The Future of Large Projects in the Himalaya—Overcoming Incomplete Knowledge and Unsound Beliefs. Chandi Prasad Bhatt, PAHAR, Nainital. 1992. pp. 50.

High Dams in Himalaya—Environment and Sociocultural Implications. K. S. Valdiya, PAHAR, Nainital. 1993, pp. vi + 37.

State of India's Environment—A Citizens Report No. 3. Floods, Flood Plains and Environmental Myths. Centre for Science and Environment, New Delhi. 1991. pp. 167.

The widespread environmental degradation witnessed in the Himalayan region is the consequence of both natural and anthropogenic processes. The former include landslides, floods and earthquakes. The latter is caused by deforestation and construction of dams, embankments and roads. Both have combined to degrade the ecology of the region. The Himalaya is a vast store of natural resources. More than 50 million people live here. It is the youngest and the most fragile of mountain systems in the world. The climate of the whole northern India is determined by conditions prevalent in the Himalaya.

Chandi Prasad Bhatt, in his book, *The Future of Large Projects in the Himalaya* emphatically brings out the consequences of deforestation in the Himalayan region. The central part of the Himalaya, known as Uttrakhand, is the source of river Ganga. Its tributary, the Alaknanda, has an incessant history of floods. In the Alaknanda river and its tributaries, major landslides and floods have been known to occur every ten or twenty years. In this book, a brief description is given of the havoc caused by floods during 1857 and 1970. The questions which emerge in one's mind are: Are we helpless and unable to reduce the intensity of destruction caused by floods? Do we have adequate knowledge about the behaviour of Himalayan mountains, so that the disaster can be averted and loss of human life avoided?

Certainly, it is possible to lessen the magnitude of the destruction caused by floods and landslides through the restoration of forests. For this, people's resistance to cutting of trees must be encouraged and supported. The realization by the people of the importance of forests in some areas has culminated in a non-violent method of hugging the tree, called the Chipko Movement, to save them from cutting. A still more serious threat to the Himalaya is from many big and small dam projects which are either under construction or proposed to be built in the sensitive tributaries of the Ganges. The author gives the history of floods and earthquakes in the region and the social movements that are striving to save the Himalayan ecology.

Adequate data about the geology of Himalayan region are not available. The steps required to be taken prior to the occurrence of disaster to reduce human sufferings are a challenge to Indian scientists. In the book *High Dams in Himalaya*, the author, K. S. Valdiya, contends that notwithstanding the fact that various dams planned and constructed in the Himalayan region may be technically sound in terms of design and construction, comprehensive evaluation of the effects of impoundment of water on varied aspects of the natural environment has not been done. The author, a well-known geologist, describes the basic infirmities of hydroelectric projects designed for the Himalayan rivers. According to him, the entire Himalayan domain is geodynamically very sensitive, as indicated by high seismicity and activeness of faults and thrust. Because the Himalayan mountains are located in a region where two drifting earth plates meet and the earth's crust is still undergoing a change, it is a region with a lot of seismic activity. The region has been rocked by both moderate and large earthquakes. There are strong reasons to dispute the choice of these sites which are vulnerable to both earthquake and landslide hazards. The Tehri Dam in Garhwal provides an example of a high dam located near an active fault. The rocks in the vicinity of the dam are highly fissured, fractured and crushed due to repeated movements and the strained rocks are under severe pressure. The fault zones are highly vulnerable to onslaught of rains, shocks accompanying earthquakes and detonations, and to tempering for civil engineering works. The big dams are likely to create many distresses. The construction of dams not only uproots the mountain people, but also causes impoverishment of the poor farmers in the command area in the Indo-Gangetic plains. The cost of remedial and restoration measures is exorbitant. Also, the fast removal of salts and alkalies from one part of the land leads to the drainage water becoming highly saline. Combating of waterlogging becomes more costly and challenging than building dams and laying down networks of irrigation canals. In view of this, it would be wiser to go in for alternative plans which do not cause radical modification of nature and large scale displacement of people. The book provides up-to-date scientific knowledge about the geology of the Himalayan region.

The Third Citizens Report in the series State of India's Environment entitled *Floods, Flood Plains and Environmental Myths* has been brought out by the Centre for Science and Environment. Every year floods are a common phenomenon in the Indo-Gangetic plain and are a major cause of misery. After Bangladesh, India is the most flood-affected country. Between 1960 and 1981, out of the 96 internationally recognized natural disasters that occurred in India, 28 were floods. Floods, which were often described as natural disasters, turn out to be social disasters as well. It is usually the poor who are severely affected, because they live on the periphery of the human habitat. Indian official statistics depict a worse picture for the period 1953–1987, when some 50,374 people died in floods, an average of about 15,000 deaths per annum during the period. Floods affected an average of 7.66 million ha, destroyed crops in over 3.51 million ha, affected 31.84 million people, damaged 1.2 million houses, and killed 0.1 million cattle. The total damages caused to crops, houses and public property have been worth Rs 768 crore per year. It seems that the flood-control measures taken have not been effective. The average flood-affected population per year increased from about 16 million in the 1950s to 43 million in the 1970s and to 53 million in the 1980s. The flood-affected population has, in effect, risen faster than India's population. Simultaneously, in flood-affected areas, damages also went up steadily. Also, the flood relief expenditure rose from Rs 230 crore in 1980–81 to Rs 567 crore in 1985–86. The most affected states are Assam, Uttar Pradesh, Bihar, West Bengal and Orissa. In the late 1970s, Andhra Pradesh, Rajasthan, Haryana and Gujarat also experienced floods in areas usually not affected earlier. The intensity of floods has increased more because of human activities like defores-

tation, drainage congestion caused by badly planned construction of bridges, roads, railway tracks and other developmental activities leading to reduction in infiltration because of increased occupation of land, big industry, large scale urbanization and construction of embankments along rivers.

The nationwide flood protection programme began only after independence. When the British left, there were some 5280 km of embankments along different rivers. The first plan was to move away from rivers and put more faith in large dams to store flood waters. The idea of a dam on the Kosi river at Barakhshetra in Nepal had to be shelved, as the proposed site was located too close to the epicentre of an earlier major earthquake. As a result, stress once again shifted to embankments, especially in North Bihar after the spate of severe floods in 1954. There was also a mass popular upsurge in favour of constructing embankments, creating in the process employment for millions. What happened was that while embankments provided safety for areas inundated with floods, in areas where a river delta is extending rapidly, embankments would raise the flood level and perpetuate the problems of drainage and waterlogging in the adjoining areas.

In all the Five-Year Plans emphasis has been laid on flood control as a social measure. In these plans, flood control outlays have generally fluctuated between 0 64 and 1.08 per cent of the total outlay. The government has spent vast sums on constructing dams. By 1986, large dams numbering 256 with heights of 15 metres and above had been built and 154 more were under construction. Thirty odd dams had been built in the Indo-Gangetic–Brahmaputra valley, the most flood-prone region. Another 15 major dams are being constructed in this area. Most of these dams are multipurpose dams. The results as far as flood control is concerned have been mixed because of conflicting objectives of the dams. While flood control demands that the reservoir be kept empty as far as possible to arrest any oncoming flood, irrigation and power generation considerations demand that the reservoir be kept as full as possible. As a result, dams themselves have sometimes become the cause of flood.

The popular perception has been that of increasing floods despite all the investment made to block the flow of rivers. Public opinion is heavily influenced by the growing concern for environment across the world. Consequently, the public criticism is increasingly focused on degradation of the watersheds of Indian rivers, especially on the extensive deforestation of the hilly and mountainous portions of their catchment areas, which lead to environmental backlash effect in the form of flooding and drought, soil erosion, sedimentation siltation, and a host of similar problems.

The Himalayan forests normally exert a 'sponge effect' soaking up abundant rainfall and storing water before releasing it in regular amounts over an extended period. When the forest is cleared, rivers turn muddy and swollen during the main wet season, before shrinking during drier period. Siltation in the Ganges is so pronounced that a number of river beds are rising at a rate between 15 and 30 cm/year. Nearly 40% of India's water resources come from forest areas. Early in this century, forest cover amounted to an estimated 60% of land area. At present, it covers about 20% of the country's land. Unfortunately, it is being reduced so rapidly that there may be little left by the end of the century. This is a very serious problem, as the Himalayan mountains constitute an ecological system naturally primed for disaster. The Himalayan valleys like Alaknanda and Bhagirathi repeatedly face major floods. Usually caused by heavy and intense rains, they become worse when associated with landslides and blocked river courses. Of late, these valleys have become more landslide and flood prone due to deforestation and developmental interventions. A monsoon-simulation experiment conducted in the US revealed that in the absence of the Himalaya ranges, South Asia would have a desert-like climate, because the dry continental air flowing in the north-west could push the rain belt far away to the south.

It is believed that the human activity, which has brought about enormous ecological changes throughout the last few centuries, is responsible for increasing floods downstream. Himalayan slope can be afforested, so that the destruction from the flood cycle is arrested. The major concern is that forests are being replaced by abusive land use in many places. For instance, the 1962 Indo-Chinese war prompted a massive road construction programme in the remotest Himalayan area. Over 44,000 km of roads now cover Himalayan area. Nearly 40,000–80,000 cu. m debris is removed to build each km of these roads and 550 cu. m of debris has to be removed per km every year to maintain them. Apart from partial deforestation, such activities contribute to destabilization of land, congestion of drainage and destruction of natural watersheds.

It is obvious that the contemporary social and political institutions and policy approach do not meet the requirements of managing the floods. The foremost difficulty is lack of an authentic database on floods and indicators of their impact. Data are not available to show how expensive a particular landuse is and to what extent it is affecting the hydrological cycle. So far, control measures like construction of dams and embankments have not provided a permanent solution to the problem of floods. In some areas, floods rejunevate the soils, leading to higher crop yields. Construction of embankments in these areas has eliminated the possibility of alluvial deposits, reducing the soil fertility. It is unlikely that the contemporary measures would reduce the incidence of floods. On the contrary, they would have adverse effects in other areas. What is important is that one has to live with floods by evolving local solutions. Also, a major effort, as a long term measure, would be to mobilize local communities for promoting afforestation. At the macro level, there is a need to undertake a review of the policies of construction of dams and embankments and explore the possibilities of generating a master plan for each river basin by giving due consideration to the lifestyle of the people and maintenance of ecological balance. For better planning of the Himalayan region, studies will have to be undertaken on priority basis to understand its geology and hydrology fully. This status report is a useful document for understanding the genesis of floods in India and their impact on the environment.

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