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Channel Migration Characteristics in Alluvial Meanders before and after Implementing Bank Protection Structures: A Case Study of Lohandra River in Nepal

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1. INTRODUCTION

Every year hundreds of hectares of agricultural areas are lost to river bank erosion in the alluvial plains of Nepal which is the major food production region of the country. Therefore, it is vital to understand the channel migration behavior in order to appropriately plan and implement the mitigation measures against river bank erosion. In this study, an attempt has been made to analyze the channel migration characteristics of a

2. METHODOLOGY

The study area is a meandering reach of an alluvial river in Nepal. The approximate length of the study reach is 1kilometer. The methodology is divided into two steps. First, the analysis of channel geometric characteristics based on the field observations and the google earth images of the period 2010-2014 (before the implementation of groynes) and 2015-2019 (after the implementation of groynes).

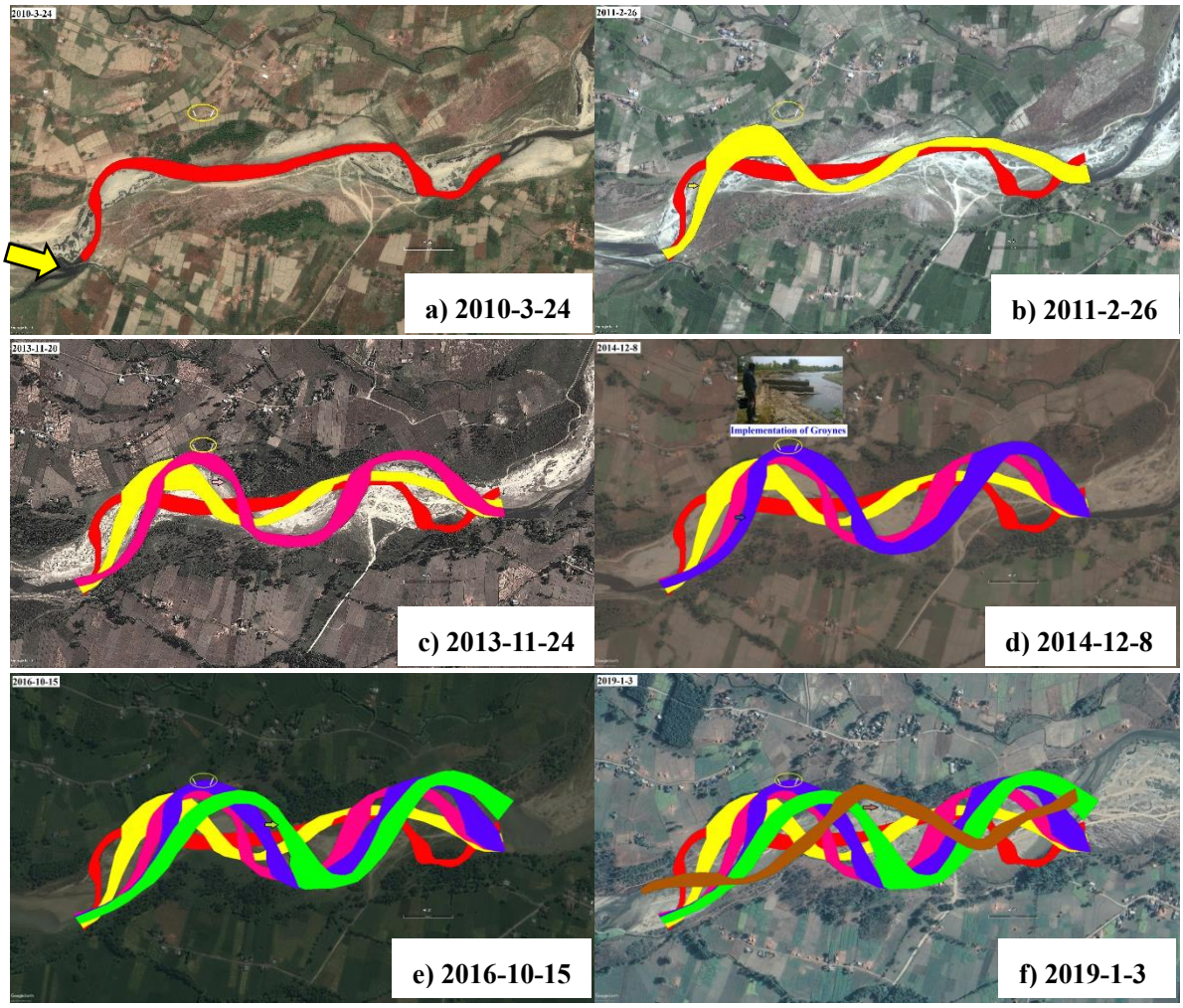

Fig 1: Chronology of the channel planform evolution.

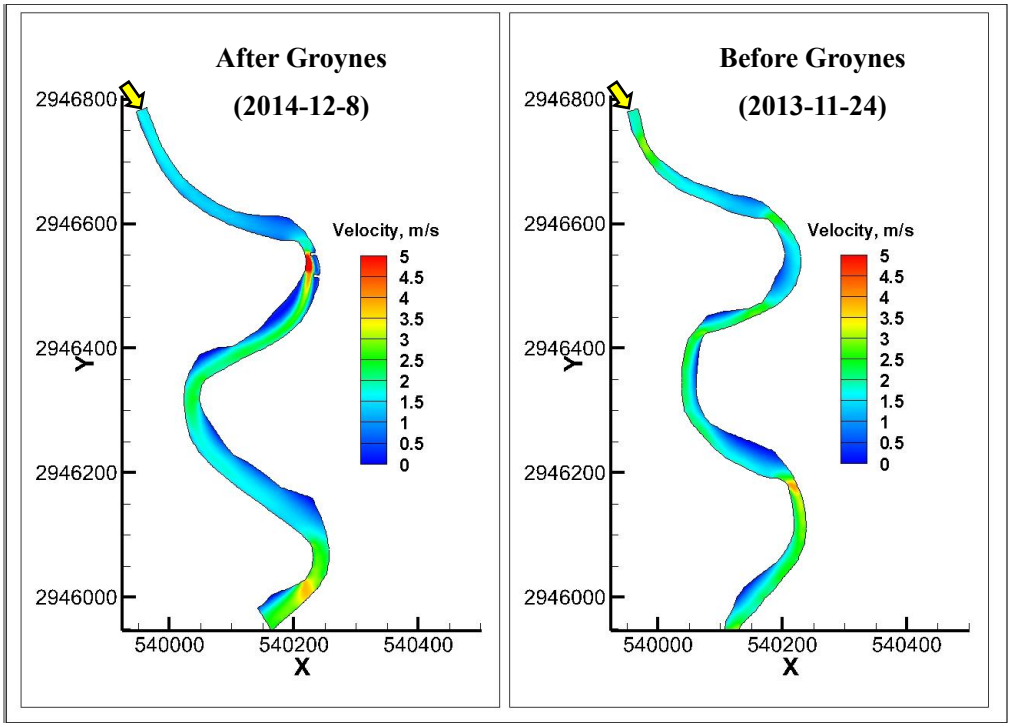

Fig 2: Velocity distribution before and after the groynes installation obtained from 2D Simulation.

Secondly, we perform 2D numerical simulation with bank erosion to understand the channel evolution pattern and predict future evolution.

3. PRELIMINARY RESULTS

Figure 1 depicts the chronology of the change in channel planform. It can be observed that in the absence of bank protection structures, the channel dominantly had a tendency to expand laterally increasing both the amplitude and the sinuosity (Fig. 1 a-d). However, after the groynes were installed at the outer bank, upstream of the apex for deterring bank erosion, the lateral migration ceased and the channel began to translate in the downstream direction by eroding the banks downstream of the apex which can be observed from Fig 1 (e-f). Meanwhile, the radius of curvature of the bend which had been consistently decreasing in the absence of bank protection works, increased after the introduction of groynes.

Next the 2D numerical simulation was conducted to investigate the hydro-dynamic characteristics of the channels before and after the implementation of groynes. Currently we considered fixed bed with flat-bed topography. Since the study channel don't have any discharge measurement, the bankfull discharge was calculated based on the average channel width, depth and the channel slope.

Fig. 2 shows the depth averaged velocity distribution in the channel for two different period-one before and the other after the installation of groynes. It can be seen that due to the presence of groynes the velocity on the downstream of the groynes increased significantly. This may be the reason for the downstream translation of the channel after the groynes installation in the real field.

4. PRELIMINARY CONCLUSION AND FUTURE WORKS

The preliminary analysis indicated that even if the bank protection structures control bank erosion at the installed location, it might shift the erosion to another locations. Therefore, in meandering channels the countermeasures on one bend should be complemented by additional protection works on the opposite bend.

In the next step, the simulation will be conducted coupling the sediment transport and bank erosion.