FLOODS IN BIHAR: A CASE STUDY OF VULNERABILITY AND IMPACT ASSESSMENT OF KOSI FLOOD

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Abstract:

The Bihar state is highly prone to natural hazards such as flood, drought and earthquakes. The unique geo-climate condition of the state prepares the stage for terrigenic, fluviogenic and hydrogenic process causing hazards induced disaster of voluminous socio-economic impacts. Among various natural hazards, flood is the most recurrent and it bears implications of wide and vast concern. The damage of men, material and infrastructure speak to disaster. The impacts analysis of flood induced disaster is supposed to be the tool to assess the problems and to take the measure management and planning for desired habitation and development of Bihar especially Kosi area. It is in the light that the above understanding that the paper attempts to evaluate the impact of Kosi flood induced disaster in different parts of Bihar. The data collected from different institutions and departments have been subjected to analysis of damage/losses of life, property and various measures taken to ensure a safe socio-economic environmental for sustainable development.

Key words: Kosi, Bihar, Hazards, Flood, Impact analysis, Damage, Management

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Flood: A Conceptual Framework

A flood is an overflow of water that submerges land which is normally dry. The European Union (EU) Floods Directive defines a flood as a covering by water of land not normally covered by water. In the sense of "flowing water", the word may also be applied to the inflow of the tide. Flooding may occur as an overflow of water from water bodies, such as a river or lake, in which the water overtops or breaks levees, resulting in some of that water escaping its usual boundaries, or it may occur due to an accumulation of rainwater on saturated ground in an aerial flood. While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, these changes in size are unlikely to be considered significant unless they flood property or drown domestic animals. Floods can also occur in rivers when the flow rate exceeds the capacity of the river channel, particularly at bends or meanders in the waterway. Floods often cause damage to homes and businesses if they are in the natural flood plains of rivers. While riverine flood damage can be eliminated by moving away from rivers and other bodies of water, people have traditionally lived and worked by rivers because the land is usually flat and fertile and because rivers provide easy travel and access to commerce and industry.

In simple words, Flood is a state of high water level along a river channel or on coast that leads to inundation of land which is not normally submerged. Flood is an attribute of physical environment and thus is an important component of hydrological cycle of drainage basin. Flood is a natural phenomenon in response to heavy rainfall but it becomes a hazard when it inflicts loss to the lives and properties of the people. Flash flood occurs within a few minute or hours of excessive rainfall, a dam or levee failure, or a sudden release of water held by an ice jam. Flash floods can roll boulders, tear out trees, destroy buildings and bridges, and scour new channels. Rapidly rising water can reach height of 30 feet or more.

Objective and Methodology

This paper rest on the following objectives first is to draw attention on the situation of flood in Bihar. Second is to focus on the impact assessment and vulnerability of the people residing in the Kosi area due to Kosi floods, and third to suggest recommendation and management strategies for the sustainability for the area. For the completion of these objectives the data is collected from the both secondary and primary sources. Various papers presented

during seminar and workshops, by persons of different fields like engineer, political scientists, social activists, non-governmental organizations, economists, policy planners and of course sociologists and anthropologists are used for covering different perspectives of the problem. Reports of planning and implementation of several projects and management plans are also used. Besides this, primary data is collected from the household survey based on the random sampling in the area affected by Kosi flood 2008.

The Problem of Floods in India: An Introduction

Floods have been a recurrent phenomenon in India and cause huge losses to lives, properties, livelihood systems, infrastructure and public utilities. India's high risk and vulnerability is highlighted by the fact that 40 million hectares out of a geographical area of 3290 lakh hectares is prone to floods. On an average every year, 75 lakh hectares of land is affected, 1600 lives are lost and the damage caused to crops, houses and public utilities is Rs. 1805 crores due to floods. The maximum numbers of lives (11,316) were lost in the year 1977. The frequency of major floods is more than once in five years. Floods have also occurred in areas, which were earlier not considered flood prone. An effort has been made in these Guidelines to cover the entire gamut of Flood Management. Eighty percent of the precipitation takes place in the monsoon months from June to September. The rivers bring heavy sediment load from the catchments. These, coupled with inadequate carrying capacity of the rivers are responsible for causing floods, drainage congestion and erosion of river-banks

The Rashtriya Barh Ayog, set by Government in 1976 put the country's flood prone area at about 40 mha. This report, thus, revealed a rapid increase in flood proneness in just over a decade. Most of these areas lie in Ganga basin, the Brahmaputra basin comprising the Barak, the Tista, the Torsa, the Sabarmati, the Sankosh, the Jaldhaka, the Dibang, and the Dihang. The most flood prone basin are those of the Gang and Brahmaputra in Uttar Pradesh, Bihar, West Bengal and Assam, followed by Baitarni, the Brahmani, and the Sunarnarekha basin in Orissa. These five states are the most floods prone. But the commission analyzed the share of damage went up from 25 to 50 percent of the total and chronically flood prone Bihar area has been increasing.

Bihar: The Ancient Civilization State

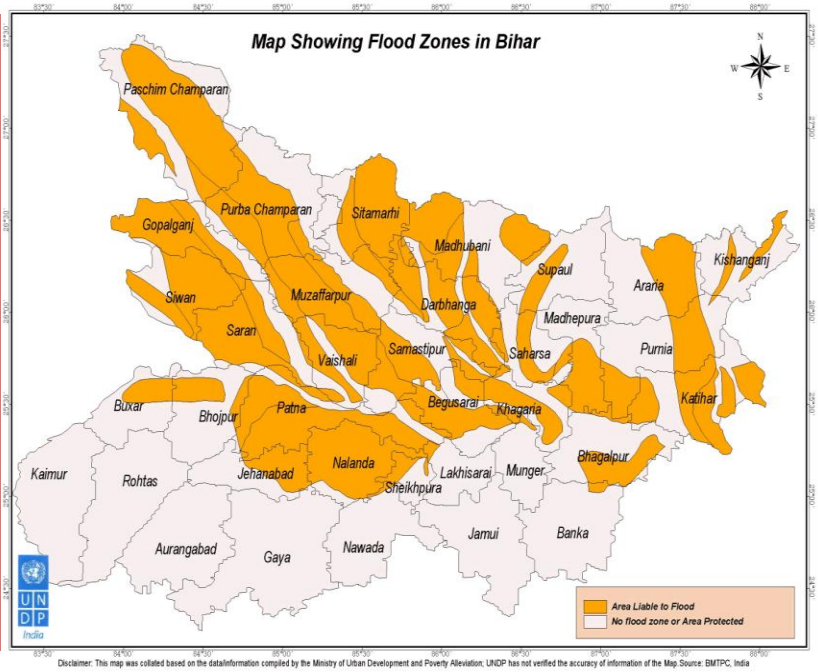
Bihar is the cradle of one of the ancient, flourishing civilizations of the world, and it finds mention in the Vedas, Puranas, epics, etc. One of the major states of the Indian Union, Bihar is

bounded on the north by Nepal, on the east by West Bengal, on west by Uttar Pradesh and on the south by Jharkhand. Bihar has a number of rivers, the most important of which is the Ganga. The other rivers are the Sone, Poonpoon, Falgu, Karmanasa, Durgawati, Kosi, Gandak, Ghaghara, etc. The large plain tract and a dense drainage network have moulded Bihar into an agricultural state since ancient times. Its population has sustained agro- based industries, and a rich handicrafts and cottage industry. Out of its total area of 93.60 lakh hectares, 78.97 lakh hectares [84.37 percent] of land is under cultivation. About 44.33 percent of the State's rural population lives below poverty line in undivided state during 1999-2000. This gives Bihar the dubious distinction of being one of the poorest states in the country

According to National Flood Commission, as per the 1992 livestock census, Bihar had 2,20,92,366 animal resources, of which there were 93.91 lakhs cows, 77.40 lakhs goats and sheep, and 36.12 lakhs bulls seen Commission. Bihar is the most flood prone area in the Country. There are many rivers in Bihar namely Ganga, Sone, Punpun, Kosi, Gandak, Adhwara, Bhuthibalan, Bagmati, Kamlabalan, Mahananda, Parman, W. Kanki and Mechi. The river Kosi, the Kosi means "koshana/curse", and Hindi name in the river Kosi. Flood occurs every year and is living up to its name.

Figure 1: Flood Prone Areas and Zones Bihar, with comparison to other states

States	1958-78	1978-90
Andhra Pradesh	1.39	1.39
Assam	3.15	3.82
Bihar	**4.26**	**4.97**
Gujarat	1.39	1.39
Haryana	2.35	2.35
Himachal Pradesh	0.23	0.39
West Bengal	3.77	3.77
Uttar Pradesh	7.34	7.34
Other	2.39	2.39



The Kamala River passes through the major district of Darbhanga in Mithilanchal. The Kamala and Gandak river are expanded up to the Ganga river in north Bihar. The Ghaghra and Gandak rivers pass through the central of the old Saran district. In this way Bihar is so vast and physically so diverse that it has experienced more floods than any other part of the country 30-40 percent of flood damages in India are from Bihar alone.

Figure 2: Annual Floods: Setting Back the Development Clock of Bihar

- Sown area is washed away, taking with it the top soil and seeds.
- Cost of cultivation increases, restricting cropping patterns and technological innovations. Farmers tend to become strongly risk averse.
- Roads and bridges are damaged, requiring greater maintenance and repair. Marketing of agricultural products becomes more costly and difficult.
- Electricity lines are broken, leading to increased maintenance costs and irregular power supply. Broken tubewell pumpsets require annual repairs.
- Human settlements along the river systems are displaced leading to seasonal unemployment, and health and social problems.

The North Bihar is flood prone by river Ghaghra, Gandak, Burhi, Gandak, Bhagirath, Kamla, Kosi and Mhananda. The districts needing urgent attention on the basis of flood damage statistics have been identified in order of priority as Darbhanga, Madhubani, Khagaria, Muzaffarpur, Saran, Pachim Champaran, Begusarai, Samastipur, Patna, Gopalganj Purbi Champaran, Gaya, Siwan, Rohtas, Nalanda and Aurangabad. Many flood control works including embankments have been constructed in the state. Possibility of failure of the works at vulnerable points is a major consideration for flood disaster mitigation.

The worst affected and vulnerable are the poor and marginalized sections and communities of India. They suffer the most in terms of human and property loss. Unfortunately, poverty is most widespread in areas that are more vulnerable to natural disasters - the flood-prone regions of north Bihar, east Uttar Pradesh and north Bengal, and the drought-prone regions of Rajasthan, Marathwada in Maharashtra and north Karnataka. Not only are the poor the worst hit, but their capacity to recover from a disaster is also limited by their social, economic and

political situation. In India, the vulnerabilities are inextricably linked to certain processes of marginalization that protect the interests of particular groups and areas at the cost of others. The nature and direction of economic development followed over the past 50 years has been unsuccessful in expanding or even distributing, social opportunity across the country. The basic needs of a large population are not satisfied. Nearly one-third of India's people live in poverty, one-third of adult males and two-thirds of adult females are illiterate and two-thirds of India's children aged 0-4 years are malnourished.

History of Flood in Bihar

In general terms, flood means inundation of extensive land area with water for several days in continuation. Floods are considered to be associated with rivers and people conceive floods as the outcome of accumulation of huge volume of water coming out of the rivers through overtopping of river banks during peak discharge period. Every year the battle against flood reaches a crescendo and takes along with lives and property of the poor people who inhabit the riverbanks. The central and the state government tried hard to deal with the situation by building embankments. Part of the problem was contained, but it also resulted in of prolonged water logging in many areas which were close to them. According to the department of disaster management, Government of Bihar, in year 1990 flood affected 24 districts of the state in which 162 blocks were affected, 475 panchayats fully and 784 panchayats were partly affected. It affected 8.73 hectares of agricultural and non-agricultural area had been damaged 3.21 lacs hectares of cropped land was affected. 569 houses of pucca and 5973 houses of Kucha were fully damaged. 23 houses of pucca and 4,444 houses of Kucha were partly damaged. 36 persons and 76 animals were dead in the flood. Worth Rs. 182.27 lacs of public properties was damaged.

In year 2001 flood affected 22 districts of the state in which 194 blocks were affected, 838 panchayats fully and 1154 panchayats were partly affected. 6405 villages, 90.91 lacs persons and 11.72 lacs animals were affected 11.95 hectares of agricultural and non-agricultural area had been damaged. 6.5 lacs hectares of cropped land was affected. 11392 houses of pucca and 117090 houses of Kucha were fully damaged. 11015 houses of pucca and 82574 houses of Kucha were partly damaged. 231 persons and 565 animals were dead in the flood. Worth Rs. 18353.78 lacs of public properties was damaged. It is evident from the government data that in year 2002 flood affected 25 districts of the state in which 206 blocks were affected, 1587

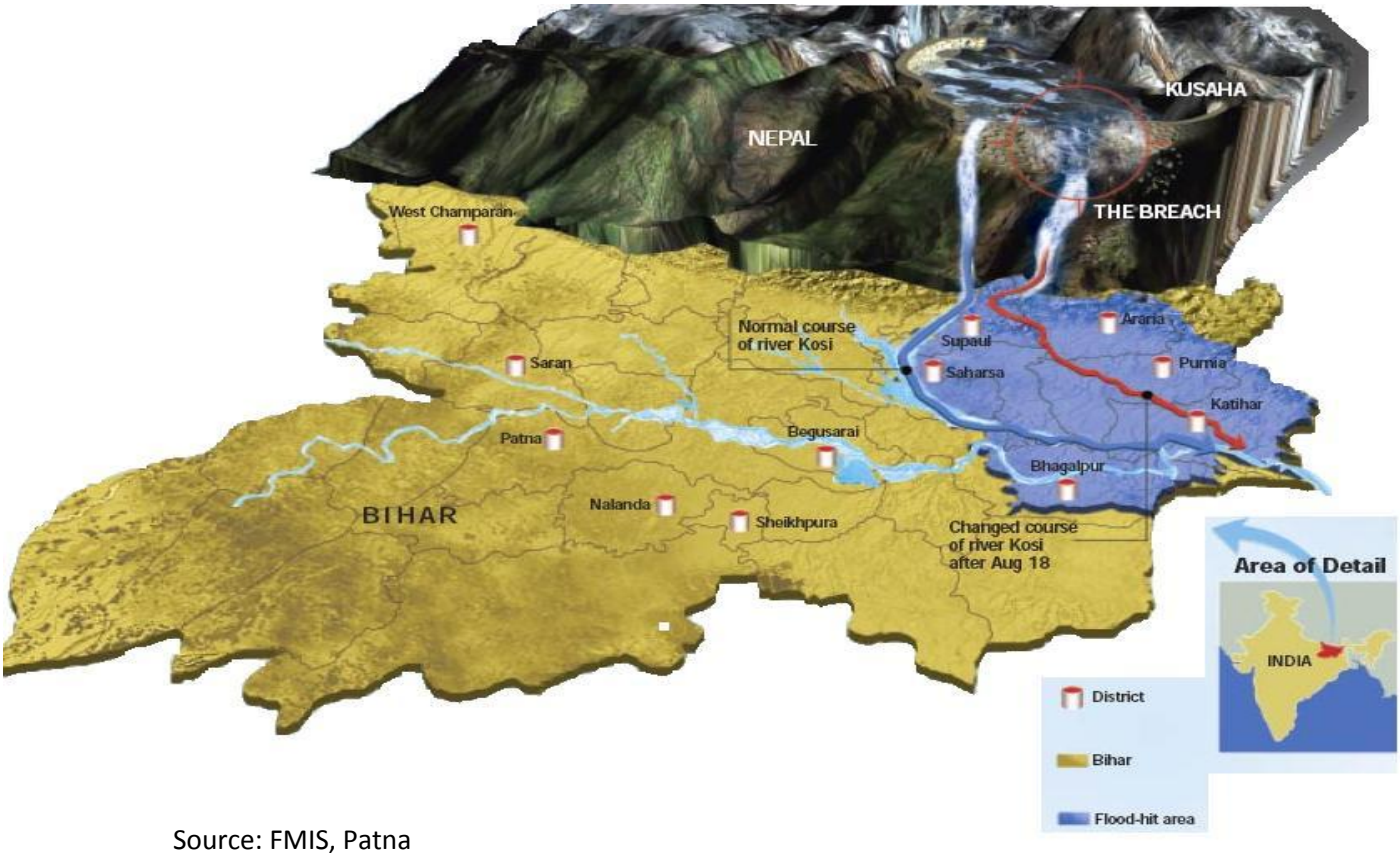
panchayats fully and 917 panchayats were partly affected 8318 villages, 160.18 lacs persons and 52.51 lacs animals were affected 19.69 hectares of agricultural and non-agricultural area had been damaged. 9.403 lacs hectares of cropped land was affected. 9452 houses of pucca and 79569 houses of Kucha were fully damaged. 19952 houses of pucca and 310041 houses of Kucha were partly damaged. 489 persons and 1450 animals were dead in the flood. Worth Rs. 40892.19 lacs of public properties was damaged.

In year 2003 flood affected 24 districts of the state in which 172 blocks were affected, 671 panchayats fully and 874 panchayats were partly affected. 5250 villages, 81.61 lacs persons and 11.65 lacs animals were affected 18.20 hectares of agricultural and non-agricultural area had been damaged. 7.922 lacs hectares of cropped land was affected. 1719 houses of pucca and 41444 houses of Kucha were fully damaged. 5191 houses of pucca and 36070 houses of Kucha were partly damaged. 297 persons and 131 animals were dead in the flood. Worth Rs. 1191.880 lacs of public properties was damaged. In year 2004 flood affected 20 districts of the state in which 211 blocks were affected, 2015 panchayats fully and 773 panchayats were partly affected. 9346 villages, 212.99 lacs persons and 86.9 lacs animals were affected 27.00 hectares of agricultural and non-agricultural area had been damaged. 13.99 lacs hectares of cropped land was affected. 17444 houses of pucca and 343573 houses of Kucha were fully damaged.

Vulnerability and Impact assessment: Case Study of 2008 Kosi Flood

The five flood-affected districts due to Kosi flood in 2008 in Bihar are among the poorest districts in India. In 2011, during the last national Census, the total population of the five districts was about 8.3 million. The population is overwhelmingly rural, ranging from 91.7 percent in *Purnia* and *Saharsa* to close to 95 percent in *Araria, Madhepura* and *Supaul*. A significant proportion of the population is Muslim, particularly in *Araria* and *Purnia* (41 and 37 percent respectively). The proportion of people belonging to STs is very small, but the proportion of SCs is high, especially in *Madhepura* and *Saharsa*. The sex ratio is unfavourable for females in all districts. All five districts also have extremely low literacy levels, much lower than the average for Bihar, which has the lowest literacy rate in India. The female literacy rate is even lower, with rates varying from 21 percent in *Supaul* to about 25 percent in *Saharsa*; in all districts, female literacy rates are less than half that of male literacy rates. This data gives a snapshot of the vulnerable situation of the Kosi flood area in 2008.

Figure 3: Spatial View and Inundated Area due to Kosi Flood 2008 in Bihar



Source: FMIS, Patna

The severe floods extensively damaged the physical infrastructure such as roads, electricity lines, embankments, bridges and culverts and telecommunication, hindering efficient relief work and access to basic services. Other important village infrastructure facilities that were severely affected included electricity and telecommunications. Electricity supply wad damaged, as electric poles were uprooted or wires disconnected by the heavy flow of water. Damage to house was extensive, the data reveals that about 37 percent of houses were completely/severely damaged and another 40 percent were partially damaged. Of the thatched houses (which account for 75 percent of houses), only 13 percent were not damaged by the floods. Flooding caused major deterioration in the quality of household's health environment, destroying or damaging toilets facilities and reducing people's access to safe water. Flooding caused enormous damage to drinking water sources, usually from public and private hand pumps. Almost half of the functioning public handpumps were damaged, as were one third of private handpumps. Public and private wells also were severely affected by floods, and the water was polluted. Unsafe

drinking water in turn caused numerous water related diseases. Unsafe drinking water in turn caused numerous water-related diseases. During the survey, villagers emphasized the significant health hazards that resulted from sources of water being grossly contaminated. For example, although the iron content in the area's water was normally high, after the floods it became so high that consumption became harmful. Nonetheless, villagers had no option but to drink this polluted water. In the camps, however, access to relatively good-quality water was available, since boring was deeper; tankers with safe water also supplied water to camp residents.

Villagers reported that water changed its colour and taste after collection. Micro-organisms were found in the water, and the percentage of sand and clay in it was also found to have increased. The villager's main expectation from the Government was that it should immediately provide safe drinking water. The floods also cause loss of cattle and human lives. Damage to the *kharif*-season crops, including paddy, maize, jute and other vegetables, was extensive. Aghani paddy, the major crop, was severely/completely damaged in nearly 75 percent of survey villages and partially damaged in another 20 percent of the villages. Similarly, jute and maize have been very badly damaged. Damage to vegetables (brinjal, chilli, potato, leafy vegetables), and pulses (*urad, mung*) was equally extensive. Three-fourths of villages reported no possibility of *rabi* crops, and in the rest, although sowing was possible, production was expected to be low. Damage to houses was extensive, the data reveals that about 37 percent of houses were completely/severely damaged and another 40 percent were partially damaged. Of the thatched houses, (which account for 75 percent of houses), only 13 percent were not damaged by the floods. Similarly, more than 96 percent of *katcha* houses were completely or partially damaged.

Loss of agricultural implements was reported by a large number of respondents. Although most respondents were poor, even medium and large farmers found their livelihoods affected by such losses. Migration was widespread in the region, even before the floods. The survey found that more than 30,000 persons from theses villages used to migrate seasonally pre-flood, to other state in India. Most found work as casual agricultural labour, construction labour, rikshaw pullers or as hawkers. The Kosi floods had a substantive impact on migration, both out-migrations. In nearly two-third of the villages, villagers reported that they found hardly any work within or near the village post-flood, and out migration increased in three fourth of the villages.

Interestingly, the flow of female migrants was either the same or less than before the floods. This may be either because females are more involved in resettling their households while males go out in search of jobs, or because the massive damage to roads has reduced the mobility from females for outside work.

Conclusion

Floods have been a recurrent phenomenon in India and cause huge losses to lives, properties, livelihood systems, infrastructure and public utilities. Flood is a very acute problem in Bihar and especially the Kosi flood. At the district and village level, significant losses from the Kosi floods were reported in terms of public infrastructure, including roads, irrigation, electricity and telecommunications. In contrast, at the household level, losses were reported in terms of lives, livestock, agricultural operations and employment opportunities. It needs to looked in with sustainability, the recommendations are: first is to ensure regular monitoring of the effectiveness and sustainability of various structures and taking appropriate measures for their restoration and strengthening; Ensuring the incorporation of flood resistant features in the design and construction of new structures in the flood prone areas; Improving the awareness and preparedness of all stakeholders in the flood prone areas and Introducing appropriate capacity development interventions for effective Flood Management (including education, training, capacity building, research and development, and documentation.)

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