded on all other sides by ocean. The diversity of this vast region is matched by the diversity of its climatic conditions which has played a distinct role in shaping the landscape, life style and culture of the people. In fact, the region is under the predominant influence of a particular type of climate—the monsoon, which comes either from the Bay of Bengal through Ganges valley or from the Arabian Sea, across Rajasthan and converge over Himalayan foothills to produce abnormally heavy rainfall.² But the uneven distribution of rainfall both spatial and seasonal put serious constraints over its control and planned management. The erratic nature of monsoon, therefore, creates either floods or droughts over the region almost every year.

The natural process of the water sheds in the Himalayan region together with human activities accomplish an incredible amount of erosion during the monsoon period of the year transporting to sea an enormous load of silt. The process further aggravates the flood situation in the lower reparation region. On the other hand, tropical cyclones in the region, originating from deperssion in the Bay of

2. B.L.C. Johnson, *South Asia*, 2nd edn. (London : Heinemann Educational Books, 1981) pp.18-19

Bengal, strike coast line of Bangladesh, India and Burma and cause coastal flooding through storm surge. Evidences show that these are not isolated natural events, rather they are interlinked with one another. Floods and droughts are directly linked with monsoon; and problems of erosion, siltation, landslides, etc., are its indirect outcome. All these natural disasters are rooted in the climatic and atmospheric dynamics and their behavioural pattern is determined by the physical setting and relief features of South Asia. The pertaining question is why disastrous events occur in the environment? Is there any global or extra regional connection with occurrence of these disasters?

Disasters are generally viewed as the consequences of oscillation of atmospheric and oceanic circulation and is particularly, associated with climatic fluctuations.³ Climatic oscillations, for their part, depend on energy inputs from water masses and on fluctuations of solar radiation.⁴ These not only disrupt thermal and rainfall regime but also induce major alterations in the normal state of environment on the earth surface.

Climatologists draw regional and even global connections and feed backs among weather and other atmospheric events that may apparently seem quite remote from each other. The interactive nature of the global climatic fluctuations and their effects are, however, yet to be strictly established within the framework of causal relationships so that their manifestations and consequences are hardly foreseen. Little has so far been achieved in the quantification of the relationships that exist between the different parameters associated with those climatic events. However, qualitative models on the basis of experiences of recent decades show undisputably that the climatic anomalies in various parts of the world are mutually linked to each other.⁵ Precipitation anomalies, over

3. C.M. Caviedes. "Natural Hazards in South America : In Search of a Method and Theory" *Geo Journal* Vol. 6, No. 2, 1982, p. 105.

4. *Ibid*, p. 102.

5. *The South*, November 1987, p: 81.

South America, the Pacific Basin, Africa, North America, Europe and Asia as well as oceanic disturbances in the equatorial regions with their ecological implications were not merely isolated incidents.⁶ On a closer focus, cyclones and floods in Bangladesh, northern India and other parts of the world and monsoon failures in South Asia could be more than just climatic coincidences.⁹ These hazardous events are certainly symptoms of vast alterations within the natural environment.

More than half a century ago Sir Gilbert Walker found strong statistical link between monsoon rainfall over the Subcontinent and barometric pressure gradients across the Pacific. By mid 1960s evidences confirmed that the southern oscillation did exist.⁹ More recently, the climatologists believe that an irregular phenomenon associated with warm ocean current off the West Coast of Latin America, known as El Nino, occurs every two to seven years, disturbs the whole global climatic equilibrium.¹⁰ Due to its influence, the easterly trade wind which pile up warm water and push it off east-wards effects the entire atmospheric circulation system with it. It is now believed that the El Nino Southern Oscillation—ENSO—is responsible for the increases in temperature in the Indian ocean and for the excessive rain and failure of monsoon in South Asia. Evidences show that twentyone out of 26 ENSOs have been associated with climatic shifts, heavy rainfall as well as with monsoon failure.¹¹

The Indian meteorologists have also relied on observations of wind swings, rising sea levels, pressure inversions and warming of

6. C.N. Caviedes, *op. cit.*, p. 106.

7. *The South*, *op. cit.*,

8. Sir Gilbert Walker, the then Director General of Indian Weather Observatories published his theory of Southern Oscillation in 1893. He was quoted in *The South*, Nov. 1987.

9. *Ibid.*,

10. Jonathan Miller, "The Seeds of Disaster", *The South*, Nov. 1987

11. *Ibid.*

ocean temperatures in the South Central Pacific for explaining the uncertainty of monsoon in South Asia. The eastward shift of rainfall over the subcontinent is also associated with ENSO and is the most dominant pattern of variability — they believe.¹² Differing this view Mike Hamilton tends to refine the conventional explanations for monsoon variability and failures¹³. Explaining the causes of displacement of monsoon over Bangladesh and disastrous floods in this region he says that circumpolar westerlies moved sluggishly toward north from South Asia due to blocking of anticyclones in northern Eurasia. Some parts of this region are always afflicted with drought or floods because it straddles so many climatic zones. The statistical link with Enso-effect is therefore neither convincing nor sufficient. The easterly jet stream which normally originates over the Bay of Bengal during monsoon period is a missing link between Enso circulation pattern and floods and drought in South Asia and African Sahel.

The environmental scientists also argue that simply an articulation of climatic fluctuations are not the only factor responsible for occurring disasters. The other factors such as a continuing relentless onslaught on environmental support and changing pattern of atmospheric phenomena might be held responsible for increasing natural disasters. It is now increasingly being recognized that man can not only modify climate on a local scale and to a limited extent to a regional scale but may also cause significant extended regional or even global changes in the climate.¹⁴

It is not unlikely that changes in surface characteristics caused by human activities such as removal of scarce vegetation and

12. This was argued by G.S. Mandal, an enthusiastic adherent of Walker School, quoted in the *South*, November, 1987.

13. Mike Hamilton is the Head of the Meteorological Hazard Research Group at Birmingham University, U. K. He was quoted in the *South* November, 1987,

14. B.L. Bose, "Warming up for Drought", *The Statesman*, 12 Nov, 1987,

polluting environment etc., could be a possible cause for environmental change and disasters like droughts, erosion and floods. A recent experiment on the effects of surface albedo¹⁵, change for a group of arid and semi arid areas including the Thar desert in Rajasthan for July shows that if the assumed vegetation cover (albedo value 0'14) is increased to an assumed bare soil albedo value of 0'35, the rainfall over Rajasthan can be reduced drastically after two weeks and total rainfall can be reduced to almost half the normal.¹⁶ It suggests that a clear link exists between a reduction in rainfall and the soil moisture retaining capacity. The capacity to hold water is reduced drastically when soil is stripped off vegetation. Although this result can not be taken as final, yet they indicate that man induced activities changing the surface albedo and the soil moisture storage capacity can profoundly effect and cause rainfall deficiency and aggravating drought.

Another important phenomenon which escalates climatic change is the increased release of carbon dioxide in the atmosphere. As time passes this has reached rather alarming stage. It has been continuously observed for the last few decades that the burning of fossil fuels (coal, gas, oil, etc.), deforestation on a large scale, cement production out of organic soil matter and gas flaring etc., have increased manifolds. A recent study shows that the mean yearly carbon dioxide level between 1978 and 1983 has risen by 9%, from 315 parts per million to 343 parts per million.¹⁷ Carbon dioxide as such does not pose any threat or danger to the health of mankind, but its increased concentration in the atmosphere could contribute to the warming of the earth surface with disastrous consequences. A disastrous consequence will occur if all the ice sheets of the entire earth melt as a result of the expected heating, sea level will rise by about 70 meters.¹⁸ If we consider

15. Albedo is the amount of sunlight reflected back from the earth.

16. B.L. Bose, *op. cit.*

17. A.M. Chowdhury, "Our Climate in Danger", Proceedings of a conference organized by ESCAP held in Dhaka in Nov. 1986, p. 215.

18. *Ibid.*

a more moderate rise in the sea level of 10 meters, it will cause flooding of a total coastal area around the globe. The whole Maldives and more than half of Bangladesh would be under the sea.¹⁹ The other consequences related with rising sea levels are reduction of world food production and increase in the salinity. Moreover, there will be increased rainfall in some places, causing floods whereas soil moisture will diminish to cause droughts. It is also not unlikely that new areas will come under the threat of tropical cyclones.

It is important to observe here that whether or not the natural disasters occurring in South Asia are linked with the global atmosphere and ecological disturbances most of these are certainly regionally interlinked with each other. Although strictly quantifiable evidences may not be available to establish the networking nature of the disasters in South Asian states, there are ample qualitative and circumstantial evidences to show their regional character. The frequency pattern and chronology of most of the disasters, particularly floods, droughts and to some extent cyclones are evidences in this direction. More important are the factors geophysically and ecologically found to be behind most of the disasters as discussed earlier. To say in this context that management of these disasters in all its implications—prevention, preparedness and mitigation—should also have a regional dimension is to state the obvious. This is particularly so not merely for the regional character of the disasters themselves but also because of the compulsions of technical and financial viability of long-term solutions. Before going into the discussion of such a regional approach we turn to the profile of South Asian disasters.

Profile of Regional Disasters

Not all the countries of the world are disaster prone, although there is not a single country which has never experienced some kind

19. *Ibid.*

of natural disaster. Type of disasters, their frequency of occurrence, extent of damages, people's response to it, etc., vary greatly. The amount of damages and lives lost bear a close relationship to the prevailing level of economic development. The disadvantaged and poorest countries are affected most severely by disasters and their people are likely to experience the most serious consequences. The annual global losses from such disasters are quite significant. During 1970 to 1981 more than one million people died in disasters with an estimated loss of resources worth US \$ 50 billion, of which 50 percent were incurred by South Asia.²⁰

Within a time span of 20 years, from 1960-1981, South Asian people witnessed 217 disaster events in which 705,200 people were killed (Table-1). Among the people killed during the period Bangladesh tops the list with India in the second position. Other South Asian countries are less prone to disaster.

Table 1 : Environmental Disasters in South Asia 1960-1981

Country	Number of Disaster events	Number of death
Bangladesh	63	633,000
India	96	60,000
Nepal	19	2,900
Pakistan	21	7,400
Sri Lanka	18	1,900
South Asia*	217	705,200

* On Bhutan and Maldives data were not available

Source : Based on US AID, League of Red Cross Societies and World Bank Data.

The monsoon in South Asia is not an unmixed blessing. The most striking characteristic of the tropical monsoon climate is the occurrence of seasonally alternating wet and dry seasons.

20. United Nations, (UNDRO Report), Vol. 12, *op.cit.*, p. 7.

From the climatic point of view the existence of a distinct dry period is an outstanding criterion of the monsoon climate²¹. Most of the disasters in this region are associated with monsoon. Particularly the floods and droughts are the result of erratic nature and large fluctuations of the monsoon. While floods are caused by excessive accumulation of water due to rainfall over a relatively short period of time, prolonged period of dryness and high temperature lead to drought condition.

Flood : The basic cause of flood is the incidence of heavy monsoon rainfall. In simple terms floods occur when the rivers and channels fail to contain and thereby constrained to pass the excess water. On many occasions other factors operate either to exacerbate an already occurring flood problem or to create a flood problem entirely of their own manufacture. These factors include location, relief pattern of the regions and the presence of natural or man-made obstructions in the flood way. Devastating floods are associated also with tropical cyclones. Such floods occur when large atmospheric depression with moisture laden winds move from the ocean to the coastal areas.

There are a number of factors responsible for devastating floods in Bangladesh. The first and foremost is the spill from innumerable rivers, particularly from the Ganges, the Brahmaputra and the Meghna. The lower reaches of these three rivers which originate from the Himalyan region and flow through Nepal, Bhutan and parts of India are within Bangladesh and they drain the discharge of the entire basin area which is about 15 times larger than the country.²² Moreover, the topography of the country is so flat and so close to the sea level that the gradient of these rivers are extremely low. Passing of river waters are further constrained by tidal blockage

21. K.R. Shaha, *et. al.*, "The Indian Monsoon and its Economic Impact", *Geo Journal*, 3.2., 1979, pp. 171-73.

22. M. Shahjahan, "Surface and Ground Water Assessment, Development and Utilization in Bangladesh" A memecograph, 1985, p. 43.

and storm surge. About 30 percent of the country is subject to flooding normally due to such spill from three major rivers.²³

Secondly, floods are associated with isolated and localized intense rainfall mainly from the adjacent hilly regions of North-east. This kind of floods occur within a very short time and are dangerous because of their suddenness and speed. Known as flash floods, they are more commonly associated with small hilly catchments, along the eastern border lying in the Meghna basin. About 38 percent of the area is subject to such kind of flooding during a normal flood season.²⁴

Thirdly, man made obstruction on the water course may also create devastating floods. Evidence can be given from the 1987 flood of Bangladesh. It submerged many areas which usually remain above flood level. The reason is unplanned localized flood control measures and other physical development activities of last few decades. It means that part of the normal flood prone areas have been protected from floods whereas the incidence of flood has been shifted to the rest of the areas which are now exposed to greater intensity of floods. On the other hand control of river in the upstream sometime create severe problem in the downstream.

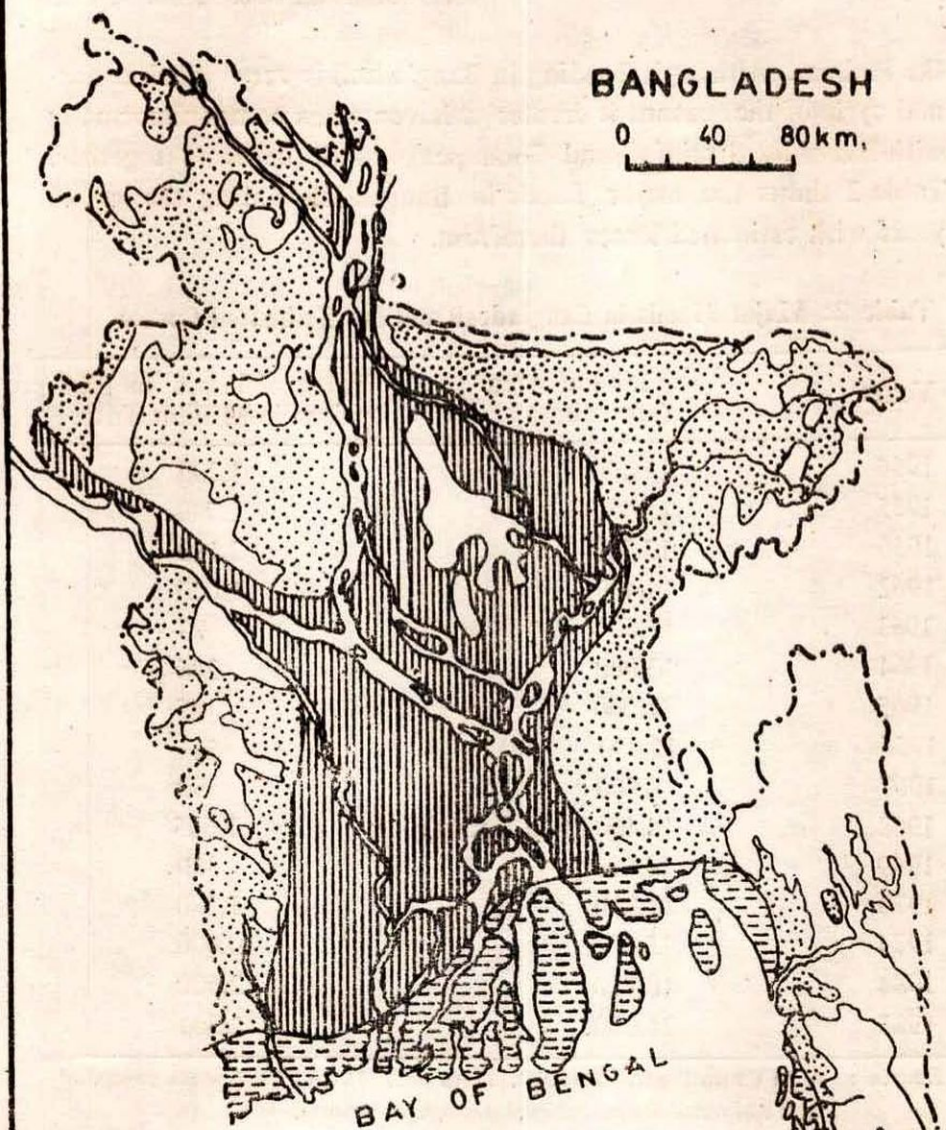

Apart from these normal flooding, severe floods occur when all the three major rivers swell together. The Brahmaputra start rising in March/April due to snow melt in the Himalayas and usually reach a peak in June and then reaches another peak in August from heavy monsoon rains. The Ganges start rising in June/July and reaches the annual peak in late August or early September. When this peak coincides with the second peak of the Brahmaputra severe flood usually occurs at the confluence and downstream. The Meghna reaches the peak in August-September and the peak is influenced by the upstream storage in depressions and the back water effect from





23. *Ibid.*

24. *Ibid.*

BANGLADESH

0 40 80km.



-  Areas Normally Flooded by Brahmaputra-Ganges-Meghna Spills
-  Areas Normally Flooded by Minor Rivers (ie. other than Ganges-Brahmaputra-Meghna)
-  Areas Vulnerable to Flooding Caused by Storm Surge from the Bay of Bengal
-  Areas Normally Free from Flooding

the Padma. Although flooding in Bangladesh is very much a normal cycle of the season, it creates a havoc when comes abnormally with heavy local rainfall and flood peaks of all the rivers together. Table 2 shows the major floods in Bangladesh during the last 40 years with estimated losses therefrom.

Table 2: Major Floods in Bangladesh and the Estimated Losses

Years	Flooded Area (sq. miles)	Value of losses in 1969 prices in Million Taka
1954	14,200	1,200
1955	15,000	1,240
1956	13,700	2,180
1962	14,400	1,020
1963	13,600	83
1964	12,000	246
1965	11,000	45
1966	12,900	544
1967	9,900	90
1968	14,400 (two floods)	1,645
1969	14,000	330
1970	14,800	1,380
1974	15,000	10,000
1984	10,000	2,500
1987	21,000	15,000

Source : A M Chowdhury, SPARSO. Data on 1984 and 1987 were compiled and estimated from various newspaper reports.

Bangladesh is not the only country in the region which is so cruelly ravaged by floods. The Himalayan region influenced by monsoon, i.e., Nepal, Bhutan and North eastern part of India are also in the grip of floods. The annual average area affected by floods in India during 1970-1978 worked out to about 10 million hectares of which 5.4 million hectares are cropped area. This is about 4

percent and 4.3. percent respectively of the country's total area.²⁵ For the major flood prone states of India, such as UP, Bihar, West Bengal, Assam and Orissa, the relevant figures are much frustrating. An estimated annual loss due to flood during the last decade (1970s) is Rs. 2600 million.²⁶

During the monsoon season in Nepal, almost all the rivers swell and cause flood. Each year hundreds of people and large number of livestock are killed by floods and landslides and cause disastrous affect on property. Floods in Nepal occur because too much precipitation occur with high intensity to overwhelmingly saturate soil surface. Other South Asian countries such as Pakistan, Sri Lanka and Maldives are less susceptible to severe flooding.

Drought : Like flood, drought is also an equally disastrous phenomenon of monsoon climate. Defining bad monsoon year as one when rainfall for south Asia as a whole is below the tenth percentile of normal monsoon rainfall it has been found that there were 16 bad monsoon years during the period of 1941 to 1977.²⁸ Unusual droughts appear as severe disasters particularly when irrigation facilities are lacking.

Compared to other South Asian countries Bangladesh is less prone to drought. Rainfall variability is the main source of drought in Bangladesh, specially in the pre-monsoon and post-monsoon seasons. There is a wide variation between years—as much as two months—in the dates when the rains start and end. There is also a great variation in the amounts of monthly rainfall received. Pre-monsoon period—April to mid-June, is the period of maximum uncertainty. There may be an early start or false start or late start to the rains, and to that extent drought is relatively frequent

25. Bimalendu Dev, "Control of Floods and Erosion in India with Particular Reference to West Bengal", paper presented at a regional conference on *Floods and Erosion*, Organized by the Institute of Engineers, Bangladesh and Federation of Engineering Institutions of South and Central Asia, 7-10 September 1986, Dhaka.

26. *Ibid.*

and fairly unpredictable. The post-monsoon period, upto mid-November, is again a period of rainfall uncertainty; too much in some years and too less in others. However, unlike the situation in pre-monsoon season any rainfall deficiency occurring in this season is considerably mitigated by the moisture stored during the rainy season. The deficiency in rainfall and soil moisture deficit is comparatively acute in the north west region of the country. Particularly, the Barind Tract, the quarter of Rajshahi Division or about 6 percent of the country's total land area, is the most drought prone in the country.²⁷

In India as many as 128 districts accounting for an area of about 68 million hectares have low to medium rainfall and have very little irrigation facilities.³⁰ The chronically affected drought region is nearly 19 percent of the total area and which afflict 12 percent of its population.³¹ In 1987, 16 out of 22 states of India were having rainfall deficiency between —20 percent and 60 percent.³¹ In Pakistan rainfed agriculture without any support from irrigation is rare and hence, droughts usually do not appear as disasters.

Cyclone : Comparatively a more dangerous and less predictable environmental disaster is cyclone, which form due to atmospheric fluctuation and cause enormous damage and loss of life in the coastal areas. Cyclone is an area of low pressure³³ where strong

27. Ajaya Mani Dixit, "Regional Sediment Erosion and Conservation in Nepal", paper presented at a Regional Conference on *Floods and Erosion*, *op. cit.*

28. K.R, Shaha, *et. al. op. cit.*, p, 177.

29. Hugh Brammer, "How Green is Our Desert", ADAB News, Vol. XII, No. 6, Dec. 1985.

30. *op. cit.*, p. 117.

31. *Ibid.*

32. *The South*, Nov. 1987.

33. A low pressure is formed due to unequal terrestrial distribution and variability of insolation (incoming solar radiation). As soon as a low pressure area is formed, air from all directions converges on it. See, A.M. chowdhury, "About Cyclone", *Space Education*, Vol. 1, 6 Oct. 1983. p. 274.

winds blow around a centre anti-clockwise in northern hemisphere and clockwise in the southern. All the low pressures do not form cyclone; low pressure together with warm ocean temperature and without vertical wind shear derives its fullest spinning motion from the rotation of the earth.³⁴

In the Bay of Bengal they are formed mostly near the Andamans, usually at the latitude greater than 5°N and move north westerly in the beginning and then curve eastward.³⁵ But this curvilinear track is not always followed. Andhra Pradesh and Orissa receive frequent cyclones from the south west quarter. Those that menace Bangladesh approach the Sundarban and the estuary of the Meghna from the south, south-west and the Chittagong and Burma coast from south west (Map). Cyclones also strike across the peninsular India to cause havoc in the Arabian sea.³⁶

Cyclone occur in the Bay of Bengal mainly in two seasons : April-May and October-November. The damages by cyclones are caused by the strong winds associated with it and by the heavy rains and tidal waves (known as storm surge). If the cyclones occur during high tide then the storm surge reinforce considerably and cause severe damage. Wind velocities, during cyclones, in excess of 160 km/h are not unusual. The great destructive force of cyclones in Bangladesh comes from the storm surge engendered by the strong winds. The most devastating cyclones in living memory on 12 November 1970 may have developed wind of 240 km/h. It produced a wave upto 9 meters high. The devastating affects of these kinds of cyclones greatly shelve the shores of the estuarine at period of high tide. However, over the land cyclones are soon dissipated as they move away from water body which is their source of energy.

34. *Ibid*, p. 274.

35. B.L.C. Johnson, *op. cit.*

36. *Ibid*.

During last 25 years, from 1960 to 1986, more than half a million lives were lost by 33 cyclones in Bangladesh—the worst hit country in South Asia (Table—3). Indian east coast and West Bengal are also cyclone prone. Within the tropical cyclone belt

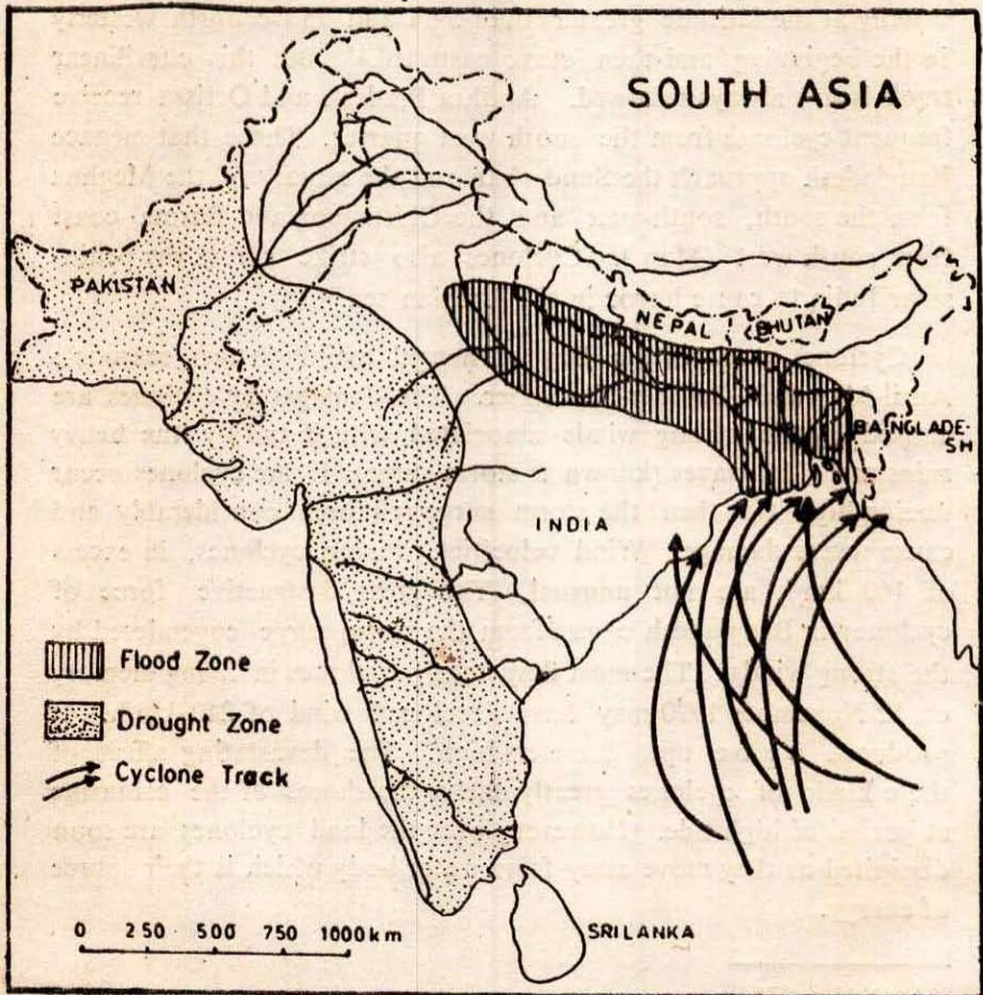


Table 3. Cyclones in Bangladesh 1960-87

Year	No. for Cyclone	People died
1960	2	8,149
1961	2	11,466
1963	1	11,520
1964	1	196
1965	3	20,152
1966	1	850
1967	2	—
1968	1	—
1969	2	75
1970	3	500,300
1971	3	—
1973	2	183
1974	2	15
1976	1	—
1977	1	—
1981	1	2
1983	2	—
1984	1	—
1985	1	11,069
1986	1	20
Total	33	5,63, 986

Source : Source : A.M. Chowdhury, "Monitoring Tropical Cyclones Using the Remote Sensing Capabilities of SPARSO" ESCAP, 1986.

Pakistan, Nepal, Bhutan and Sri Lanka have rarely been seriously hit by these storms. Only 4 times in the last one hundred years cyclonic storm moved west ward to strike Sri Lanka.³⁷

Erosion : Soil erosion or loss of top soil is a disastrous natural process, one that is as old as the earth itself, though its importance

37. Mainz M. Domroes, "Monsoon and Land Use in Sri Lanka", *Geo Journal* 3.2, 1979, pp. 179-82.

is often inadequately viewed. Unlike cyclones, floods, volcanic eruption, earthquake and other natural disasters, erosion as a disaster is unfolding gradually.

For most Third World countries information on soil erosion is largely indirect. India is one of those few countries which compile soil erosion data. It was estimated that 6 billion tons of soil are eroded from India's crop lands each year.³⁸ In the last 2-3 decades there has been excessive destruction of forests which escalates erosion process, particularly in the Himalayan area. In mountainous region, particularly in Nepal and Bhutan construction of terraces historically permitted farmers to cultivate steeply sloping land that leads to quick loss of its top soil. The growing competition for crop land in the hilly areas is forcing farmers move up the slopes at pace that does not permit the disciplined construction of terraces. This in turn contributes to landslides that sometimes destroy entire village exacting a heavy human toll. 240 million m³ sediments are being carried out through Karnali, Gandhaki and Kosi rivers per year.³⁹ Due to massive deforestation for various purpose such as agriculture, human settlements, fuel wood etc., the process of soil erosion is increasing alarmingly. The results of such erosion is obvious not only for the country where erosion is taking place but also for those which receive them as silt on the river bed.

Impact of Environmental Disasters

Economic Impact : Natural disasters effect the society in various ways. Besides loss of lives—direct and indirect--the damage usually comprise loss of capital goods such as the destruction of roads, railways, bridges etc., and community infrastructures (schools, hospitals, electric networks, etc.) loss of stocks intended for final consumption

38. M. Q. Mirza, Watershed Management and Sediment Control" unpublished paper, Department of Water Resources Engineering, BUET, Dhaka.

39. Ajaya M, Dixit, *op. cit.*

or for intermediate production units and crucial losses in production due to destruction of harvests, death of livestock, the closure of shops and small business establishments. In any disaster first and hardest hit are the landless poor. Most of them become jobless during disasters and it is not merely a famine out of food shortage but also out of lack of work.

Natural disaster may have some indirect effects on the local as well as on national economy. Cost of emergency relief and repairs are usually gigantic and impose a tremendous burden on the national economy. The government is constrained to curtail development activities and impose various financial and economic stringencies. Fiscal and monetary instruments, are imposed which often increase the burden of the affected populace. Performances of various productive sectors suffer from dislocation and distortions. A succession of these effects may be compared to a process of economic recession. A decline in the economic activity, for example, in agriculture, result in a reduction in the employment and production and sooner or later cause a decline in national income, final consumption and the investment capacity. In fact, all these create a chain of negative reactions within the economic system. And by the time there is the sign, if any, of the recovery the new wave of disaster sets in.

Among the other effects, reference should be made to physical injuries which have an undoubted economic impact. Losses relating to injured persons are not restricted to the cost of rescue work and the treatment only, but these costs must be added to the value of the loss of activity by the persons in future years. To determine actual loss caused by natural disaster is rather very difficult. All the intangible effects of disasters such as human suffering, frustration, feelings of economic dependence and insecurity and increase in crime can hardly be evaluated in economic terms. But there is little doubt that these are enormous. The same is true for the indirect or secondary effects which are always underestimated in the balance-sheet of natural disasters.

Social Impact : Disaster is an event located in time and space that produces conditions whereby the continuity of the structure and process of social units become problematic. Individuals or groups within a community sometimes seem to react or continue to function after a disaster in approximately the same or even the better way they functioned prior to a disaster.⁴⁰ For example, one of the biggest seismic disturbances in Bihar (India) in 1934 caused destruction over an area of 15,000 sq. miles with loss of at least 7000 lives.⁴¹ When the entire structure of life and society in the state was in utter confusion, the suffering people had not lost their mental poise and patience. There had been no instance of crime, no abnormal manifestation of panic even under such exceptional circumstances.⁴² But, this kind of positive response is not usually found. Except for a few, the damage and destruction leave people sitting the ruins, confused and helpless. Trapped survivors are dependent upon the arrival of the search and rescue teams. The shock and agony are very likely to result in significant disturbances for the social order. Even the specialised government machinery and voluntary organisations often fail to keep pace with the challenge. In the chaos and confusion social order breaks down and the people take this opportunity to exploit poor and helpless people. The unscrupulous opportunists have been even ready to take advantage of natural calamity by buying and hoarding food and by striking hard bargains over loans with all in need.

It has been observed that manmade disaster like famine and social disorder usually follow natural disaster. For example about 10 million people died in famine in Bengal in 1770; 800,000 in Uttar Pradesh, one million in Orissa in 1965-66 and in Bihar in 1967.⁴³ In Bangladesh thousands of people died of starvation after a devas-

40. United Nations, *op. cit.*

41. *Record of the Great Indian Earthquake, 1934*, quoted in United Nations, *op. cit.*, p. 12.

42. *Economic and Political Weekly*, Nov. 1982.

43. B.L.C. Johnson, *op. cit.*, p. 68.

tating flood in 1974. This underlines that some significant factors other than disasters are involved in creating famine conditions. The Orrissa famine of 1965-66 has been blamed on traders who are denuding the regions graneries of stocks in the immediate pre-famine season when only crop deficiency was enough to precipitate disaster.⁴⁴

Migration of the people from disaster prone areas to other areas is another social impact caused by disaster. But there is no official or government assessment of how much migration has taken place to other work places and building sites, industrial areas and cities from disaster prone areas. There is a strong correlation between disasters like floods, cyclones, river bank erosion and influx of squatter population in major metropolises of Bangladesh.⁴⁵ According to an estimate only from Karnataka state (in India) 6 lakh people migrated to other areas following a drought in April 1985.⁴⁶

Political Consequences : The chain reaction that is triggered off by environmental disasters is not only restricted to ecological, economic and social sphere but they spill over into the sphere of politics. The aftermath of a disaster is sometime so crucial that it may even influence the political stability of the country. Floods of 1987 in Bangladesh is an example of how natural catastrophe can provide occasion for a government to take political advantage over the opposition. On the other hand, 1974 flood in the country ceased legitimacy from the then government, due to the latter's inability to manage the post-disaster crisis. The stability and legitimacy of a government in a disaster prone country are most often vulnerable to the incidence of disasters and management capability of the government.

44. *Ibid.*

45. Nazrul Islam, *et. al.*, *Squatters in Bangladesh Cities*, CUS, 1979.

46. Janaki Nair, "Many Faces of Drought", *Political and Economic Weekly*, 3 May 1986, p. 768.

As the political agitations follow almost every disaster the governments tend to respond to escalating unrest with strong hands. In September 1986, 20,000 people marched in Orissa in protest against the government's indifference policy.⁴⁷ In Bihar, police opened fire to disperse an angry crowd of food rioters.⁴⁸ Political opposition, agitation and violence are infact a common scenario all over South Asia after almost every disaster.

Particularly in India, one can observe an interesting politics of disaster management.⁴⁹ The centre-state polemics on the quantum for disaster assistance is a common phenomenon in Indian politics. What the state government generally demands as the assistance required is alway greater than the figures arrived at by the central government. The difference is more pronounced when the two governments are formed by different political parties. The whole issue assumes political overtones especially in an election year. Charges are traded about the neglect of the disaster situation either by the centre or by the state.

The reaction to disaster relief operation and management are quite clearly divided along political lines. Both the government and the opposition can be accused of making political capital out of it. It is more so because of subjectivity and administrative loophole in disaster relief operation and in declaring an area as disaster prone. Sometimes, the fortune of political party in India depends upon whether it succeeds in getting an area declared as disaster prone, which qualifies it for relief funds and programmes.⁵⁰ In Bangladesh the process of management of natural disasters is often alleged to be exposed to enormous malpractice and corruption. It is more so, because of the involvement of substantial foreign assistance.

47. Juliet Reynolds, "India Under Weather", *The South*, Nov. 1987,

48. *Ibid.*

49. R.S. Deshpande, "A Report on the Drought", *Political and Economic Weekly*, 3 November 1984, p. 1960.

50. *Ibid.*

The governments are compelled to exempt various taxes and to provide with subsidies to facilitate economic activities during the post disaster period. This creates a lot of pressure on the economy particularly on the government financing. In Bangladesh the government stopped fresh recruitment after the floods of 1987. Other examples of financial pressure and constraints include financial measures like levy of special taxes to compensate budgetary deficits.

An Approach to Disaster Management

Existing System : Before partition of India not much attention was given to the natural calamities. It is only after 1947 that the problems of disasters, particularly the flood disaster drew the attention of the respective governments. Numerous measures include construction of embankments, barrages and dams. Construction of reservoirs and digging canals for irrigation, river training programmes for navigation and various town protection measures were undertaken. But all these measures were undertaken at the local and state level. Because of this fragmentary treatment of a large regional problem not much tangible benefit could be produced.

In 1954, a major part of India and Bangladesh experienced a severe flood causing devastation in large scale. Since then the respective governments realised the magnitude of the problem and started thinking for a systematic flood control measure. The Government of India soon adopted a National Flood Control Policy covering the whole country. A Central Flood Control Board was also set up which recommended for setting up two separate commissions for the Ganges and the Brahmaputra.

The Ganga Flood Control Commission (estd. 1970) is engaged in the preparation of comprehensive plan for flood control in Ganges basin, for the system lying in India. The plan is on the progress in a coordinated cooperation of the Indian state governments without

consultation with the other co-basin countries. Similarly, the Brahmaputra Board prepared a Master Plan for the control of flood and bank erosion and improvement of drainage of the Brahmaputra. The Board started functioning since 1982 and some of its projects were already completed.⁵¹

In the then East Pakistan a Flood Control Commission was set up in 1955. The objective was to control flood, develop irrigation facilities and to generate hydel power. The commission from time to time examined the flood problems, initiated studies and investigation and recommended a number of flood control schemes for implementation.⁵² But the supply and demand of water from upstream in India was a serious hindrance in the implementation process. Several meetings were held at the expert level on the problem of flood management. It was agreed that India will give flood warning and hydro-meteorological data for the major rivers and subsequently data were also exchanged. During the Secretarial level meeting between the two countries in 1969, the question of further cooperative arrangements on exchange of flood warning and allied matters were discussed.⁵³ As no further discussion could be made possible at the political level, effective cooperation could not be made between the two countries. Most of the flood control measures were, therefore, completed without any comprehensive planning. After emergence of Bangladesh no Master Plan on flood control has been prepared as yet. Emphasis was rather given to small and medium sized, low-cost labour intensive projects in shallow flooded areas and such schemes involved low embankments and gravity drainage requiring simple and less sophisticated technology.⁵⁴

51. Amjad Hossain Khan, "Floods: Problems and Prospects : Regional Overview" a Keynote Address in a Regional Conference on *Floods and Erosion*, *op. cit.*

52. *Ibid*

53. *Ibid*

54. N.I. Nazem and M. H. Kabir, *Indo-Bangladesh Common Rivers and Water Diplomacy*, BISS Paper No. 5, Dhaka.

In Nepal, the Government has recognized the need to attack the colossal problems of floods, erosion and landslides and has initiated plans for implementing control measures by constructing embankments, dams and other forms of river training works. Most of these measures are not comprehensive and integrated with soil and water conservation in upland areas. Result is large scale landslides and breaking of dams which cause further flooding. The 1981 flood in Butwal was the result of temporary dam formation by landslides in the Tinau river.⁵⁵ Similar surges have occurred in Tamor, Sunkosi Trishuli and number of other rivers in the country. Glacial Dam burst in 1985 in the Everest region created a flood that totally washed the small hydel project built at Namch Bazar.⁵⁶ The Himalayan country, Bhutan is also facing the same problem.

For drought hazard, India has taken several measures for the development of drought prone areas. These include development of irrigation, formulation of schemes specially designed to benefit the dry areas, agricultural research specially oriented towards the problems of low rainfall areas, scarcity relief which helps in creating provision of services like drinking water supply, etc., and special programme like Emergency Agricultural Production Programme (EAPP). The main thrust of Drought Prone Areas Programme (DPAP) is the restoration of a proper ecological balance in the selected areas. Some of the important elements of the programme are (i) development and management of irrigation sources (ii) soil and moisture conservation and afforestation and (iii) restructuring of cropping pattern.⁵⁷

Need for a Regional Approach : In the last three decades various types of flood control, anti-erosion, anti-drought and cyclone preparedness devices have been designed and applied. The devices are mainly serving the immediate purpose and cannot be claimed

55. Ajay M. Dixit, *op. cit.*

56. *Ibid.*

57. K. R. Shah, *op.cit.*

as a permanent solution to the problem. Moreover, it was found, in many cases, that this kind of piecemeal solution of a larger problem is often detrimental too. It is primarily because of absence of total scientific approach to the problem and inadequate data base, the existing management of natural disasters either transfer the distress of one area to another or from one problem to another.

It has already been mentioned that environmental disaster in South Asia originate in a unique hydroclimatic condition of the region. The Himalayas as the source of thousands of river channels which form numerous watersheds spread over several countries play the dominant role. The disasters in this region are, therefore, interlinked with each other. Floods and droughts are linked with precipitation and erosion with floods and rainfall. All these are again associated with various human activities like deforestation and settlements, numerous unplanned and piecemeal structural measures to control disasters. Cyclone is altogether a different phenomena although it causes severe flooding and large scale erosion in the coastal areas of the region. Any preventive measure, therefore, demands a total and comprehensive regional approach. This can help achieve many diverse objectives such as efficient use of land and water resource, control of erosion and sedimentation, aquifer recharge, salinity control and siltfree water in the streams. Since this kind of management approach needs to be multi-source, and holistic, it is likely to be technically and economically more viable.

Adhocism in disaster control, which is now in practice, ignores the fundamental aspects of ecology of nature. The control measure for disasters requires a total understanding of the whole system in terms of their nature, behaviour and pattern with scientific and philosophical approach through proper study of mythology, history and geography of their occurrences in the region. What is indicated here is the need for adjustability of the measures to local traditions, values and perceptions which would ensure greater acceptability on

the part of the affected people. Only then a viable planning is possible. Such planned control measures are expected to provide full control over the total areas. The modality of the programme may be complex but not unattainable.

Suggested Approach : The total spectrum of disaster management is very wide, complex and multifaceted. Man either does not have sufficient appropriate scientific knowledge to enable him to avoid severe disaster or he does that, but does not know how to apply it even if the possible technical know-how is available. In the relationship between man and disaster, classically, emphasis is generally given on the disaster, that the people have come to think about disaster as dynamic partner of man and man is the passive one.⁵⁸ But, the recent evidences show that the scientific, technological, social, economic and political processes in many parts of the world have made man an equally dynamic counterpart vis-a-vis environmental disaster.⁵⁹ How far man can control the natural phenomena depends on better understanding of the problem with empirical knowledge and quantitative information. The full realization of the benefits of the understanding of the physical dimensions of natural disasters and perceptual aspects would, however, depend on the organization of the effective management techniques and technology for specific situation.

In order to help resolve the problems presented by the hydro-climatic disasters in South Asia a comprehensive regional approach to its management is required; first, to make the best out of the given environmental resources and second, to explore the possibilities of bringing about modification in the physical characteristics which lead to disaster situation. For these, modification in the economic, social and political factors is necessary. An alternative approach can be the minimization of adverse impacts of the hydro-climatic hazards.

58. United Nations, *op. cit.*

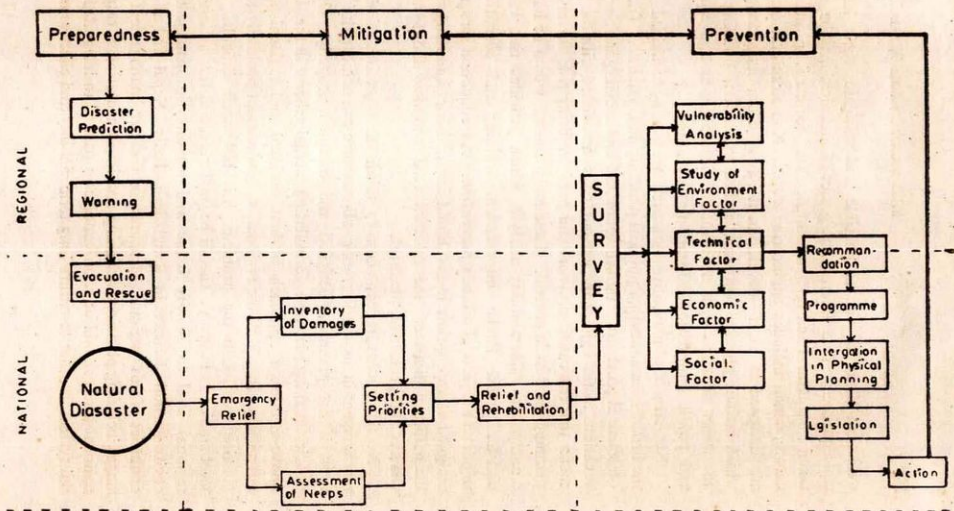
59. *Ibid.*

Three different courses of action may be considered as strategy. First, alteration of the hazard producing weather situation. Second, designing economic activities and planning, specially the physical planning and landuse in such a manner that can be best suited with natural environment. And third, better management of the activities of the people so as to offset weather problems. All these can be done in the following three different phases. Since disasters are inevitable, it is always better to be prepared to face them. Preparedness, therefore, is an essential component of organized efforts to overcome the effects of adverse natural phenomena as short term or emergency measure. It represents the capability of the government and people to safeguard life and property in a timely and effective manner in successive phases (Fig-3). First, appropriate authority can predict any disaster event well in advance through consultation and cooperation with other regional countries. Second, when disaster threatens or while the meteorological conditions might result in disaster, warning should be given in time so that people can save their lives and valuables. And the third and most challenging task is evacuation and rescue work while disaster actually hits or prevails. All these capabilities have to be planned well in advance and tested in experiences.

The second step towards the management of disaster is a chain of rapid works (Fig) in order to mitigate the damages done by the event. The foremost important task in this stage is the operation of emergency relief so that the extreme hazard is reduced. After giving emergency relief, two important aspects are to be undertaken simultaneously—the inventory of damages and assessment of needs. Then, on the basis of priority the distressed people are to be helped in terms of cash or kind unless they are properly rehabilitated.

The third step towards management is prevention. Disaster prevention, in fact, is directed towards the formulation and application of long term permanent measures which would serve either to avert the impact of potentially dangerous phenomena or to

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withstand them as far as possible and mitigate their harmful consequences. Two different categories of measures may be undertaken : structural and non-structural. The former is protective in nature, which includes engineering works. Non-structural measures are designed to steer development away from hazardous zones which include physical planning, landuse legislation, building codes and other measures such as taxation, insurance, mortgage policies and public information, education and training.

Non-structural preventive measures are usually contained within the broader framework of physical planning and landuse. The main objective is partly to establish economic and social goals for given locations in the light of the various risks associated with the phenomena that can cause disasters and partly to bring risk factors in the planning process in general. Landuse planning would be based on a composite vulnerability analysis which provides risk values in disaster areas. Public information, training and education are important aspects of disaster prevention. An education programme designed at appropriate levels should impart basic knowledge about the nature of disasters, the risks involved and also about warning services and protective measures.

No single measure can claim to fulfill the objectives of disaster management in its totality, nor all measures can achieve the objectives, if not planned, designed and executed properly. Devising policies, making plan and formulating actual scheme in the light of above-mentioned approach both at national and regional levels is not so easy. But, if all the regional countries react positively towards genuine solution to the problem, it is not much difficult. Expert level studies and surveys should be undertaken at the national and regional level to identify issues and measures in management of environmental disasters in Bangladesh, India, Nepal and all other countries of this region. Measures for disaster management in all stages including planning, designing and implementation at respective national levels should be coordinated as a part of an integrated regional system in order to ensure long term viability and effectiveness.