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SPATIO-TEMPORAL STUDY OF FLOODS AND THEIR IMPACT ON SOCIO-ECONOMIC LIFE: A CASE STUDY OF KOSI-MAHANANDA DOAB

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Abstract: *Natural disasters, in present scenario, are responsible for loss of life and property. These natural disasters can be identified in the form of earthquake, volcanic eruption, landslides, droughts, floods etc. and are limited to regions depending on the factors responsible for their origin. Flood, one of the major natural disaster, is responsible for the loss of life, loss of property, loss of infrastructure, loss of agriculture, soil erosion and is responsible for infections, epidemics and 'Water-Born Diseases'. In India, Kosi is known as the "Sorrow of Bihar" because of the highly frequent floods and the damage caused by these floods. Floods are recurrent phenomena in India from times immemorial. After Bangladesh, India is the most flood prone country. Flood is a global phenomenon and severe floods frequently occur almost every year in various isolating regions of the world causing immense loss of life, large scale damage to property and untold miseries to millions of people.*

Key words: Floods, Flood Prone Region, Socio-Economic Life, Water Born Diseases.

Introduction

Kosi-Mahananda Doab is the most flood-prone region of Bihar, about 16.29 percent of the population living in the region under the recurring threat of flood devastation. Floods in Bihar are a recurring disaster which on an annual basis destroys thousands of human lives apart from livestock and assets worth millions. The 2013 Flood in Bihar affected more than 5.9 million people in 3,768 villages and in 20 districts of the state. North Bihar plain is intensively hit by severe floods. River Kosi which is known as the "Sorrow of Bihar" is mainly responsible for bringing severe floods in the study region due to its changing course. Nearly 27 percent of flood damages in India are a part of the Bihar State. Annual destruction of property and crops by the River Kosi is estimated to the tune of Rs.100 million.

Objectives

The objectives of the present research study are as follows:

- To analyse the Spatio-Temporal extent of floods in Kosi-Mahanada Doab region.
- To analyse the impact of floods on Socio-Economic life of people in Kosi-Mahanada Doab.

Methodology

The present research study is based on the secondary data collected from the following agencies:

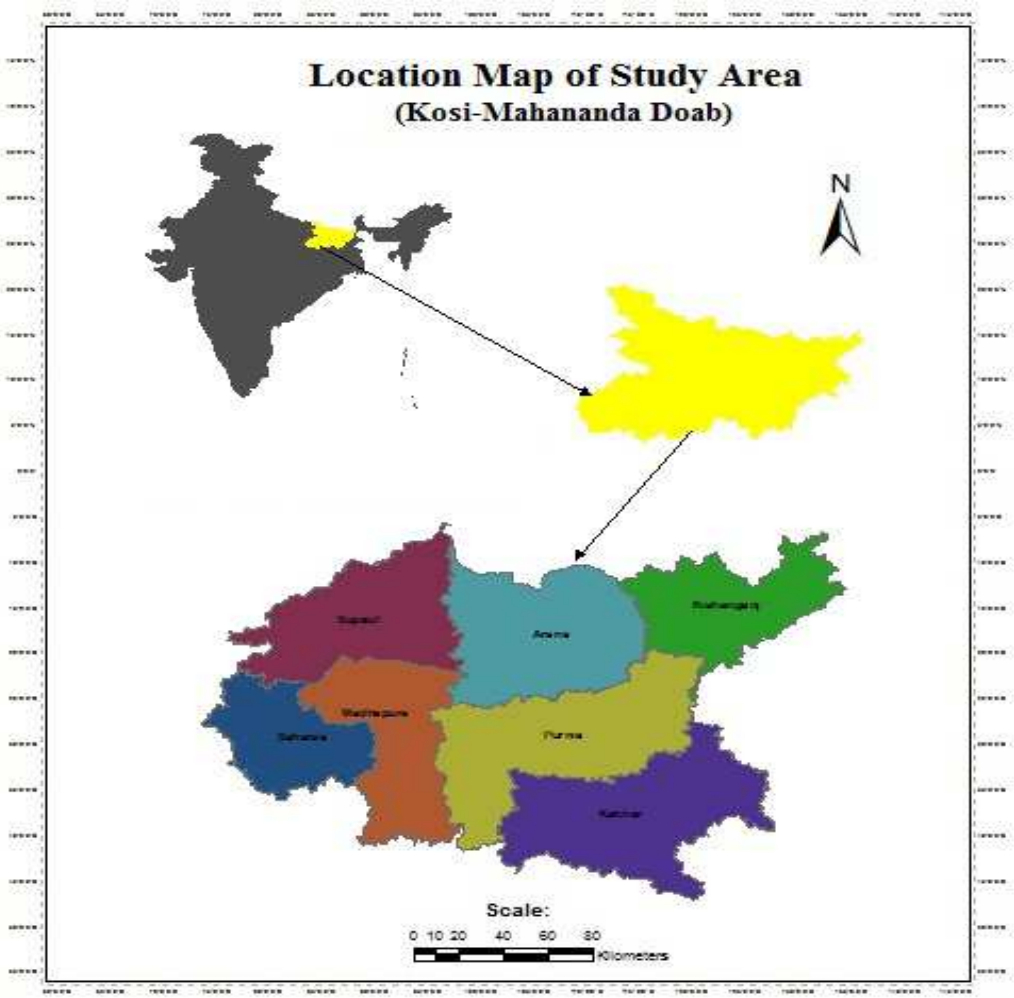
- Flood Management Information System, Government of Bihar, Bihar.
- Water Resources Department, Government of Bihar, Bihar.
- Disaster Management, Government of Bihar, Bihar.
- Census of India, Government of India, India.

To find out the variations in their demographics and socio-economic conditions, Gazetteers of India, Magazines, Professional Journals, Statistical Digests and climate data from Indian Metrological Department, New Delhi has been consulted.

Study Area

Nearly 19 districts were in the grip of severe floods during 2007 but the worst flood affected districts were Madhepura, Araria, Purnea Katihar, Saharsa and Supaul while Kishanganj is partly affected. This plain is frequently hit by the severe floods almost every year and the region are termed as the Super Floods Region of Bihar. Such destructions of nature have far adverse impacts not only on existing environment, human and livestock population but also destabilize the state economy.

Figure 01: Location Map of Kosi-Mahananda Doab, Bihar



Spatio-Temporal Extent of Floods of Kosi-Mahananda Doab

The study region is the most flood prone region in the entire country which accounts for about 11 percent of the total flood affected area of India. Out of 38 districts of Bihar, 7 districts have been identified as most flood affected districts. Almost all districts including their concerned villages were affected and influenced. During the period of last 29 years or so (1979-2007), the study area has confronted with several disastrous and furious floods with different level of damages. The least affected area was recorded merely 0.76 lakh hectare during 1992 against 27 lakh hectare highest affected area during 2004.The similar trends have also been observed in case of cropped area affected by floods. In the same year (1992) only 0.25 lakh hectare cropped area was hit by flood disaster, the lowest figures during the given time which has further touched the highest figure that is about 16.42 lakh hectare cropped areas in 2007. The study region has experienced flood disasters of different extent and magnitude. But the recent fierce floods of 2007 proved very disastrous and distinctive in the state of Bihar in the north Bihar plain's economy as well as its agricultural crops. It has been estimated that about Rs. 3,70,981.07 lakh property including crops, houses & public property was hit and damaged by these floods. About

12.52 lakh ha. Cropped area was damaged of the value of Rs. 130508.22. Ultimately, the existing situation was very alarming and critical. Out of 38 district of Bihar 19 district of north Bihar plain have been identified flood prone during the flood of 2007. About 883 villages of study area were in the grip of flood fury and the worst affected districts were Katihar (319 villages), Saharsa (184 villages), Purnea (107 villages), Supaul (194 villages), Madhepura (46 villages), Araria (25 villages), and Kishanganj (8 villages). The similar trends have also been observed in case of damaged cropped area by these districts.

Analysis of Spatio-Temporal Changes

A scrutiny of the drainage system indicated the following:

- Almost all the streams are in a state of perpetual in-equilibrium, shifting widely within their meander belts and, as in the case of Bagmati River abandoning their entire course by avulsions.
- Kosi has shifted markedly to the west, in keeping with the general lateral migration of the streams.
- Although meandering, many streams flow through linear aligned courses.
- Sharp knee-bends of several adjacent streams have definite orientation and alignments, the major directions being NNE-SSW to N-S, WNW-ESE to E-W, NW- SE, and NE-SW.
- These alignments converge with the major alignments, and derangement of drainage along certain linear stretches is also noted.

Response of each region to sedimentological adjustments and neo-tectonics is different in magnitude. The study area is an established sedimentation sink. The upstream areas of all the tributaries lie in metamorphic rock areas that are criss-crossed by faults and thrusts. Aggradation has been the result of increased alluvial deposits. The high sediment load during monsoons and frequent spillage lead to changes in channel configurations, which are further influenced by changes in local slope conditions. Further, the lineament map revealed that the entire segment between Ganga and Himalayan Foothills has two sets of faults having different down-throw blocks one almost parallel to the Himalayas and the other oblique. The oblique faults also have the highest potential for earthquakes. The northward progress of the Indian plate has been geologically proved to generate the greatest horizontal compressive stress in the

Recent earthquakes in 1934 and 1988 indicate that these faults are active and responsible for Neo-tectonism in the study area. The western part of the study area is geologically stated to be uplifting in the upstream area, with the result that the general slope is tilting in Southeast direction. This also could have contributed to the draining out of the tectonic sags and the surface depressions of the western part of the study area towards east and southeast. Further, movement along the Malda-Saharsa Ridge is stated to be responsible for the westward shift of the Kosi. This is crucial towards explaining the gradual sedimentation and shrinkages of the numerous water bodies in the interfluves west of the Kosi Fan.

Socio-Economic Impact of Floods on Lives of People of Kosi-Mahananda Doab

The socio-economic impact of floods in the Kosi-Mahananda Doab can be investigated under the following heads:

- Area Affected.
- Population Affected.
- Cropped Area Affected.
- Loss of Property.

Impact on Area

The statistical figures (Table 1) of the period (1979-2007) reveal that there are many ups and downs about area prone to flood hazards in North Bihar Plain. The area affected by floods was 8.06 lakh hectares in 1979 against 1.81 lakh hectares in 2006 with a peak of 47.50 lakh hectares during 1987 and an average of 13.76 lakh hectares affected annually during the period of 29 years viz. 1979-2007. Surprising, the total area affected has varied only between 17.86 lakh hectares in 1980 to about 27 lakh hectares on average during the last few years; the only exceptional was 1978 when the total area affected exceeded 47 lakh hectares.

Table 01: Socio-Economic Aspects and Flood Damages in Bihar

#	Item	Unit	Average Flood Damage	Max. Damage Year	Damage During 2007
1	Area Affected	Lakh ha.	13.76	47.50 (1987)	N/A
2	Population Affected	Lakh	77.23	286.62 (1987)	244.46
3	Human Lives Lost	Numbers	235.24	1399 (1987)	948
4	Cattle Lives Lost	Numbers	741.93	5302 (1987)	988
5	Cropped Area Affected	Lakh ha.	7.03	25.70 (1987)	16.42
6	Value of Damage to Crops	Rs. Mill.	1833.31	13320.40 (2007)	13320.40
7	House Damages	Mill.	0.22	1.70 (1987)	0.69
8	Value of Damage to Houses	Rs. Mill.	1131.09	9281.59 (2007)	9281.59
9	Value of Damage to Public Utilities	Rs. Mill.	1010.06	15807.25(2007)	15807.25
10	Value of Damage to Houses, Crops and Public Utilities	Rs. Mill.	3869.97	38409.24(2007)	38409.24

Source: Disaster Management Department (2007), Government of Bihar, Bihar.

Impact on Population (Both Human and Livestock)

Floods affects rural life as it results in great loss of human lives and livestock population. Rural population during flood suffers the problem of food, shelter and clothing. The conditions are worsened by the loss of livestock population as livestock serves as means of transport and carriages in rural life. The average affected population during the designated time has been recorded has been recorded 77.23 lakh million, with maximum 286.62 lakh million in 1987. The tentative affected population according to the latest figures of 2007 was registered 244.46 lakh relatively very high than the average. But all of them, the worst strike is the precious and priceless lives of hundred lost in such vagaries of nature. Hence, the concept of casualty of human-being is totally governed by the degree and extent of hazards magnitude in the flood-prone areas. The average loss of human lives was more than 235, with highest 1399 in 1987 alone. The cattle loss was relatively higher in comparison to human loss in the same duration. The average cattle loss was relatively higher in comparison to human loss during the same period. The average cattle loss was noticed to be 741 whereas the worst-cattle strike year was 1987 in which nearly 5302 cattle lost their lives. Moreover, occasionally hundreds of livestock fled away and as many as died in the wake of fodder resources in the flood-prone areas. On an average, the natural disasters take a tool of over 235 human lives and damages 0.22 million houses annually.

Table 02: Flood Damages in Kosi-Mahananda Doab, 1979-2007

District	Number Of Affected			Population	Number of Line Lost		Damage to Crops		Damage to House		Value of Public Property	Value of Damaged Crop,
	Block	Panchayat	Village	Affected (Lakh)	Human	Cattle	Area (Lakh Ha)	Value (Rs. Lakh)	Number	Value (Rs. Lakh)	Damage (Rs. Lakh)	House and Public Property (Rs L.)
Katihar	16	86	319	5.40	36	1	0.40	2768.85	2299	216.62	33.65	3019.12
Saharsa	6	68	184	3.65	25	-	0.25	861.4	16383	935.25	140.38	1937.03
Supoul	6	35	94	2.54	1	-	0.25	574.84	15000	300	17.75	892.59
Purnea	4	27	107	1.70	-	-	-	-	4783	-	-	-
Madhepura	3	24	46	0.70	19	-	0.05	116	2100	32.00	10.00	158
Araria	1	12	25	0.04	-	-	-	-	12	-	-	-
Kishanganj	7	57	340	6.10	37	-	1.51	900	24321	2445.00	1000.00	4345
Bihar State	251	3365	11850	244.46	948	988	16.42	1335203.47	690237	92815.96	158072.46	384092.39

Source: Disaster Management Department (2007), Government of Bihar, Bihar

Impact on Cropped Areas

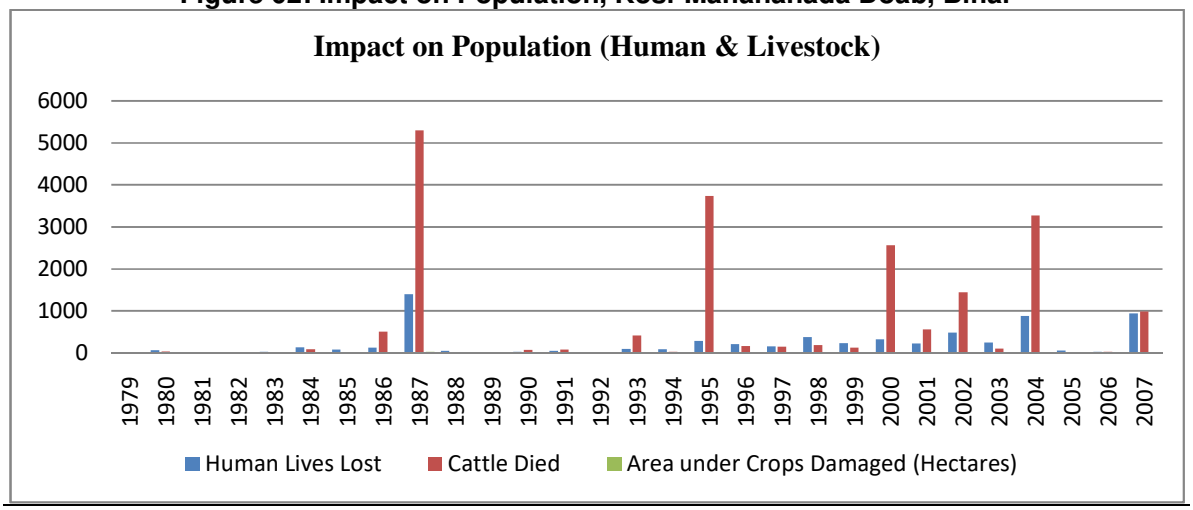
Every year thousand hectare of land including fertile and productive cropped land is severely damaged both in the hilly areas as well as in the plain areas of the study area. As a result, huge loss of nutrients and other supporting elements required for genetic growth of crops and plant. The total cropped area affected annually is about 7.03 lakh hectares and was as high as 25.70 lakh hectares in 1987, the worst year in the past 29 years. The agricultural land dominated by

Kharif cropped area is probably the first victim of floods in the vast plain areas of Kosi-Mahananda Doab. Hence, the flood hazards have a great impact on the rural agriculture system which is the base of local economy; consequently, thousand hectares of crop land either converted into barren land or attained the status of degradation. In case of crops, they are badly strike and damaged and ultimately costing Rs. 15,807 million in the year 2007 (Table 2 & Figure 2). The total loss because of flood damage to crops, houses, and public utilities was estimated around Rs. 3,869 million and highest of Rs. 38,409 million was recorded in 2007, the worst year in the past 29 years in the country (Table 2 & Figure 2). Total damage caused by floods is estimated to the tune of Rs. 38409 million during 2007 at an average of Rs. 3869 million between 1979 and 2007.

Precisely, the flood disasters have the following impacts on the various anthropogenic activities including two major sectors viz. agriculture and socio-economic conditions of society.

- Every year millions of people become homeless, rendered for shelter for many days and most of the cases they are forcing to stay under the open sky.
- Thousands to millions of houses and settlements have been badly damaged and large number of them collapsed.
- Similarly, thousands to millions of hectares of agricultural land come under deep flood water and not in the condition for further cultivation.
- Millions of tons of fertile top soil have been eroded by several major rivers and their tributaries of the country and ultimately deposited in the seas/oceans.
- Hundreds of people fled away in the flood water and equally numbers have been died either due to lack of food availability or epidemics.
- Thousands of hectares land has been converted in to waste land/barren land and resultantly problems of salinity and alkalinity including water logging originate.
- Due to standing of large quantity of flood water at certain places for long time, various types of water borne diseases and ground water table suddenly rose up.
- Thousands of livestock either fled away in flood water or died in wake of fodder shortage (Table 2.10).
- Due to over flow of flood water in various rivers, tributaries, canal and drains there always remained the threat of breaches and seepage at several vulnerable points.

Figure 02: Impact on Population, Kosi-Mahananada Doab, Bihar



Conclusion

To achieve sustainable development, the model Flood Plain Zoning Bill should be introduced to all the Indian states including the state of Bihar. Although, the bill was come in to force in 1975 but only Manipur is state which have enacted legislation based on model bill, keeping in mind the relevance and importance, the adoption of the bill should be made necessary so that fruitful results may come forward in the affected region by human settlement in the flood plain of a river. To achieve the same goal, massive afforestation programmes should be launched along the

river, canals and drains to strengthen their embankments. At local levels, drainage system should make wider, deepen and strengthen generally in those areas which are frequently flood prone. On large scale drive “clean up” should also be started in all the vulnerable rivers and their tributaries including canals in the presence of expert engineers right before the occurrence of rainy season so that deposited silts, sand and debris be removed so that is may be helpful to increase the carrying capacity of rivers and canals.

Moreover, another but most suitable and useful method for mitigation of floods in the flood plain is zoning. It is considered the most effective and reliable method for flood prevention but before identification for flood plain zoning, there is an urgent need for the better understanding of behaviour of river, that can help to prevent occurrence of floods. So, flood – prone areas should be identified and mapped. Aerial survey should be made specially to assess loss of agricultural crops, vegetation cover and property to the exact flow of flood water. During critical flood hours, along the sides of river and canals strict vigil by army/police personals should be taken to face any eventuality and to prevent local population. Apart from all these started efforts and techniques described in the strategy, the other one more significant and important method, the other one more significant and important method is the warning system which is now easily possible and easier with the help of satellites and INSATS. By adopting all the stated methods, techniques including strategies, it may be possible to achieve the sustainable development and can save the millions and avoid the huge burden of national economy spend on flood measures. Moreover, it will also be helpful to maintain the ecological balance of the affected areas.

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