

Morphodynamics of River Betwa: An Analytical Review of Literature

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ABSTRACT: The review paper is a detailed analysis of the review of literature related to the research topic “Morphodynamics of Betwa River in Bundelkhand Region” which is part of research work being pursued by the researcher in the current time. In this paper the researcher has made efforts to present the complete outline of the work. Changes in the Morphodynamics of the river Betwa in the past ten years will be observed and recorded. Study will be conducted to its best level with the help of Remote Sensing and GIS techniques. For the ease of study researcher will be covering the area of Betwa River in Bundelkhand region (including both UP & MP).

KEY WORDS: Morphodynamics, Betwa River, Remote Sensing, GIS.

I. INTRODUCTION

River is an accumulated point of various sub- tributaries connecting with it. River morphology and its synonym fluvial morphology are not only used to describe the shapes of river channels but also how they change in shape and distinction overtime. The study of river is accomplished in the field of fluvial geo-morphology, the scientific term.

Further morphology, of a river is a fluid of science which deals with one change of river plan and cross-sections due to sedimentation. In the field dynamics of flows and sediment transport are the principal elements The Morphological Studies, therefore, play an important role in planning, designing and maintaining river engineering structures. In recent years, there has been a growing awareness about the need for taking up Morphological Study of rivers in the country, especially with particular reference to their unique problems.

For the purpose of the study work the researcher has selected River Betwa which is a seasonal river. It originates from the Vindhya Range. The main tributaries of Betwa are Bina, Jamini, Dhasan, Virma, Aur, and Narayani. Rajghat Dam, an Inter-state Dam project of the Government of Madhya Pradesh and Uttar Pradesh being constructed on Betwa River. On the downstream Matatila Dam, Dhukwan Dam and Parichha Dam are there.

The objective of the “Morphodynamics of Betwa River in Bundelkhand region” is to improve the understanding of river systems on time scales. Thus, study of the morphometrics analysis is to determine the drainage characteristics of Betwa River as well as to develop a clear picture about the sediment processes, future trends of channel evolution, identification of management options and Catchment wide characterization of fluvial system. Further, the researcher will work on the following geomorphic indices to study the morphodynamics of the river which are as follows:

Stream Order (U), Stream Length (L_u), Mean Stream Length (L_{sm}), Stream Length Ratio (R_L), Bifurcation Ratio (R_b), Basin Relief (B_h), Relief Ratio (R_h), Ruggedness Number (R_n), Drainage Density (D_d), Drainage (Stream) Frequency (F_s), Texture Ratio (T), Form Factor (R_f), Circularity Ratio (R_c), Elongation Ratio (R_e), Length of Overland Flow (L_o), Constant of Channel Maintenance (C). This research paper comprises of mainly seven sections [1] INTRODUCTION [2] DEFINITION OF STUDY [3] REVIEW OF RELATED LITERATURE [4] KEY POINTS [5] KNOWLEDGE GAP [6] IMAGES [7] CONCLUSION.

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II. DEFINITIONS RELATED TO THE STUDY

Morphodynamics of a River: River morphodynamics is the study of river bedforms in response of erosion and sedimentation. The understanding of river morphodynamics is functional to the correct management and prediction of important erosion and sedimentation processes involved in river activities, such as bank erosion, overflows, sediment balance in dam regulation, sediment wave propagation, interactions with anthropic structures (bridges, weirs), silting up of reservoirs, renaturalization, sediment mining, degradation/aggradation, planform changes, regulation of equilibria setting of slope and hydraulic geometry, renaturalization issues.

Meandering: A meander, in general, is a bend in a sinuous watercourse or river. A meander forms when moving water in a stream erodes the outer banks and widens its valley, and the inner part of the river has less energy and deposits silt.

Remote sensing: is the technique of observing an object from a distance, without physical contact with the object. The human eye is a good example where we “see” objects from a distance. Here the light rays that fall on our eyes are used to identify the object. In practice any part of the electromagnetic spectrum or sound waves or radiation can be used to observe from platforms such as balloon, aircraft, satellite, ship etc. Thus remote sensing gathers information through the electromagnetic radiation reaching the sensor. In remote sensing, a variety of devices are used for gathering information on a given object or area.

Geographical Information System (GIS): is a tool which has been employed for integration of spatial and non-spatial data. GIS is a specific integrated system of hardware, software and procedure designed to support capture, management, manipulation, analysis and display of spatially referenced data for solving complex planning and management problems. GIS based Network Analyst is a powerful extension that provides network-based spatial analysis including routing, travel directions, closest facility, and service area analysis.

III. REVIEW OF RELATED LITERATURE

Maria Hosu and Helena Sabo (2012): worked on the morphodynamics of Someș river channel in north western Romania. The geomorphologic observations have been carried out in the field and the measurements have been done in two sectors in the longitudinal profile of the river. The rivers have been presented as geomorphologic system with complex ties between the control of water flow and sediment discharge (Schumm S.A, 1977). The researchers have led to the formulating of the hydraulic geometry theory, together with the pioneering work of the Leopold and Maddock (Leopold & Maddock T. 1953), who established relations of power between the two domains. The variable that has a powerful control on the bed geometry is the sediment transport, given by the alluvial deposits entrance, bigger or smaller, from the side basin. The depth of the bed and the modification of the transversal section geometry can have numerous environmental effects such as: endangering the bridges, the dams and other engineering structures, the loss of agricultural fields, the evacuation of great volumes of deposits, damages to under water and river side ecosystems, effects on the relationship between the river and the phreatic water, damages brought to the river side vegetation. The Someș river bed is full process of deepening on the analysed sector. The process of aggradation (especially the left bank) corresponds to the interval with reduced flow when unstable alluvial structures are generated, which are redistributed in intervals with maximum water flow. The sediments transport represents an important element in the equation result of the river bed processes.

AdegokeKayode Martins et al (2015): Studied the morphometric analysis of the upper Yedzaram catchment. This research focuses on the hydrological and geometrical analysis with emphasis on the morphometric characteristics of the catchment such as the Watershed Analysis, Bifurcation Ratio which forms the linear properties, Stream Order (Nu), Stream Length (Lu), Drainage Density (D), Stream Frequency (Fs), Texture Ratio (T), Elongation Ratio (Re), Basin Relief and Basin Ratio. Morphometric is the mathematical analysis of the earth surface configuration, dimension, shape, and landforms. Geomorphology has developed over many years with quantitative physiographic means of depicting the characteristics of drainage network (Leopold et al 1953). Without the morphometric analysis of this catchment, the challenges of environmental management, underground water analysis, engineering project, water

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pollution and health of the populace will be at risk of environmental mismanagement. River Yedzeram is one of the rivers that drain into Lake Chad. The morphometric parameters is an immense tools used in evaluating river basin and the watershed preference for soil, conservation of water and resource management at micro level. The analysis carried out for the Yedzaram catchment basin depicts that the basin is tending towards elongated shape. The morphometric analysis is of great importance in hydrological behaviour of basin for water quality project, engineering works, public policies applications and flood forecasting, erosion control and environmental management, it is also essential for accurate modeling analysis.

MostafaKamel Abdel Ghany (2015): Worked on Qusseir and Marsa Abu Dabbab along Red sea coast with the help of Remote Sensing and GIS techniques. It is one of the most important areas. Usually it is attacked by natural hazards, especially flash floods although rainfall is scarce in Eastern desert; it is well known for its flash floods with high velocity. Flash floods in arid and semi-arid zones are among the most devastating natural hazards in the world, causing the largest number of deaths and property damages. They occur as a result of high-intensity rainy storms over catchment areas which have steep slopes and poor vegetation cover, producing sudden and high velocity flows (Xiao, L., 1999). Absolute protection against flooding is unachievable and unsustainable, due to high cost and inherent uncertainties (Schanze, J., 2006). Along the Red Sea coast, flash flooding represents the main natural hazard posing greater threat on life, constructions and even marine life. The present study area is dissected by numerous parallel pronounced valleys (wadis) that initiated from the mountainous country and run towards the Red Sea following the general eastward slope. It is occasionally subjected by heavy showers during winter times, followed by sporadic torrential floods that may cause disastrous damage to roads and the sporadic settlements. A morphometric analysis of the basins in the area helps in our understanding and management of their developed areas for future generations. Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimension of its landforms. This analysis can be achieved through measurement of linear, aerial and relief aspects of the basin and slope contribution (Nag and Chakraborty, 2003).

B.C. Kusre (2016): studied Morphometric Analysis of Diyung Watershed in Northeast for flood Management. They found that North eastern region is characterized by undulating terrain and high rainfall. Such condition creates a situation of floods in the downstream plain areas of Assam. They concluded that the region is one of the unique regions in the world in terms of its bio diversity and vast natural resources viz., water and land. They observed that application of GIS technique can yield better and efficient results as compared to traditional approach.

Abu Reza Md. Towfiqul Islam (2016): observed the fluvial morphological characteristics of the river Padma in north-western Bangladesh. Morphological and morpho-dynamic maps of this river were prepared using remote sensing techniques. Bangladesh has a unique hydro-geologic setting and deltaic floodplains which are formed by the deposition of the Ganges (Padma), Brahmaputra (Jamuna) and Meghna River (Islam SN,et al 2010). These river formations and its dynamics over the Padma river plays an important role in changing morphological behaviours than any other rivers (Alam MM.1996). However, the Padma river along its course in north-western Bangladesh is vulnerable to channel shifting and bank erosion (Hassan S et al 2010). Since prehistoric time, the Padma river is known as 'Sharbagrashi' (literally in English word 'disastrous') due to its intense channel shifting and destructive bank erosion (Neill CR,et al 2010). Hence, channel morphology of Satellite remote sensing technique is very effective in examining fluvial channels dynamics over a large area. Although this technique has been widely used to examine fluvial channel migration (Thorne CR,et al 1993-Yang X,et al 1999) and to identify palaeo-braided channels on terrace surfaces (Leigh DS,et al 2010) and also to investigate the long-term trends and rates of bank erosion and accretion of the Jamuna river (Baki ABM et al 2012). A number of studies on Padma River provide an important site for fundamental research on channel dynamics in complex fluvial geomorphology. This study aims to explore the change of fluvial channel dynamics and shifting of channel of the Padma River in surrounding area. The Padma is a typical meandering river with highly dynamic in nature. Results indicate that the morphological change is comparatively high because of alteration of the fluvial flow regime in the study area.

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III. KEY POINTS RELATED TO THE RESEARCH TOPIC “MORPHODYNAMICS OF BETWA RIVER IN BUNDELKHAND REGION” AFTER EXTENSIVE REVIEW OF LITERATURE

1. Remote sensing and GIS techniques are essential tools for Morphometric analysis.
2. Morphodynamics analysis also contributes in the characterization and the quantitative description of water – sheds.
3. Remote sensing and GIS techniques are far better than traditional approaches.
4. Morphometric parameters such as the river channel migration through time and space is critical to many geo morphological river management problems.
5. Through study of river morphology and river morphometry the factors which resulted in the dynamism of river morphology can be conveniently traced.
6. Remote sensing contributes to study about river shifting and migration and also analyze the channel platform.
7. Meandering affects channel slopes which is key parameter in all studies of bed rock river erosion and land scape evaluation.
8. Remote Sensing & GIS is helpful to understand the past and present river related hazards.
9. To understand difference between Horizontal and Vertical erosion.
10. Morphodynamics helps in understanding relation between the inner and outer bank changes.
11. Use of modern measurement and modeling techniques such as aerial photographs and terrestrial laser scanning.
12. Helps in introduction with the original observation.

IV. KNOWLEDGE GAP FOUND IN THE ANALYTICAL REVIEW OF RELATED LITERATURE

The study of the topic “Morphodynamics of Betwa River in Bundelkhand region” is a less attempted topic in the Bundelkhand University, Institute of Earth Sciences for research work. Therefore, the researcher decided to opt for the topic as it its interesting at the same time challenging too. Further, Many workers have carried out Morphometric analysis using GIS and Remote Sensing techniques, Digital Elevation Modal (DEM), Shuttle Radar Topography Mission (SRTM), Arc GIS software, Erdas software in drainage basin analysis but If one uses high resolution satellite data in different climatic and geological conditions than it will help in better understanding of the status of landforms and other parameters like Transportation planning, Environmental issues, Erosion dynamics of land and soil and River dynamics etc. Moreover, research work can be made more authentic and genuine with the help of field observation.

V. RESULTS

These images represent the pictures of River Betwa, Meandering of river, Remote Sensing as well as the software (GIS) to be used for the study of morphodynamics of river during the research study.

Images for the Morphodynamics of Betwa River



Figure No.1



Figure No.2

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Betwa River near Bhojpur, MP, India

Courtesy: Amit Solanki

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Example of Meandering of the RIVER

Source: US Fish and Wild Life Service

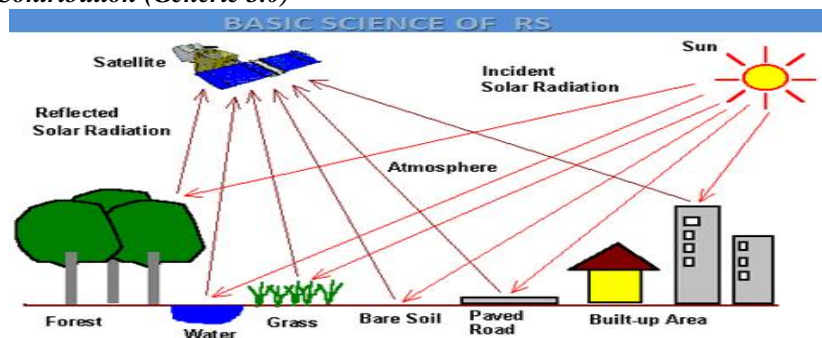


Figure No. 3 Representation of remote sensing to be used in this study

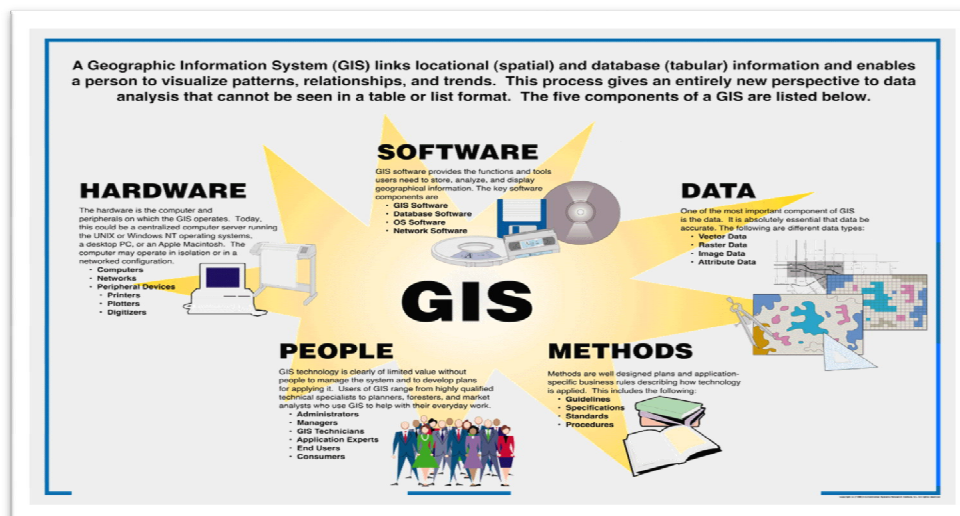


Figure No. 4 Representation of GIS to be used in this study

VI. CONCLUSION

The researcher has undergone a number of research papers before selecting the topic for study. The researcher also visited the river site and very keenly observed the various dimensions of the river to be observed and recorded in due course of the research work. Remote sensing and GIS techniques will also play a vital role in studying the Morphodynamics of the river in the past ten years. There is no doubt that the critical and analytical study of the related review to the topic “Morphodynamics of the Betwa River in Bundelkhand Region” has created clear cut picture of the work design in the mind of the researcher.

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