

Impacts of some anthropogenic activities on the morphology of the River Jhelum, Kashmir Himalaya, India

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Abstract:

In order to estimate the impacts of some anthropogenic activities on the morphology of this riverine ecosystem, studies were conducted for a period of one year from 20 April 2020 to 19 April 2021 at four different sites with varying topography and physiology. Major activities, responsible for changing the morphology of the river were found mining & channelization (for diverting water for irrigation). Other minor factors noticed were soil erosion, dumping of waste material, construction of bridges and other anthropogenic activities. It is clear from the present study that anthropogenic activities along with natural environmental changes greatly affect the fluvial regime of the river. Based on the interactions between river morphology and human activities, some easy and quick measures can be proposed to save the river as well as to save the lives and properties of the residents within the river basin.

Introduction

The Jhelum River is one of the major rivers of the Kashmir valley located at latitudinal extension of 32°58' and 35°38'N, and longitudinal extension of 73°23' and 75°35'E. The total geographical area of the Jhelum basin is about 34775 Sq. Kms. with a total length of 402 Kms (Singh & Rashid 2020).

The Kashmir Valley of India is also a riverine state. Among the major rivers of Kashmir, the river Jhelum originates from Cheshma Verinag situated at the foot hills in the south eastern corner and flows towards west through the Valley (Singh, 1982). The topography of this alluvial valley is typical. The river banks as is usual with rivers running in alluvial plains are higher than the land behind them (Singh, 1982). The scenario of the valley of the Jhelum basin looking downward shows that the main streams and its tributaries flow between high definite banks except small reaches where the banks are low, ill defined and swampy, which causes the floods and loss of property (Singh, 1982).

In the late 20th century, rivers of India play a vital role in modern civilization and also raise the environmental concern. Growing urbanization (Klein, 1979; Laronne & Shulker, 2002) and associated human activities are of major problem to the river system (Ebisemiju, 1991). Though those human activities such as bridge, artificial levees are important for development and welfare of human beings but they have adverse impact on river morphology (Gregory, 2006; James and Marcus, 2006; May et al., 1997) and on its natural characteristics (Khan & Islam, 2015). Human activities along with natural environmental changes greatly impact on the fluvial regime of rivers. On mountain and semi-mountain territories these processes are developed in the most complicated manner due to man-made activities diversity throughout river basins. In the Kashmir valley little

literature is available on the anthropogenic activities affecting morphology of River Jhelum (Dar et al., 2019).

Thus, to study such an important issue of the Jhelum river, the following objectives have been taken into consideration (i) to identify the course changes and the causes behind such individual changes (in terms of sand mining and channelization, etc.) and (ii) to analyze other changes like soil erosion, dumping of waste material, construction of bridges and other anthropogenic activities within the river basin, due to the human activities and probable consequences of them.

Methodology

In order to estimate the impacts of some anthropogenic activities on the morphology of this riverine ecosystem (Fig. 1), studies were conducted for a period of one year from 20 April 2020 to 19 April 2021 at four different sites with varying topography and physiology (Table 1). At each sampling site, anthropogenic activities were recorded on monthly basis.

Table 1. Sampling sites to monitor anthropogenic activities (River Jhelum)				
S. No.	Site Name	Elevation	Latitude	Longitude
1	Larkipora	5675ft	33°363 N	75°1423 E
2	Ashajipora	5255ft	33°472 N	75°0624 E
3	Padgampora	5210ft	34°081 N	74°4942 E
4	Kursu Padshahi Bagh	5223ft	34°506 N	74°8346 E

Qualitative approach method

Focussed group discussion (qualitative approach method) was carried out among the population in the sampling sites to assess the knowledge, attitude, and awareness anthropogenic activities responsible for changing the morphology of the river Jhelum.

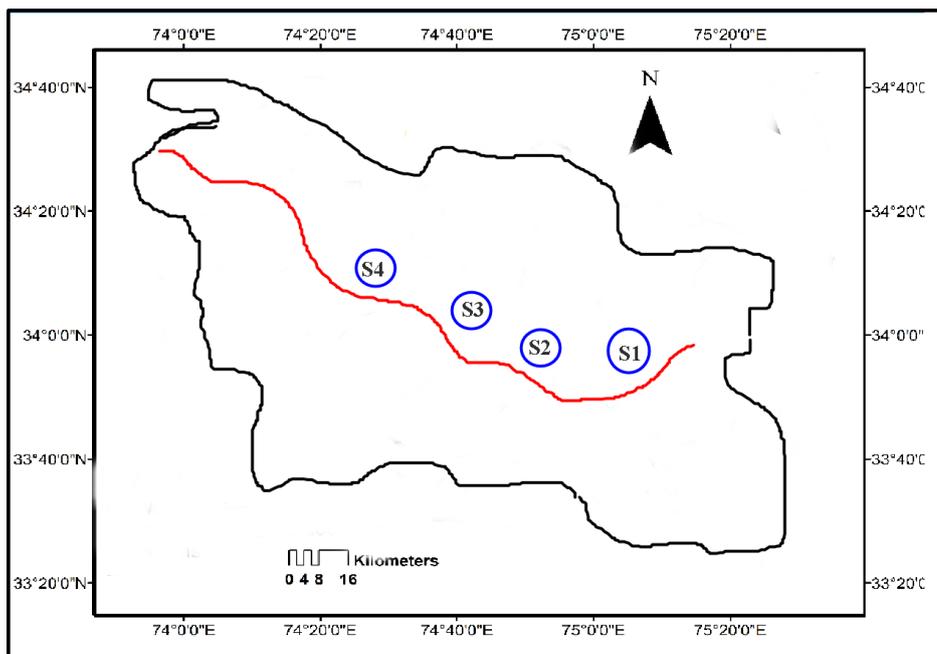


Fig. 1 Map of river Jhelum showing study sites (S1 TO S4)

Results and discussion

1. Major anthropogenic activities

During the study period (from 20 April 2020 to 19 April 2021) two major activities, responsible for changing the morphology of the river were found mining & channelization (for diverting water for irrigation).

i. Effect of sand mining

Sand mining activities are one of many recognized pressures affecting riverine ecosystems (Koehnken et al., 2020). In the present study, mining for sand extraction was found at all sampling sites (Fig. 2). Increasing reports about the negative environmental of sand mining, calls grow for stronger regulation of mining (Schandl et al., 2016). Impacts of sand mining on rivers may be direct or indirect. Direct impacts are those in which the extraction of material is directly responsible for the ecosystem impact, such as due to the removal of floodplains habitat. Indirect impacts are related to ecosystem changes that are propagated through the system due to physical changes in the river system resulting from sand extraction.



Fig. 2 Extensive Sand mining

ii. Effect of Channelization

River channelization mainly involves alterations for the purposes of flood control, drainage, navigation, and prevention of soil erosion that affect all the rivers morphology. During the present study, formation of many water channels (Fig. 3) was observed at sampling sites which directly effects Jhelum river ecology and morphology. As per the stream continuum concept (Vannote et al., 1980) the linear configuration of stream systems makes them more vulnerable to disturbances that occur upstream. For example, heavy precipitation in the watershed is concentrated in the stream channel, scouring the channel and redistributing materials and organisms downstream.



Fig. 3 Channelization

2. Minor anthropogenic activities

During the experimental period (2020-2021) three minor activities were also found effecting morphology of the Jhelum river viz. dumping of solid waste material, soil erosion and construction of bridges.

i. Effect of solid waste material

The deposition of solid waste materials in rivers seems to have direct impacts on the balance of riverine ecosystems (Mekonnen et.al., 2020). Solid waste (Fig. 4) material mainly domestic, which is discarded in rivers, is also responsible for causing pollution of rivers. Over time, waste accumulates, causing the river to silt up. During rainy seasons, when water level increase, the flow of the river decreases and causes flooding on the banks and serious damage to people who live nearby. We also observed deposition of solid waste material on the banks of Jhelum River, thus contributing negative effect on riverine morphology.



Fig.4 Solid waste materials deposited on the banks of river Jhelum

ii. Effect of soil erosion

Anthropogenic forces that modify the physical landscape cause substantial soil erosion which have negative impact on riverine bodies (Issaka & Ashraf 2017). It has led to increased pollution and sedimentation in streams and rivers, clogging these waterways and causing declines in fish and other species. Deforestation (Fig. 5) on the banks of river Jhelum was observed as main factor contributing soil erosion and thus directly impacts morphology of this river.



Fig. 5 Soil erosion on the banks of river Jhelum

iii. Effect of bridge piers

During the present study, constructions of bridge piers (Fig. 6) on the Jhelum river seems to have direct impact on morphology of this river. Recently Bandyopadhyay & De (2018) reported some impact of bridge piers on the Haora River Tripura, India. Pier scouring occurs when water discharge is suddenly increased (Heidarnejad et al., 2010) and most of the soil particles removed surrounds the bridge piers by turbidity currents (Pasiok & Stilger-Szydło, 2010)



Fig. 6. Constructions of bridge piers

Conclusion

It is clear from the present study that anthropogenic activities along with natural environmental changes greatly effects on fluvial regime of rivers. The intensity of damage of the Jhelum river is also clearly observable from the study sites. Huge silt deposition, sand extraction, channelization, and construction of bridges indicating the vulnerable condition of the Jhelum river. Thus, it is quite sure that any major type of change in the physical behavior of the river may take place during any major flood event (Gharbi et al., 2016; Mili et al., 2013; Peppler, 2006). Based on the interactions between fluvial system and human activities some easy and quick measures can be proposed to save the river as well to save the lives and properties of the residents within the river basin.

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