Riverine Morphology in Interfluve and Landuse: A Review

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Abstract

The present work is concerned to find out and saturate the voids in terms of concepts and methods of research related to riverine morphology in interfluve. In the field of Applied Geomorphology a good number of research works are made on interfluves. Each and every research work has adapted own methodology and considered various parameters to analyse the riverine morphology and interfluve. The present investigation will commit suggestion relating to the similar type of research work observe similar problems. To achieve the aim a detailed review of literature has been conducted which covers almost all the major area of interest. The previous works concerned with interfluve or *duab* in mountain and plain regions have enriched the present work.

***Key words*- Interfluve, Riverine Morphology, Paleochannels, Channel configuration, hydraulics of flow**

Introduction

The present work is a comprehensive attempt to analyse the different aspects of riverine morphology and agricultural landuse in interfluve region. On the basis of the details of riverine morphology (cut-offs, marshes, flood plain, paleochannels *etc*) hydrological characteristics of the rivers and agricultural aspects like land use pattern and economic output of the riverine landforms.

The whole literature review has been divided into three broad aspects to understand the conceptual aspects, methods, case studies and finally to find out the research voids.

Conceptual Aspects

i. Interfluve
ii. Riverine Morphology
iii. Agricultural Land Use

The term **Interfluve** means the higher ground which separates two adjacent river valleys (Thomas and Goudie, 2000). Interfluve is a tract of land between two rivers (Webster's Third New International Dictionary, 2013). Interfluve is an area of higher ground between two rivers in the same drainage system (Whittow, 1984). In the Merriam Webstar Dictionary this term means the area between adjacent streams flowing in the same direction. According to the Cambridge Dictionary the term Interfluve is defined as the areas of high terrain located between valleys. In the Wiktionary the free dictionary this term means the region of higher land between two connected river valleys. The term 'doab' means tract of land lying between two converging, or confluent, rivers (doab or duab, n., *OED Online, Oxford University Press, March 2014*) In the Oxford Hindi-English Dictionary, R. S. McGregor defines it as region lying between and reaching to the confluence of two rivers. In the Merriam Webstar Dictionary this term means a tract of land between two rivers.It is similar to an interfluve (doab or duab, n., *OED Online, Oxford University Press, March 2014*).

The word 'riverine' is a general term that refers to any landform produced by the action of a river and 'morphology' is the science of form. The term **Riverine Morphology** means the landforms or the features created by the action of river. Riverine Morphology the resultant effect of the interaction among various parameters like the hydraulics of flow (velocity, discharge, roughness *etc.*), channel configuration (width, depth, shape, slope and pattern), load entering the reach and bed and bank material (Crickmay, 1974:2) *etc*. The resultant morphology is the expression of the balance between the river energy and the resistance of material comprising the channel perimeter.

Palaeochannels are the remnants of old rivers which can be filled up by the sediments and do not have continuous flow. This type of channel may occur due to climate change, tectonic disturbances, river capture *etc.* Palaeochannels are not necessarily permanent, there is always a possibility of reactivation of erosional activities in the river system (Nandini *et al*., 2013, Bates and Jackson, 1984).

River capture means the natural diversion of one stream by another. Usually one stream is either flowing at a lower level or is much more aggressive due to high discharge which permits it to erode into the adjacent drainage area (Chorley *et al*.).

AGRICULTURAL LANDUSE

Agricultural, the primary economic activity includes not merely food grain production but also animal husbandry, forestry, mining, irrigation, pisciculture, dairy etc. (Zimmermann, 1933, p. 147; Roy, 1992, p. 149). Therefore, agricultural landuse means when a bit of land is under agricultural practices.

	Published Literature	
	Work done in India	**Work done in Other Country**
Interfluve	Biswas (1987), Sinha *et al*. (2007), Roy *et al.* (2011), Gayen*et al*.(2013), Umar *et al.* (2011), Mukhopadhyay *et al.* (2013), Roy.S*et al.* (2015), Ghosh (2016), Das (2017), Mohammed (1969), Amani (1972), Khan (1980), Naseem (1987), Qureshi(1999), Saini *et al*. (2015)	Brecheisen*et al.* (2017), Ferrao*et al*. (2017), Jehangir *et al*. (2002), Ashraf *et al*. (2008)
Riverine Morphology	Bagchi and Mukherjee (1978), Reaks (1919), Mukherjee (1938), Basu and Chakravorty (1972), Chatterjee and Majumder (1972), Bandopathyay (2007), Rudra (2008), Pal (2018), Sarkar *et al*. (2018), Sarkar R *et al* (2019)	Crickmay (1974), Gregory (1977), Knighton (1984), Morisawa (1985), Bridge (2003)

Agricultural Land Use	Rafiullah (1965), Bhat (1968), Aherwadkar (1967), Mishra (1969), Ayyar (1969) More (1980), Mishra (1987), Rajasekharan (2000), Singh and Dhillon (1984), Huasin (1996), Dutt (2000), Dutt (2001), Mukherjee and Prasad (1984), Banerjee (1992), Goutam *et al.* (1988), Singh, Saffi, Mandal, Shri Devi (2014), Nagarajan *et al.* (2011), Prakasam (2010), Muthusamy (2010), Sokta*et al.* (1962), Adeniyi *et al.* (1999), Bhagawat (2011), Ramchandra (2008),	Jonasson (1925), Baker (1926), Stamp (1931), Buchanan (1935), Whittlessey (1936), Weaver (1954), Evance (1962), Kostrowiki (1965), Reeds (1972), Stamp (1930), Minnesota (1986), Anderson (1976), Yuan Fei (2005), Stella (2008), Murphy (1967), Bestor (1967), Griffin (1968), Lampe (1968), Chang *et al.* (2018)

Sayantan Das (2017) in his thesis on 'Evolution of Drainage and Morphology Of Upper Bhagirathi-Ganga Interfluve Region of West Bengal with Special Reference to Palaeochannels' under the University of Kolkata has identified some remarkable findings like- (a) the distributaries of the Upper Bhagirathi-Ganga Interfluve are decaying due to the closure of their offtakes by sedimentation. (b) Due to the capacity reduction of distributaries, the Upper Bhagirathi-Ganga Interfluve has become vulnerable to flood hazard during the rainy season. (c) Human encroachments are modifying the ecologically sensitive riverine environment at a very brisk pace.

'Diffusion of Agricultural Innovations in upper Ganga-Yamuna Doab' by Fazlur Rahaman under the supervision of Prof. Azimuddin Qureshi, Department of Geography, Aligarh Muslim University (1999) he discussed the diffusion of agricultural innovations. Various qualitative and quantitative techniques have been used for his study. To find out different types of crop combination region used Weaver's minimum deviation method. Kendall's ranking method has been used analysis the various crops under different scale of performance over a period of time. He also used the technique of composite Z score has been employed to determine the levels of diffusion of innovations and the correlation between the agricultural productivity and diffusion of agricultural innovations. There is strong and power full relationship between the prompt availability of inputs and adoption of agricultural innovations. The study further showed strong and positive relationship between yield and adoption of agricultural innovations. The rate of adoption of such innovations helps to increases yield in much higher as compared to others. At the end ofstudy, he made some suggestions to enhance the impact of techno-institutional and socio-economic conditions. These are rational programme of consolidation should be implemented and legal restriction should be imposed of fragmentation of holding, develop irrigation facilities,

power generation should be accelerate, the supply of diesel for agricultural purposes should be rationalised, adequate and timely credit to the farmers, uses of new variety of seeds, policy makers and social researchers should give much emphasis to economic variables.

Krishna Biswas in her thesis on 'Soil productivity of a part of the Mayurakshi-Bakreswar interfluve, Birbhum, West Bengal' under the supervision of Prof. N.K.De, University of Burdwan (1987) She made an assessment to indicate the soil productivity and classification of land based on physical and chemical properties of soil and terrain aspects influencing crop production in the Mayurakshi-Bakreswar interfluve.

A.K. Shri Devi (2014) has evaluate 'Assessment of Agricultural Land Use for Sustainable Development: A Case Study of Paramakudi Taluk, Ramanathapuram District, Tamilnadu.' The author has major findings are-(1)The study on the Land Use pattern between 1990 and 2010 showed the huge difference of crop Land and plantation. The crop Lands have been found decreased from both irrigated and rainfed because most of the area are converted into plantation. 2. The season wise changes of crop area, production and productivity have been analysed using spatial and temporal analysis, resulted the paddy, ragi, sugarcane *etc* have constituted the major crops with higher percentage during rainfed method, both season Kharif and Rabi. 3. The crop concentration analysis have been analysed using the tabular data of crops block wise during five-year period from 2005-2010. The concentration of paddy is higher in Bogalur and Nainarkoil blocks. The crop concentration using irrigated method is found higher in Paramakudi then Bogalur and Nainarkoil block. The millets, pulses concentration is higher in Paramakudi all the year then Nainarkoil and Bogalur whereas oilseeds concentration is found higher in Bogalur and Nainarkoil than Paramakudi. Cotton and sugarcane concentration are higher in Paramakudi block than Nainarkoil and Bogalur. 4. The crop diversification in the study area as per the calculation noticed that the paddy crops were well specified in the region with high value calculated using the heriphendal index while all the other crops are well diversified in the region with very less value of heriphendal index crop diversification in the region of the whole taluk. The data which was collected from the district collector office was used for calculating the diversification of all the crops in the region of the study area. 5. The ground water quality in taluk have been analysed from which sodium content in the water is found more with suitability for irrigation during the period. Hence the ground water quality can be more improved by using some good fertilizer and removing the invasive alien species to allow the soil to increase its fertility.

Roy *et al.* in their paper entitle 'Aggradation, incision and interfluve flooding in the Ganga Valley over the past100,000 years: Testing the influence of monsoonal precipitation' made findings e.g. Ganga River experienced strong variation in its equilibrium profile overrelatively short periods, linked to varied sediment and water discharge from the Himalayan mountains and the lowland alluvial plain.

Mitrajit Chatterjee (2014) in his thesis 'Riverine Morphology and Socio-Economic Environment in the Southern part ofNadia District, West Bengal: An Impact Assessment'under the University of Burdwan has identified remarkable findings *e.g.*there is a strong relationship among hydrological characteristics, riverine

morphology and land utilisation. The river channels have an oscillating tendency from the ancient times in the SPND. There is also a clear relationship between river channel change throughout the historical past and related fluvio-morphological features such as bils, ox-bow lakes, marshes *etc.* The land use characteristics totally coincide with the fluvio-geomorphic features. Any kind of change in fluvial geomorphology alternates the age old economic and occupational structure of that particular place.

Soumita Ghosh (2016) in her thesis 'Land Utilization of Ajay-Mayurakshi Interfluve in Birbhum District, West Bengal: Determinants, Evaluation, Implication and Restoration' give some remarkable measures *e.g.* i) Interfluve restoration programme are to be adopted following the total evaluation of land and its proper usage and planning. ii) Land use planning followed by proper evaluation of land may be the best possible measure for land development and proper restoration. iii) An irrigation facility mainly in Rabi Season is highly required to convert the fallow land into cultivated land. A detailed irrigation plan should be prepared for the area. iv) In the western part of the study area, there is very little possibility of agricultural development, due to undulating rugged topography. It is advisable to grow only tree plantation. Falling or cutting of trees (Deforestation) *e.g.* mainly degraded Sal forests to be checked to avoid soil erosion and gully erosion. Besides this, overgrazing should be stopped. v) A detailed knowledge of hydro-geomorphological condition for understanding the processes of the formation and degradation of soils and landscape is needed.

Sarkar R *et al.* in their paper entitle 'Analysis of River Long Profile and Hydraulic Geometry to Evaluate the Present Scenario of Kulik River, India and Bangladesh' identified some observable findings- Kulik River is trying to be more competent by modifying its long profile by homeostasis principle and negative feedback mechanisms to continue its flow. Long profiles or the energy profiles change over time and become steeper by depositing in the upstream direction and eroding in the downstream direction and made a Regraded profile. The river flows over a less resistant lithological composition of Holocene sand-silt alternated base as a consequence in the downstream direction the river deepen its valley rather than widening. The basic equations of hydraulic geometry demonstrate that the river energy losses by eroding the bed which in turn again depicts the formation of regarded profile. Further on this regarded long profile if deposition continued in the source region than the river will be in crisis of water as ground water cannot feed after a critical elevation. As a consequence, the river may slowly dry. Human interferences like construction of embankment, settlement in meander belt enhances the deposition initially in the downstream direction. Meander belt should be free from constraint like a settlement for continuous oscillation and adjustment and embankment enhances sedimentation which again causes aggradation in lower course and as a consequence profile gradient decrease. To maintain the gradient the river starts to aggrade in the source region and starts to erode in the downstream direction, but continuous aggradation and less removal of sediment from source region may cause of the water crisis, which in turn might convert the river dry.

7.2 RESEARCH VOIDS

The literature review has been done on the profound aspects of the research area like Interfluve, riverine morphology, flood plain topography, agricultural landuse. Both the national and international level work in spatial context has been studied. The main objectives of literature survey are to identify the research voids and to make the research framework. The author has identified some methodological, technical as well as spatial gaps in the analysis. Some of these major gaps which the author wants to incorporate in his thesis are mentioned as follows:

i. Basically, the interfluve related work is done in upstream and moribund delta region, but yet no work is done on the piedmont and fan deposited areas.
ii. There was some work has been done on the interfluve in national and international level, but no work has been done in a spatial unit of Nagar-Kulik interfluve.
iii. No such work is done to understand the relationship between river metamorphosis and economic output of a region. To investigate the relationship, the researcher has selected this region as the study unit.

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