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Environmental Sedimentology of Bishnumati River, Northwest Kathmandu Basin, Central Nepal

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Abstract: **The Bishnumati River, a sixth-order perennial river with a humid climate, has been under serious degradation due to both natural and man-made disturbances. One of the prominent problems is surface water pollution, which has resulted from the direct disposal of sewer effluents, disposal of solid waste, and illegal settlements on riverbanks. The overall state of the river is deplorable, with major contributing factors being uncontrolled wastewater discharge, indiscriminate dumping of wastes, unauthorized encroachment, sand quarrying, and unsustainable urban expansion. Human activities along the riverbanks have significantly affected the environmental features, with a heightened rate in the deterioration of the river. These issues can be resolved with prompt and effective governmental action, such as the imposition of strict wastewater treatment regulations, sustainable waste collection and disposal systems, and illegal settlements removal. Consequences of these measures are crucial to the rehabilitation and protection of the Bishnumati River, its ecological balance maintenance, and prevention of further degradation.**

Keywords: ***Bishnumati river, Anthropogenic disturbances, Electrical conductivity (EC), Total dissolved solids (TDS).***

Introduction

The Kathmandu Valley is a vast intermontane basin in the Lesser Himalayas of central Nepal, covering an area of about 650 sq. km and having an elevation of 1220 m to 1500 m (Stocklin and Bhattarai, 1977). It is covered by Pleo-Pleistocene and recent fluvio-lacustrine deposits above the Kathmandu Complex rocks. The Bagmati River and its tributaries, including the Bishnumati, Dhobikhola, Hanumante, Manohara, Nakhu, Godawari, Balkhu, and Bosan Khola, drain the valley. The Bishnumati River, measuring approximately 15.2 km in length, originates from Bishnudwar in the Shivapuri Range and is joined by tributaries such as the Sanla Khola and Mahadev Khola (Tamrakar, 2004). Its primary sources of water are natural springs and rainfall.

Current issues include narrowing of the channel, sediment erosion, reduced flow, and degraded water and sediment quality (Sayami and Tamrakar, 2007). For instance, Teku Dovan exhibits high Biological Oxygen Demand (BOD) and negligible Dissolved Oxygen (DO), making the environment unsuitable for aquatic life (Nepal, 2006).

Methodology

The research area is located in the northwestern section of Kathmandu District, Bagmati Zone, between Latitude 27º41'00" N to Longitude 85º19'00" E, an area of approximately 100 km. The Bishnumati River, which is a sixth-order stream, has a dendritic drainage pattern.

Throughout the study, in-situ parameters like pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), and surface water temperature were recorded at 10 different locations. Moreover, important morphological parameters like meander wavelength, meander belt width, radius of curvature, and Sinuosity were computed from topographic maps. For sediment quality and organic content identification, sediment samples were collected from various locations in the study area. Additionally, disturbance mapping and sediment distribution mapping at a 1:10,000 scale was carried out to assess spatial changes and environmental effects in the watershed. These assessments furnished valuable information on the transient river morphology, sediment characteristics, and environmental degradation of the Bishnumati River. The sediment samples were taken from the three different places of the study area and were gathered and analyzed for organic matter concentration. A sample of 1g was put in a 500 ml Erlenmeyer flask, then 10 ml of 1N potassium dichromate solution was added. After that, 20 ml of sulfuric acid was added, and the solution was rotated gently for one minute before being allowed to react for 30 minutes. In a different preparation, 0.5g of diphenylamine was dissolved in 20 ml of deionized water and 100 ml of sulfuric acid was slowly added with stirring using a glass rod.

A second 1g soil sample was taken in a 500 ml Erlenmeyer flask, and the same procedure was followed with the addition of 10 ml of 1N potassium dichromate solution and 20 ml of sulfuric acid, mixed and left for 30 minutes. The solution was subsequently diluted with 200 ml deionized water, to which 10 ml phosphoric acid, 0.2g ammonium fluoride, and 10 drops of diphenylamine indicator were added. It was

subsequently titrated with 0.5N ferrous ammonium sulfate solution until a color change from dull green to turbid blue. Titration was proceeding drop by drop until the end point was achieved, which was signaled by a brilliant green color. A blank sample was also prepared and titrated using the same procedure for the sake of accuracy.

Result and conclusions

Both natural and man-made factors have an impact on the Bishnumati River, but in the current situation, human-caused disturbances are the most important. The health of the river has been negatively impacted by practices like waste disposal, wastewater discharge into the river, and excessive sand quarrying. Climate change also plays a role in the river's deterioration. The river travels through a narrow channel during the dry season, and the riverbanks are exposed due to the lack of vegetation. Because of this, the bank sediments become loose and improperly bound, which makes them extremely vulnerable to erosion. The main cause of the disruptions on both banks of the river, especially between the Teku Bridge and the Bus Park Bridge, is human activity. There is a noticeable buildup of solid waste on the roads on the left side of the Bishnumati River in Teku.

Chemical fertilizers, insecticides, and pesticides are introduced into rivers through surface runoff from agricultural land, further degrading the quality of the water. Water degradation is also a result of livestock grazing along riverbanks. The environmental problems of the river are further exacerbated by excessive sand excavation in its upper reaches, which lowers the riverbed and speeds up erosion downstream. The Bishnumati River is now severely disturbed by human activities associated with daily life and economic growth.

Construction material excavation, channelization and damming, urbanization, floodplain reduction, agricultural expansion, and livestock grazing are some examples of these activities. These disruptions have also been made worse by climate change, which has resulted in more frequent droughts and altered precipitation patterns, which have lowered river and stream water levels.

Water quality problems are made worse by this decrease in water volume, which reduces the ability to dilute contaminants. By accelerating evaporation, warmer temperatures also exacerbate river degradation. Furthermore, variations in precipitation patterns affect the frequency and magnitude of river flooding, changing the dynamics of natural flow and possibly hastening the deposition of sediment and erosion.

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