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# CONSTRUCTION OF COFFER DAMS FOR FIGHTING FEROCIOUS KOSI

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## Abstract:-

*Kosi River is an alluvial stream flows through Shivalih hill in Nepal & Tibet (China).It comes on the plane at Chatra about 45km North of Indo –Nepal border. There is a barrage on Indo-Nepal border at Bhim Nagar, Birpur in Supaul District of Bihar, Inia.Kosi River was devastating before it was tamed.In eighteen century it was flowing near Purnea town and shifted westward, now flowing near Supaul. It shifted about 120 km westward in 275 years.*

*This river is formed by the confluence of seven small streams flowing through Tibet a Nepal. These seven streams are – Indravati, Tamar Kosi, likhu Kosi, Doodh Kosi, Arun Kosi and Tama Kosi. It travels about 729 kms from source to confluence with Ganga in Kurshela.*

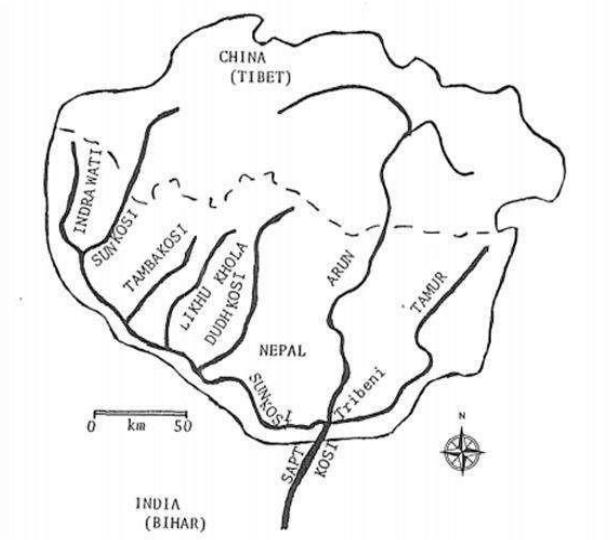
*Some hydraulic particulars of the rivers were:-*
*Design Discharge of Barrage -9, 50, 000 cusec*
*Max Discharge observed on 5th Oct 1968- 9,13,000 cusec( after construction of barrage)*
*Total No .of Gate- 46*

*On 16th Aug, 2008 there was a breach in eastern Kosi Afflux Bund of river Kosi In Nepal. The location of breach point was 13 m upstream from barrage. The river was flowing in three streams. Technical experts decided to construct three coffer dams to retrain the three streams into one and bring back the river river in main channel. it was on 24th Janurary,2008 on which the main flow of Kosi was stopped through bridge and diverted towards barrage through pilot channel. The barrage again stated functioning.*

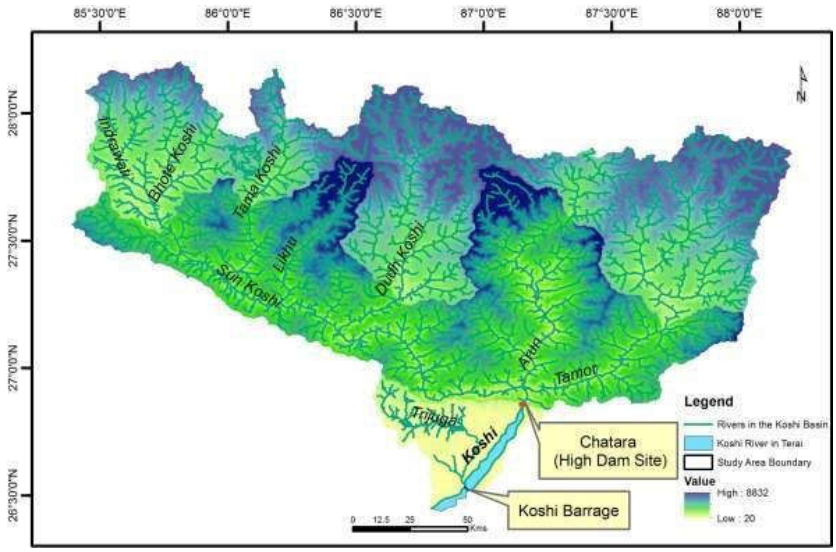
**Keywords:-** *Catchment, Watershed, Alluvial, Gorge, tributaries, confluence, sorrow of Bihar, erosion of soil, evidence of lateral channel shifting, KOsi barrage designed for peak discharge of 27,014 $m^3/s$ (954,000 cu ft/s), silt yield of about 19 $m^3$/ha/year (10 cu yd/acre/yr), August, 2008, the devastating flood in Kosi,, breaching of afflux bund, river in three streams, construction of three coffer dams, river trained in the main channel and barrage started functioning*

## INTRODUCTION

The Koshi or Kosi River drains the northern slopes of the Himalayas in Tibet and the southern slopes in Nepal. From a major confluence of tributaries north of the Chatra Gorge onwards, the Koshi River is also known as Saptakoshi for its seven upper tributaries. These include the Tamur Koshi originating from the Kanchenjunga area in the east, Arun River and Sun Koshi from Tibet. The Sun Koshi's tributaries from east to west are Dudh Koshi, Bhote Koshi, Tamba Koshi and Indravati Koshi. The Saptakoshi crosses into northern Bihar where it branches into distributaries before joining the Ganges near Kursela in Katihar district.




The Koshi is 720 km (450 mi) long and drains an area of about 74,500 km$^2$ (28,800 sq mi) in Tibet, Nepal and India (Bihar). The river basin is surrounded by ridges which separate it from the Yarlung Tsangpo River in the north, the Gandaki in the west and the Mahananda in the east. The river is joined by major tributaries in the Mahabharat Range approximately 48 km (30 mi) north of the Indo-Nepal border. Below the Siwaliks, the river has built up a megafan some 15,000 km$^2$(5,800 sq mi) in extent, breaking into more than twelve distinct channels, all with shifting courses due to flooding Kamalā, Bāgmati (Kareh) and Budhi Gandak are major tributaries of Koshi in India, besides minor tributaries such as Bhutahi Balān.




Its unstable nature has been attributed to the heavy silt it carries during the monsoon season and flooding in India has extreme effects Fishing is an important enterprise on the river but fishing resources are being depleted and youth are leaving for other areas of work.

## GEOGRAPHY:

The Kosi River catchment covers six geological and climatic belts varying in altitude from above 8,000 m (26,000 ft) to 95 m (312 ft) comprising the Tibetan plateau, the Himalayas, the Himalayan mid-hill belt, the Mahabharat Range, the Siwalik Hills and the Terai. The Dudh-Kosi sub-basin alone consists of 36 glaciers and 296 glacier lakes. The Kosi River basin borders the Tsangpo River basin in the north, the Mahananda River basin in the east, the Ganges Basin in the south and the Gandaki River basin in the west.

The three major tributaries meet at Triveni, from where they are called Sapta Kosi meaning Seven Rivers. After flowing through the Chatra Gorge the Sapta Kosi is controlled by the Koshi Barragebefore it drains into the Gangetic plain.

The Bagmati river sub-basin forms the south-western portion of the overall Koshi basin. The Dudh Kosi joins the Sun Kosi near the Nepalese village of Harkapur. At Barāhkṣetra in Nepal it emerges from the mountains and becomes the Koshi. After flowing another 58 km (36 mi) it crosses into Bihar, India, near Bhimnagar and after another 260 km (160 mi) joins the Ganges near Kursela.

The Kosi alluvial fan is one of the largest in the world, and extends from Barāhkṣetra across Nepalese territory, covering northeast Bihar and eastern Mithila to the Ganges, 180 km (110 mi) long and 150 km (93 mi) wide. It shows evidence of lateral channel shifting exceeding 120 km (75 mi) during the past 250 years, via at least twelve major channels. The river, which flowed near Purnea in the 18th century, now flows west of Saharsa. A satellite image shows old channels with a confluence before 1731 with the Mahananda River north of Lava

**Floods**

The Kosi River is known as the "Sorrow of Bihar" as the annual floods affect about 21,000 $km^2$ (8,100 sq mi) of fertile agricultural lands thereby disturbing the rural economy.

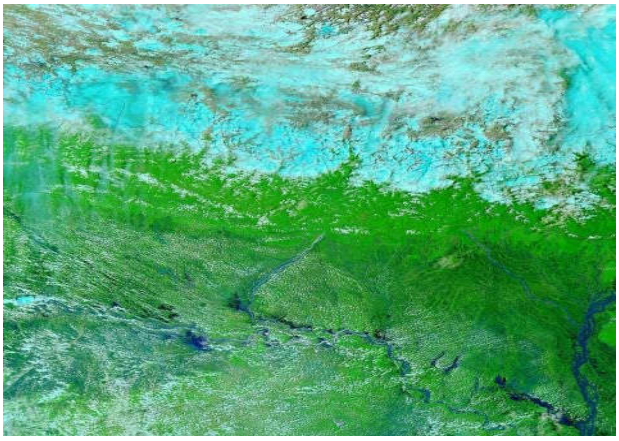
The Koshi has an average water flow (discharge) of 2,166 cubic metres per second (76,500 cu ft/s). During floods, it increases to as much as 18 times the average. The greatest recorded flood was 24,200 $m^3/s$ (850,000 cu ft/s) on 24 August 1954. The Kosi Barrage has been designed for a peak flood of 27,014 $m^3/s$ (954,000 cu ft/s).

Extensive soil erosion and landslides in its upper catchment have produced a silt yield of about 19 $m^3$/ha/year (10 cu yd/acre/yr), one of the highest in the world. Of major tributaries, the Arun brings the greatest amount of coarse silt in proportion to its total sediment load. The river transports sediment down the steep gradients and narrow gorges in the mountains and foothills where the gradient is at least ten metres per km. On the plains beyond Chatra, the gradient falls below one metre per km to as little as 6 cm per km as the river approaches the Ganges. Current slows and the sediment load settles out of the water and is deposited on an immense alluvial fan that has grown to an area of about 15 000 $km^2$. This fan extends some 180 km from its apex where it leaves the foothills, across the international border into Bihar state and on to the Ganges. The river has numerous interlacing channels that shift laterally over the fan from time to time. Without channelisation, floods spread out very widely. The record flow of 24 200 $m^3/s$ is equivalent to water a metre deep and more than 24 km wide, flowing at one metre per second.

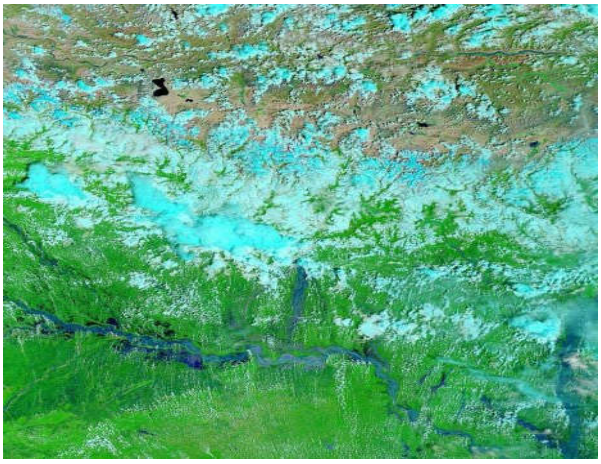
The Kosi's alluvial fan has fertile soil and abundant groundwater in a part of the world where agricultural land is in great demand. Subsistence farmers balance the threat of starvation with that of floods. As a result, the flood-prone area is densely populated and subject to heavy loss of life. India has more flood deaths than any country except Bangladesh.

**2008 FLOODS IN BIHAR**

On 18 August 2008, the Kosi river picked up an old channel it had abandoned over 100 years previously near the border with Nepal and India. Approximately 2.7 million people were affected as the river broke its embankment at Kusaha in Nepal, submerging several districts of Nepal and India. 95% of the Koshi's water flowed through the new course.aharsa, Madhepura, Purnia, Katihar, Parts of Khagaria, northern part of Bhagalpur as well as adjoing regions of Nepal. Relief work was carried out with Indian Air Force helicopters by dropping relief materials from Purnia in the worst hit districts where nearly two million persons were trapped. The magnitude of deaths or destruction were hard to estimate, as the affected areas were inaccessible. 150 people were reported washed away in a single incident. Another news item stated that 42 people had died.



**KOSI ON 08 AUGUST 2008**



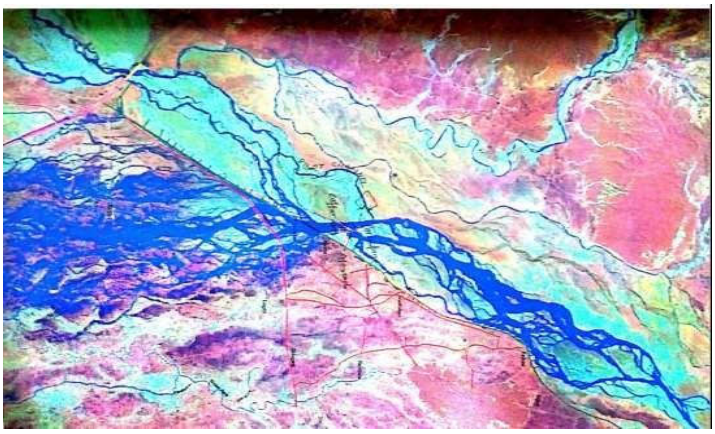
**KOSI ON 24 AUGUST 2008**

The Government of Bihar convened a technical committee, headed by a retired engineer-in-chief of the water resource department to supervise the restoration work and close the breach in the East Kosi afflux embankment. Indian authorities worked to prevent widening of the breach, and channels were to be dug to direct the water back to the main river bed. The fury of the Koshi river left at least 2.5 million people marooned in eight districts and inundated 650 $km^2$. The prime Minister of India declared it a national calamity. The Indian Army, National Disaster Response Force (NDRF) and non-government organizations operated the biggest flood rescue operation in India in more than 50 years

**Why construction of coffer dam in 2008?**

There was a major disaster during flood period in the year 2008. On 16th Aug, 2008 there was a breach in eastern Kosi Afflux Bund of river Kosi In Nepal. The location of breach point was 13 m upstream from barrage. Massive damage started to life and infrastructure in Nepal and India. The main effect of this flood was suffered by five districts of Bihar – Saupaul, Madhepura, Saharsa, Araria and Purnea. A column of 15 feet of water rushed into the villages of India. Several town and villages was submerged. The breach widened upto 1.9km. River Kosi almost started flowing through its old courses, through which it was flowing 150 years back. Complete avulsion of river was apprehended. So it was decided to check downward movement of river by flood fighting. Since Kosi barrage was only 13kms downstream of breach place. Govt. of India and Nepal including Bihar jointly decide to plug the breach and bring back river to its original course so that it can flow through barrage and barrage may be functional. At time of breach three streams were flowing upstream of breach but all these streams joined together at breach site. Team of technical experts visited and inspected the site and decided to plug the breach. Construction of three coffer dams on three streams was essential. All the reservoir turned were joined together to divert the kosi water into a pilot channel was also to be constructed so that was can be diverted into it to guide the flow to barrage. And then the breach will be plugged. The times was very less. In any how the breach had to be plugged before 1st week of March the discharge of river starts rising due to melting of snow. It was decided to start the wale in 1st week of Dec 2008 since during Dec & Jan discharge of river are generally at its lowest end. Following values were recommended by the Tech expert committee to plug the breach:-

i. Construction of three coffer dams as state above
ii. Construction of a pilot channel 8.0km long to divert river water through this channel to guide the flow towards barrage
iii. Collecting of Earth and protection materials like boulders craters both end of the breach so that as soon as the coffer dam is complete the breach can be plugged immediately
iv. Construction of protection wall like a battery of new spurs each 150 m length starting from new embankment
v. Revetment of new embankment on river side and rock to on country side
vi.



**Construction Method**

Our main emphasis is the construction of coffer dams in alluvial rivers. Since kosi is an alluvial rivers it carries large amount of silt. Success breach plugging depends upon the diversion of water into pilot channel by constructing three coffer dams. Fortunately the work was completed on schedule and we could safe further damage during 2009 flood in our country as well as Nepal. All the three existing channel of Kosi were flowing upstream of breach side. There was a strong spurs at about 15km in upstream. During survey it was decided to construct three coffer dams on all the three channels and they tagged them to spur at 15.0 km. First coffer dam was started from the nose of spur at 15.0km .All the three coffer was constructed and tagged to the spur at 15.0km.A service road cum embankment constructed to join all the coffer dams for inspection and proper movement of vehicles. Just upstream of third coffer dam as shown in the sketch, 8.5km long pilot channel was dug with base width 8.0m to divert the water upstream of three coffer dams and to guide the floor towards barrage. A dredge was working all 24 hours at the mouth of pilot channel to avoid siltation at the mouth. As soon as the coffer dam completed water stopped flowing through the breach except few amount ground water flow. Water flow stopped through the breach, collected earth, sand bags, boulders were swiftly dumped to close the breach. A new embankment of 1.9 km was constructed on the old alignment in the designed section. It was strengthen by riveting the toe of embankment and constructing a battery of spurs each 150m long at a distance of 300m each.

**Method of construction of Coffer dam**

After selection of site construction material like B.A. wire crates, nylon crates, boulders, sand bags were collected as per estimate. As per requirement the equipment's were collected and were operational for the work. Across the flow line of channel no.1 the channel bed was lined by sand bags in 20m width. After completing bed lining work construction of coffer dam was started from both banks of the channel .Nylon crates (1m*1*m*1m) filled with sand bags were used for the purpose. Even B.A. wire crates were also use for the purpose. These crates were continuously laid all 24hours. As we came closer from both side the velocity of flow increased sharply and there was a big level difference of upstream and downstream level. Both the edge of river bank were protected by Sal Ballah piling in two rows filled with nylon crate sand bags. Final assault of closing was done by dumping large number of carted boulders and nylon crated sand bags. It took about two days of continuous dumping. When final closing was done by boulder crating water was flowing through it. Hence in the upstream of perforated coffer dam 10m wide earth filling was one to seal the flow of water through it. One point to note that at the final closing point coffer dam was curved. **The main principle of coffer dam final closing "Rate of dumping must be greater than the rate of displacement of dumped material by the river flow".** In the same way the coffer dam on the two more channels were constructed and tagged by 10m wide embankment upstream of coffer dam to the spur at 15 km. The pounded water started flowing into pilot channel 8.2km long already constructed. This pilot channel was just upstream of coffer dam. Remembering the date it was 24$^{th}$ Janurary,2008 on which the main flow of Kosi was stopped through bridge and diverted towards barrage through pilot channel. The barrage again stated functioning.

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