

Channel shifting of Narayani River and its ramification in west Chitwan, central Nepal

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ABSTRACT

The analysis of satellite imageries and topographic maps of different dates revealed that the Narayani River near Mangalpur migrated about 32 km to the west. Its westward shift is also clearly evidenced by the continuation of wetlands parallel to the main river course. The interpolated contours of 2 m interval obtained from the topographic map of 1:25,000 scale also revealed many parallel depressions. These depressions belong to an old abandoned channel, and are closely associated with a sharp bend of the Narayani River. There is a high possibility of breaching a weak and unconsolidated natural levee, which is currently protecting the abandoned channel from flooding. The flood disaster after the breach is inevitable and it can devastate the six Village Development Committees situated within the abandoned channel.

INTRODUCTION

The Narayani River is one of the three largest drainage systems of Nepal. It originates in the Higher Himalaya and Trans Himalaya, and flows through the western border of the Chitwan district. Though the river has a high volume of water round the year, the runoff input of monsoon season further increases its discharge. The peak discharge is over 5000 m³/sec, whereas the low flow remains below 1000 m³/sec during the winter months.

The Chitwan district is located in the south-central part of Nepal (Fig. 1). It covers about 2,237 sq km of area. The district has a population of 472,048 (CBS 2002) with two municipalities (Bharatpur and Ratnanagar) and 36 VDCs. Out of them, 9 VDCs are located in the hills, 4 in the Madi valley, 11 in the eastern Chitwan (east of the Barandabhar forest), and the rest (12) are in west Chitwan. A large part of the district is covered by the Royal Chitwan National Park and government forest. The two municipalities and two VDCs (New Padampur, and Khairahani) have a population density of more than 1000 persons per sq km, whereas five hilly VDCs (Lothar, Siddi, Chandi Bhanjyang, Dahkhani, Kabilas) have a density of less than 100 persons per sq km.

The Chitwan valley can be divided into the following three physiographic regions: the Mahabharat Range, Siwaliks, and lowlands (Terai). The Mahabharat Range is located to the north of the Main Boundary Thrust, and is made up of the Lesser Himalayan rocks. Its altitude ranges from 900 to over 1900 m. Mainly nine VDCs (Darechok, Chandibhanjyang, Dahakhani, Kaule, Kabilas, Lothar, Siddi, Saktikhor, and Korak) are confined in this region. The Siwaliks,

made up of soft sandstones and mudstones, surround the valley. Since the Prithvi Highway and Mugling–Narayanghat Road pass through the valley, the areas in their vicinity are densely populated.

METHODOLOGY

Channel shifting of the Narayani River was detected mainly from the analysis of the satellite imageries of various dates and large-scale (1:25,000) topographic maps. Further information was also obtained from other available reports and maps. A field study was carried out between July and August 2003 to assess the present extent of channel shifting and a possible flood risk in the adjacent low-lying areas.

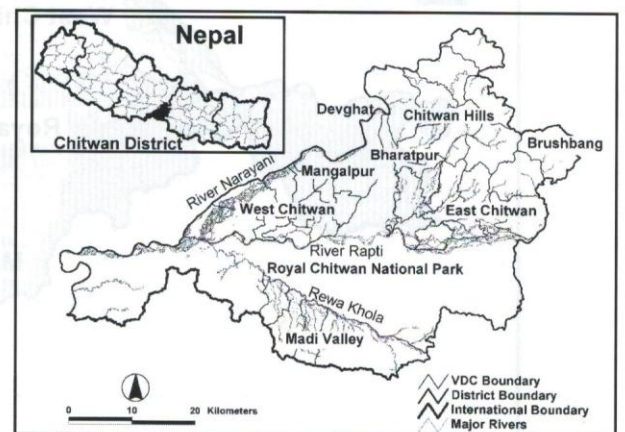


Fig. 1: Location map of Chitwan district

Landsat imagery and topographic map analysis

A land use/cover map (Fig. 2) was prepared from the topographic map of 1:25,000 scale, in which the following five categories were recognised: 1) forest, 2) cultivation, 3) grassland, 4) water (mainly running), and 5) floodplain.

The Multi-Spectral Scanner (MSS) data of April 1984 and Landsat TM data of November 1990 and April 2000 were used to generate a second land use/cover map of the area (Fig. 3). The data were processed using computer software ILWIS 3.12a. Digital image processing was carried out for the supervised classification of the image. These maps were used to analyse the channel shifting pattern of the Narayani River.

Westward shifting of Narayani River

Just after crossing the Mahabharat Range, the Trishuli and Kali Gandaki Rivers confluence at Devghat, and form the Narayani River. The river takes an eastward course from Devghat. While reaching Narayanghat, the river follows the southward trend. There is a sharp bend at Mangalpur and then flows in the westward direction. The bend displays a contrasting sharpness. On the other hand, the land use information from the map and imageries show several parallel

depressions that could be part of an abandoned channel. There is a distinct depression close to the western end of the Barandabhar forest. Similarly, the remnants of past river course are also observed at Gitanagar, where they are known as the Gitanagar Ghol. Another distinct depression begins at the western part of the Lonkhu Tandi and continues up to Sukranagar and the Rapti River. The aerial distance from the first eastern depression to the present river channel is over 32 km. Present river also has various braided channels downstream from Gaidakot. Many new and fresh channels are extending to the western part close to the Nawalparasi district, where the channel is 10–12 km wide. Every year, eastern Nawalpur faces an acute flooding problem, indicating the westward-shifting trend of the Narayani River.

The westward migration of the Narayani River near the Bharatpur Municipality and the western margin of the Mangalpur VDC was detected from the study of satellite imageries. The imageries of different times showed a continuation of the wetland parallel to the present main river course. The interpolated contours of 2 m interval obtained from the topographic map of 1:25,000 scale also revealed many parallel depressions (Fig. 4). The local inhabitants too have expressed the same view.

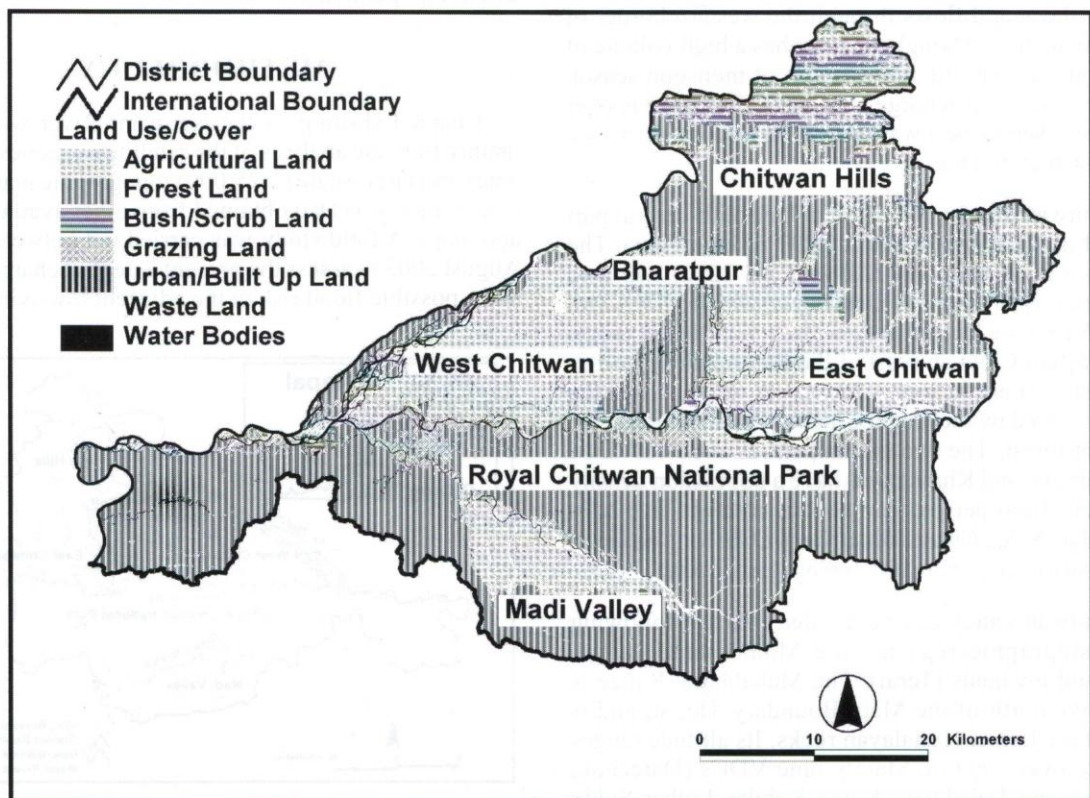


Fig. 2: Land use/ cover map based on topographic map of 1994

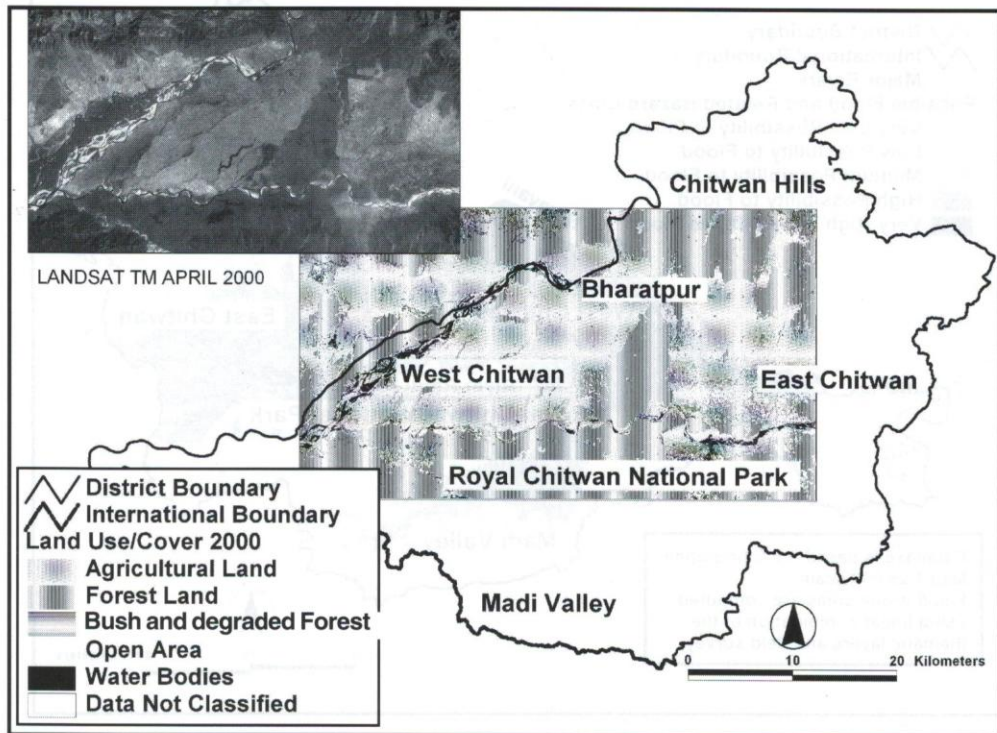


Fig. 3: Land use/cover map based on supervised classification of satellite image of Landsat TM 2000

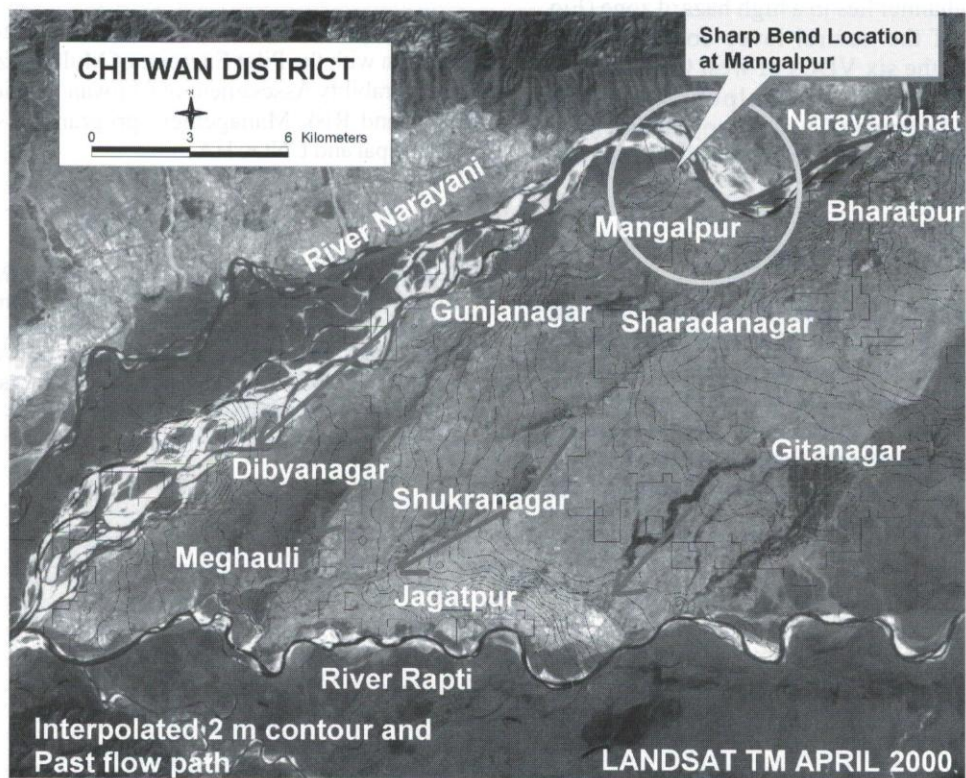


Fig. 4: Parallel alignment of depressions in west Chitwan

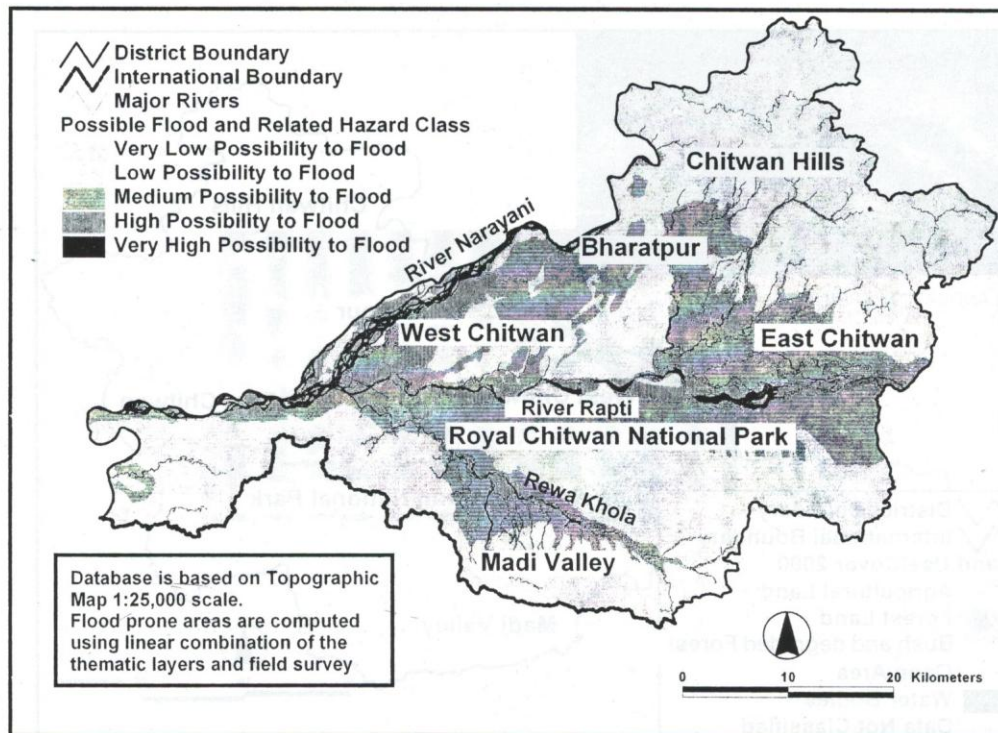


Fig. 5: Flood hazard map of Chitwan district

The flood hazard map of the Chitwan district shows that the abandoned channel lies in a high hazard zone (Fig. 5). The breaching of the natural levee could result in devastating floods in the six VDCs of west Chitwan (i.e., Dibyanagar, Gunjanagar, Mangalpur, Meghauri, Sharadanagar and Sukranagar). They occupy about 124.21 sq km of area, and there are 12,977 households with 67,391 inhabitants (CBS 2002).

CONCLUSIONS

A sharp meander of the Narayani River is visible at the border of the Mangalpur VDC and Bharatpur Municipality. In this area, the present river channel is over 10 km wide. The river has migrated about 32 km westward, as indicated by the aligned old and recent depressions. Hence, there is a high risk of water-induced disaster in the western part of the Chitwan district. Six VDCs with a population of about 67,500 lie in this highly vulnerable zone.

ACKNOWLEDGEMENTS

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