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ENVIRONMENTAL IMPLICATIONS OF DAM BUILDING ACTIVITIES IN INDIA

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ABSTRACT

India has currently about 4291 large dams having a height above 10 metres. The construction of dams is often associated with several implications associated with environment, which can be categorized broadly as due to existence of dams and due to pattern of dam operation. Besides, the dams also change climate and have great social and economic implications. The paper highlights all such major problems associated with dams.

INTRODUCTION

India is among the foremost countries in the world in developing water resources. India is gifted with vast land and water resources but, in fact, it is water short country in relation to agriculture, municipal and industrial needs. About 80% of the annual rainfall and runoff are concentrated in the monsoon months. During this period maximum utilization of water can be made from the run of the river with small regulation requiring very little storage. Less than 15% of the hydropower potential has been achieved. Also only 25% of cultivable areas are irrigated. About 70% of river flows are discharged into sea without utilization. The rainfall is not evenly distributed in space and time, resulting in flooding in certain areas and drought conditions in other parts of the country. Therefore, it becomes necessary to store water by building large storage capacity reservoirs and storage tanks so that supplies for multiple purposes like domestic, irrigation, industries and power generation can be assured during dry season, in addition to effecting flood control in certain rivers.

DAM BUILDING ACTIVITIES IN INDIA

Modern dam construction began during the second half of 19th century, even though these had been built since ancient times. At the turn of 20th century (1900) there were 42 dams in India. During 1901 to 1950 about 250 dams were added. That is, at the time of the beginning of plan periods (1950-51), after India obtained independence in 1947, there were a total of about 300 dams. During the next twenty years, there has been a spurt in the dam construction activities in which 695 dams were added bringing the total number of dams to nearly 1000 up to the year 1970. The dam building activities intensified during the next two decades and at the end of 1990 the total number of dams stood at 3244. The Central Water Commission (CWC 1994) has compiled the National Register of large dams; India has 4291 large dams including the 695 dams under construction. Distribution of large dams in India and the year in which they have been constructed are given in Table 1.

State-wise picture of the distribution of large dams indicates that nearly half the large dams are in the two States of Maharastra and Gujarat. It is also seen that almost three-fourths lie within the three States of Gujarat, Maharastra and Madhya Pradesh. The position is summarized in Fig 1.

Table 1: Large Dams in India.

S.No.	Period	Number of large dams and their approximate height in, m		
		10 to 15	>15	Total
1	Up to 1900	14	28	42
2	1901-1950	133	118	251
3	1951-1970	277	418	695
4	1971-1989	1069	1187	2256
5	Beyond 1990	60	56	116
6	Details not available	162	74	236
7	Under construction	234	461	695
8	Total	1949	2342	4291

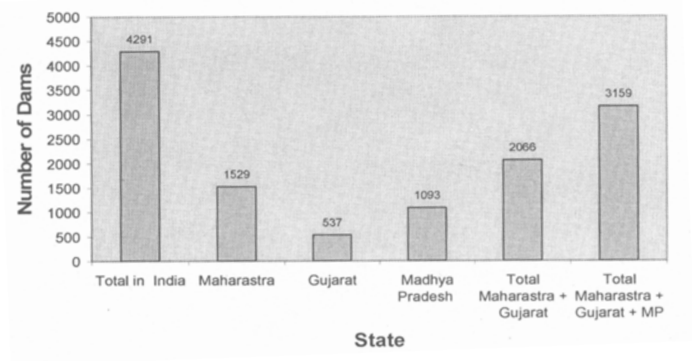

Fig. 1: State-wise distribution of large dams.

A significant number of these dams were built for irrigation (more than 92%) purposes only. The two great famines of 1897-98 and 1899-1900 in India led to the appointment of the first Irrigation Commission in 1901 to report on irrigation means of protection against famine in India (Paranjpye 1988). The commission proposed a number of measures, which included the construction of storage dams in different parts of India.

ENVIRONMENTAL IMPACT AND DAM CONSTRUCTION

The environmental impacts of dams can generally fit within two categories: those due to the existence of the dam and reservoir; and those due to the pattern of dam operation, while wide variations occur from site to site (Singh 2002).

Impacts Due to Existence of Dam and Reservoir

1. Imposition of a reservoir in place of a river valley (loss of habitat).
2. Changes in downstream morphology of riverbed, delta and coastline due to altered sediment load (increased erosion).
3. Changes in downstream water quality: Effects on river temperature, nutrient load, turbidity, dissolved gases, concentration of heavy metals and minerals.
4. Reduction of biodiversity due to blocking of movement of organisms (e.g., *Salmon*) and because of above changes.

Impacts Due to Pattern of Dam Operation

1. Changes in downstream hydrology:
   a. change in total flows
   b. change in seasonal flows (e.g., Spring flood becomes Winter flood)
   c. Short-term fluctuations in flows (sometimes hourly)
   d. change in extreme high and low flows
2. Changes in downstream morphology caused by altered flow pattern.
3. Changes in downstream water quality caused by altered flow pattern.
4. Reduction in riverine/riparian/floodplain habitat diversity, especially because of elimination of floods.

The impacts of these changes are magnified by changes in the flow pattern of rivers downstream that is caused by normal operation of dams. These changes, whether in total stream flow, in seasonal timing, or in short-term, even hourly fluctuations in flows, generate a range of impacts on rivers. This is because the life of rivers is usually tightly linked to the existing flow patterns of rivers. Any disruption of those flows, therefore, is likely to have substantial impacts.

DAMS AND CLIMATE CHANGE

Latest scientific estimates show that Indian dams are the largest global warming contributors compared to all other nations. As per Intergovernmental Panel on Climate Change (IPCC), there are six global warming gases, of which large dams could be sources of three: methane, carbon dioxide and nitrous oxide. For over a decade now large dams have been known to be emitters of greenhouse gases. The "fuel' for these gases is rottening of the vegetation and soils flooded by reservoirs, and of the organic matter that flow into and also grow under the reservoirs. Methane is produced at the bottom of the reservoirs in the anaerobic conditions prevailing there (Fearnside 1995).

The study estimates that total methane emission from India's large dams could be 33.5 million tones per annum and could be 27.86% of the methane emission from all the large dams of the world (SANDRP 2007a). China and USA have more large dams than India. However, Indian dams, being situated in tropical climate, could be such big contributors to global warming, because the methane emissions are much higher in tropical climate (due to higher temperature) than those from reservoirs elsewhere. This is similar to the phenomena of lower generation of gas in winter in biogas plants in India.

LARGE SUBMERGED AREA

The total submerged area of large dams in India is 4.426 million ha (1.094 crore acres). This area is larger than the area of whole of Kerala state (3.886 million ha) or whole of Haryana (4.421 million ha). The land taken for the reservoirs fall under four categories: forest land, riverbed land (and other waste land), private land (agriculture and home stead) and common property nonforest land (Panchayat land, grazing land, etc.) (SANDRP 2007b).

SOCIAL AND ECONOMIC IMPLICATIONS OF DAMS

Dams also have a range of social impacts, the most important of these being compelled relocation of millions of people. For example, it has been estimated that since the independence of India, about 14 million people have been displaced by dams and related construction, such as irrigation canals. Perhaps another 10 million people have also been displaced. Displacement due to execution of irrigation projects has disproportionately affected the poorest sections of the society consisting of scheduled castes, scheduled tribes, and other economically weaker sections (Jethoo 2005). The rehabilitation problems for dam construction in India are different from other countries due to high population density at Indian river basins and also due to role of agriculture on Indian economy and minimum land holdings (Jethoo 2006 a). The problems related to social and technical aspects of rehabilitation and resettlement often lead to cost overruns and delays of the project (Jethoo 2006 b).

In the great majority of cases, the economic well-being and health of those affected have declined after being relocated. Existing communities have been uprooted, often dispersed, causing people to lose their social support networks, as well as their livelihoods and ways of life.

CONCLUSION

In recent years there has been a severe controversy regarding large dams due to massive displacement and poor rehabilitation package implementation. The dams do not fulfil the economic promises made for them; they cost more than claimed, they fill with silt long before promised, and they produce less power than expected.

The planning and implementations are top down, bureaucratic, with little or no involvement of the affected and other concerned people. In addition to this a large part of the costs, especially the environmental and social costs, have been ignored in project planning. The thin and suboptimal spreading of resources, increase over the sanctioned project costs, projects spilling over a long periods, which are the reasons behind the major controversies.

The planning of a dam cannot and should not be done in isolation. It has to be part of the larger economic, social and environmental plan for the region and the country. For specific regions and areas, some challenges might be more important than others. In a semiarid and industrially underdeveloped region, there might be a great need to improve agricultural productivity and in a fast growing industrial belt there might be a great demand for power. Therefore, more technically safe, environmentally responsible and socially acceptable dams are constructed in the near future.

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