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TOPOSHEET AND FIELD BASED GEOMORPHOLOGICAL STUDY OF KOSI RIVER BASIN, BIHAR, INDIA

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ABSTRACT

The Kosi river is one of the highest bed –load carrying rivers in the world. It has gentle slope from north to south along which Kosi river and its tributaries are flowing. Geologically, it forms a part of the north Bihar plain which is underlain by thick unconsolidated sediments of Quaternary age that consists of sands of various size-grades i.e- gravels, pebble and clay. The methodology adopted includes georeferencing of toposheet and its digitization in Arc GIS 10.2 software. Then, the geomorphological study of Kosi river includes study of Kosi river includes study of geomorphological features of toposheet no. 72J/11, 72 J/12 , 72J/15, 72J/16, 72K/9 and 72K/12. The geomorphological study is also supported by field photographs of dhars, flooding, paleochannel, Kushaha breach and sediment dispersal. At last, the introduction and conclusion are quoted to make this research paper unique and interesting.

KEYWORDS: - *Dhars, Meanders scrolls, ox-bow lakes, paleochannel, flood-plain.*

INTRODUCTION

The Kosi river that is known as the "Sorrow of Bihar" originates from Himalya Mountains and reach the foothills in Nepal and the alluvial plain in North Bihar. Further, flows in a deep gorge in the Himalya Mountain before it enters the Gangetic plain (Gole and Chintale ,1996) The major tributaries of Kosi river include Sun-Kosi river, the Arun river and Tumur river, which meet at Triveni in Nepal. The mean annual suspended load transport of the Kosi river is 130 million m^3 (Singh et. al. 1993).

The Kosi river that has formed from one of the major alluvial fan in the south eastern Asia by constant deposition of sediments by shifting of its course east to west. The outer flanks of the fan are co-terminus with the Gandak fan in the west and Mahananda-Tista fan in the east.

Moreover, flooding of the Kosi river in the plain of the North Bihar is found to be responsible for extrusive and frequent loss of human life and property over recent decades. A number of flood events (Kale, 1997) that occurred in this region indicates that the Bihar region that suffered the highest number of flood events in decades compared with other parts of India.

The river changes its course in westerly direction and moved laterally nearly 150 km (Gole and chittale, 1966, Wells and Dorr,1987). The location map of the toposheet of Madhepura, Saharsa and Supaul district of the Kosi river basin is shown below (Fig-1):-

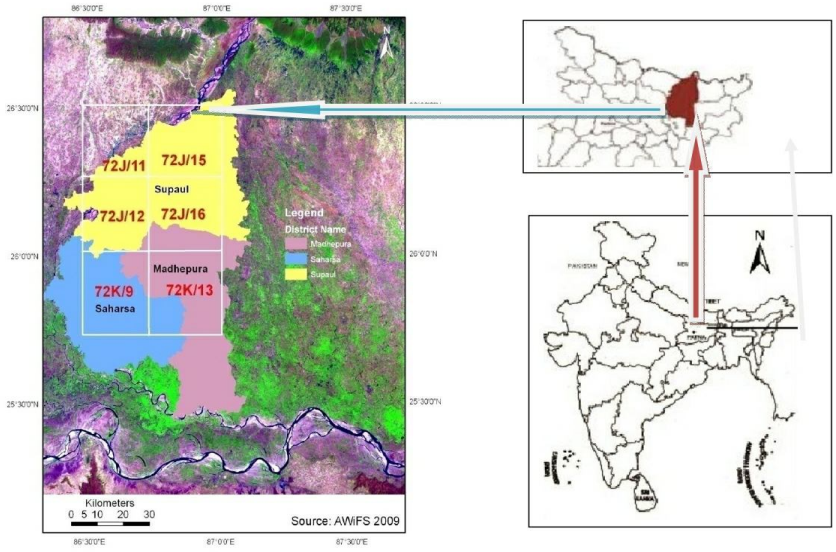


Fig-1

Finally, the introduction can be quoted as:-
"The geomorphological study begins with identification of landforms of toposheets".

METHODOLOGY:

At first , toposheets (72J/11, 72J/12, 72J/15, 72J/16, 72K/9 & 72K/13) are georeferenced. Then, these are in Arc GIS 10.2 software with WGS 84 datum. After, that, geomorphological features like alluvial fan surface, alluvial island, chute channel, embankment, flood plain, fresh sand , Kosi river, lateral bar, Dhar, mid-channel bar, paleochannel, pond ,wetland, active channel belt, alluvial island, chute channel, East Kosi channel, flood channel, lateral bar , mid-channel bar,point bar, old flood plain, ox-bow lake, etc. are traced. Then, geomorphological features are supported by field photographs- (A) of Dhars (B)of flooding (C)Paleochasnnel. (D) of sediment dispersal (E) Kushaha breach.

Geology and Geomorphological setting of the Kosi river:

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 geomorphological study engulf different geomorphological features like island, alluvial land surface, chute channel, embankments, flood plain, lateral bar, mid-channel bar, ox-bow lake, paleo-channel, old flood plain, flood channel, active channel belt, alluvial island, lateral bar, mid channel bar, point bar, wetland, pond, river etc. in different Survey of India Toposheet no. 72J/11, 72J/12, 72J/15 and 72J/16, 72K/9 and 72K/13 . Definition of the these geomorphological features is given below:-

(i) Kosi river- It is a tributary of Ganga river originating from Tibet and the southern slopes in Nepal..
(ii) Alluvial fan surface:-If a fan is built when debris flows it is properly called a debris cone or colluvial fan. These flows from a single point source at the apex of the fan to occupy many positions to form alluvial fan surface.
(iii) Chute channel:- It is formed when the river cuts through its own point bar, resulting a new channel across the neck of a meander called chute channel.

(iv)Embankment- It is an artificial bank raised above the surrounding land to protect it from flooding by a river.
(v)Flood plain When river crosses it bank, the water spread in adjoining areas. After that sediments deposit in the form of layer. That layer is called flood plain.
(vi) lateral bar:-These are attached to bank and have an asymmetric shape.
(vii)Medial channel bars:- Medial bars are symmetrical, and have lobate shape detached from the banks
(xiii) Ox-bow lake- During high water times, the stream acquires high velocity. Due to which river flows straight and leave its curved path. In due course of time , curved path get detached and form ox-bow lake.
(ix)paleo-channel- These are remnants of stream channels cut in to older sediments and filled by younger overlying sediments. These paleochannel get det detached from main watercourse and exist at given geological time in the past.
(x)old flood plain- It is only flooded when there is heavy monsoon rainfall and are covered with old alluvium.
(xi) Flood channel- It is a enlarged stream channel that carries water during floods..
(xii) Active channel belt:- The portion of the channel or floodplain network that receives channels that exist within the anastomosing pattern
(xiii) *point bar*- A curved ridge of sand and gravel along the inner side of a meandering stream
(xiv) Alluvial island- Formed in midstream within large rivers.
(xv) *Wetlands* occur where water meets land. Examples include mangroves, peatlands and marshes, rivers and lakes, deltas, floodplains and flooded forests, rice-fields,.
(xvi)Pond- A pond is an area filled with water, either natural or artificial, that is smaller than a lake. Ponds are frequently man-made, or expanded beyond their original depth and bounds.
(xvii)River- It is a natural flowing watercourse, usually freshwater, that flows towards an ocean, sea, lake or another *river*.
(xviii)Dhar:-Abandoned channel of river due to breaching of river bank of sand during flood times.
(xix)Fresh sand:- It is a deposition of sand by the side of river..
(XX) East kosi canal.- Canal situated towards east of Kosi river bank is known as Eastern Kosi command canal or East kosi canal.

i. Analysis of Geomorphic Map of Toposheet No. 72J/11:

This area covers an area of 379.8054 sq km which is dominated by wetland/flood plains having an area of 210.344 sq km and minimum area coverage is with ponds covering an area of 0.314671 sq km., Eleven geomorphic features have been identified in this region. *River* covers the area of 49.93772 sq km. *Palaeo channels* covering an area of 6.862561 sq km. *water body which is a part of wetland/flood plains* covering an area of 2.689084 sq km. Mainly two in stream features have been identified in this area, *eight Point bar* covering an area of 4.177279 sq km, maximum size is 0.951251 sq km and minimum size is 0.063442 sq km. *fifty three Mid channel bar* covering an area of 19.70169 sq km, maximum size is 2.905017 sq km and minimum size is 0.010238 km. *Ox bow lakes* are present covering an area of 0.314671 sq km., and alluvial island covering an area of 76.03633 sq km.

ii. Analysis of Geomorphic Map of Toposheet No. 72J/12 .

This area covers an area of 906.2383 sq km which is dominated by wetland/flood plain having an area of 724.8258 sq km and minimum area coverage is with Ox Bow Lake covering an area of 1.437214 sq km. Several dhar are also visible in this area flowing from north to south.,

Eight geomorphic feature have been identified in this region. *Palaeochannels* covering an area of 53.04796 sq km.. This area is dotted with six *Ponds* having area coverage of 12.08517 sq km, maximum size is 11.69717 sq km and minimum size 0.031871 sq km. six *Ox bow lakes* are present covering an area of 1.437214 sq km, maximum size is 0.663479 sq km and minimum size is 0.08119 sq km and *Wetland* most dominated feature of this region. This area is having river covering an area of 56.44732

sq km with three in stream features namely point bar covering an area of 15.89318 sq km, they are twenty nine in number with minimum of 0.063512 sq km and maximum of 2.452217 sq km, mid channel bar covering an area of 31.47356 sq km, they are fourty five in number with minimum of 0.009888 sq km and maximum of 5.130231 sq km and lateral bar covering an area of 6.726028 sq km, they are four in number with minimum area of 0.162228 sq km and maximum of 3.491706 sq km and fresh sand sediment with the total area of 4.302018 sq km.

Analysis of Geomorphic Map of Toposheet No. 72J/15.

This area covers an area of 838.0541 sq km which is dominated by alluvial fan surface/alluvial upland/older flood plain having an area of 520.7571 sq km and minimum area coverage is with chute channel covering an area of 0.934734 sq km. A dhar is also visible in this area flowing from north to south. 11 geomorphic features have been identified in this region. *River* covers the area of 226.269 sq km. *Palaeo channels* covering an area of 149.074 sq km. Mainly 2 in stream features have been identified 13 *Point bar* covering an area of 4.326408 sq km, maximum size is 0.811908 sq km and minimum size is 0.082437 sq km. 1*6 Mid channel bar* covering an area of 37.96102 sq km, maximum size is 35.66383 sq km and minimum size is 0.021706 km. this area is dotted with 22 *Pond*s having an area coverage of 2.820938 sq km, maximum size is 0.678053 sq km and minimum size is 0.028264 sq km. 7 *Ox bow lakes* are also present covering an area of 1.088662 sq km, maximum size is 0.320636 sq km and minimum size is 0.05937 sq km. In north east corner of this area a *Alluvial island* is present which covers an area of 20.16912 sq km, few *Sand deposit* patches are also visible having an area coverage of 6.136958 sq km, and natural levee covering an area of 14.27811 sq km.

4.2.3. Analysis of Geomorphic Map of Toposheet No. 72J/16

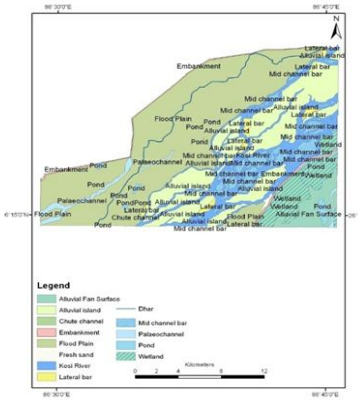
This area covers an area of 902.9282 sq km which is dominated by alluvial fan surface/alluvial upland/older flood plain having an area of 760.1380 sq km and minimum area coverage is with ox bow lake covering an area of 0.679133 sq km. 8 geomorphic feature have been identified in this region. *River* covers the area of 25.79408 sq km. In south western corner of this area an *Alluvial island* is present which is covering an area of 19.29379 sq km. *Chute channel* covering an area of 1.786212 sq km. *Palaeo channels* covering an area of 86.44545 sq km. No in stream features have been identified in this region. This area is dotted with 3 *Pond*s having an area coverage of 7.994659 sq km, maximum size is 5.731102 sq km and minimum size is 0.048916 sq km. 4 *Ox bow lakes* are also present covering an area of 0.679133 sq km, maximum size is 0.243529 sq km and minimum size is 0.137122 sq km and *fresh sand deposit covering an area of 0.796303 sq km.*

4.2.4. Analysis of Geomorphic Map of Toposheet No. 72K/9

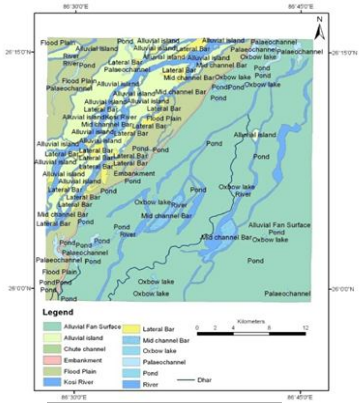
It consists of paleochannel that are irregular in outline and there are four paleochannel found at upper left, upper right, central and lower right part of the toposheet . Then, pond lies at central, lower left and right part of the basin. Ox-bow lake that are formed by the sediment accumulation of detached part of the river. Ox-bow lies at central, left and right of the bottom..

4.2.5. Analysis of Geomorphic Map of Toposheet No. 72K/13

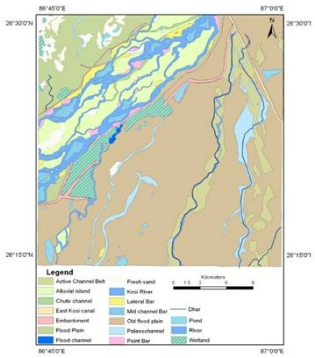
It consists of paleochannel that lies all along the Dhar in different parts of toposheet. Ponds are located at central and right part of the bottom. Dhar are located on left and right side of the toposheet and old flood plain in brown colour.



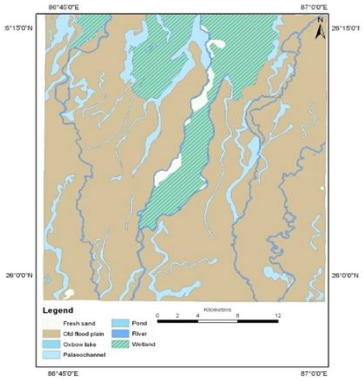
Geomorphological map(toposheet no.-72J/11)



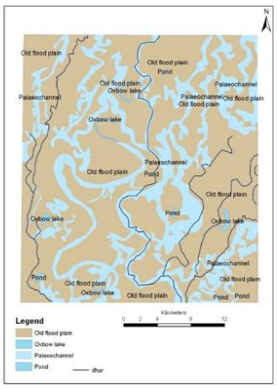
Geomorphological map (toposheet no.-72J/12)



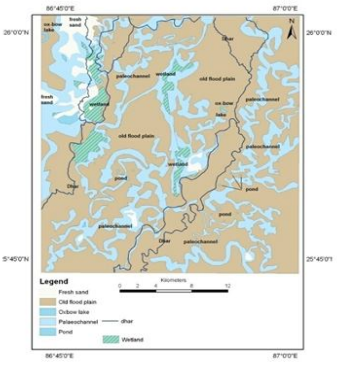
Geomorphological map (toposheet no.-72J/15)



Geomorphological map (toposheet no.-72J/16)



Geomorphic map (toposheet no. 72 K/9



Geomorphic map (toposheet no. 72 K/13

FIELD WORK:

Dhars are passing through the plain area show meandering pattern marked by yellow lines in photograph (A). Then , as we know that Kosi is known for shifting of course which in many cases causes flooding. The flood become so powerful in some cases that its collapse the bridge structure. In photograph (B) the broken part of the bridge shown in photograph is marked by red circle. As we discuss previously about the shifting of Kosi river . When the Kosi river shift from one course to another, the abandoned course is called paleochannel. In photograph(c) paleochannel is marked by yellow colour line which is partially filled with water. Moreover, due to shifting of course, a large no. of sediment that are eroded from bank and carried away in water of Kosi river. This is shown in photograph (D)where bank is marked by yellow line. Further, photograph (E) shows Kushaha breach at Kushaha in Nepal, which cause mega flood in North Bihar in 2008.

CONCLUSION:

Geomorphological and toposheet study of Kosi river basin is dyanamic and have shifting pattern. Besides, it passes through plain area. These basin is sculptured by important geomorphological features like river, ponds, wetlands, alluvial islands, point bar, active channel belt, flood channel, old flood plain, embankment, chute channel, alluvial fan surface, island etc. These geomorphological study is reinforced by field study. The photograph of flood, paleochannel,sediment dispersal , dhar, Kushaha breach make this work attractive. It should be noted that dhars assist in regional planning of ground water resource. At last, conclusion can be quoted as:

"Toposheet &field work makes the complete picture of geomorphological study of Kosi river basin".

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