

Strategies for Flood Mitigation in Bihar

An Assessment of Its Effects & Future Orientation

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ABSTRACT

Environmental aspects of Integrated Flood Management advocates a balance approach, preserving eco-systems while addressing a society's development needs & factoring in flood risks. It outlines an environmentally sensitive economic analysis & highlights the participatory strategies for the community development & stakeholder participation. Severe floods in the north-eastern region in 1954, 1974, 1975, 1976, 1984, 1987, 1988, 1993, 1998, 1999, 2000, 2004, 2007 has taken away heavy tolls of life & has caused intense damaged to the economy's resources.

The State of Bihar is the most flood affected state in the country, accounting for 17% of the flood prone area of the country. The post bifurcation Bihar now supports a population of 64.25 million within a geographical area of 93.80 lakh hectares of which 68.80 lakh hectares are flood prone & 10 lakh hectares perpetually water logged. The seasonal flooding in Bagmati, Burhi Gandak, Kamla Balan, Gandak & Kosi river basin affects 36% of the population of the state on an average & the state share in the total annual value of damage in the country is about 23% i.e. slightly less than one fourth.

Several Structural & non-structural measures, i.e. community preparedness & capacity building, flood forecasting & warning, flood proofing programmes, construction & maintenance of embankments, construction of reservoirs & flood insurance programme have been undertaken. These measures have provided reasonable degree of protection to only half of the region's flood-prone area. During high floods many breaches occur causing inundation over vast area for most of the monsoon months from May to September.

This paper deals with the effectiveness of the measures taken so far and with the future strategy to lessen the adverse impact of floods on socioeconomic conditions with special emphasis on participatory flood management and flood loss mitigation preparedness programmes.

Key Words : Bihar, Floods, Disaster, Disaster Management.

Introduction

Bihar is India's most flood-prone State, with 76 percent of the population in the north Bihar living under the recurring threat of flood devastation. About 68800 sq Km out of total geographical area of which 94160 sq Km comprising 73.06 percent is flood affected. The plains of Bihar, adjoining Nepal, are drained by a number of rivers that have their catchments in the steep and geologically nascent Adhwara Group of rivers originates in Nepal, carry high discharge and very high sediment load and drops it down in the plains of Bihar. About 65% of catchments area of these rivers falls in Nepal/Tibet and

only 35% of catchments area lies in Bihar. A review by Kale (1997) indicated that the plains of north Bihar have recorded the highest number of floods during the last 30 years. In the years 1978, 1987, 1998, 2004 and 2007 Bihar witnessed high magnitudes of flood. The total area affected by floods has also increased during these years. The flood of 2004 demonstrates the severity of flood problem when a vast area of 23490 Sq Km was badly affected by the floods of Bagmati, Kamla & Adhwara groups of rivers causing loss of about 800 human lives, even when Ganga, the master drain was flowing low. Himalayas, Kosi, Gandak, Burhi Gandak, Bagmati, Kamla Balan, Mahananda It may be noted that the problem of flood & drainage congestion and

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water logging is more acute in North Bihar. About 83% area is flood prone & 15% area is waterlogged in North Bihar. RBA (1980) in its report has indicated the flood prone area in undivided Bihar as 4.26 million hectares (ha). The entire flood area falls in Bihar as there is no flood prone area in Jharkhand. According to Ganga Flood Control Commission (GFCC) report the flood prone area in different river basin in Bihar is 64.61 Lakh ha. The Second Bihar State Irrigation Commission (SBSIC) has divided the river basins of Bihar in three regions and the percentage of flood prone area to the total drainage area of different region in Bihar are North Bihar (83%), Main Ganga Stem (76%) & South Bihar (55%). The total for the entire Bihar is 73.34%. The percentage of flood prone area is maximum (89%) in Kosi basin followed by Burhi Gandak (86%), Ghaghara (85%), Mahananda (84%), Kamala Balan (82%) and Gandak (80%). In South Bihar the % of the flood prone area is maximum in Punpun Basin (76%) followed by Kuil-Harihar (51%), Badua Belharana (47%) and Bilasi Chandan (43%). The flood prone area under some basin is about 3.7 lakh ha as per the reports by the GFCC & SBSIC.

On an average 15.13 lakh ha area is affected due to flood out of which 6.6 lakh ha is crop area. Annually 186 human lives, 676 heads of cattle sacrifice their life & on an average 1.96 lakh houses are damaged by the floods. The value of damage to crops, houses and public utilities accounts for RS/ 155 Crore annually.

The most common structural measure in use to counter floods in the region is embankments. Altogether more than 3400 km embankments exist along different rivers in Bihar. In the focus area main rivers are mostly embanked. River Burhi-Gandak is embanked except in the upper reaches. Bagmati is embanked from Dheng bridge to Runnisaidpur and the from Hayaghat to Badalaghat. Khiroi, an important tributary of Bagmati is also embanked. Darbhanga-Bagmati is embanked on left bank in the vicinity of Darbhanga town. Kamala is embanked up to Darjiya. River Kosi is also embanked on both sides.

These embankments have seized the wide range migrations of rivers. However, these embankments have some gaps which reduce its effectiveness. Channel improvement is also not a usual practice. Flood forecasting for certain points along rivers are being done by CWC since long. Those forecasts have been used by the concerned departments for issuing warning when required. Improved flood forecasting with

increased lead time and accuracy is one of the main objectives of FMIS, Bihar.

The paper is organised as follows. In section I - Flood Problem, Government expenditure on flood protection & the extent of flood damage has been dealt with. In Section II Analysis of causes of flood disaster in Bihar have been summarized in view of the existing problem. In section III- Flood mitigation participatory strategies & their actual status are highlighted and section IV- Findings, Suggestions and Conclusion.

The research methodology in the present paper is the summarization of the existing flood mitigation measures under taken by the government, viewed from the real government reports provided by the officials of the department of relief and rehabilitation, Ministry of Bihar. An effort is made to analyse the status of the programme for knowing the findings in terms of the effectiveness & its critical review. Amicable suggestions for the future orientation & improvement is given and finally concluded in view of the discussion in section-I, II and III. The references are cited at the back because most of the data and facts cited are from the original documents of the different departments provided by the government of Bihar. In section II & III most of the part of the analysis are revealed through the personal investigation and interaction with the officials of the department of relief & rehabilitation, government of Bihar, UNDP- Representative & State project officer Mr. Dilip Bhanj, district project officers on UNDP rolls and in some cases the real victims of the flooding. This point is also worth noting the author himself is the native of Bihar and to some extent born and brought up in that environment.

Flood History, Problem, Damages and Government Policy in Bihar

The central water commission (CWC) being an apex body monitors any trivial matter causing two specific issues i.e. irrigation & flood control in the country as whole. The devastation story of 1954 flood in North Bihar made the government to be on the toes to come up with intense structural measures, The flood of 1954 was limited to North Bihar, affected an area of 2.46 MH and a population of 7.61 million (out of 18.393 million), 8119 villages (out of 21,107 villages) were crushed leading to a loss of standing crops over 15.96 lakh hectares. Some 1,79,451 houses were destroyed & 63 persons lost their lives in the flood. 1944 cattle had also perished in the flood this year &

the flood loss was valued at RS/ 50 Crores. The First Flood Policy of the country came into being in 1954 but the proposal to Dam Kosi at Barahkshetra in Nepal was dropped in favour of embankments along the river citing the reason that the proposed dam would be a safety hazard for the people living in the downstream areas. After this all the major rivers of Bihar were embanked and the process continues still. The flood prone area of Bihar in 1954 was 2.5 MH and the state had only 160 kilometres of embankments along its rivers.

The deadly impact of the 1974 flood was witnessed in the south of Ganga and also in the districts of Munger and Santhal Pargana and had a spread area of 3.182 MH. The cruel hands of the flood affected a population of 16.39 million and crops over 1.751MH were lost. The total number of 5,16,353 houses were destroyed & this flood killed 80 persons & 288 cattle. The total Losses were put at RS. 354.59 Crores. Following the flood this year the GoB decided to appoint a committee under the Chairmanship of Kanwar Sain,(former chairman of CWC) to suggest the means to combat floods. The committee reiterated the idea of construction of the Barahkshetra Dam on the Kosi and stressed this fact that the embankments

could only be temporary solution to the flood problem of the state. The 2192 kilometre long embankments constructed till 1974 were only protecting a meagre land of 1.5 MH. The flood prone area of the state, however, had shot up to 4.3 MH by this time. The worst ever recorded flood of 1987(Record not broken till 2007) impacted both North Bihar as well as South Bihar. An area of 4.668 million area of the present day Bihar and a population of 282.38 lakhs was badly hit by this year flood which engulfed 23,852 villages and destroyed crops over an area of 2.51MH. In total it destroyed 16,82,059 houses & killed 1373 persons. By the end of 1987, there were 3321 kilometres long embankments in the state with an expected protection capacity of 2.873 MH of land against flooding but unfortunately there were 104 breaches in these embankments and the flood prone area of the state had gone up to 6.461 MH. Subsequently, Naresh Chandra Committee was appointed to look into the causes & remedies to deal flood in the state.

The flood of 2004 spread over 20 districts of North Bihar had affected 2.13 crores of population & impacted an area of 2.772 MH (4.99mh according to CWC). The flood engulfed 9346 villages, destroyed

crops over an area of 1.399 MH and swept away 9,29,773 houses killing 885 persons. By the end of the year 2004, The State of Bihar was left with an embankment length of 3465 kilometres out of which 24 kilometres went to Jharkhand and another 11 kilometres was swept away, the remaining 3430 kilometres are still with Bihar while the flood prone area of the state has gone up to 6.88 MH.

The devastating disaster toll of 2007 floods affected 20 districts, fully hampered 9939 villages and swallowed 20.5 millions persons & families roughly affected about 5-6 millions families with a total crop loss of 1.64 million hectare amounting to 113.6 billion. The details of the damages due to floods in Bihar can be properly viewed from Table - 1

Flood Problem in Bihar

In Bihar typically, about 80% of the annual rainfall occurs within a span of four months from June to September, which is within the monsoon period. Rivers having inadequate capacity to accommodate monsoon discharges over flow their banks causing flood in the adjoining and adjacent areas. Bihar is situated in the central portion of the Indo-Gigantic plain. The portion lying on the northern side on the left bank of the Ganga is known as North Bihar and that lying on the north eastern side as Central Bihar. Almost the entire northern region of the State is affected by floods almost every year. Due to cyclical and climatologically factors, the problem of floods are confined not only to the plains of North Bihar, but cover large tracts of Central Bihar too. The flood problem in Bihar has unique characteristics. It is a play ground of many rivers particularly in alluvial belt. There is the spilling of the river banks and drainage congestion because of peculiar deltaic formation of the soil in the North Bihar as also in the area between the hills and Ganga in the South Bihar and severe erosion by both major & minor rivers. Another peculiar feature of the rivers of the North Bihar is that all of them originate in the hills of Himalayas and come through Nepal making them international rivers.

The wide spread and pervasive nature of the problem is evident from the following Table 2.

The average annual figures of damage do not represent the real severity of the problem, which is revealed by the maximum value in the particular year.

The maximum flood affected area was 17.5 million ha (1978) and maximum damage to the crop area was 10.15 million ha (1988). The maximum population affected by flood was 70.45 million (1978), the maximum loss to human life & cattle head was 11316 (during 1977) and 68,248 (during 1979) respectively. The maximum value of damage of crops, houses & public utilities was Rs. 5846 Crore. The details of average annual flood damages and maximum damages with relevant years are given here under in Table 3.

Expenditure on Flood Protection Measures in Bihar

The severe nature of the flooding disaster forces us to know the extent of the planned expenditure by the government of Bihar in mitigating such disaster. The Rastriya Barh Ayog (1980) has recommended that the comprehensive approach to the problem of floods must form the part of the overall comprehensive approach for the best possible utilization of land & water resources for optimum production on a sustained long term basis. The authenticity of the fact whether the flood management works really worked in Bihar or not, it would be proper if both the structural & non structural measures are evaluated with reference to the expenditure on the flood protection measures in Bihar as is given in Table -4

Table 4 shows the plan wise expenditure on flood management Programme in Bihar as well as India at current Price & also at constant Price (1980-81) was around 41% of the total expenditure on flood management in the country. This was indispensable in view of the severe flood devastation during 1954. However this level of expenditure could not be maintained during successive plan periods and the % decreased considerably and it varied between 12% to 20%. During Eighth Plan (1992-97) the percentage of flood expenditure on flood protection measure in Bihar came down to only 9.75% of the total expenditure under this sector in the country. This may be one of the reason for the poor achievement as protection has been provided in only 43% of the flood prone area in Bihar so far.

This point is worth noting is that the amount spent on drainage schemes of the Kosi and Gandak Irrigation Projects have not been included in the total expenditure shown during the planning period till 2002. Total outlay for the tenth five year plan at 2001-02 price has been fixed at 1910.20 crores. Out of this, 1771.70 crore is proposed to be spent on works and 138.50 crore on establishment.

Analysis of Causes of Flood Disaster in Bihar

Various studies have shown that flooding apart from being a natural phenomenon, it is also a man-activity induced problem, the major reasons for the causality of flooding disaster in Bihar are as under :

General Causes

The general causes responsible for Bihar flooding are river channels carrying flows in excess of the transporting capacity within their banks. This is due to excessive precipitation in north-eastern India, backing up of water in tributaries at their out falls into the main river with or without synchronization of peak floods in them, heavy rainfall coinciding with river spills over a short period of time, land slides blocking stream courses and then sudden release of blockage, Upland floods coinciding with high tides, heavy local rainfall, Cyclonic storms, Inadequate drainage to carry away surface water quickly, Inadequate waterways at rail and road crossings and encroachments in the flood plains, Loss of soil mantle in Himalayan friable watersheds, Lack of proper control of land use and developmental works resulting in obstruction of the natural flow, steep slopes of the rivers as they enter the plains and absence of easy outfall facilities, and deforestation in the upper catchments areas reducing retaining capacity of water and holding soil and consequent soil erosion resulting in silting of riverbeds, which shift course.

During the field survey, it was noted that the following are the main causes of flood in the geographical area covered in the study.

Marginal Embankments

Most of the embankments in Bihar are constructed during the 1950s and 1960s when reliable hydrologic data were not available. Later on, they were found to offer inadequate protection. After studies in depth, the following deficiencies found are as follows ; The design-flood adopted for embankment design was lower than the high flood levels recorded in subsequent years, Hydraulic gradients adopted were not based on actual tests, Inadequate drainage sluices provided in the embankments resulted in drainage congestion behind the embankments, embankments built along the junction of main rivers and tributaries created pockets of drainage congestion, embankments were not aligned through a suitable foundation, resulting in seepage through the seat of the embankment, embankments were constructed close to the riverbanks

to protect as many villages and towns as possible and thus costly anti-erosion works had to be undertaken subsequently to protect them, spurs constructed to protect the embankments had an adverse effect on the opposite bank, farmlands were deprived of silt-laden waters having fertilizing value.

Drainage congestion

Severe rainfall-induced drainage problems occur in naturally low land, and large areas (up to 2 million hectares) remain under water for a long time. Drainage congestion is due to heavy rainfall of short duration coupled with high flow levels in the main river preventing rainwater from draining quickly into the riverbed. They can also be induced by construction of roads, railway tracks and embankments that obstruct natural flows with encroachment on the riverside areas due to population pressure. Insufficient capacity of drainage channels and natural bowl-shaped topography of land resulting from defunct river courses also contributes to drainage congestion.

Corrosion Problem in broad

Bank erosion by the Ganges, the Brahmaputra and their tributaries has become a matter of serious concern to both the people and the government, and erosion control works consume large chunks of the budget. In the past few years an average of more than 80 percent of total allocations made in the flood sector is being spent on anti-erosion works to check the erosion of land and marginal embankments constructed so far, leaving little for further protection works. At many places, long stretches of riverbanks along towns, villages, fertile land, and lines of communication are eroded by the river.

The causes of heavy erosion are excessive sediment loads, steep bed gradients, transverse bed slopes, the depreciable nature of bank material, the formation of char islands and consequent development of side channels. Erosion is mostly observed upstream and downstream of stable reaches or nodal points. It is also observed below the confluence of the main tributaries.

Environmental Assessment

Water-logging

Embankments over 459 km were constructed along both banks of the Kosi River in 1959 along with a canal system in the Kosi basin, which added to the drainage problem and thus exacerbated the water-

logging problem in the basin by intercepting the natural drainage system.

The countryside behind the eastern embankment has a wider waterlogged area due to the choking of outlet sluices in the embankment owing to the rise in the bed level of the river. The water table in the command area has shown significant rise due to seepage through embankments and canals, as observed in the various wells in the command area. The waterlogged area has been estimated to cover about 182 000 ha out of a total command area of 1.5 million ha.

Siltation in river and canal systems due to excessive silt change in river water

The Kosi and its tributaries in the Himalayan catchments bear much sediment (about 200 million tons) resulting in erratic and unpredictable morphological changes and bank erosion at an annual maintenance cost of about Rp.100 million. The only solution adopted is to keep watch of the yearly behaviour of the river and protect embankments in likely vulnerable reaches in time.

The silt charge in the main canal resulted in the rise of the bed level by some 3 metres, which in turn reduced canal capacity to 30 percent, requiring maintenance of canal capacity at great cost.

Erosion problem

The Kosi dam and marginal embankments have greatly helped in mitigating the flood problem. The dam was commissioned in 1953 and marginal embankments were completed in 1959. These measures have successfully checked the alarming lateral westward shift of the river which used to engulf many villages and towns frequently. But now the marginal embankments on both banks are subjected to river water pressure and consequent severe erosion. In order to maintain the embankments in position, large-scale anti-erosion works in the form of spurs, studs and revetments are carried out, including retirement of embankments, every year before the flood season at vulnerable locations.

Resettlement and rehabilitation

Before the construction of the Kosi dam and embankments, villages and towns over a large area had to be rehabilitated due to the lateral shift of the river. The resettlement and rehabilitation of people in the Kosi region has been substantially controlled, and

development of Sopaul and Saharsa district towns and other blocks has taken place after the project. Without embankments and dam, the Saharsa divisional town and Sopoul district town would not have existed.

Hydrometeorology

The meteorological conditions in the catchments of Brahmaputra, Barrak and Ganges comprises different climatic atmosphere in hilly ranges in Bhutan, Nepal and India and the plains of the Assam valley and the Gangetic plain. The drainage area in India is subjected to cyclonic storms originating in the Bay of Bengal, particularly in the latter part of the monsoon season.

The mean annual rainfall varies widely from 800/1400 mm in the northern part of the Ganges basin to 2600 mm in the Brahmaputra basin.

In view of the aforementioned problems which accelerate the process of high flooding, the government of Bihar has taken following initiatives in the form of structural and non-structural measures over the years from 1954-2002, the critical analysis of which follows.

Flood Mitigation Strategies, Effectiveness & Status In Bihar

The structural and non-structural measures taken so far in the Bihar river basin for the mitigation of flood hazards and their impact on people's welfare and the local economy need to be continued to a great extent. Government investment in flood management works has increased from year to year and more areas have been protected; (Table-4), yet, the estimated value of damage has also increased. (Table-1) Undoubtedly the measures taken have provided a reasonable degree of protection against low- and medium-level floods to half of the flood-prone area. But when high floods strike, a large number of breaches occur in the embankments mainly because of the lack of maintenance of existing works, encroachment of embankments, and encroachment in the free board due to deposition of silt in riverbeds and the erosive action of river waters.

Construction and maintenance of embankments

The structural measures for flood protection/moderation implemented so far in Bihar are mostly construction of embankments which are considered as a short term measure but this short

measure has not been properly implemented and many schemes are languishing since long. There are gaps and raising & strengthening over due. Embankment breaches are normal annual features & their annual maintenance is not up to the mark. The embankments in Bihar is not expected to provide protection in case of occurrence of flood of higher frequency higher than the designed one, (which is usually 25 years) For assessing the utility of embankments in flood control and for taking steps for improvements in future, performance evaluation studies of embankment schemes were carried out. The outcome was that, by & large, Gandak embankment has provided substantial control over the floods from Gandak on its lower

reaches since 1954. It provides security & relief to the people of Chapra, Siwan, Gopalganj, Champaran, Muzaffarpur & Vaishali District in Bihar. Since 1957, The Kosi embankment on an average has protected 2.13 lakh ha of land in Darbangha (0,47 lakh ha) and Saharsa(1.66 Lakh ha) districts of Bihar from the ravages of flooding. Though RBA (1980), SBSIC (1994), NCIWRD (1990) have advocated case studies of the embankments schemes implemented as flood control measures to evaluate their performance, the progress in this regard is very dismal. Before assessing the performance of the embankments as a structural measure in Bihar, It would be proper to know the phases of embankments construction in Bihar from Table -5.

If we analyse the aforementioned table-5, we find that targeted effectiveness of the embankments in terms of area protected has decreased over the planning years particularly in 7th plan. The performance of embankments in Bihar has always been a sensitive matter in terms of the annual financial allocation for the annual maintenance of ramps & cuts & to mend the breaches. Thus, embankments in Bihar are the temporary solutions and not a permanent measure. The government of Bihar needs to search for viable alternative in the form of reservoir and construction of dams as permanent measures.

Watershed management

Watershed management means harmonious development of land water within the natural boundaries of a watershed so as to produce on a sustainable basis an abundance of plants and animals

for the good of mankind while still delivering a controlled flow of clear water downstream. The main objectives of watershed management programmes are to increase infiltration into the soil; control damaging excess runoff; and manage and put runoff to useful purposes.

As per the field survey analysis, Bihar has yet to come with a strong watershed management programme by covering afforestation, grass planting, banding and check-dams to fully use the watershed for the detention of water where it fell. These measures would increase rain water infiltration, detain water and silt, help to moderate floods and their impact downstream, and increase groundwater storage. Recharging ground water resources would prove to be beneficial for effective flood mitigation in Bihar.

Soil conservation and afforestation

The effectiveness of soil and water conservation measures on reduction of runoff from the catchments to reduce peak flow into the systems has not been of significant achievement in Bihar. Large floods which cause devastation are almost invariably associated with prolonged periods of rainfall (during which the soil becomes nearly saturated.) It was felt necessary to take soil conservation measures in the catchments area of rivers flowing down from Nepali hills to arrest the silt charge which settles in riverbeds and reduces the free board of embankments and which is responsible for riverbed braiding and shoal formation leading to breaches in the embankments. For this, the cooperation of the Nepali government is required, since most of the catchments area of north Bihar lie in Nepal.

In Bihar, soil conservation measures were taken in a few flood-prone catchments with limited available resources & with people participation. These measures remained limited to pilot and experimental applications. Their effectiveness in reducing the flood peak was encouraging. Soil conservation measures were found to have beneficial impact by way of a significant reduction in the quantity of silt flowing into the rivers (Table 6).

The soil conservation programme became the biggest source of rural employment and it also created ponds and field bunds, productive assets that the people can use for all kinds of purpose. This needs to be given preferential importance in Bihar.

Afforestation

Soil eroded from the upper and hilly catchments areas of the Bihar rivers basin is flushed downriver through floodwaters; it settles in the riverbeds and results in braided formations and in inter se distribution into channels which shift from time to time. These braided channels subsequently trigger the erosion of riverbanks, and the protection works that have to be undertaken are very costly for the state of Bihar alone. As per the research analysis, People participation in afforestation efforts in Bihar, not only helps reduce soil erosion but also improves the socioeconomic conditions of the community as a whole. The analysis says that government of Bihar is highly non-responsive in this regard.

Flood plain regulation and zoning

The basic concept of flood plain management is to regulate the land use in flood plains in order to restrict the damage due to floods, while deriving maximum benefit from them. Flood-plain zoning recognizes the basic fact that flood plains are essentially ruled by the whims of river flows, and as such all developmental activities in flood plains must be compatible with the flood risk involved.

No doubt, flood Plain Management & Zoning are the indispensable components of non-structural measures which reduces the flood damages & miseries affected by the flood. However there is no seriousness about it and even the beginning has not been made. Flood Plain Management & Zoning has two important components; preparation of map for flood Zone based on the actual contour and enactment of proper legislation for management of flood zone plain. It is really high time that Bihar should make sincere efforts to accomplish this task.

Flood proofing

Flood-proofing measures help greatly in mitigating people's distress in flood-prone areas. They consist in structural improvements along with emergency action without evacuation from the flood-affected area. In Bihar 100 flood proofing schemes were undertaken for implementation during IX plan period at an estimated cost of Rs. 1121.30 lakh. These are located in flood prone area of North Bihar. These included construction of 99 number of raised platforms, one anti flood sluice. However the

construction work is going on at 69 sites and it could not be started at remaining sites due to land acquisition problem. A sum of Rs. 430.22 lakh has been spent in 2001-2002. Whatever may be the scheme & investment, nothing has yet been accomplished in the structural form of flood proofing, the highlight of which are as under :

Raising of villages

The progress of the work of raising of the villages are very slow in Bihar in terms of their connectivity to nearby roads & embankments. This raises a question mark on the government responsiveness.

Raised platforms

These are raised earthen platforms to provide temporary shelter to people and livestock of the affected villages, which get marooned frequently and suffer from acute hardship due to disruption of basic civic amenities and communication links. This scheme is being implemented at least every five years in those parts of North Bihar where village homestead areas are inundated. The platforms are built near or in the villages 60 cm above the 25-years'-flood level and are provided with food, fodder, drinking water and public conveniences. The platforms are connected to either all-weather roads or service roads on embankments for the emergency needs of the people. Provision of a motor boat or country boat is made for clusters of platforms where road communication is not possible or viable. The raised platforms are constructed with the participation of the people of the area and their maintenance is being done by village panchayats and local bodies. The scheme is a fake scheme as it has never been implemented in Bihar & reveals a myth story during annual flooding.

Quick drainage facilities

Relieving drainage congestion efficiently alleviates hardship in chronically flood-prone areas. This scheme, which is under implementation in North Bihar with people participation, includes restoration of existing sluice gates and connected works, provision of additional drainage openings and improvement of approach and outfall channels in the sluices. The people who reside in the problem areas are fully aware of necessary corrective measures to be taken and readily extend their help. The North Bihar every year during flooding enumerates its suffering tale due to drainage congestion on which the state government has never

acted upon.

Flood forecasting and warning system

Flood forecasting as a non-structural measure was brought into operation in 1969 by the Central Water Commission (CWC). Bihar accounts for 36 nos. of flood forecasting station out of a total of 157 in the country, located on Ganga Brahmaputra-Meghna System. At present forecasts for all important tributaries are issued by various methods with sufficient time lag. The forecasts are formulated after collecting the observed gauge, discharge and rainfall data through wireless and other communications and disseminating them to the administrative and state engineering agencies concerned with flood hazard mitigation. So far, the forecasts of incoming floods have been 98-percent correct.

The following table shows the level of performance of flood forecasting Station in Bihar.

By now it has assumed considerable importance for flood management. It is considered as the most reliable, cost- and time-effective measure for loss mitigation, planning evacuation of people and livestock in the flood plain, early harvesting of crops, transporting movable items and safeguarding the embankments.

From the analysis of the aforesaid table, we can say that the flood forecasting & warning system reveals a success story over the years but the accuracy of the forecast is showing a downward trend as it has come down from 98.2% in 1996 to 96.2% in 2000.

What in reality is required in Bihar is the proper education of the people on how to react to warning signals to save life and property has top priority. The danger levels are marked at important public places such as bus stands, railway stations, hospitals, etc. Potential flood victims are notified in advance of where to move to in order to be safe. As per the analysis, the government of Bihar has taken stand in the most recent UNDP-MHA programme in Bihar but poor implementation has diluted the programme to a great extent as the number of human & cattle deaths have increased over a period of time.

Disaster preparedness and management

Looking into the multi hazard proneness of the state the GoI-UNDP Disaster Risk Management Programme has been implemented in the state of Bihar in the 14 most hazard prone districts of the state. The

basic objective of the programme is to create community capacities for vulnerability reduction and involvement of all stakeholders in capacity Building, Awareness generation on various disasters, Preparedness planning and integration of these initiatives Development planning. Emphasis has been laid on paradigm shift from relief to preparedness and reconstruction to mitigation in the recent years. The name of the Relief Department has been changed now to Disaster Management. This is a revolutionary step in changing the mindset of all from drolling out to preparedness and effective preparedness at all levels. The state Disaster Management Act which has been approved by the State Assembly in 2004 will now be repealed and the National Act will be now adopted for the state of Bihar. Rules and Regulations for the setting up of Disaster Management Authority is already been prepared and submitted to the law department for approval and necessary action on this. The state Disaster Management Policy is being prepared which will facilitate in effective disaster management at various levels. Large scale awareness generation among various stakeholders including government officials, Panchayati Raj Representatives and common mass is being carried out at various levels through state level exhibition like Chetna, Rally among school students, Slogans and wall paintings in buildings on various Do's and Don'ts on Disasters, Slides in Cinema halls, and Competitions among School Children in various schools are being conducted. Various Capacity Building training Programmes for government officials, NGOs, PRIs, Teachers are being conducted on role of various agencies in Pre, During and Post Disaster Situations. Training of Masons and Engineers are being carried out in the GoI- UNDP adopted DRM districts on construction of seismic resistance building constructions along with construction of Technology Dissemination Units(TDUs) for mass awareness. Many of the Engineers, Architects are being sent to various IITs of the country from time to time to undertake training on Earthquake resistibility of Building technologies. Multi hazard preparedness Planning are being prepared from the District to Village level along with specialized training on Search, Rescue and First Aid training to build the capacity of the Community to face any disaster.

If we analyze the figures of damages given in table -1, we find that the programme has shown the positive sign except in one of the abnormal year of 2004, where the programme effectiveness has failed to a great extent but abnormality never counts.

Drainage congestion relief

Recently drainage improvement work was carried out at the initiative of the federal government in the Mokamah-tal area, which stretches over 100 km along the left bank of the Ganges east of Patna. The whole area has had acute drainage problems during the monsoon months well into November. Early drainage would facilitate cultivation of two crops, which would bring great changes in the local economy. The work started in April 2001 to resection the main Kiul-Harohhar channel emptying into the Ganges. Early drainage of the congested area has led to a marked improvement, but overall performance is not up to the mark.

Flood insurance

Flood insurance has yet to be implemented, but efforts are being made to insure crops against losses due to floods. This can be further extended to the people living in low and medium risk areas. Insurance of high flood risk zones has to be shared by the government out of the capital invested in the relief and rehabilitation of flood victims.

Flood insurance as a concept has not yet been properly thought of by the Bihar government, Implementation has to take a long way to come.

IV Findings, Suggestions and Conclusion

Findings :

On the logical assessment of both the structural and non-structural flood mitigation measures as mentioned above, the following findings are summarized below :

- i) Bihar being a predominantly an agricultural state accounts for about 17 % of the total flood prone area of the country. Post-bifurcated Bihar has a total geographical area of 93.80 lakh hectare out of which 68.80 Lakh hectare is flood prone and about 10% is perpetually water-logged.
- ii) The flood problem of Bihar has international dimensions, as most of the rivers enter Bihar through Nepal where they have considerable catchments area.
- iii) The flood protection structural measures so far implemented in Bihar in large scale with huge investment is construction of embankments which is considered as a short term measure

which encompasses a heavy expenditure in the form of repairs of breaches. The permanent measures of construction of reservoir and dams for flood preventions remains in contemplations and is considered as a political dilemma so far implementation approach is considered.

- iv) The area under protection due to embankment is only 43% and still 57% of the flood prone area remain uncared by the government.
- v) The issue of water logging is also of prime importance. About 9.00 hectare of agricultural land is water logged in Bihar itself. An integrated drainage scheme in Kosi and Gandak commands was formulated by the state government in 1986-87 but was never been properly addressed. On a suggestion of the task force constituted by the planning commission six pilot schemes namely Maniyari drainage scheme, Jharahi drainage scheme, Daha drainage scheme, Upper Noon drainage scheme, Tel drainage scheme and drainage scheme under phase-II of western Kosi command were technically cleared but due to acute financial crunch of the State, it was not properly executed.
- vi) The share of plan expenditure under both water resources as well as the flooding sector has considerably decreased as can be witnessed from table -4.
- vii) With half-hearted implementation of the structural programmes in Bihar, the recent shift has been on non-structural measures, a case to the point is UNDP-MHA Natural disaster programme in 14 selected districts of Bihar, but ironically the disaster damage data stated in table- 1 implies that such programme of non-structural measures have made no significance difference in protecting the Bihar economy from the natural disaster demon.
- viii) In order to create a self sustained base of development in the state of Bihar, the infrastructural needs of the state needs to be properly catered, particularly in North Bihar, where the need of the hour is the implementation of long term sustainable structural measures of flood control.

Suggestions

The following are the suggestions and future orientation offered in the line of mitigation practices followed by the government of Bihar, as under :

- i) For embankment to be effective needs to be effectively planned along with finalizing the proper alignment of embankment under consideration. If appropriate construction methods using suitable construction material is not adhered to, embankments are likely to be frequently damaged. Spacing of embankments can be decided by accepted design procedures and where necessary, studies of the river to avoid increase in rise of flood stages and erosion. Construction of suitable designed forward embankments can also be tried in many cases as has been done in case of river Kosi.
- ii) The economy of the Bihar is dependent on agriculture. Crop losses alone account on average for about 76 percent of the total damage caused by floods. The first flood generally occurs in June and damages standing crops of rice and jute. The cropping pattern must be changed as much as possible to ensure the stability of crop production. Restructuring the cropping pattern becomes indispensable.
- iii) Improving drainage by building new channels or improving the discharge capacity of the exiting drainage system has become an integral need of the flood management programme in Bihar river basin.
- iv) Several reaches of rivers are highly silted causing diversion of the towards the embankment which results in erosion and sometimes even breach of the embankment. Such situations may be better tackled by dredging of the selected reaches of the river. Therefore , a provision for the dredging has to be made.
- v) The Remote Sensing Agency provide satellite imagery of inundation areas with flood which gives an overview of the flood affected areas of the state. But this image should be supported with analysis and database to enable the department for effective and timely decision making process on quick response.
- vi) A mechanism needs to be developed to forecast the possible areas to be affected after certain

period on the basis of release of water from the catchments area so that necessary preparedness planning and response mechanisms can be expedited. A proposal has also been submitted in this regard to department. Necessary guidelines may be given for more effective & better flood management.

- vii) The proposal of inter-linking of the rivers is long talked and pending for decision before the planners for nearly a decade. This can be promptly implemented in coordination with Nepal without making it a prolonged political issue over discussed for political benefits.

Conclusion

The focus of this paper has been on the management of floods in the Bihar river basin, as it is of crucial importance for the economic development of the region. Flood management has been studied in detail. The current proposals need careful review. Construction of multipurpose dams in the region is essential to mitigate floods but requires considerable time, and the agreement of neighbouring countries. In the meantime, optimum protection of flood-prone areas can be achieved through various measures which have been reviewed in this contribution. In India flood management is almost entirely done by government agencies. The number of flood work executed so far in Bihar will make our conclusion more concrete for future orientation from (Table -8) as under :

The need to ensure people participation at the planning, implementation and maintenance stages of the fight against floods has been recognized for quite some time, however, and several attempts and experiments in this direction have been made over the years. In emergency situations, people's involvement has had encouraging results. In such circumstances, the complex rules and regulations of public agencies tend to prevent timely intervention, resulting in huge damage suffered by the community. A revision of administrative procedures is therefore needed to eliminate delays in the speedy implementation of emergency works.

The long term solution of flood problem in Bihar lies in the provision of reservoirs in the upper reach of main rivers and their tributaries. Unfortunately, most of these rivers originate in Nepal

and flow through it for the considerable length before entering into Bihar. All suitable dam sites fall in that country. Only with the sincere co-operation of the Govt of Nepal and Central Government, construction of dams in Nepal territory is possible. Sites on the tributaries of Kosi river have been investigated and a high dam at Barakshetra is proposed which would moderate the maximum probable flood of 42475 cumecs (15 lakh cusecs) to a flood of 14000 cumecs (5 lakh cusecs) at Barahkshetra. It will also trap the bulk of coarse and medium silt carried by the river which in turn help stabilize the river and reduce the meandering/braiding tendency of the river. On the other major rivers like Bagmati and Kamala, the probable sites for construction of reservoirs have also submitted to Govt. of India. Apart from construction of these dams in Nepal, catchment area treatment in big way is required in Nepal territory to trap the silt load coming to India through these rivers. However, before such measures come into reality, the State will have to depend rivers. However, before such measures come into reality, the State will have to depend on short-term measures including the construction and maintenance of embankments along therivers. Flood management works so far implemented comprise construction and maintenance of 3430 km. of embankments, revetment in selected portions of river banks, land spurs-367 nos. (284 in Kosi, 30 in Mahananda, 18 in Ganga and 35 in Gandak) and such others flood protection works.

Total outlay for the tenth five year plan at 2001-02 price has been fixed at 1910.20 crores. Out of this , 1771.70 crore is proposed to be spent on works and 138.50 crore on establishment. As stated above, before long term measures are taken up, the state will have to continue on the embankments for the solution of flood problems. During the last five year plan, no progress can be made in the completion of any embankment. In the tenth five year plan, 11 ongoing embankments as well as 29 new embankments are proposed to be completed. Rs. (317.09+262.30) 579.39 crore has been provided for this. Benefit of (2.1791+7.9672) 10.1463 LHa will be achieved after completion of these schemes. The existing embankments of the State need raising and strengthening since the beds of the embanked rivers are going higher and higher every year due to silt depositions and consequently the protection from the existing embankment is diminishing on

account of spills. Raising and strengthening will restore the benefit from the existing embankments. Construction of Pucca Road on the existing embankments will ensure rapid inspection and execution of anti-erosion as well as flood fighting works and provide all season road communication in the rural area of the State. This will also bring additional development in other sectors. Several towns and villages are in sever threat due to erosion during the flood season every year . Their protection is of utmost importance. There are huge public demand for the protection of such towns and villages resulting in a number of Assembly/ Parliamentary questions by the respective representatives. It needs early redressed. Therefore, tenth five year plan aims to provide protection to them. Spurs have been constructed to protect the embankments. During floods, these spurs and embankments are under high water pressure and get damaged. They need continuous replenishment and protection with anti-erosion measures. Also, some new spurs, as per the requirement on .

The prosperity of the region lies in regional cooperation and people's participation. Since crucial natural links among the countries are provided by trans-boundary rivers, proper development and sharing of their waters could be an effective means of achieving the integrated development of the region. There is an urgent need to create a conducive environment for cooperation in order to solve outstanding regional water-related issues and undertake joint efforts for the benefit of all concerned. Technical experts have worked out all possible options for developing regional water resources in a sustainable way, which could change the face of the region, but actual decisions and implementation are a matter of political will. The region has chronic devastating flood problems which cannot be mitigated despite the construction at great cost of miles and miles of embankments unable to withstand the sudden onrush of storm water due to its high erosive power and to inadequate maintenance. Participatory flood management measures and disaster preparedness to mitigate the recurring flood losses have to be adopted in a comprehensive manner, not piecemeal as has been the case so far.

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Table -1: Year Wise Flood Damages Data of Bihar (1980-2007)

Year	Area Affected (Lakh ha)	Damage to Crop		Damage to Houses		Human lives Lost (Nos.)	Damage to Public Property(Rs. Lac)
		Area (Lakh ha)	Value (Rs. Lakh ha)	Nos.	Value (Rs. Lakh)		
1980	15.6547	8.665700	6646.762	99310	777.4192	66	679.6200
1981	10.6730	6.857000	6098.922	75340	375.540	17	231.5620
1982	7.5880	2.827000	7734.986	61524	859.3227	26	884.7717
1983	16.2483	4.662300	2309.703	33664	150.3318	23	267.0250
1984	29.8292	13.34460	16798.66	242655	3382.152	128	4311.989
1985	8.17621	3.338700	2660.333	89060	615.6893	58	166.3984
1986	16.3097	6.578500	8030.313	150280	525.0464	101	3033.823
1987	40.9033	24.55350	56707.39	2E+06	26691.84	2321	35531.74
1988	11.0820	4.267600	5599.572	14397	234.2360	77	155.6980
1989	7.0872	1.877100	777.0480	7399	174.9950	23	67.0110
1990	14.3130	4.452000	2614.272	13559	190.9610	41	211.3410
1991	10.5760	4.384800	2241.583	23162	412.3770	56	125.7440
1992	0.7600	0.250000	58.0900	1281	16.1400	04	0.7500
1993	15.6200	11.04000	13942.23	219378	8812.220	105	3040.860
1994	6.3500	3.350000	5562.030	34449	475.8200	83	103.6600
1995	8.8000	4.100000	19176.40	244694	6763.060	246	1904.690
1996	11.8600	7.320000	7168.290	115744	1488.040	222	1035.700
1997	14.7130	6.541010	5734.660	174084	3050.130	139	2038.090
1998	24.9400	12.66000	36441.87	197554	5503.700	351	9284.040
1999	8.4500	3.040000	24203.88	91813	5384.950	243	5409.990
2000	7.7900	4.254000	7553.430	227897	14856.26	308	2854.710
2001	11.950	6.500000	26721.79	222074	17358.44	231	18353.78
2002	19.690	9.403000	51149.61	419014	52621.51	489	40892.19
2003	18.200	7.922000	9444.71	844249	3756.71	297	1191.880
2004	27.000	13.99000	52205.64	929773	75809.51	885	103049.64
2005	4.6000	1.350000	1164.500	5538	382.79	58	305
2006	17.8277	1.480000	1431.920	28115	2597.78	44	8527.47

Source :-(1) Bihar Development Report 2006.

(2) Department of Relief & Rehabilitation, Govt. of Bihar.

Table -2

Zone	Total Geographical Area (In L Ha)	Flood Prone Area (In L ha)	% of flood Prone of total Area zone wise	Length of flood Protective Embankments (in Km)	Protected Area (in L Ha)
North Bihar	58.50	44.46	76.02	2952	27.16
Central Bihar	35.31	24.34	53.35	478	2.00
Total	93.81	68.80	67.48	3430	29.16

Source : Bihar Flood Report 2007, Memorandum Part III, CWC, Sector wise detail report.

Table 3: Flood Affected Damages In Bihar (1969 1991)

Sl No.	Item	Unit	Average Annual	Maximum Damage	
				Extent	Year
1	2	3	4	5	6
1	Area Affected	M. ha	1.513	4.293	1971
2	Population Affected	Million	8.0	-	-
3	Human Life Lost	Nos.	186	2321	1987
4	Cattle Lost	Nos.	676	4151	1987
5	Cropped Area Affected	M. ha	0.65	2.455	1987
6	Value of Damage to Crop	Rs. Crore	101.97	567.07	1987
7	House Damage	Million	0.20	1.62	1987
8	Value of Damage of House	Rs. Crore	30.20	262.92	1987
9	Value of Damage of Public Property	Rs. Crore	23.03	355.32	1987
10	Value of Total Damage	Rs. Crore	155.26	1189.31	1987

Source : Report of the Working Group on Flood Control Programme for the 10th FYP (2002-2007) Central Water Commission, GOI (2001)

Table 4: Plan-wise Expenditure Under Flood Management Programme In Bihar

Plan Period	At Current Price (Rs. Lac)	At Constant Price (Rs. Lac) (1980 – 81)	% of expenditure in Bihar of India
1	2	3	4
First Plan (1951-1956)	556	3421	41.08
Second Plan (1956 -1961)	1988	10301	41.36
Third Plan (1961-1966)	1363	5775	16.60
Annual Plan (1966-1969)	493	1377	11.74
Fourth Plan (1969-1974)	2719	6632	16.77
Fifth Plan (1974 – 1978)	5841	8465	19.56
Annual Plan (1978-1980)	4138	5278	12.54
Sixth Plan (1980-1985)	11912	10626	15.14
Seventh Plan (1985-1990)	21830	13860	23.18
Annual Plan (1990-1992)	6155	2870	13.36
Eight Plan (1992-1997)	17566	5903	9.75
Ninth Plan (1997-2002)	41702	-	14.19
Total (1951-2002)	116263	-	14.70

Source : Water & Related Statistics, Central Water Commission (2000) Report for the working Group on Flood Control for the 10th FYP (2002-2007) (web site : www.bih.nic.in)

Table -5 : Plan-wise Embankment Construction, Targets & Achievements

Plan Period	Embankment Construction (Km.)		Area Protected (Ha.)	
	Target	Achievement	Target	Achievement
Cumulative up to 6 th Plan	-	3396	-	2083000
7 th Plan	75	56	85000	45000
Annual Plans (1990-92)	12	12	6000	6000
8 th Plan (1992-97)	98	-	100000	-
9 th Plan (1992-02)	52.74	-	-	-

Source : Report on Bihar Flood (2007), Memorandum For Central Assistance from National Fund for Calamity Relief. Web Site Address: www.wrd.bih.nic.in , www.bih.disastermgt.nic.com

Table-6: Estimates of Land use & Soil Loss

Land use	Soil loss (T/ha/year)
Agricultural land without soil conservation	
Hilly areas	20 to 40
Plain areas	5.0 to 20
Agricultural Land with soil conservation (Varying from simple agronomic practices to engineering measures.)	
Hilly areas	1 to 19
Plain areas	0.0 to 3.0

Source : Manual on Natural Disaster Management In India, March 2001, published by National Centre for disaster Management, IIPA

Table 7 : Year wise Performance of Flood Forecasting during IX Plan Period

Forecast	Year of Forecast				
	1996	1997	1998	1999	2000
Issued	1952	1567	2281	2329	1700
Correct	1917	1536	2247	2297	1687
% Accurate	98.2	98	98.5	98.6	96.2

Table-8 : Number of flood mitigation work executed

Year	Number of flood protection works executed
1998-1999	274
1999-2000	338
2000-2001	335
2001-2002	275
2002-2003	301
2003-2004	260

Source: Disaster Management Cell, Targets & Achievements (2007), Govt. of Bihar. (www.disastermgmt.bih.nic.in.com)