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Geomorphic Characteristics and Signatures of Narmada Basin: Future Prospects of Research

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Abstract: Geomorphology deals with the processes involved within landforms, their origin, characteristics, evolution and significance. These geomorphic processes have their distinctive mechanisms which also generate unique landforms/features known as geomorphic signatures. Fluvial process is one of the dominant geomorphic processes which can create very significant and unique landforms. Each and every drainage basin is the product of fluvial process and important part of fluvial system. The size, shape and characteristics of the drainage basins vary from one region to another (morpho-climatic and morpho-tectonic mechanism). This paper is an attempt to review the researches about the most important drainage system of India – the Narmada basin and Finds the gaps in it. This paper also recommends the untouched field of research regarding Narmada.

Keywords: Geomorphology, Geomorphic Process, Geomorphic Characteristics, Geomorphic Signatures, Morpho-Climatic Mechanism and Morpho-Tectonic Mechanism.

INTRODUCTION

Geomorphic characteristics of a landform experience one or more than one cycle of erosion. The single cycle of erosion produces mono cyclic landforms while more than one cycle or multi-cycle produce polycyclic landforms which is more common than mono-cyclic landforms. According to Thornbury (1954), *complexity of geomorphic evolution is more common than simplicity*, most of the world's topography bears the imprints of more than one cycle of erosion. Thus in peninsular India, Narmada basin is one of the important examples of polycyclic landscape having geomorphic signature of multi cyclic features.

The older erosional topography may be represented only by limited upland remnants or by benches along the valley sides above present valley floors. Features of multi-cyclic origin have been described from all the continents except Antarctica. It should be recognized that both a monocyclic landscape and a multi-cyclic landscape may be either simple or compound in nature.

In recent years, it has become evident that many landscapes have evolved under more than one set of climatic conditions with accompanying variation in the dominant geomorphic processes. Many of these climatic conditions were associated with the fluctuating climates of Pleistocene time, but in some areas certain aspects of the topography reflect climatic conditions that existed in Tertiary time.

Climatic variations may affect the operation of geomorphic processes either directly or indirectly. The indirect influences are largely related to how climate affects the amount, kind and distribution of the vegetal cover. The direct controls are such obvious ones as the amount and kind of precipitation. It's intensity, the relation between precipitation and evaporation, daily range of temperature below freezing, depth of frost penetration, and wind velocities and directions. There are some other factors also, such as period of frozen ground, intensity and frequency of rainfall, differences due to slope facing sides etc, but the affects doesn't dominant.

Geomorphology concerns itself primarily with the origins of the present landscape but in most landscapes, there are present forms that date back to previous geologic events. The recognition of erosion surface and the study of old topographies is called Paleaogeomorphology which is now becoming very important. Bryan (1941) recognized this nature of Geomorphology.

It may be described as Pure and Applied Aspects of Geomorphology. It also considered various patterns and facets of in terms of the Static, Dynamic, Genetic and Environmental significance of landforms. For a long time Geomorphology was considered as a subject comprising mainly academic purpose. Recourse of the proposed study may draw better results with the help of geo-spatial techniques. Digital Elevation Model (DEM) is the representation of the 3D earth's surface. Extraction of the 3D representations of the earth's surface using overlap areas of two images automatically is known as automated DEM extraction. Traditionally, the manual DEM generation (measuring elevation points in a stereo viewing mode) was very labourious. At present high end digital photogrammetric software

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support automatic or semi-automatic DEM generation functionality. Digital image matching techniques are also used to automatically identify and measure the position of common ground points appearing within the overlapping area of two adjacent images. Using sensor model information determined from block adjustment, the image position of the ground points are transformed into 3D point positions. In this technique, computer algorithms match features between the images of a stereo pair, calculate the parallax of every pixel, and generate a topographic map for the entire scene. The calculation is identical to that for the manual derivation of heights and depths of the features, but the automated DEM extraction procedures has the advantage of producing an elevation measurement for every pixel within the overlapping area (Bhatt, 2011). This study will also be based on the Location Based Survey (LBS) method.

The main objective of this proposed research work is to find out the plausible stages of geomorphic development of Narmada river basin and its significance from the livelihood point of view for the total population of this catchment. Ultimately it will reflect the sustainability of the basin by 2050 in holistic way.

Narmada Basin (Regional Set up)

The Narmada River carried unique behaviour as far as the other rivers in Indian sub-continent have. It is characterized by pronounced narrow and elongated shape (fig -1, 2). In contrast to other major rivers of peninsular India, it has not attained mature stage and still has well defined ungraded sections marked by pot holes, waterfalls, very steep descent and narrow gorges. These features have been attributed to the recent tectonic disturbances and the valley has been designated as a rift valley with bounding uplifted blocks viz., Vindhyan and Satpuras.

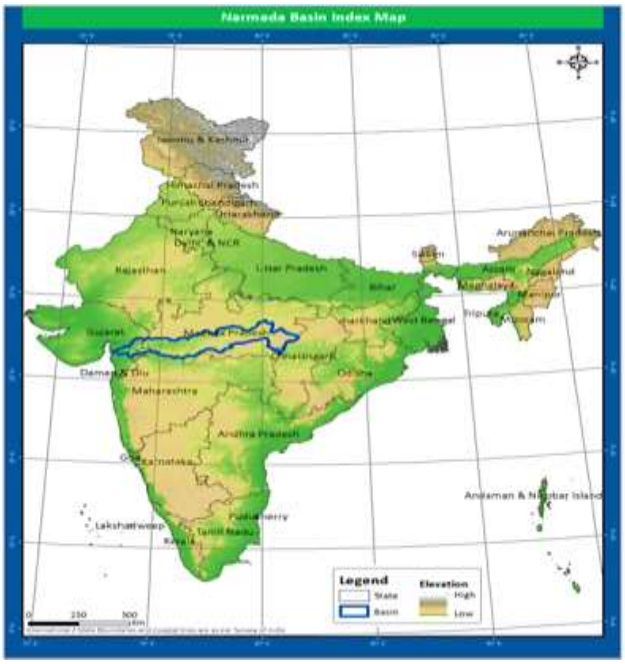

Figure 1. Narmada Basin Index Map
Source: aquapedia.waterdiplomacy.org

The Narmada is one of the Twin Rivers of Central India. The Narmada flows from east to west which is against its slope. It flows through Madhya Pradesh (1,078 km), makes boundary between Madhya Pradesh and Maharastra (32km) , Maharastra and Gujrat (40 km) and debouches to Arabian Sea after crossing Gujrat (160 km) (fig 1). Thus the total length of Narmada is about 1,310 km and the total area of the basin is approximately 98,420 km². The source of Narmada is in Amarkantak (1057metre), one of the highest spots of Maikala range (Law, 1968).

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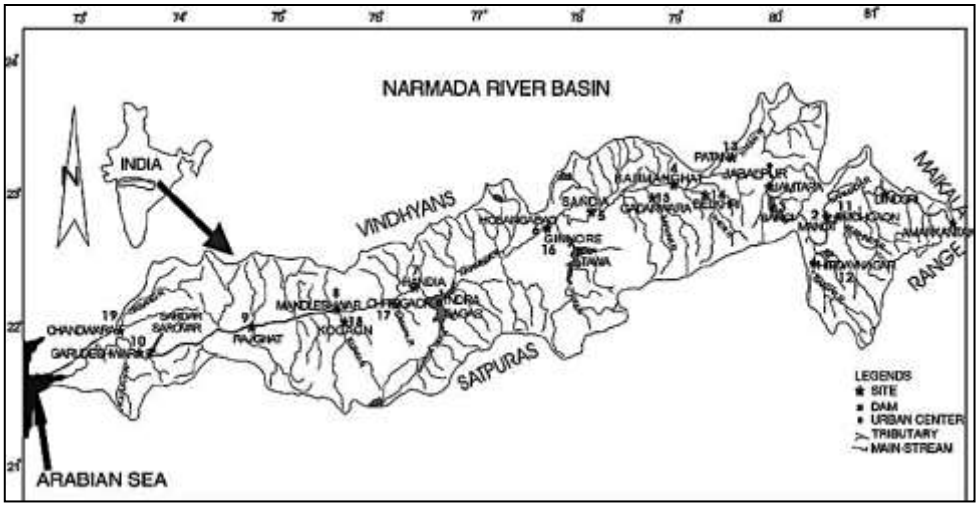

Figure 2. Narmada River Basin
Source: Researchgate.net

Considering the relevance of drainage basins in geomorphic studies mainly characteristics and signatures of landforms, the Narmada basin is selected for the study.

PREVIOUS STUDIES

Several studies have been done over the Narmada Basin and its surroundings from the disciplines of Geology, Geomorphomertry, Hydrology, Environmental Sciences, Climatology, Geochemistry, Zoology, Geography and Management.

The Kothyari & Rastogi (2013); Gupta *et al.* (2010); Chamyal *et al.* (1995); Khan (2017); & Gupta & Chakrapani (2005) are some important contributor in the field of Geology.

Krishnaswamy & Tripathy (2012) summarizes the researches on present and past chemical and physical erosion patterns of river basins of India and their link with climate and tectonics.

Kothyari & Rastogi (2013) have made an attempt to study the neotectonics of the upper Narmada river basin following one of the active Son-Narmada fault (SNF central fault) zones in Central Peninsular India through tectonic geomorphometric parameter. It established the fact of enhanced upliftment in the Narmada river basin through morphometric indices and drainage pattern. In this paper an attempt has been made to review the studies relating to linear, areal and relief aspects of the Narmada Basin. It also focuses the static characteristics of the landforms, surface and sub surface processes which have been operating over the basin. The role of geomorphic processes and their resultant landforms over livelihood is also highlighted.

According to Gregory & Waling (1973) the drainage basins require geomorphololgical study for three main aspects- first, their existence in physical landscape and their significance in producing fluvial landforms. Second, their importance indirectly in relation to many other geomorphological processes in fluvially dominated landscape. And third, their significance for human use from livelihood point of view.

Geomorphic descriptions in recent years have become digital in nature replacing the former qualitative approach which left ample gap for subjectivity. The use of geo-statistical and sophisticated equipments and the geo-spatial technique in the measurement of landforms and their geomorphic signatures are being used to fill the gap.

Similarly the techniques of landscape profiling, morphological and morpo genetic mapping have been introduced to allow recording of the topographic expressions and their origin. These types of studies were done earlier by Horton (1932) who has given Law of drainage composition. Similarly Athol Abraham (1970) has also worked on Drainage topology. The Horton's method was slightly modified by Srahlar (1950); Schumm (1956); Miller (1958); Melton (1959), Morriswa (1958); King (1967); Mueller (1968); & Jha (1983).

Geomorphologists like Brunsden (2001); Dury (1951); & Clarke (1966) have also contributed to the development of quantitative approach. Other notable contributions in this field as well as in this region have been made by Wadia (1926); Krishnan (1949); & Pal (1972).

Khan's (2017) work is on study the various aspects of geomorphology and geomorphic revolution, Quaternary tectonics and sedimentation of Narmada valley in Jabalpur -Bharouch Section with special reference to Hominid locality Hathnora and occurrence fossil man.

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Gupta & Chakrapani (2005) studied the spatial and temporal (annual, seasonal, monthly and daily) variations in water discharge and sediment loads of Narmada River and its tributaries and discussed the probable causes for these variations. Daily water discharge at nineteen locations and sediment concentrations data at fourteen locations in the entire Narmada River Basin from twenty two years are collected to carry out the study.

Krishnaswamy & Tripathy (2012) summarizes the works based on present and past chemical and physical pattern of erosion of river basin of India and their link to climate and tectonics.

Joshi & Shah (2019) reviews the impact of climate change by assessing the trend of annual and monthly rainfall and representing spatial variability over the Orsang river basin in Narmada lower river basin in the state of Gujarat, India. It may be helpful to study the impacts of climate change on hydrology and water resources, and planning & management of water resources, environmental protection, and ecological balance over the Orsang river basin.

Gupta (2006) in his doctoral thesis "Environmental Geochemistry of Narmada River Basin" discussed drainage network, prevailing climatic conditions, geology, soil conditions, vegetation and land use of Narmada river basin very minutely. Here the water and sediments characteristics dissolved chemical composition and nutrient flow pattern of the study area is explained with proper annotation.

Bhoumik *et al.* (2017) comparison of pre- and post-impoundment eco-environment and fisheries revealed changes in water quality, productivity, and aquatic flora and fauna of the river system.

Gupta (2010) addresses the fundamental issues of river basin management in a multi-objective framework with a unique case study of Narmada River Valley Development, and demonstrates that the socioeconomic needs of the people override the rest of the working objectives. In inter-state water allocation, even a non-riparian state is considered when looking at the needs of the people. The author focuses on the Sardar Sarovar Project on the river Narmada and highlights its rehabilitation, environmental and social aspects, and concludes that the project is a lifeline for people in western India.

Shrivastava *et al.* (2018) explained the status of water resource use and strategies for its future in the five revenue districts of upper Narmada basin.

Kumar *et al.* (2000) describe the irrigation system and water governance in Sabarmati River Basin, Gujrat.

Shelat (1987) described the policies, strategies and implementation process of resettlement policies for the Saradar Sarovar Project on the river Narmada i.e., efforts made by the state government to resettle the project-affected people in the new habitats. The paper depicts recommendations and suggestions to strengthen the resettlement process.

Peterson *et al.* (2010) made an attempt to looks at one of the more famous instances of transnational involvement in stakeholder struggles over large dams, the long-running contention over dam construction on the Narmada River in India.

Sahoo *et al.* (2014) highlighted the multipurpose use, benefits, complication and controversies of Sardar Sarovar Project and Narmada Sagar Project. The author also suggested some recommendation for the same.

Murty (2002) discussed about the inter-state water sharing problems in India especially for Satluj, Beas, Ravi, Narmada, Krishna, Godavari and Kaveri and also explain the role of National Water Resource Council.

Yadav *et al.* (2011) focuses on the issues related to sustainable usage of canal water for drinking purpose of Narmada main Canal based drinking water project. It also deals with the challenges like reliability of supply, adequacy of supply, unequal inter village distribution, unequal intra village distribution, inefficiency in operation and maintenance, water charges, recovery of charges, neglected local source of water, lack of systematic disposal of used water, village level management and neglected local water sources. The paper discusses the above issues with probable remedial measures to make the scheme sustainable.

Gupta *et al.* (2014) studied water balance and predicted stream flow in the Upper and Middle Narmada River Basin of India, which can be used for understanding the effects of future development and management actions.

RESULTS AND DISCUSSION

Several research work have already been done relating to physical and human aspects of the Narmada basin and its surroundings, however some of the important aspects are still untouched even though the techniques and methodologies are also needed to be revised to cater the population of the study area. Some of the finer studies using observation, experiment (field based) and instrumentation generated data are also needed.

Human beings have the ability to adjust in any environment. Whatever the topographic structure, climatic condition, land capabilities, availability of resources are concerned they find their own way to

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sustain themselves. Each physical environment creates unique lifestyles and distinctive livelihood.

Narmada river has very important geological set up and create significant geo-morphological base in terms of the origin of distinct landforms are concerned. These also termed as geomorphic signatures. A focus should be made over the formation, orientation and distribution of the signatures. It also affects the traditional livelihood of the region. An attempt should be made to enlighten this perspective too for a better understanding of the present livelihood of Narmada river basin and towards its sustainability for future generation.

Considering all these gaps a work should be framed in such way that may act as a bridge between the natural resources including landforms and human resources. It will ultimately provide the best quality of life in terms of livelihood in coming years.

REFERENCES

1. Bhaumik, U., Mukhopadhyay, M. K., Shrivastava, N. P., Sharma, A. P., & Singh, S. N. (2017). A case study of the Narmada River system in India with particular reference to the impact of dams on its ecology and fisheries. *Aquatic Ecosystem Health & Management*, *20*(1-2), 151-159.
2. Chamyal, L. S., Khadkikar, A. S., Malik, J. N., & Maurya, D. M. (1997). Sedimentology of the Narmada alluvial fan, western India. *Sedimentary Geology*, *107*(3-4), 263-279.
3. Gupta, A., Thakur, P. K., Nikam, B. R., & Chouksey, A. (2014). Water balance study of Narmada River Basin: An Integrated Approach using Remote Sensing and GIS Tools and Techniques. In *Proceedings of the 3 rd National Conference on Trends and Recent Advances in Civil Engineering (TRACE)*.
4. Gupta, H. (2006). *Environmental Geochemistry of Narmada River Basin* (Doctoral Dissertation). Indian Institute of Technology Roorkee. Retrieved.
5. Gupta, H., & Chakrapani, G. J. (2005). Temporal and spatial variations in water flow and sediment load in Narmada River Basin, India: natural and man-made factors. *Environmental Geology*, *48*, 579-589.
6. Gupta, H., Chakrapani, G. J., Selvaraj, K., & Kao, S. J. (2011). The fluvial geochemistry, contributions of silicate, carbonate and saline–alkaline components to chemical weathering flux and controlling parameters: Narmada River (Deccan Traps), India. *Geochimica et Cosmochimica Acta*, *75*(3), 800-824.
7. Gupta, R. K. (2001). River basin management: A case study of Narmada valley development with special reference to the Sardar Sarovar Project in Gujarat, India. *International Journal of Water Resources Development*, *17*(1), 55-78.
8. Jha, V. C. (1996). Himalayan Geomorphology (p-224). New Delhi: Rawat Publication.
9. Joshi, G.S., & Shah, J. (2019). Spatial Variation in Annual and Monthly rainfall in Orsang River Basin, Gujrat, India. International Journal of Innovative Technology and Exploring Engineering (IJITEE), 8(10), 584-587.
10. Khan, A. A. (2017). Stratigraphy of Quaternary deposits of Narmada Valley Central India. *International Journal of Scientific & Engineering Research*, *8*(4), 892-955.
11. Kothyari, G. C., & Rastogi, B. K. (2013). Tectonic control on drainage network evolution in the Upper Narmada Valley: implication to neotectonics. *Geography Journal*, *2013*.
12. Krishnan, M. S. (1960). Geology of India and Burma. *(No Title)*.
13. Krishnaswami, S., & Tripathi, G. R. (2012). Chemical and Physical Basis of River Basins of India: Link to Climate and Tectonics. Proceedings of Indian National Science Academy, 78(3) 299-311.
14. Kumar, M. D., Ballabh, V., & Talati, J. (2000). *Augmenting Or Dividing?: Surface Water Management in the Water Scarce River Basin of Sabarmati*. Institute of Rural Management, Anand.
15. Law, B.C. (1968). Mountain and Rivers of India. *In the Proceedings of 21st International Geographical Congress* (p 413-419). Calcutta: The Narmada, Calcutta: National Committee for Geography.
16. Peterson, M. J., Kiratli, O., & Ercan, I. (2010). Case Study: Narmada Dams Controversy.
17. Sahoo, T., Prakash, U., & Sahoo, M. M. (2014). Sardar Sarovar Dam Controversy-A Case Study. *Global Journal of Finance and Management*, *6*(9), 887-892.
18. Shrivastava, R.N., Nema, R.K., & Awasthi, M.K. (2018). Strategy of Water Resource Utilization in Upper Narmada Basin. International Journal of Current Microbiology and Applied Sciences. 7(5), 591-602.
19. Thornbury, W.D. (1954). Principles of Geomorphology **(**p-602**)**. London: New Age International Publisher.
20. VAN LANEN, H. A., & Demuth, S. I. E. G. F. R. I. E. D. (2002). Regional hydrology: bridging the gap between research and practice. In *Proceedings of the FRIEND Conference, IAHS Publication* (Vol. 274).
21. Verstappen, H.T.H. (1983). Applied Geomorphology (p 437). Elsevier.
22. Wadia, D.N. (1926). Geology of India (p. 402). Macmillan and Co. Limited, London.
23. Yadav, S. M., & Chauhan, K. A. (2012). Case study of Narmada main canal based drinking water supply project: issues and challenges. *WIT Transactions on Ecology and the Environment*, *167*, 365-373.

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