Fluvial Geomorphic Analysis Using Remote Sensing Techniques For Detection Of Palaeo Channels And Old Valley In Kharun River, Mahanadi System, C.g., India

[1]Dr. S.S. Bhadauria, [2]Dr. H.D. Diwan, [3]Dr. R. Shridhar
[1]Teaching, [2]Teaching, [3]Teaching
[1]Govt. NPG College of Science, Raipur C.G. India,
[2]Pt. Ravishankar Shukla University, Raipur, C.G. India,
[3]Govt. NPG College of Science, Raipur C.G. India

Abstract - **The geomorphic characteristics largely determines the behavior of fluvial drainage system of a river catchment. The morphological changes of river tract, channels occurs mainly due to disturbances of equilibrium in fluvial drainage system. In this study the migration and shifting of river tract and geomorphic features of old flood plains has been detected using remote sensing techniques interpretation with limited field checks. The study reveals that the Kharun river of Upper Mahanadi Catchment, at north of Raipur City reaches mature stage and flows over undulating plains and low relief topography. The carrying capacity of Kharun river reduced and bed load of sediments have been deposited as concave – convex loop or bands of one of the meandering channels. The litho contacts of varied sedimentary rock formation causes the meandering and shifting of river channels. The structural trend and features like joints, lineament, fracture, fissures and Topographic ground land scape and slope also governs the river flow alignment in the valleys. The clues regarding palaeo channels and old river valley traces evidenced by reminant of geomorphic features associated with fluvial zones, as it is a dynamic system and changes in channelization depends on existing geomorphic conditions. The palaeo geomorphic features have immense values hydrogeologically since these features acts as controlling factor in management and development of catchment area.**

keywords - **Fluvial Geomorphic Units, Remote Sensing, Palaeo Channels, Old Valley, Mahanadi System, Kharun River, Meanders.**

A. INTRODUCTION

The study area lower Kharun river is a tributary of Master Shivnath river lies in the Mahanadi catchment. The area is characterized by rolling undulating plains with 2°-8° slope. The protereozoic sedimentary rocks sandstone, shale and stromatolytic limestones are major lithotypes underlies the region. The development of river tract is controlled by joints, fracture and Lineaments (Structural Controls) in most part of the fluvial regime. (In the present study various geomorphic characteristics and parameters have been determined to evaluate the drainage system attributes of lower Kharun river catchment. The Kharun river Catchment lies under Mahanadi fluvial system and exposed between 80°30' - 82° longitude and 21°30' to 22° latitude spread over an area of 3900 Sq Km . Since remote sensing data products are convenient and faster tool for Terrain analysis / natural resource / land use / land cover / land form geomorphic features. It provide a synoptic views of a large area. With the inductive and deductive reasoning the objects can be interpreted using key elements like colour, tone, texture, pattern, size, shape, association etc. Various fluvial geomorphic features have been demarcated. The study indicates that in the geologic past the Kharun river drainage basin faced many changes in Master River Course due to changes in upstream land cover / land use and due to structural, lithological, diversity. The geomorphic features like palaeo channels, old flood plains, meandering scars, valley fills, Ox – bow lakes have been recognized near Kumhari, Bahesar, Akola etc. and scar , abandoned channels, shifting of river course occurs in Sondara, Chikhli localities. The Quarternary Deposits are largely influenced by fluvial processes where palaeogeomorphic features have immense value hydrogeologically.

B. METHODOLOGY

The S.O.I. toposheets have been utilized as a base map. The hydrogeomorphic and fluvial features have been identified using remote sensing Satellite Data FCC, IRS, MSS, PAN Data with limited field checks i.e. ground truth. The linear and aerial measurements (digital) respectively. The interpretation keys were made on the basis of colour, pattern, tone, texture, location and association of recognition criteria (Lilisand and Keifer, 1979) .

C. PHYSIOGRAPHY, LANDSCAPE AND DRAINAGE

Physiographically, the study area represents an undulating rolling plains with altitude of about 300 metres AMSL. The ground slopes are low and commonly below 3°. The regional topography exhibits a gentle undulating landscape with north flowing drainages. The altitude of river tract ranges between 254 m and 306 m. AMSL. The Kharun river is a tributary of master Shivnath river in Upper Mahanadi River System. The subdentritic drainage pattern is dominated in the area. Small ridges laterite capped mounds or uplands are common features .

D. LITHOLOGY AND ROCK TYPES

Geologically, the fluvial area of Kharun river lies in Chhattisgarh supergroup rocks of protereozoic age where the sedimentary rock exposed (Das et. al, 1992) . It includes ferrugenous Sandstone, Stromatolitic limestone shale, laterite and alluvium. The rock strata occurs in nearly horizontal positions and shows gentle dip below 5° towards north. The soils and alluvium are found insitu and in stream, river banks. Laterites are developed in ferrugenous sandstones and occurs as capping over sandstone mounds. The Matasi and Dorsa soils i.e. silt -clay soil and clayey silt soil formed as thin veneer over pediment and shallow – deep buried pediments in low lying areas. The limestone is stromatolitic and karstic in nature, the features sinkhole, doline, micro channels are common. The limestone is thickly bedded and joints / fractures of secondary origin shows NE – SE and E-W lineament direction. The combination of shale – limestone and platy sandstone – Khaki shales are common. The limestone constitutes Aquifer zones and hold water in secondary porosity like fissure, fractures, cracks, solution openings, voids etc.

E. FLUVIAL GEOMORPHIC CHARACTERISTICS OF KHARUN RIVER

The tract has been represented by undulating plains varies from 310 – 257 m. AMSL where the erosional processes have been dominated and forms upland, undulating plains, pediments, buried pediments and valley fills – alluviums etc. The fluvial processes includes interaction of flowing surface water and the ground surface. The degradation of existing landscape has been performed by natural surface drainages. The eroded material is transported, deposited to the low lying areas and river channels. The fluvial process largely depends on velocity of water, slope of ground roughness of stream channels, particle size, shape etc. The transportation of sediments, bed load and fine grained flow out with water a long distance. The rock fragments and particles as shingle, gravel, sand, silt clays are major bed loads of stream or river flowing water. The elevation difference from 272 m. to 257 m about 15 mtrs. In the study area creates equilibrium condition in lower Kharun. The river channel morphology and river bank dimensions govern the flow characteristics of river. The river channel dissection capacity is determined by drainage density, i.e. the density of stream channels in a ground surface per unit area. It varies from 2 Km /Km^2 , 4 km / km^2. The stream / river channel geometry is expressed meandering parameter of river. The loops or bands developed due to 1.) high bed load 2) low gradient of stream channel, valley 3) lithological variation susceptibility to wear and tear. 4) Structural Trend :- orientation of joints, cracks, lineaments.

F. PALAEO CHANNELS AND OLD VALLEY

The shifting of river course main trunk during past history, the old remains of river tract is called Palaeo channel and corresponding valley as old valley. The flood plains of river includes both the old flood plains (OFP) and current flood plains (CFP). The major controlling factors include 1. Lithological variation rock material composition 2. Structural Trend Density and nature of joint / fissures / lineament 3. Carrying capacity of river water , bed load etc. 4. Channel Geometry (Main Trunk of River Configuration) meandering river and straight river mostly controlled by joint, fracture pattern and slope of the tract. It is generated in the mature stage of fluvial cycle of a river. The remains of old valley includes ox bow lake, meandering scars, water pools, old flood plains, alluvium plains and shifting of ricer course / valley in lateral direction either side, present case the shifting towards east direction meandering causes the new path of river channel (1.5 Km distance) apart from old channel. The abandoned and old palaeo channels are storage potential GW zones. The erosion process is dominated in lower Kharun catchment which is largely influenced by fluvial activity and lithological variation of the terrain. The meandering scars, abandoned channels, have been delineated near Kumhari village. Bahesar, Pahanda , Akola, whereas lineament and shifting of river course, observed from Gomachi to NE Chikli, Mundrethi village. The gulley erosion and top soil removal leads formation of bad land topography in riparian tract of lower kharun. The severelly affected erosion prone zones (EPZ) are marked near Akola, Gomachi and Kandarka etc. The meaders are s shaped loops found in the course of a river channel. The meandering scar indicates presence of old deposited terrace, Gomachi, Bendri, Karra in the (left) western bank of Kharun River. The presence of ox bow lake makes clear evidence of old channel of Kharun river, which is a small elonguted water containing geomorphic feature found in the palaeo channels. It holds sufficient ground water for supply. It can be identified in remote sensing data product interpretation by shape, size orientation parallel to old channel dark tone with greenish and isolated feature. The sand bar in the river channel also generate the River Island after stability and Growth of Vegetation. It originates a nuclie of sand deposits of river channel and migrate the river water flow by divided or bifurcated channels. It changes the river flow direction with acute angle to some extent. The geomorphic criteria for detection of old valley river channel is illustrated in table.

DISCUSSION AND CONCLUSION

The fluvial process insculpturing the various land form units e.g. uplands, undulating plains, pediments old flood plain, current flood plains, old valleys, palaeochannels, , meandering scar, ox -bow lakes, etc. Since the remote sensing data product imagery provide the synoptic view of a large area and interpretation through inductive and deductive reasoning and identification keys various fluvial geomorphic units have been demarcated. The delineation of associated features like ox bow

lakes, wet lands, meandering scars give clues regarding the channel route traces in the old flood plains (OFP) . The palaeo channels and old flood plains acts potential ground water zone for supply of water during scarcity periods. It also gives the fluvial history of river drainage system / network for further watershed planning and management.

Table 1

Geological succession (generalized)

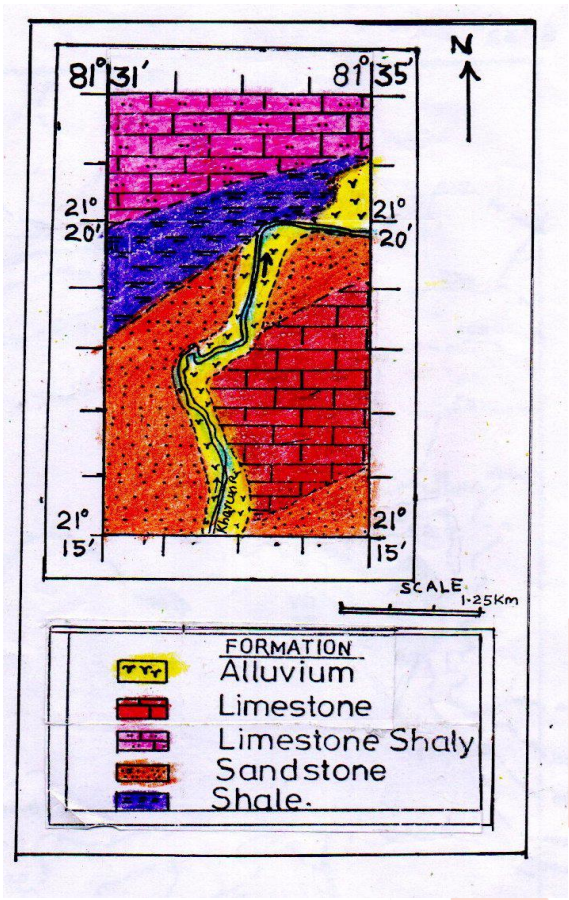
Age	Group/formation	Lithology
Recent	Laterite/Alluvium	Medium grained laterite Sand alluvium fine grained
Proterozoic	CHHATTISGARH SUPERGROUP CHANDI FORM Deodongar Sand Stone Raipur Limestone	Platy ferruginous brownish red sand stone stromatolitic pink and grey coloured thick bedded jointed lime stone (Karstic)

(Source : Diwan & Kuity, 2016)

TABLE - II GEOMORPHIC CRITERIA FOR DETECTION OF OLD VALLEY / FLOOD PLAIN

S. No.	GEOMORPHIC UNIT	GEOMORPHIC FEATURES (Form)	CHARACTERISTICS (Detection)
I.	Flood Plain (FP)	a. Old Flood Plain (OFP) b. Current Flood Plain (CFP)	Narrow and Deeper soil / sediments sand alluvium thickness 20 metres Loose sands, widely exposed, Alluvium, shallow zones
II.	River Terraces (Depositional Type)	a. Ist level b. IInd level c. IIIrd level	Step like structure, Triangular Shape , sand and silt, with vegetation Bare Graded Sand, silt, conglomerate thickness vary 1 to 3 metres.
III.	Meandering R. Channel	a. Loops with curvature b. Multiple Lopps	Ground slope very low relief (below 3°) Number of bands / deposit and formation and slope and River channel Gradient low.
IV.	Meandering Scar	a. Traces of sand Ridges b. Concentric Pattern	Striations, Concentric ridges of ribs of sands
V.	Ox – bow lake	Detachment of lake from old channel of River after meandering	Semi circular – shape occurs as isolated band in old flood plain of river, G.W. wet land. Evidence of palaeo channel
VI.	Sand Bar	As a Nuclie, Core of the River Banks Deposition, Stable and permanent with high growth of vegetation	Patches of sands on current flood plains, Channelize the river in many river flow branches
VIII.	Old valley	Abandoned channel segment filled with soil / sediments/	Valley surface of old channel persist with slope and parallelism of current river

			valley occurs as infilled soil and sediments



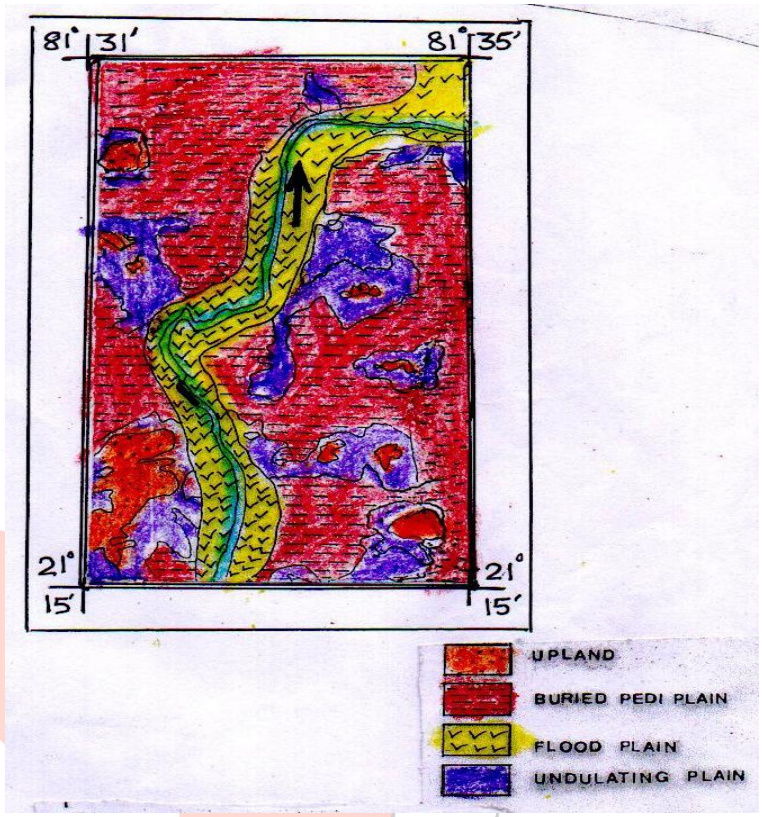
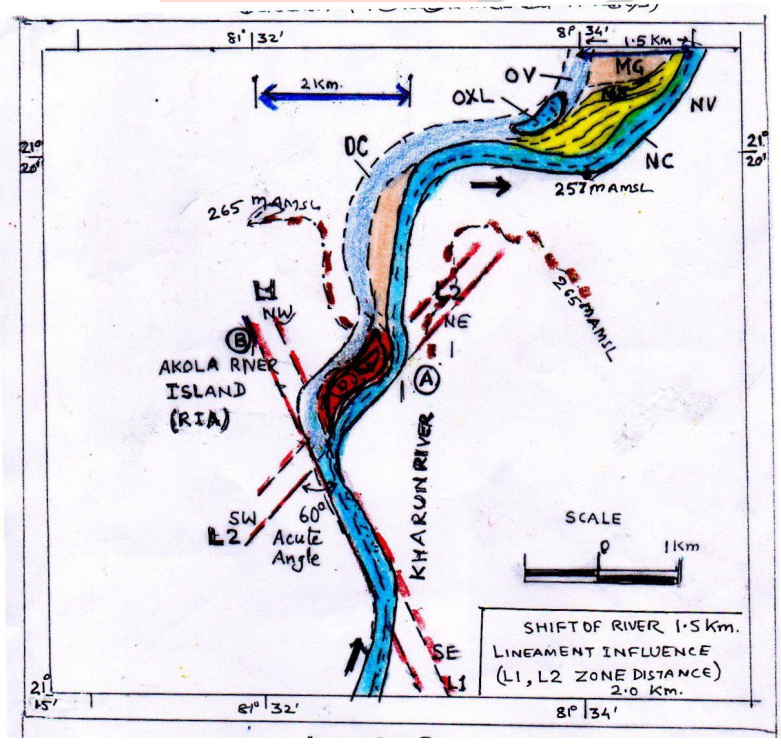


FIG I – LITHOLOGY – Protereozoic Sedimentaries (Chhattisagarh S.G..- Raipur G.P.- CHANDI FORMATION)

FIG-II –Kharun River –Geomorphic Units



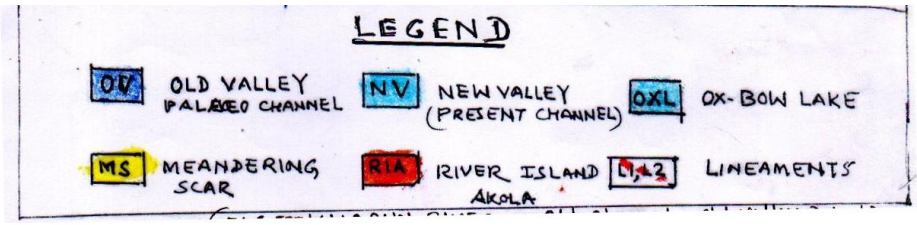


FIG –III- FLUVIAL GEOMORPHOLOGY (Palaeo Channels and Old Valley)

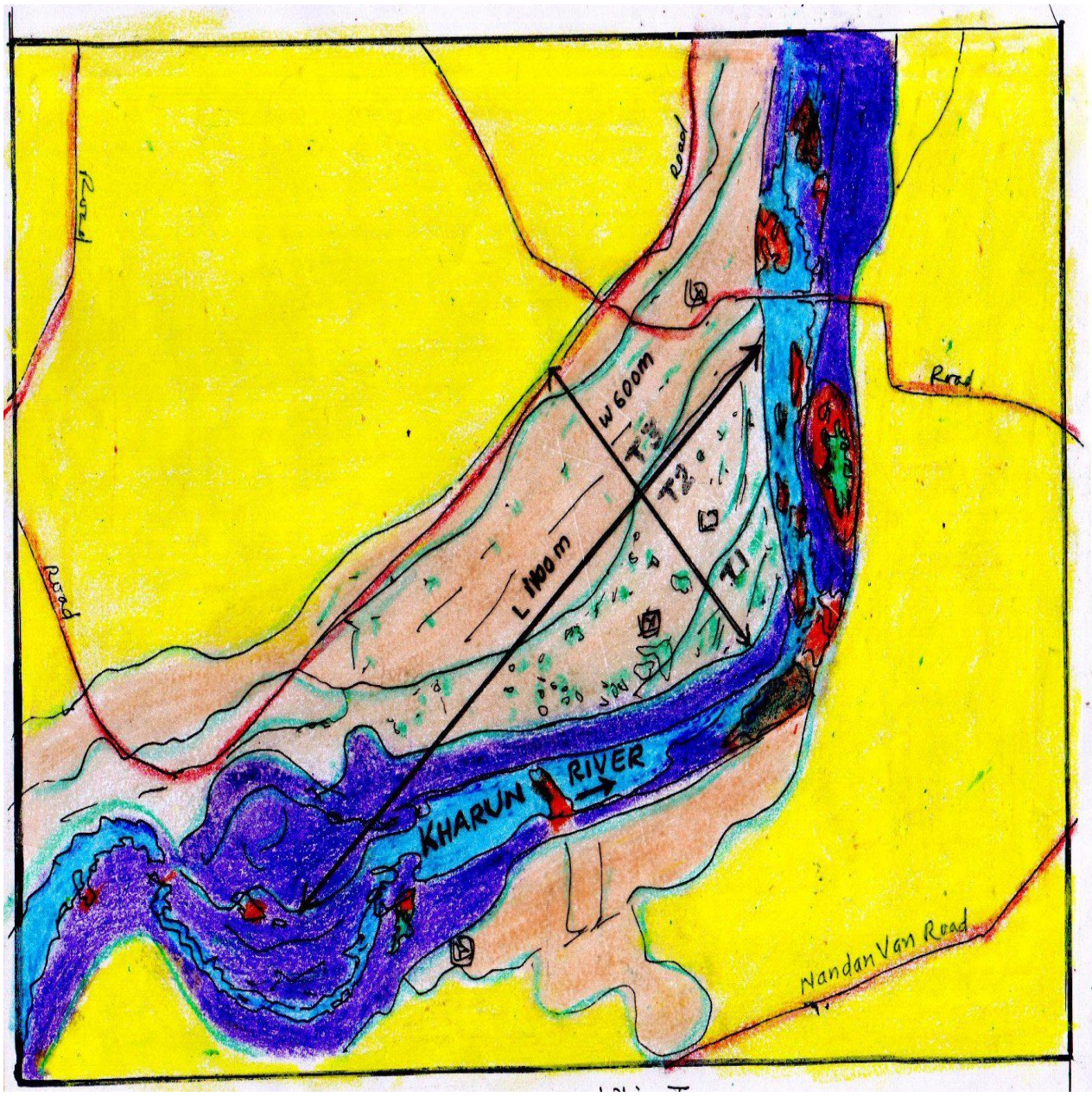


FIG- IV - KHARUN RIVER (Flood Plain , Terraces)

FIG – V KHARUN RIVER – (OX BOW LAKE , MEANDER SCARS)

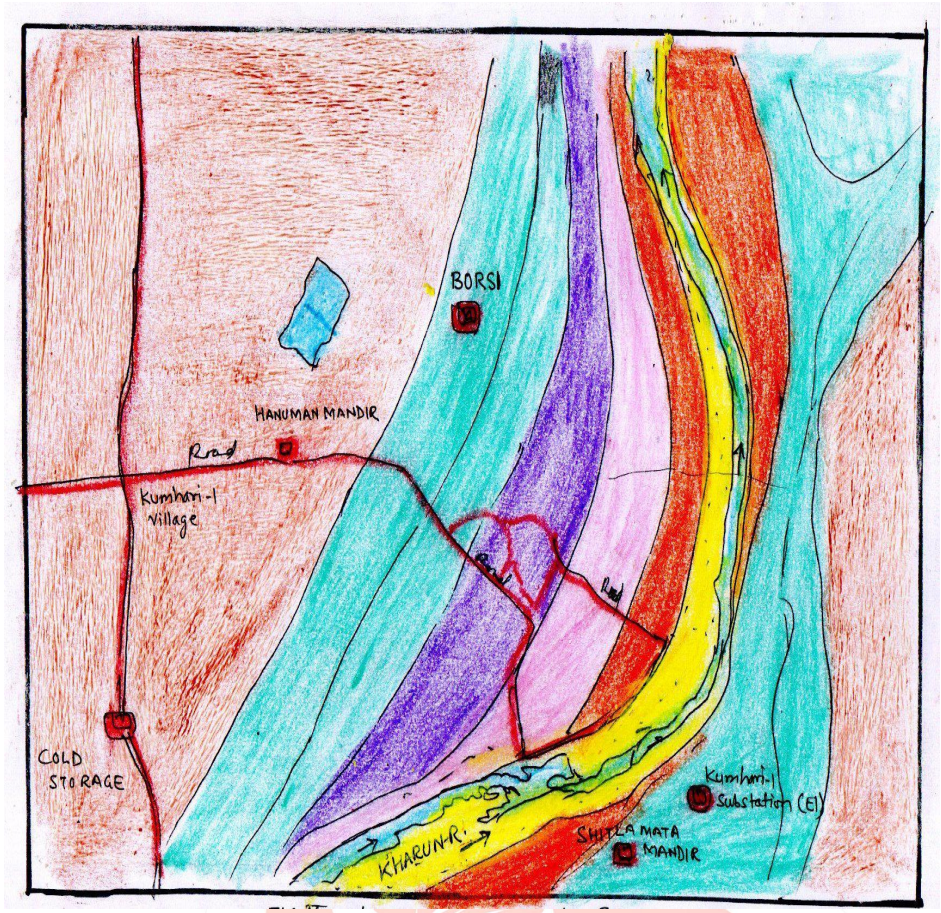


FIG –VI-KHARUN RIVER – (Meander Scars)

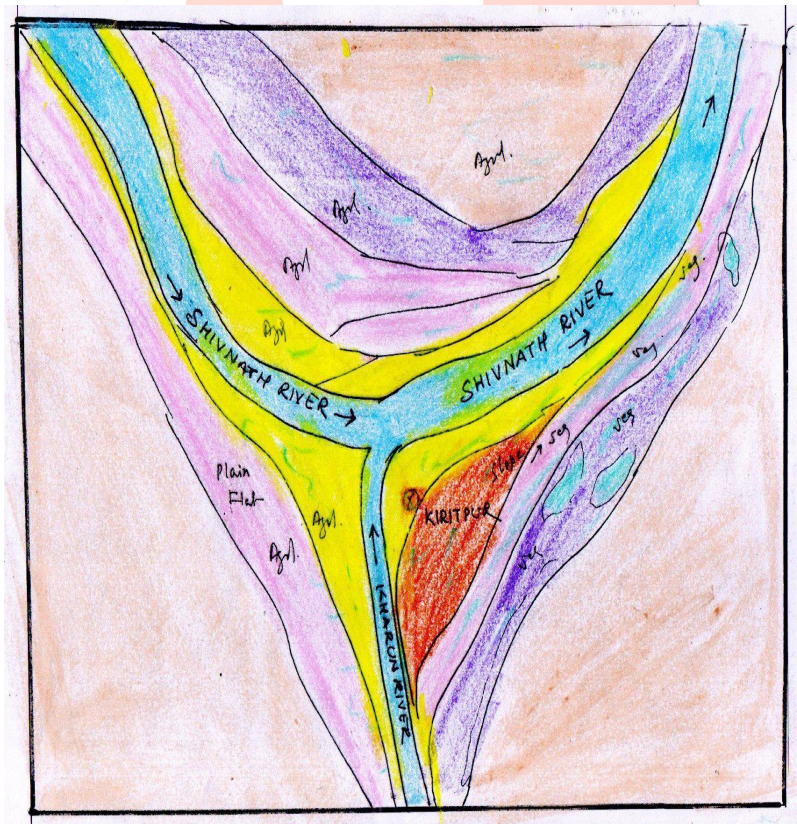


FIG –VII- CONFLUENCE OF KHARUN – SHIVANATH RIVERS (AT 90°) (Shivnath Meadering Convex - Kharun Lineament Controlled)

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