REVIEW OF RESEARCH

REMOTE SENSING AND GIS BASED TECTONIC STUDY OF KOSI RIVER BASIN, INDIA

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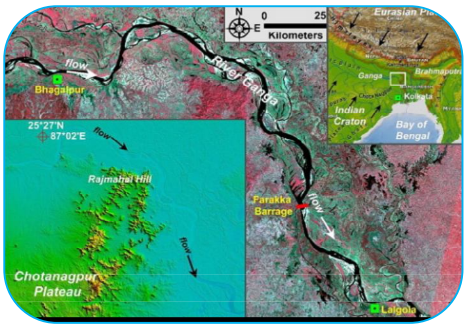


ABSTRACT:

Kosi river covers plains of south Nepal and north Bihar with the apex in chatra in Nepal. It starts its journey at a height of about 7000 meters in the Himalayan range. Geologically, it forms a part of the north Bihar plains, is underlain by thick unconsolidated sediments of Quaternary age which consist of sands of various size-grades i.e. gravels, pebbles and clay. Then, drainage are extracted in Arc GIS 10.2 version software and faults (like Begusarai fault, Bhawanipur fault, Bhagalpur fault, Katihar fault, Kishanganj fault, Malda fault, Begusarai basement fault) are traced. Further, Madhubani depression in the west and Purnea graben causes relatively less movement of drainage through that. At last, the introduction and conclusion are quoted to make this paper unique and interesting.

KEYWORDS: *SRTM, Arc-GIS, Tectonics, Kosi basin, Fault, Depression.*

INTRODUCTION

The study area(Kosi basin)covers the plains of South Nepal and North Bihar with the apex in Chatra in Nepal. The basin covers 62,620 sq. km. drainage area in Nepal and 11,410 sq.km. drainage area in Bihar. The Kosi basin covers 74,030 sq.km. of total drainage area in Madhepura, Saharsa and Supaul districts. The Kosi basin has 52,219 mcm of water resources. The river is known as “The Sorrow of Bihar” as it is highly prone to flooding and has avulsed over 120 km in the past 250 years. This unstable nature of the river is due to the heavy sediment load that it carries from the himalayas. The Kosi starts its journey at a height of about 7000 meters in the Himalayan range. Its upper catchment is located in Nepal and Tibet. Kosi is fed by 7 tributaries namely – Indravati, Sun Kosi, Tamba Kosi, Likshu Kosi, Doodh Kosi, Arun Kosi and Tamar Kosi Further, the location map of the kosi river basin is shown below (fig-1.1)

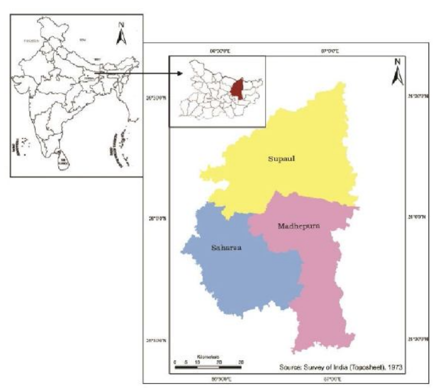


Fig-1.1

Morphotectonics is the outcome of the basin formed by tectonic processes. The quantitative dimensions of basin are consummate on the base of result of satellite images and field works. Furthermore, morphotectonics is used as important tool of active tectonics. The term "Active tectonics" is amongst the most significant and fastest growing disciplines in Earth Sciences since it provides quantitative information about various tectonic driven processes viz. upliftment rates, incision rates, erosion rates, catchment asymmetries, river diversions and sudden truncation, slip rates on faults in time domains (Schumm et al., 2000; Burbank and Anderson, 2001; Keller and Pinter, 2002; Salvany, 2004; Schoenbohm et al., 2004; Bull, 2007; Pérez-Peña et al., 2010).Besides, there are voluminious literature regarding tectonics. But, the mention is noteworthy. Finally,the introduction can be quoted as-

The shift of Kosi & gift of flood…_the outcome of tectonic bomb….!

GEOLOGY OF THE STUDY AREA:

The study area, which forms a part of the north Bihar plains, is underlain by thick unconsolidated sediments of Quaternary age which consist of sands of various size-grades i.e. gravels, pebbles and clay (which occurs in the uppermost horizon).The Lithostratigraphic sequence of each morpho-stratigraphic unit has been worked out by GSI (2000). The alluvial fill can be divided in to two broad divisions, viz. (i)The Purnia Formations of Holocene age and (ii)The Diara formation of Recent age.The Kosi fan area is characterized by three major morphogenetic units namly 1. Purnia surface, 2.Ganga-Kosi-Mahananda plain and 3. Diara plain(fig-1.2)

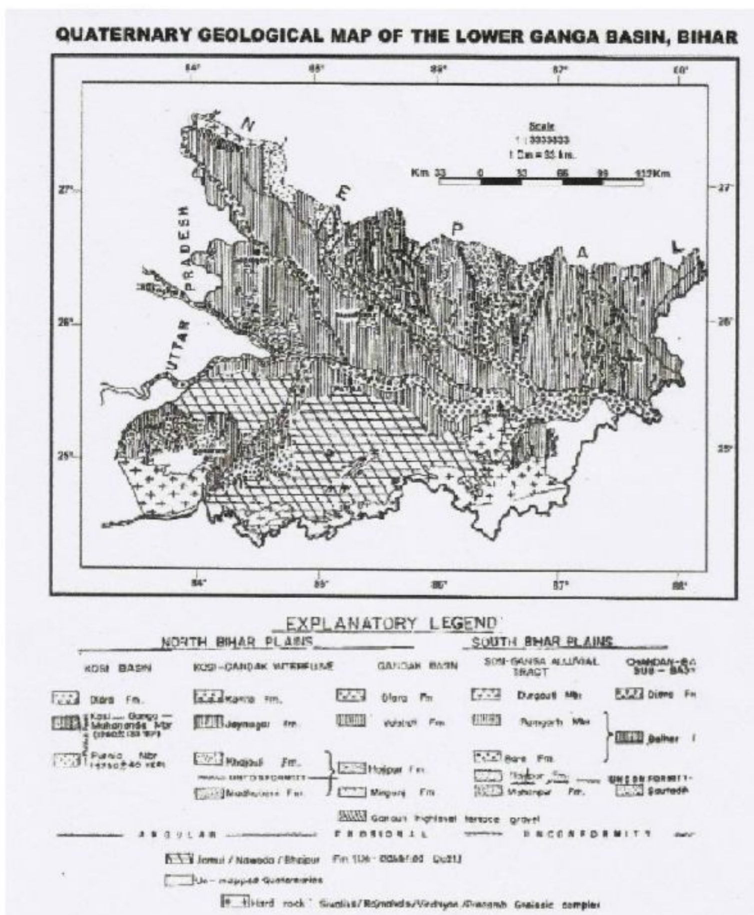


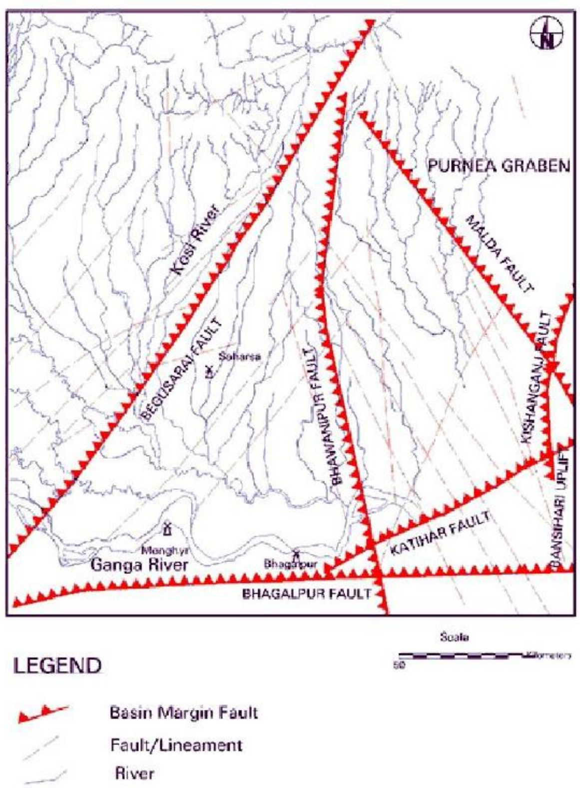
Fig-1.2

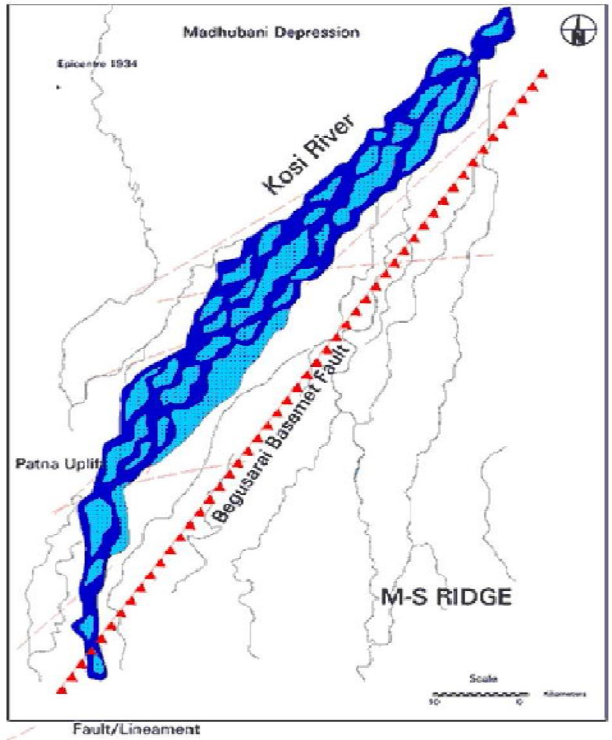
1. Purnia Surface : This surface constitutes the highest elevation in the alluvial landscape of the area and occurs as detached patches of various size and shape.
2. Ganga-Kosi-Mahananda Plain: The vast stretch of monotonous flat ground occupies the intermediate position between the Purnia surface and the present day flood plain (Diara plain).
3. Diara Plain: This plain represents the lowest ground in the alluvial landscape. The plain occurs as linear narrow tracts along the Kosi dhars and other distributaries of the Kosi River.(Mahadevan, T.M., 2002)

METHODOLOGY

The extraction of drainage basin map from SRTM data downloaded from CSI CGIAR having resolution of 90m × 90m. The data were processed in Arc GIS 10.2 environment with WGS 84 datum using Arc-Hydro tool for regional scale of the basin.After that, drainage are extracted and faults are digitized.

Tectonic set up of Kosi basin:





Geomorphological map showing shifting of Kosi river along faults

Kosi flood basin lies over an extremely uneven basement formed by important tectonic features like Purnea depression, Mongyr-Saharsa (M-S) Ridge and Madhubani depression.

Mongyr- Saharsa ridge is crossed by basement faults like NNW-SSE trending Kishanganj and Malda basement faults in the east while the Bhawanipur faults lies in the west (Sastri et. al ,1973, Rao, 1973). All these faults looks straight trending NNE & SSW direction excluding Malda-Kishanganj fault (fig-1.3).

The arcuate shaped Malda-Kishangang fault has been bended westward close to M.S. ridge. Madhubani depression (fig-1.4) that lies towards west of the basin having accumulation of sediments that has maximum thickness of 6km. On the other hand , Purnea depression is situated towards east of the M.S. ridge at the shallow depth (fig.-1.3 &fig-1.4).

The eastern Gangetic plain maintains it's tectonic activity as outcome of several recent major and minor earthquakes (1883,1934 &1988) in the region. The rate at which Kosi river shift is highly variable irrespective of the discharge and sediment load that reflects an obvious control of tectonics. The rate of shifting is high (0.7 miles/year, 1770-1825) which is the result of several earthquakes that has occurred in adjacent Nepal Himalya in 1720, 1764 &1826). The rate of shifting was relatively less particularly when it was flowing in Purnea graben (prior to 1956 position). The deposition of sediment at fan-head is associated with kosi basin shows the rate of uplift of the mountain front is relatively higher in comparison to the rate of stream –channel down-cutting in the mountain. The westward skewed shape of the Kosi basin shows that alluvial fan area is tilted towards west which is the cause of subsidence in Madhubani Depression (fig.-1.4) & the uplift of Himalya (Agarwal and Bhoj,1992). A no. of points & flood breaches are mapped along the middle course of the Kosi river. A echelon pattern of Quaternary surface fault system that has been encountered in the region, that are associated with the Begusarai faults (fig.-1.3). All the diversion & floods breaks lies on the intersection points of Begusarai fault and echelon fault. Neotectonic movement that lies along the belt called as Himalyan Seismic Belt (Gahalaut, 2000) and basement tectonics have influenced the diversion point and flood breaches. It should be noted that the convergence point of the Kosi river with Ganga river is fixed that lies close to the intersection point of Bhawanipur & Bhagalpur faults.(fig.-1.3).

The continued subsidence in the Madhubani depression while relative uplift Monghyr-Saharsa Ridge and the resultant E-W tilt of the basement towards west causes the Kosi river to have continuous westward migration. Then, faults namely, Malda-Kishanganj Fault, Begusarai Fault, Monghyr-Saharsa Ridge Fault & other Quaternary echelon surface faults (fig.-1.3 and fig.-1.4) causes avulsions in the Kosi river (Agarwal &Bhoj,1992).

CONCLUSION

Lineament and fault study using Remote sensing and GIS techniques have proved to be efficient tool in basin-tectonic studies. Kosi river basin suggests the predominance of dendritic to sub-dendritic drainage patterns.The lineament analysis provides comprehensive picture of the drainage basin . It controls the drainage pattern that is not in much symmetry over the drainage basin. Tectonic study is attributed to changes in slope and topography as a result of structural control in the basin development. The echelon surface faults have remained responsible for the avulsions in the Kosi River. The continued subsidence in the Madhubani depression and the relative uplift of Monghyr-Saharsa Ridge, and the resultant E-W tilt of the basement towards west has helped the Kosi River in maintaining its continuous westward migration. Madhubani depression, lying at the west of the basin has a thick accumulation of sediments with a maximum thickness of 6 Km while Purnia depression is situated further east of the M-S ridge but at a shallower depth. Finally, the conclusion can be quoted as:-

"Faults and grabens closes the episode…,the tectonic bomb of the Kosi river basin".

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