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# Problem of waterlogging due to floods in north Bihar,India

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***Abstract:***
*Flood management system is not effective to contain flood waters in many parts of the country. Many parts of India are prone to flooding. North Bihar is one such part. Yearly floods in Kosi, Gandak, Baghmati, and Mahananda river systems affects millions of people. Silt coming with flood waters in large areas of north Bihar creates the problem of waterlogging to a large extent.*
*Rising riverbed levels, poor maintenance ofearthen embankments and their unlined canal systems are responsible for waterlogging of vast areas that severely affect the production of agricultural produce. Properly planned and implemented drainage systems are destroyed year after year by devastating floods to further deteriorate the situation. However, restoration and upgrading of drainage networks to improve drainage from these waterlogged regions will improve this alarming situation.*
*Dredging as a method of silt management may be considered as a viable option. In flood analysis, parameters of drainage, river morphology, status of clogged drainage system must all be adequately incorporated. Risk maps must be updated through the knowledge base of river dynamics, experience specific data and high-resolution satellite imagery.*

***Key Word:*** *waterlogging, floods, drainage systems, clogging, drains, dredging, satellite imagery*

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## I. Introduction

No less than 70% of country's land area is affected by the floods year after year. Most flood-prone state is Bihar. Problems are further alleviated by poverty, illiteracy, low land availability per capita and waterlogging.

Water logging is a problem that is going out of proportions. Kosi, Gandak, Bagmathi, and Mahananda, and their tributaries are inundated with floods. These rivers do not have a sufficient drainage network and thus further alleviate the problem on both banks, causing water logging in agricultural areas. Either because of scarcity of water or excess of water during the floods, the marginal farmers are left with no option than to migrate in search of livelihood, even when they have the land to support them if their fields are not waterlogged.

It is no exaggeration to say that the floods occur due to clogged drainage network. Waterlogging due to this clogged network system has damaged the fertile and productive agricultural fields.

Non-governmental Organizations (NGOs) and some people's networks are promoting people-centered activities of natural resource management through participatory procedures at local levels.

## II. Understanding the River dynamics and silt load.

From July to October every year, the flood plains of north Bihar are inundated. Although agricultural areas are benefited from enhancing soil quality and nutrients during this period, but waterlogged areas will not yield any crops. At the onset of monsoon season, meandering rivers flow past the danger mark and the entire agriculture system go out of gear. The worst is the condition of water logging that endangers the crop for much more time after the flood water recedes.

The construction of earthen embankments and other flood control measures on rivers in Bihar started as early as the first five-year plan. Though the building of embankments assisted in the containment of floodwaters, other issues began to emerge with restriction on the free passage of drainage water from these systems.

These constructions have imposed the restrictions on the free flow of drainage water from neighboring areas into the river, resulting in waterlogged fields on either bank of the river. Waterlogging, which used to be limited to a few months during the monsoon season, has now spread beyond the monsoon season, and many of these problems have either become permanent or trying hard to become permanent.

Almost all the natural drainage systems have clogged over the years due to deposition of heavy silt load carried by rivers during the floods and in absence of any effective rehabilitation schemes, the problem has deteriorated to have become the worst.

The Kosi river has a very high sediment yield of 0.43 million tones/year/km$^2$. It is accommodated in a very narrow alluvial plain. Thus, an aggrading channel of the Kosi builds up a very large positive topography called 'megafan'. The confinement of the Kosi within the embankment has worsened the situation to cause a significant aggradation within the channel belt. The embankments along the Kosi have not only outlived but are also poorly maintained. And this may be the reason of the breach at Kusaha. All previous breaches after the construction of embankments question the embankment strategy for taming the Kosiriver.

Kosi has caused enormous floods year after year and so it is rightly called, the sorrow of Bihar. In 2008 it breached the embankment in Kushaha (Nepal) and shifted 108 km eastwards.

The cause behind the tragedy could be more than 1,000 million tonnes of silt that has been deposited in it in the last more than fifty years.The total mass of sediments accumulated between Chhatra and Birpur gauge stations of Kosi during the post-embankment period could be approximately 1,082 million tonnes. This translates into 408 million cubic metres in terms of volume, and this may have accumulated at a rate of 5.33 cm per year.

This is the highest amount of silt deposition in any river of the Ganga Basin.

The riverbed rises due to this heavy silt deposition. As a result of this heavy silt deposition, the longitudinal course of the river is agitated to be a causative effect for the river to make searches for a lateral path (left or right) to escape by breaching.

After breaching the embankment, as water loaded with heavy silt spreads over the large area including the vast agricultural system, and as slowly the water recedes, the silt deposits and clogs the drainage system of agricultural fields causing waterlogging.

The reason of channel instability of Baghmati River is frequent overbank spilling, high silt load and rapid aggradation. Channel migration of Baghmati River is primarily due to high hydrological variations and sediment adjustments. A zone of excessive deposition in a particular reach causes significant changes in channel configuration thereby triggering channel movement. In the Baghmati plains, several fluvial anomalies such as compressed meanders, offset of river courses, U-shaped meander cut-offs, straight channels etc. are observed, which prove beyond doubt that neotectonics factors cause significant changes in channel morphology and affect channel-floodplain slope. Such tectonic tilting is another important triggering mechanism for the avulsion events.

The Burhi-Gandak has different morphological, hydrological and sediment transport characteristics. The Burhi-Gandak is a single-channel river with a high meandering, especially in the lower reaches, and is unbraided throughout its course (Sinha & Jain, 1998, GFCC, 1992). The meandering pattern is more pronounced in the lower reaches. There are several erosion points spread over the reach downstream of Muzaffarpur. The average annual sediment load at Sikanderpur and Rosera are 5.4 million tons and 14.5 million tons. About 90 % of this silt load is transported in the monsoon months. The floodplain is gradually accreting due to high silt load. The carryingcapacity of the channel is reduced due to deposits within channel or banks,

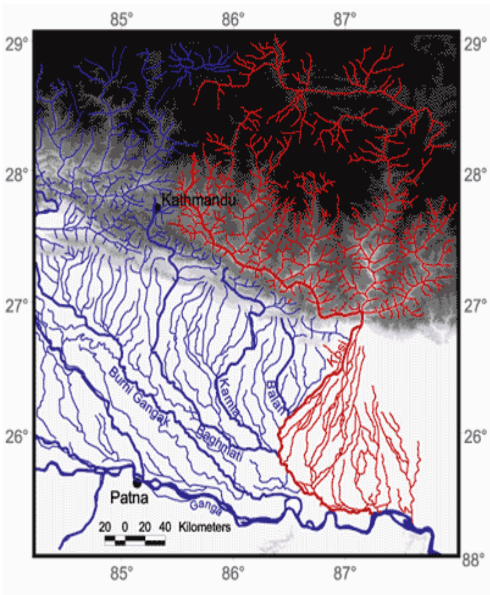


**Fig 1:** Drainage system of Kosi river

**Fig-2:** Drainage network of Baghmati River

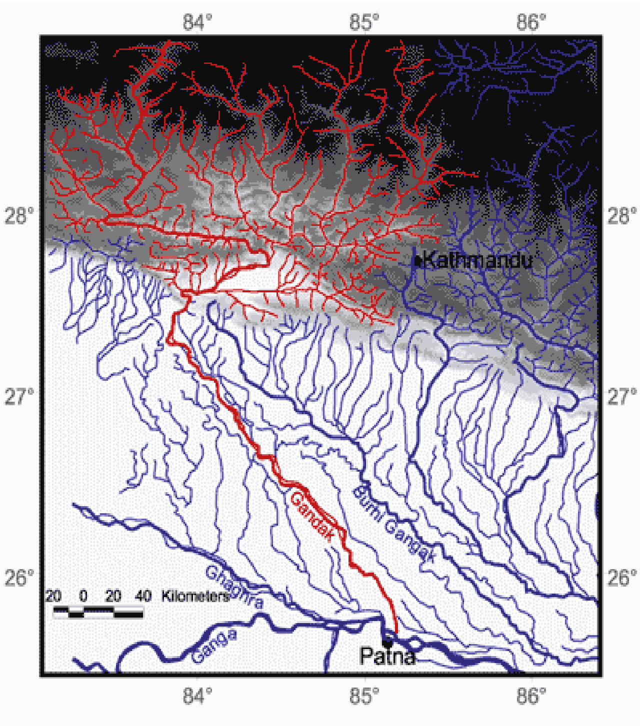


**Fig-3:** Drainage system of Gandak River

resulting in overspilling of water on the adjacent plains. Although no quantitative estimates are available for north Bihar plains, it seems that low forest cover may be a significant factor influencing the high flows in their rivers draining the plains (Sinha & Jain, 1998). The neotectonics movements in the north Bihar plains and Himalayan region contribute to the flood risk. Earthquakes in the Himalayan region have resulted in unstable slopes and higher river gradients. All these effects contribute to high sediment load of the rivers and, as a result, the beds of these rivers are rising rapidly (Sinha & Jain, 1998)

## III. Some Action Plans

There are some proposals made in the Storm Water Drainage Scheme for Muzaffarpur City (i) Fall out drains of

| Sl.No | District | Pre-monsoon waterlogged area (ha) | Post-monsoon waterlogged area (ha) | Waterlogged area excluding perennial water bodies (ha) |
|---|---|---|---|---|
| 1 | Bhagalpur | 12967.31 | 35721.82 | 17081,24 |
| 2 | Katihar | 10671.45 | 33258.38 | 15786.31 |
| 3 | Purnia | 767.61 | 15619.84 | 11118.12 |
| 4 | Kisanganj | 1991.09 | 5225.89 | 773.61 |
| 5 | Sahibganj | 7432.9 | 18777.36 | 8680.2 |

| | | | | |
|---|---|---|---|---|
| 6 | Godda | 478.38 | 1307.04 | 954.77 |
| 7 | Banka | 1312.51 | 2793.83 | 1474.92 |
| 8 | Madhepura | 332.66 | 11177.08 | 9328.32 |
| 9 | Munger | 5628.15 | 12547.4 | 3960.99 |

**Table 1:** Waterlogged area of some Districts

39.325 kms have been proposed in BurdhiGandak river, old course of BudhiGandak River, Furdoo Nallah and low-lying areas of DighraChour (ii) Pumping of flood /storm water to Brahmaputra Lake (iii) Three more pumping stations at existing sluice gates (iv) One pumping station at Kalyani Chowk (v) DG sets to be provided at pumping station due to intermittent power supply.

The Government of Bihar (GoB) has focused on structural interventions, such as constructing, raising, and strengthening of embankments (levees), river training, and riverbank protection measures. More than 3500 kms of embankments have been constructed over the years, which remain a major and important component of the flood risk management system in the State. Continuously monitoring the safety of embankments in terms of proper maintenance must be given a topmost priority. Preparing schemes for maintenance of the embankments, strengthening specific river training works and riverbanks. A high level Technical Advisory Committee (TAC) reviews the schemes submitted by the field engineers and makes suitable suggestions. The field engineers prepare working estimates as per recommendation by Technical Advisory Committee (TAC).

## IV. Conclusions

Waterlogging for agricultural system originates from poor maintenance of drainage network and clogging of drains with the silt coming with the flood waters and that too, year after year with no caring about silt clearance.

The issue must be resolved at two levels. At local level the drains must be restored or rehabilitated. At the level of river basin, many factors must be attended.

Dredging as a method of silt management may be considered as a viable option. One of the most common refrains against dredging is the high cost and that the dumped silt on the riverbank will go back into the river, and thus, the money literally goes down the drain. We must seriously opt for various commercial uses of the silt.

The samples of Kosi silt collected from different regions were sent to the Central Glass and Ceramics Research Institute (CGCRI). The Kosi silt consists of fine to very fine sand and is dominated by quartz and significant amounts of muscovite mica.

Silt can be used as backfill material in road construction, for manufacturing fired bricks, for use in construction of building and can be even used as replacement of raw material for manufacturing Portland Cement. There may be voluminous uses of dredged materials in agriculture. The fine dredged sediments can rejuvenate poor agricultural soils, as it supplies organic content and nutrients to deficient soils to increase productivity.

A lot of flooding is due to water logging and impeded drainage, and not because of river flooding.

Flooding also occurs through breaching of embankments, which is said to be often man-made. Backwater effect of Ganges and overflowing water from other rivers (Koshi, Kareh) may be partly responsible for downstream inundation. Drainage congestion due to in-adequate waterway provided in the rail/road bridges, especially in the East Champaran district, may be causing problems at many places.

Successful River management is site-specific, long experience specific and proper upkeep and maintenance specific. It must include the assistance from satellite imaginary & geomorphological parameters. It may be very rewarding to incorporate drainage network parameters and river morphology in flood analysis. A complete understanding of river dynamics is effectively possible through high resolution satellite imaginary and data.

Excessive sediment load in the Kosi, due to high erosion in hilly catchment area, influences the flow parameters. Riverbed is silted, free board in the embankment is reduced, maintenance is not proper and so consequences are disastrous.

Efficient decision Support systems can be assisted by long experience specific data base, river dynamics and satellite imaginary assisted risk maps, as ground surveys and aerial observations are not adequate.

We failed to follow a strategy after independence. At strategic points these rivers may have been connected to some nearby embankment dams with gated structures. These points have been our controlling points to divert the floods and store the flood waters. The floods waters maythen be used for irrigation purposes. Though a very extensive planning was required but Bihar would have been free of this misery.

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