FLOW VARIABILITY, CHANNEL CHANGES AND ASSOCIATED HAZARDS OF NOA-MANGALDOI RIVER SYSTEM, ASSAM

AN ABSTRACT

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1.1 Statement of the problem

The rivers and their processes are dynamic and are found to vary in intensity and magnitudes in different climatic regions and also along gradients of temperature, precipitation, altitude and seasonality. While flowing they are constantly cutting, scouring, transporting, depositing and networking the landscape (Bloom, 1998).

Generally, water and sediment discharge are the principal determinants of the dimensions of a stream channel expressed in terms of its width, depth, meandering wavelength and gradient. Physical characteristics of stream channels such as width/depth ratio and channel pattern like straight, meandering and braided are highly affected by flow and sediment load (Osterkamp, 2006). Flow in a river channel has been nature’s way of conveying water on the earth’s surface from upstream to downstream. Men living adjacent to river has always been blessed by the type of flows under control and plagued by their destructive force when out of control. It has therefore, been a subject of constant study. Thus, characteristics of river flows are of importance to everyone dealing with water resources (Morisawa, 1968).

Thus, flow variability of both spatial and temporal is a common character in every river. In rivers, extreme flows of both high and low flows are highly essential for maintaining physical and biological characteristics. The physical properties of flow variability which include volume, magnitude, velocity, etc. have always strong geomorphological and environmental consequences at local as well as regional scales. Frequently occurring extreme high and low flow regimes may bring catastrophic change over a long term established fluvio-geomorphic regime of the river (Naiman et.al, 2008).

The available past records reveal that flow variability, earth movement and resultant channel changes including channel shifting are causally linked, as many of the river valleys of the world have already experienced major shifting of channel courses either during extreme high flow regime or immediately after the tectonic movements of high intensity. Shifting of channel course is a natural phenomenon and every river has a tendency to shift its channel course when it debouches into the plains and continues up to its downstream. Though geological, geomorphological, hydrological and climatic
factors primarily govern this process, presently, the role of human interference also
cannot be ignored (Devnath, 2007).

Water specially the river water is an important commodity and it is also a
destructive as well as constructive force. On account of its destructive nature the river
water during its extreme situations causes many hazards which include flood, drought,
landslide, erosion, siltation etc. However, among all such hazards the floods have been
the most common as well as disastrous natural hazards in terms of economic damage
and human casualty including loss of animal life under fluvial environment (Benito and
Hudson, 2010). The human actions sometimes modify the basin environment especially
in terms of landuse landcover changes.

In a river system the three aspects, i.e flow variability, channel changes and
associated geomorphic hazards are very closely correlated and among these the flow
variation is the independent variable on which channel changes and associated hazards
depend.

1.2 Study area

The Noa-Mangaldoi river system is located in between 91°56′ E and 92°05′ E
longitudes and 26°21′ and to 26°58′ N latitudes. The rivers Noa-Nadi originates from
the sub-Himalayan ranges of Bhutan at an elevation of 1750 m and traverse for about
103 km from north to south to finally meet with the Brahmaputra River at an elevation
of 50 m above the mean sea level. The river system covers a total area of 745 km² out of
which about 94 km² (12%) lies in the sub-Himalayan tract of Bhutan and remaining 651
km² (87.38%) lies in the Brahmaputra valley of Assam. The Noa-Mangaldoi river
system is characterized by high degree of flow variability, frequent changes of channels
and severity of geomorphic hazards including flood and bank erosion. The spatio-
temporal changes of flow, channels and occurrence of geomorphic hazards are the
products of the ongoing fluvial processes of the river system which is trying to adjust
constantly with its delicate fluvial regime. Keeping all these points in mind the present
study has been carried out to deal with the flow variability, channel changes and
associated hazards of Noa-Mangaldoi river system, Assam.
1.3 Objectives

The research problem has the following objectives:

1. to analyse the variability of water flows and sediment flows and their relationship with basin and channel parameters.

2. to analyse the pattern and processes of channel changes of the Noa and Mongaldoi rivers at spatio-temporal scale.

3. to identify the major geomorphic hazards of the river system and assess their impacts on the fluvial environment and socio-economic life of the inhabitants.

4. to evaluate the causes of genesis of the geomorphic hazards and suggest some strategies for their management.

1.4 Methodology

The deductive reasoning has been considered as the methodological base for the present study. Data used in this study are both primary and secondary. The primary data are generated from the field survey, whereas, the secondary data on various aspects have been collected from different offices or State and Central Governments.

Thus, to make the study more systematic it has been organized in three successive stages. In the initial stage the research problem has been formulated. Following this, relevant literatures from various sources have been made. The second stage involves the collection of both primary and secondary data. For primary data and information field observations have been conducted. The secondary data have collected from different departments including Water Resource Departments and Brahmaputra Board, Govt. of Assam; Geological Survey of India, Govt. of India; Block Development Offices, DC’s Offices, Panchyat Offices, Circle Offices etc. The final stage deals with the processing and analysis of raw data by using standard and appropriate statistical and hydrological techniques. Finally, all the analysis have been represented in forms of maps, tables, graphs, charts, diagrams etc. to prepare the report in the form of thesis.

1.5 Findings

The major findings of the work are:
1. The average value of bifurcation ratio of 3.87 for the basin generally indicates no influence of structural control over the fluvio-geomorphic activities of the river. However, the low $R_b$ values of 1.6 in between 4th and 5th order streams indicates easy concentration of water in the lower reach of the main channel in a short time which may cause peak flow leading to flood.

2. The minimum length of overland flow of 0.35 km clearly suggests that the river is capable of causing frequent flood as the water takes less travel time to get collected at the main channel.

3. The water discharge pattern of Noa-Mangaldoi river system has shown marked variation in monthly, seasonal and annual discharge. The occurrence of high flow and low flow discharge are always associated with corresponding rising and falling of stage respectively.

4. The flow variability analysis of the high and low flow series clearly suggests that the occurrence of high flows in Noa-Nadi is more consistent and inconsistent in Mangaldoi river, while the occurrence of low-flows in the Noa-Nadi is more inconsistent indicating low irrigation potential of the river, especially during the winter months as compared to Mangaldoi river where the variation of low-flow is relatively consistent.

5. In order to make the most reliable estimate of low-flow and high flow frequencies and probabilities in the Noa-Nadi, the best method is found to be the Gumbel’s Extreme Value Distribution, as revealed from the computations of D-Index measure.

6. The magnitude of shifting of channel in Mangaldoi river is very high than the channel of Noa-Nadi. Except in a small reach from Chamtabari to Outala covering about 2.95 km where eastward channel shifting was observed due to channel avulsion, the other parts of both the rivers have been characterized by westward channel shifting.

7. Field works and channel morphology study reveal that the Noa and Mangaldoi rivers are undergoing morphological changes which include changes in channel planform and cross-sectional geometry due to both natural and anthropogenic processes.
The natural processes like shifting and abandonment of meandering bends, widening, narrowing and deepening of channel course, channel avulsion etc., especially during high flow regime and the man-made channel diversion can certainly be held responsible for changes in channel morphology.

8. The erosion and deposition as the process of channel change have been found very active although the channel length of both Noa and Mangaldoi river.

9. The floodplain zoning carried out in the basin leads to identification of five zones, viz. very high, high, moderate, low flood hazard zones and flood free zone.

10. The impacts of flood and erosion hazards on the people of the basin are seen mostly on the occupational and place of residential changes either permanently or temporarily.

11. Institutional supports towards flood and erosion hazards management in the basin include flood control, anti-erosion measures, emergency operation, land improvement, agriculture and rural development measures. Among all the Mangaldoi channel diversion done by the local public in the year 1977 has been found to be the most beneficial measure.

12. The most common and widely adopted mode of human adjustment with flood is seen in agricultural practices.