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Floods in Brahmaputra basin : causes and management

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The Brahmaputra river basin extends to four northeastern states of India viz. Arunachal Pradesh, Assam, Meghalaya and Nagaland; with an area of 194 x 10^3 km^2. The river has more than 100 tributaries, of which 15 in the north and 10 in south are fairly large. The basin has a very steep gradient in the north and eastern sides but extremely gentle gradient in the south, falling at the rate of 13 cm km^{-1}. The average annual runoff in the Brahmaputra river is 537.2 km^3. More than 660 m^3 km^{-2} silt load is brought by the northern tributaries and about 100m^3 km^{-2} by the southern tributaries. Due to high rainfall (2470 mm, annually), the annual soil loss due to erosion is 455.9 million tonnes, carrying with it about 976 thousand tonnes of nutrient load. The problem is further aggravated by the prevalence of shifting cultivation in 2119 km^2 in the catchment area, deforestation, faulty land use, improper land tenure system and lack of awareness. This results in huge loss of soil from the hills and silting of river beds, causing floods in the plains. This has resulted in many cases irreversible damage to the water resources, thereby increasing the risk of floods . Total area prone to floods in the basin is 31740 km^2 while 3609 km^2 area experience floods every year. Extreme floods in the basin are a product of meteorological input like precipitation as well as spatially and temporally variable basin properties. The runoff generation processes such as infiltration, macropore flow, surface flows are qualitatively understood, however little is known about how different processes combine to generate the extreme flood in the basin. A knowledge of flood generation processes is crucial for evaluating the vulnerability of a basin to floods. This is important for sustainable integrated river basin management as well as flood risk assessment. Three types of processes causing floods in Brahmaputra basin are (i) long - rain floods, where long duration rainfall saturate the catchment resulting in high flows causing flood events, (ii) short-rain floods, where high intensity rainfall occurs for short duration and (iii) flash floods when short but high intensity rains cause flood even when the catchment is dry. Though the rainfall is an important indicator to flood processes in the basin, the characteristics of the catchment also play a major role. Climatic fluctuations are responsible for the unusual behavior of the Brahmaputra river. In Brahmaputra basin the ecosystem has been disturbed by rapid population growth, uncontrolled developmental works, deforestation and land use, which encourage flood events. For mitigation of flood event; the social, economical and ecological events were taken into account. Flood control and or reduction in severity in Brahmaputra basin should include long term measures as afforestation, construction of reservoirs in upstream areas and controlled urban development efforts as well as short term measures as flood diversion, rain-water harvesting and vegetative cover for *in-situ* retention of rain water. Prevalence of shifting cultivation in the region also causes heavy soil erosion in the hills and silting of river beds and floods in the plains. A multidisciplinary study was started in 1983 to evolve new economically viable and ecologically sound land use systems to replace shifting cultivation. Up to 95% *in-situ* retention of rainwater and minimum soil loss due to erosion has been found in various land use systems studied. Since runoff is greatly reduced, this would help flood reduction in the basin.