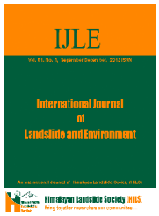
Assessment of Community Vulnerability to Flood in Hanumante River, Bhaktapur, Nepal: Finding the Causes and Mitigation Approaches

Poudyal S.

Civil Engineering Research and Consultancy Pvt. Ltd., Kupondole, Lalitpur, Nepal



* Correspondence to: Shrijana Poudyal, P.O. Box 3321,
Civil Engineering Research and Consultancy,
Kupondole, Lalitpur, Nepal
Tel: +977-9841373321;
E-mail: pdlshrijana@gmail.com

Keywords: Monsoon rainfall; flood; vulnerability; catchment; Bhaktapur

1 Introduction

Nepal is a mountainous country with large number of perennial and seasonal rivers with almost 83% of the total area covered by hilly and snowy mountains. Large sections of the river network have a high risk of premature damages due to the combination of adverse climatic and geological conditions. Most of these rivers while flowing overland the existing fragile, steep and geologically young terrain of the country coupled with its adverse climatic conditions on their way down, give rise to frequent water induced disasters like landslides, debris flow and floods in every monsoon season. These disasters cause heavy loss of life and properties and damages to the infrastructures resulting in negative impact on socio-economic development of the country.

Nepal is at an early stage of development and needs an appropriate natural resources management system that can promote and sustain further development works. Nepal is also situated in an area prone to natural disasters. The river system in Nepal has unique characteristics that impose high costs and high risks for investment in river and the government has a limited capacity to adequately maintain the systems.

The Hanumante River is one of the important tributaries of Bagmati River in Kathmandu and also causing serious damages to agricultural land, standing crops and lives every year. Due to the meandering path that it follows, it is affecting a large amount of valuable land and generating troubles to the nearby settlers. The settlement, public property and the highly fertile land along the river are at high risk of flood causing the loss of investment of farmers, land and property owners.

With this insight, the study using geographical information system (GIS) and engineering technology was conducted to find the mitigation measures of flood along different reaches of the River. The main objective of the study is to direct or guide the flood mitigation activities by preparing long term technical plan for flood relief in the selected reaches.

2 Study Area and Methodology

The Hanumante River where this study was conducted originates from the north-east of the Kathmandu Valley and runs east-west up to the confluence with the Manohara River. Several river bank problems were observed due to unstable banks and human intervention in the river.

The study started with extensive field visits to the project site, geometrical and hydrological survey of the river and review of related literature. Arrays of research procedures and data collection techniques were used for gathering primary data. These survey results formed the bases for identification of flood affected areas. The collected information and data were processed and used for analysis of river behavior, and identification of different stretches of the river requiring protective measures. Flood analysis was done with Water and Energy Commission Secretariat method, modified Dickens's method, and Ryve's method.

3 Results and Discussions

In the study area, the data relating to the flood damages including pre and post flood disaster were not available. Inadequacy of the basic data has made it difficult to assess the flood damage in terms of the monitory value and its extent of severity. Therefore the damage estimation was done primarily based on the local inquiry and expert judgment.

Based on the collected information, a flood prone area has been delineated in a topographical map. Based on the topographical map and the field survey, the severity of the flood damage has been assessed. The damage due to bank cutting, which causes the loss of land or requires river channeling in case of river shifting, has been assessed under the severe damage class. Similarly, household and infrastructure including the cultural heritage sites, which has been damaged or prone to damage, has been assessed under severe damage class.

Various types of bank protection and flood mitigation measures, both structural and non-structural, for a fifty year

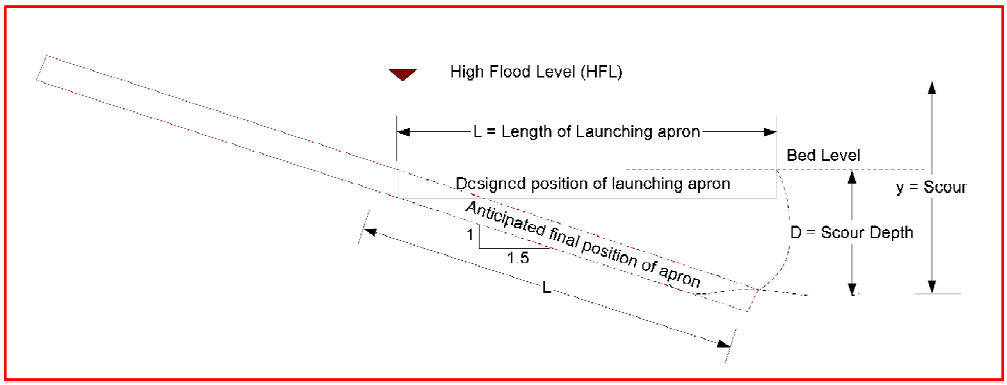


Fig.1. Figure for design of launching apron

return period flood, were identified. Flood banks or levees, launching aprons, retaining walls were designed as the structural measures and watershed management was identified as the best non-structural measure to address the existing problem.

Flood bank or the levees were designed to increase the bank height and to confine the flow in the channel. It has been designed to ensure the passage of flood waves between the embankments maintaining the favorable hydraulic condition. Launching apron were design for the channel lining works, retaining walls and check dams. The general sketch relevant to launching apron design is shown in fig. 1.

For the river sections consisting of bank slopes with heavy erosion and relatively larger magnitude of erosion, levees or channel lining works were not sufficient to protect further erosion and bank cutting. Therefore for such sections, gabion retaining walls along with launching apron were designed. The portions of slope uncovered by the retaining walls were treated with bioengineering works so as to prevent erosion during heavy rainfall period. These were designed to cascade towards the river side and to withstand water pressure as well as earth pressure from backside. Details of the structures are presented in table 1.

Table 1: Proposed River Training Measures

SN	River Stretch (Chainage)	Proposed Measures	Remarks
1	Chainage 0+198m -0+218 Right Length = 20m	Vertical revetments Type I	Dual function of channel formation and bank retaining
2	Chainage0+243m-0+252Left Length = 9m	Vertical revetments Type I	Dual function of channel formation and bank retaining
3	Chainage 0+341m -0+350 left Length = 9m	Vertical revetments Type I	Dual function of channel formation and bank retaining
4	Chainage 0+356m -0+377 Right Length = 21m	Vertical revetments Type II	Dual function of channel formation and bank retaining
5	Chainage 0+581m -0+590m both bank Length = 9m	Vertical revetments Type I	Dual function of channel formation and bank retaining
6	Chainage 0+714m -0+723 left Length = 9m	Vertical revetments Type II	Dual function of channel formation and bank retaining
7	Upstream catchment	Watershed Management	To minimize sediment transport

4 Concluding remarks

1) The results of the study showed that the reasons for the occurrence of flood and damages are (i) occurrence of high rainfall in monsoon season, (ii) undefined river banks, iii) transportation of sediments and debris from upper catchments, (iv) rising of bed level at the lower reaches due to disposal of solid wastes and construction materials haphazardly.

2) The Hanumante River has been inflicting damages mostly to settlement area and cultural heritage sites as the level difference between them is very low; and in order to protect the damages by river flood, adequate structural and non-structural measures should be implemented.

Acknowledgements

The authors would like to express thanks to the Department of Water Induced Disaster of the Government of Nepal, for granting opportunity to conduct this study.

References

Agor, R. "A text book of surveying & Levelling, Khanna Publishers, 2-B Nath Market, Nai Sarak, Delhi-110006, Eight Edition 1996.

Arora, K. R. "Surveying volume I, Standard book house, 1705-A, Naisarak, Delhi – 110006, Fourth Edition, 1995.

Chakraborti, M. "Estimating, Costing, Specification & Valuation in Civil Engineering, M. Chakraborti 21B, Bhabananda Road, Kolkata – 700026

Arora, K. R. "Irrigation, Water Power and Water Resources Engineering". Standard Publishers and Distributors, Delhi, Fourth Edition 2002.

"Manual for Community based Flood Management". Asia Pacific Journal on Environment and Development.