A STUDY OF GEOMORPHOLOGY RESEARCH ON MANDAKINI RIVER BASIN OF UTTARAKHAND

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ABSTRACT

The traces of geomorphic evolution are scattered here and there along the course of river Mandakini as different landforms. Since it is a 7th order stream it has undergone a considerable period of standoff. As the basin has developed over the growing young mountain chain of the Himalaya different types of tectonic landforms are present in this area. Knick points, valley in valley, incised meanders, straight river course and waterfalls are the indicators of adjustment between tectonic upliftment and down cutting of the river. Presence of major thrusts like MCT, faults and lineaments play a crucial role in the landform development of this region. The present landforms are the result of polycyclic endogenetic and exogenic process operating with varying intensities with time [23]. For the assessment of geomorphic evolution of an area it is necessary to use basin hypsometry. The hypsometric curve expresses the volume of rock mass in the watershed and the amount of erosion that has taken place in that watershed against the remaining mass (Faran et al. 2015).

KEYWORDS: geomorphic, river Mandakini, Himalaya, mountain chain.

INTRODUCTION

Physical geomorphology is the investigation of end genetic and exogenesis landforms, their arrangement, their procedures and connection between them. The connection among landform and its environment is concentrates in environmental geomorphology. Similarly the geomorphology of atmosphere is identified with particular atmospheres and geomorphic forms. The quantification of linear, areal and help parts of geomorphology is called quantitative geomorphology. Structure plays a significant job in age of landforms however not all that ever. It is the organization of various sort of geological units like igneous, sedimentary and transformative. The separation in landforms is depends to the power of endogenetic and exogenetic powers. The driving and opposing powers connect to change the scene at the appropriate time of time which likewise a significant wonder in geomorphology. Fluvial geomorphologists have been captivated with both qualitative and quantitative proclamations of waterway system.

GEOMORPHIC PROCESS AND LANDFORMS:

Presence of different landform developing environments creates a complex landform system in this region and this is further accompanied by structural and tectonic control. These are Glacial, glacio-fluvial and fluvial. Geomorphically the Mandakini valley can be divided into three broad zones: (i) the upper glaciated zone (above 3500 m), (ii) the middle para-glacial zone (between 2000 and 3500 m), and (iii) the lower fluvial zone (below 2000 m)[24]. A classification of geomorphological unit has been done in the above table. Though the main focus of this research work is fluvial geomorphology, the glacial and glacio-fluvial landforms have been discuss to enlighten the broader geomorphic scenario of the study area.

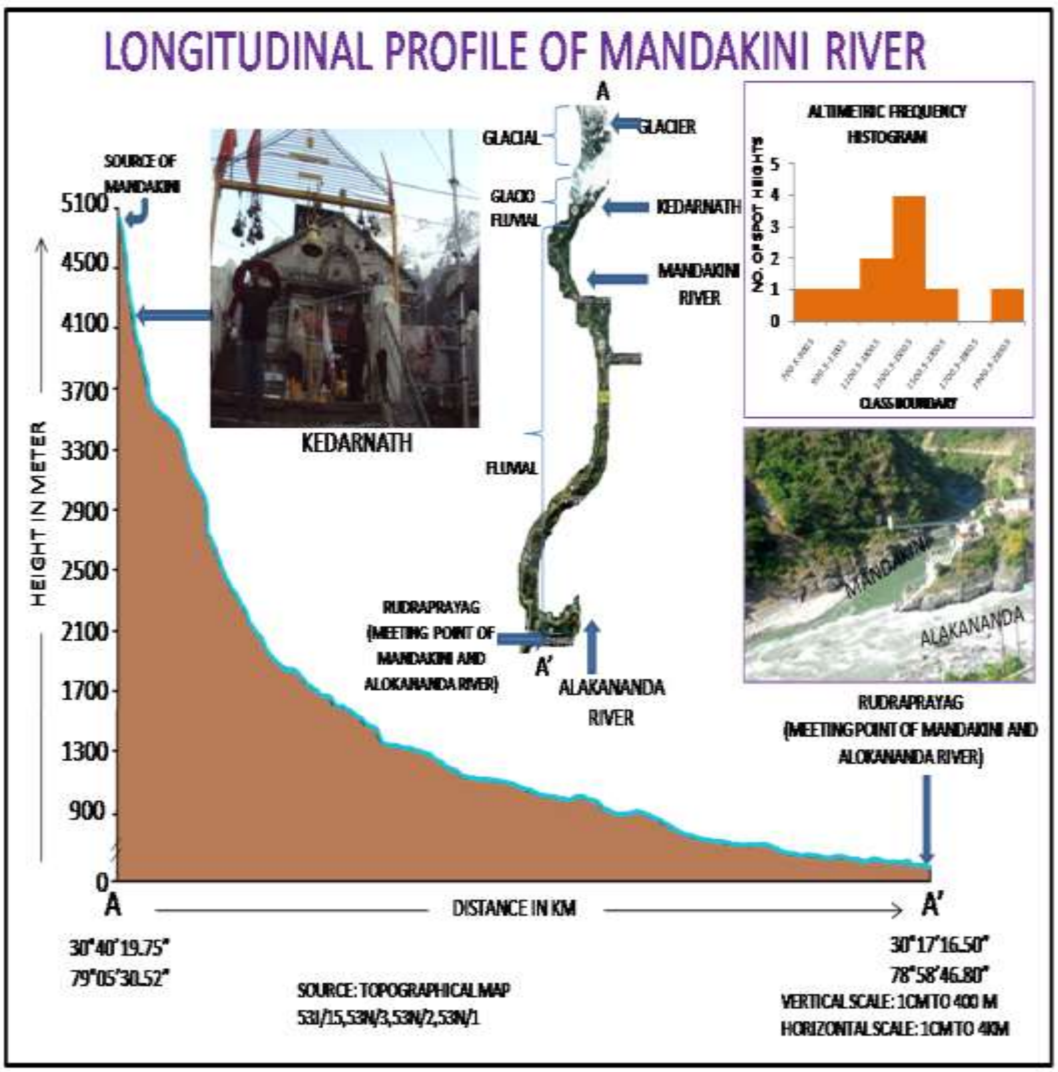

Fig 1. Longitudinal Profile of Mandakini River

GLACIAL LANDFORMS

There are mainly two glaciers which are present in the source of the Mandakini River. They are Chorabari glacier(7 km long) and Companion glacier (4.3 km long).There are two type of landforms present in this area. They are-

❖ **Erosional Landforms:**

A. Cirque

Cirques are the typically arm-chair shaped hollows that form in mountainous terrain, though their form and size may be varied [25]It has three part-(a) head wall, (b) basin and (c) threshold in the front. Two prominent cirques can be identified near the Vasuki and Panya lake area. Probably these basin lakes are formed due to the freezing-thawing and abrasion.

B. Arêtes

Arêtes are the steep ridges that separate two adjoining cirques. In the Kedarnath region some arêtes are very indefinable. One of such is over the Mathagani ridge developed between Vasukiganga and Mandakini River.

C. U-shaped Valley

U-shaped valley has broad valley floor and steep side walls. This is very common in the Upper Mandakini region like Kedarnath. The present fluvial system in this area occupies mostly the glaciated valleys. Dudhganga, Kedarnath valley are typical example of U-shaped valley which have been covered by alluvium subsequently.

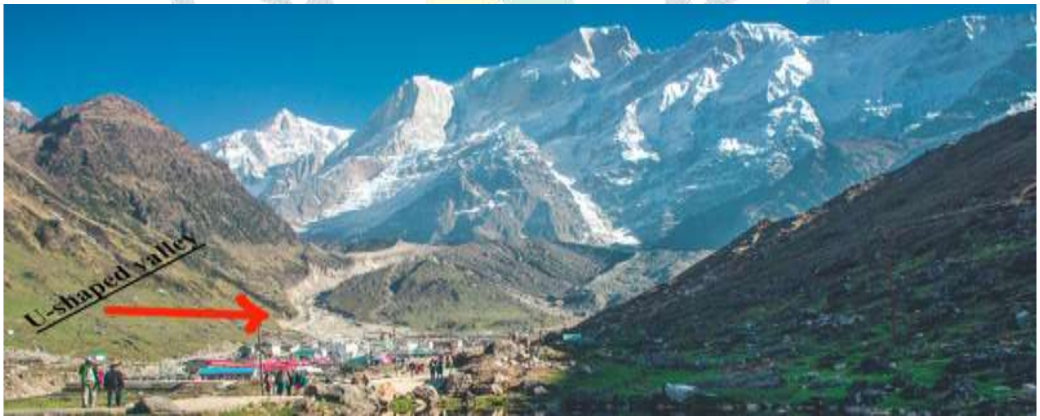

Fig 2. U-shaped Valley in the way to Kedarnath (courtesy: MohitBhel)

D. Hanging Valley

In Rambara different small tributary flow along the small glacial valleys and join Mandakini. These valleys are of the tributary glaciers which join the main glacier.

❖ **Depositional Features**

A. Moraines

Moraines are the accumulation of glacial debris. There are three types of moraines are easily visible. They are lateral moraines, medial moraines, terminal moraines.

- Lateral moraines: It is extended upto the Snout of the Chorabari and the companion glacier along the both side of these glaciers.
- Medial moraines: Where both the glacier meets together a high amount of deposition of glacial debris occurs and results in medial moraines.
- Terminal moraines: It is present in front the snout of the chorabari behind the Kedarnath temple. But it is extended up to Rambara.

Fig3. Moraine in the way to Kedarnath from Gourikund

GLACIO-FLUVIAL LANDFORMS

Spectacular glacio-fluvial landforms are also present in this are mainly from Kedarnath to Rambara. One of such landform is Outwash plain. The Kedarnath town is situated on a outwash plain, about 1 km long and .05 km wide and the channels emanating from the chorabari and the companion glacier encircle the outwash plain one from the left and other from the right and meet below the township where the plain ends[23]. There is a glacio-fluvial terrace with 3 steps which is identified by Naithani from the outwash plain to the Garurchatti.

FLUVIAL LANDFORMS

Typically landforms made by running water can be termed as Fluvial Landforms. Fluvial landfoms can exactly be observed from Rambara to the downstream. The major fluvial landforms present in this area are-

❖ Gorges and V-shaped valleys

Shape of a river valley depends on different factors like stream power, underlying rock th structure and lithology and tectonics. As the Mandakini is a 7th order stream hence it is powerful. On the other hand Mandakini and its tributary like KaligangaMadmaheshwar are flowing over the hade rock of central crystalline. Thus Gorges are found in their courses mainly in upper catchment area. As hard rocks are less affected by weathering and valley-side surface runoff river become narrow. Thus a series of gorges are present from Rambara to Gourikund. A number of gorges are also can be seen in the path to Sonprayag. The gorges present in this area are very narrow having the vertical depth of 20-40m. In the lower portion of the basin the river become wide and thus V-shaped valley can be noticed in the middle and lower Mandakini basin. But surprisingly a gorge is present near the Tilani village in Rudraprayag.

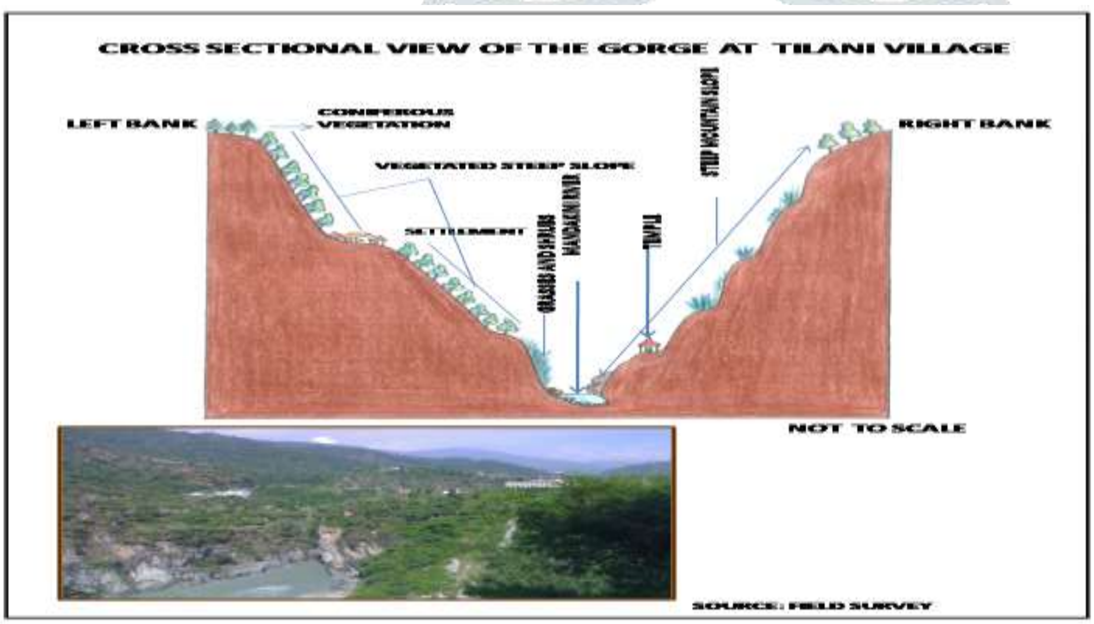

Fig 4. Gorge at the Tilani Village

❖ Waterfalls

Waterfalls or simply falls are caused because of sudden descents or abrupt breaks in the longitudinal course of a river[12]. In the course of Mandakini two types of waterfalls are present on the basis of water supply. They are seasonal and perennial. A 100m fall can be seen at Sonprayag. Here Vishnuganga meets Mandakini. Probably it is a glacial step because two glaciers had joined together and extended downward and caused erosion. There are another falls present at Gourikund and Rambara. In case of some waterfalls Plunge pool is present.

Fig 5. Waterfalls near Rambara(courtesy Joyti Joshi)

Fig 6. Waterfalls near Sonpryag (courtesy Joyti Joshi)

❖ **Incised Meander**

It is a fluvio-tectonic landform Incised meanders are the representative feature of rejuvenation and developed through vertical erosion leading to valley incision or valley deepening. Unlike simple alluvial meander incised meander develops by cutting resistant bedrock. Several incised meanders have been developed in the course of Mandakini River. One noticeable thing is in many cases the alternate development of the cliffs and slip off slopes along the meandering valleys. Meanders are of mainly two types. They are entrenched and ingrown meanders. Entrenched meanders having equal slopes on the either valley sides mainly made by vertical erosion related to rejuvenation where as ingrown meanders having unequal slopes on the either sides and dominated by lateral erosion. Ingrown meander can be noticed in different places like near Ratanpur, Medanpur and Ratansaletc whereas entrenched meander can be seen at Bansu.

Fig 7. Ingrown meander near Ratansal

Fig 5. Entrenched meander at Bansu (courtesy-Google earth)

CONCLUSION

River Mandakini has frosty starting point, which changes geo-material of the earth that continually changes its structure by the procedures including disintegration, transportation and testimony by different mass development procedures, for example, trash stream and landslides; geomorphic operators, for example, icy masses, running water, biotic and structural exercises. Fluvial procedures starting from Glaciers and the resultant calamities like the Kedarnath catastrophe are regularly startling and excessively confused for us to comprehend, in light of the fact that we have no limitation plan over when and where they happen. Locales that are bound to have natural fiascos, for example, the quake inclined Himalayan district, areas vulnerable to deluges and floods, require legitimate and logical techniques for foreseeing catastrophes and cautioning the networks quickly. Waste basins chose as units for an appropriate comprehension of dangers and fiascos might be helpful .The investigation shows that each landform bears stamp of working procedure and procures trademark structure and creating scene with its own character inside the seepage basin. Along these lines, the examination not just aides in understanding physical changes inside the Mandakini river basin yet in addition in getting ready for debacles.

The progressions of these natural procedures into fiascos happened simultaneously with the presence of the human framework; when human creatures began collaborating with natural framework. The effect is bigger in the particular geographical areas and geological–geomorphologic settings, for example, in the current examination zone. Connection between condition, natural calamities and formative works require appropriate.

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