

River Vishav Contribution to 2014 Devastating Floods of Kashmir (India)

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Abstract: Floods cannot be absolutely controlled but can be managed to reduce the losses. The changing climate is a major cause of the increasing trends in the erratic and heavy rainfall events causing floods. The rains those lashed out during the first week of Septemeber-2014 in Kashmir Valley resulting in a devastating flood is one of the examples of such hazards. Many attempts have been made by different agencies and the people to ascertain the cause of this devastating flood. Most of these studies focus on the River Jhelum's main course and do not pay much attention to the role of its tributaries in the said event. The present study is an attempt to analyse the role of the most hazardous tributary of the River Jhelum, known as Vishav River in the horrible catastrophe. River Vishav is a major tributary of the river Jhelum and contributes to nearly one-fifth of its discharge. On basis of the information collected and the survey conducted after the floods, it is believed that this tributary of river Jhelum played a major role in the 2014- devastating floods. The present study highlights the present status of the river Vishav, its behaviour, its role in 2014 floods and flood mitigation measures in the Vishav basin.

Index Terms: Catastrophes, Damage, Floods, Kashmir, Rain, River Vishav.

I. INTRODUCTION

The European Union (EU) Floods Directive defines flood as a covering by water of land not normally covered by water. Floods may occur due to incessant rains causing overflow of waters in the rivers beyond its full capacity level or the accumulation of precipitation on the saturated grounds. Size of lakes or rivers is subjected to fluctuations due to seasons and the change in precipitation throughout the year; this change is contained within these bodies and is not a cause of any major floods. But the unprecedented rainfall events often due to the changing climate affects the carrying capacity of a river/lake and pushes it beyond the buffer stage; this causes a significant amount of water to escape through the channel/river causing flooding of the areas; this flooding may cause devastation on a huge scale depending upon the amount, velocity and duration of inundation. A huge loss is incurred in the form of loss of human lives, livestock, property, degradation of the water courses, etc. Various researchers attribute the increasing frequency of floods to the various aspects of the climate change, particularly in the region of Indian subcontinent [1-5]. Pockets of substantial

long-term precipitation fluctuations have been acknowledged [6-7]. Some studies carried out [7-8] showed that precipitation has increased over north-western states in India. [8] Observed decreasing trend in mean annual air temperature for the period of 1901–1982 over the northwest Indian region. Trend analysis of temperature data at 121 stations in India for 1901–1987 showed increasing trend in maximum air temperature and trendless minimum air temperature, followed by rise in mean and diurnal range of temperature. Various meteorological indices like Standard Precipitation Index (SPI) have been used by a number of researchers [9-10] to detect flood events. Floods are of many types; they may be flash floods, riverine floods, glacial lake outburst floods, coastal floods, etc. Moreover, floods may occur on a number of scales, it may be local, community level, or the entire basin level. Floods cause a huge damage to homes, businesses and agricultural activities. The human settlements have often been around the river course because of easily available fertile land and easy navigation; this is the main cause of the great effects of floods on the inhabited areas.

II. HISTORY OF FLOODS IN JAMMU AND KASHMIR

Jammu and Kashmir has a long history of flood events. Floods have been occurring every alternate year affecting different areas of the Valley. Sir Walter Roper Lawrence in his book, 'The Valley of Kashmir' [11] has given a detailed account of the Kashmir Valley floods; he has especially mentioned the terrible inundation which followed the slipping of the Khadanyar mountains below Baramulla in AD 879 causing complete blockade of the Jhelum River which lead to submergence of a substantial part of the valley. The year 1841 also witnessed a major devastating flood, followed by another catastrophic flood in 1893 due to 52 hours of continuous and warm rainfall, beginning 18 July.

One of the greatest floods known in the history of Kashmir valley came in the Srinagar city on 23 July 1903, converting the whole city into a lake. The water level of the 1903 floods was 3 points higher than that of the 1893 floods. No major flood events were witnessed in the valley up to 1929 because of certain measures taken by the administration. In 1929 the Valley was again grappled with a major flood. The region remained comparatively free of floods till 1948, when a flood was witnessed. It was followed by a major flood in 1950 due to the heavy rains causing overflowing of River Jhelum resulting in a casualty of 100 human lives and collapse/damage of about 15,000 houses.

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Devastation again occurred in the 1957 floods where the entire valley was submerged; it was recorded as the highest ever in Jammu & Kashmir State causing colossal damage.

Till this date all the major floods recorded in the history of Valley were riverine floods due to excessive rainfall, but in July 1959, a massive glacial flood was reported when four days of incessant rains lashed the valley triggering the Jhelum. Flood waters of Jhelum touched 30.25 feet on 5 July which was over six points above the danger level.

In 1992, heaviest rainfall since 1959 was recorded which resulted in an unprecedented flood fury; more than 200 human lives were lost and over 60,000 people marooned in several north-western border districts; effect of these floods was worst in Pakistan-occupied Kashmir where more than 2,000 deaths were reported.

In August 2010, massive cloudburst flood was witnessed in the Leh-Ladakh region of the State; flash floods were triggered in the area after a heavy downpour. More than 250 human lives were lost and many buildings, hospitals, communication network, etc. were destroyed.

In September 2014, an unprecedented amount of rainfall was recorded which resulted in one of the worst floods of the Kashmir Valley. In the valley, floods have been invariably linked with the river Jhelum, its tributaries, streams and rivulets. The scale of devastation caused by the 2014 floods was massive, with over 200 people losing their lives. The worst hit of this flood was the capital City of the State, Srinagar that got fully inundated by an average water depth of 15 feet [12-13]. The administration and the general public lay helpless before the nature. Almost all the public institutions got trapped in this catastrophe and the whole government and its administrative machinery got crippled. Various studies have been carried out on the main cause of these floods, which mainly focus on the main River Jhelum course and the urbanisation in the flood plains. Along with the unprecedented rains and the flood water running in the Jhelum main course and its tributaries, the abrupt water level rise in the Vishav River, a flashy tributary of the Jhelum during the night of September 6 and 7 is believed to be the main cause of River Jhelum breach on upstream and through the Srinagar City that almost drowned the whole city and the important government establishments.

III. STUDY AREA

River Vishav is one of the main tributaries of Jhelum River. The northern slopes of the PirPanjal are drained by the river Vishav. River Vishav originates from three headstreams; one in the vicinity of BudilPir Pass, a major stream rising in the Gulalmarg and Zajimarg area and a third stream originating from a very famous lake known as Kounsar Nag. River Vishav has a catchment area of about 623.67 km² and can be broadly divided into 2 sub-catchments, 7 watersheds and 74 micro-watersheds. River Vishav joins River Jhelum at Sangam. The catchment of the River Vishav has a high relief and is vulnerable to high precipitation and cloudburst events.

The main characteristics of River Vishav are as follows:

- **Perennial River:**
It is a Perennial Rivers carrying a significant flow throughout the year. It obtains its flow from snow melt for

larger part of the year besides getting rain water during the rainy season.

- **Flashy River:**
It is a flashy river and its stages rise and fall in a very short period, mainly during the rain spells.
- **Degrading River:**
The River is flowing through a steep terrain for most of its length, as such is highly degradable in nature.
- **Mountainous River:**
It is a mountainous river taking off from glacier fed Lake Kounsar Nag having a steep bed slope and high flow velocity. The bed and sides comprise of mixture of boulder, gravel, shingle, and sand.
- **Meandering River:**
The river course at its tail for last 10 to 12 km exhibits a meandering character as it flows through plains before it joins river Jhelum at Sangam.

IV. POSSIBLE CAUSES OF FLOODS

The 2014 devastating flood of Kashmir Valley can be broadly attributed to the following three main causes:

- Excess Rainfall
- Occupation of flood Plains
- Poor maintenance and Encroachment on the River Rights

A. Excess Rainfall

The main cause of the 2014 Kashmir devastating flood is the rainfall in excess that continued from September 3 to 6, 2014. During this period a heavy rainfall of about 350 mm just occurred during a period of 30 hours. This rainfall was of about a 100 year return period rainfall for the region. The flood in the only drainage channel of the Valley got worsened due to the very heavy rainfall in the catchment of a flashy tributary of the Jhelum River, known as Vishav River. There is also un-official information of some cloud burst in the catchment of this tributary. This resulted in the unprecedented flood in the river Jhelum that caused a flow of about 120, 000 cusec at the Capital City of Srinagar through it against a capacity of about 45,000 cusec. Through Srinagar city the River has a carrying capacity of about 30,000 cusec and a flood spill channel just on the upstream of the city has capacity of about 15000 cusec.

B. Occupation of Flood Plains

The Valley of Kashmir has an area of 15,120.3 km² and the water body area is about 260 km². The flood plains amount to about 594 km². The mountains on the right side are closer than the left side river; as such most of the flood plains lie on the right side of the river. The left bank of the river is as such in filling through its various reaches and acts as a barrier between the flood plains and the river stream. During the floods these flood plains flooded either due to the over topping of the banks or breaches. With the passage of time some of these flood plains got silted and most important and crucial plains especially near the city got inhabited.

The bank barriers between the river and the Flood plains just on upstream of the Srinagar City could not get breached, rather were not allowed by the inhabitants to allow their breach, caused the very high levels of water adjacent to the City area and some breaches in the river bank. This started the inundation of some inhabited City areas. The flood plains far ahead on upstream of the Srinagar City, mainly those of the Vishav River which got inundated due to the flashy rains and the run-off contribution from the steep catchment areas of the Vishav, started entering the river through the breaches just on upstream of the City. This caused about 16 breaches in the River Jhelum within the City area that inundated almost the whole city of Srinagar. The banks overflowed about 3 to 5 feet through the Srinagar City and the inundation depth was about 15 feet.



Figure 1: Encroachment of river path by trees planted in the river course

C. Poor maintenance and Encroachment on the River Rights

Encroachment of The River Rights is a common occurrence along the river course (Fig 1) in the form of trees planted in the normal course of river. This type of encroachment is also a common practice in the course of River Vishav. Its banks have got damaged at a number of places, some construction have taken place within the river rights, causing the narrowing of the water course, banks have been turned as the garbage sites at various places that results in the creation of rat burrows across the bank. All such factors cause the breaches and overtopping of the banks resulting in the flooding of plains which in turn damage the river Jhelum banks downstream of the Vishav-Jhelum confluence and result in flashy type of flood in the Jhelum River, as was experienced in 2014.

The worst hit of the 2014 floods was the Capital City of Srinagar of Jammu and Kashmir, most part of which remained inundated for about 10 to 15 days as a result of about 16 breaches in the river each though the City areas and the major cause is attributed to the improper management of the River Vishav flows.



Figure 2: Improper maintenance of river embankments

Table 1: Precipitation data of the three rain gauge stations during Sept 14.

DATE	QAZIGUND RAINFALL (MM)	KOKERNAAG RAINFALL (MM)	PAHALGAM RAINFALL (MM)
1/9/2014	8.2	0.6	0
2/9/2014	7.3	10.5	0
3/9/2014	80.4	57.7	0
4/9/2014	156.7	119.4	0
5/9/2014	206.0	149.5	0
6/9/2014	102.7	88.6	0
7/9/2014	56.1	43.3	0
8/9/2014	1.3	6.0	25.8
9/9/2014	1.0	0	0
10/9/2014	0	0	0
11/9/2014	0	0	0
12/9/2014	0	0	0.6
13/9/2014	0	2.3	0
14/9/2014	0	0	0
15/9/2014	0	0	1.6
16/9/2014	0	0	1.2
17/9/2014	0	0	0.2
18/9/2014	0	0	0
19/9/2014	0	0	0
20/9/2014	0	0	0
21/9/2014	0	0	0
22/9/2014	0	0	0
23/9/2014	0	0	0
24/9/2014	0	0	10
25/9/2014	5.7	5.0	0
26/9/2014	0	0	0
27/9/2014	0	0	0
28/9/2014	0	0	4.4
29/9/2014	0	0	0
30/9/2014	0	0	0

Analysis of the rainfall data (Table 1) indicates that among all stations, Qazigund received the maximum precipitation of 206 mm on a single day on 5th of September, but it cannot be categorised as a Cloudburst since the rainfall intensity should have been equal to or greater than 100 mm per hour, which was not the case.

V. STUDY OF FLOODS IN VILLAGE ASTHAL-AN EXAMPLE

Asthal is small village located in Kulgam Tehsil of Kulgam district, Jammu and Kashmir with total 195 families residing. Kulgam, Damhal Hanjipora, Devsar etc. are the nearest towns to Asthal village. It has an area of about 33 hectares, surrounded on all sides by River Vishav. In the recent floods of September 2014, after flowing from far off areas two rivers which met in this village, caused heavy devastations in this village



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The only bridge connecting Asthal village to the rest of the district was washed away during the last year floods and a diversion was created later on to connect the village.

The possible reason of floods in the village is its geographical location and topography of the area. The village is like an island surrounded on all sides by the River Vishav. Due to high discharge of September 2014 floods and hydrodynamic forces associated with it the embankments were completely washed away flooding the entire village (Fig 3).



Figure 3: Map of the village Asthal during 2014 Floods

The best possible solution to avoid such floods in future is raising the level of existing embankments and construction of new embankments where ever necessary at a suitable depth based on scour depth. The height of embankment should be greater than the highest flood level.

VI. RECOMMENDATIONS AND PREVENTIVE MEASURES

In order to avert 2014-like situation in the River Vishav, three sets of measures are proposed - short term and long term.

Immediate Measures: All the breaches need to be properly closed and the weaker lengths of the banks need to be strengthened by suitable measures. Flood ways of the river adjacent to its banks need reclamation so that the flood water can be diverted through these flood ways safely.

Short Term Measures: The design of existing embankments may be revisited and appropriate raising/strengthening may be planned and implemented wherever required. The encroachments on the river rights need to be removed and the proper maintenance of embankment may also be ensured by the concerned agencies.

Long Term measures: These long term measures can be further classified as structural and non-structural measures.

A. Structural Measures

a) Storage and Detention Reservoir: As per Indus Water Treaty between the two countries India and Pakistan the bigger storages cannot be created in Jhelum basin, however small storages can be created. In the Vishav Catchment there is a good scope for this measure and such storage cannot only reduce the flood water affect on the downstream side but can also be utilized for the Irrigation purpose later on, as the flows in the river varies vastly because of its flashy nature.

b) River Training: River Training includes all such

measures as are taken for controlling and regulating river flow and river configuration. There is also a scope for these works in the River Vishav course. The construction of Spurs/Groynes and Guide banks are some of the main river training works those can be employed in the River Vishav course. At certain places there is also a scope for marginal embankments/levees/dykes. These can restrict the moderate flood waters thus protecting nearby property which otherwise gets affected every alternate year.

c) River Channel Improvement: Channel Improvement as a flood control measure can be used to reduce the river stage at a specific point in a specific reach of a river at the time of floods. Consequently, the banks are not overtopped or are less frequently overtopped. The flood stage at any section can be substantially reduced by improving the capacity of the river. Various measures proposed for improving the Vishav River Channel can be summarized as follows:

i. Increasing the channel section:

The channel cross section can be increased at various places for increasing the channel storage. The excavated material can be utilised for creation of the flood plains with marginal embankments on either side of the channel.

ii. Increasing velocity in the river:

The velocity of the flow can be increased by deepening the river, reducing width or by shortening the channel lengths at bends by artificial cut-off especially in its alluvial reaches some kilometres before it meets the main Jhelum River.

B. Non Structural Measures

a) Storage and Detention Reservoir: A particular advantage of non structural measures when compared to structural measures is the ability of non structural measures to be sustainable over the long term with minimal costs for operation, maintenance, repair, rehabilitation, and replacement.

i. Flood Plain Zoning:

Flood plain zones are geographic areas that have been determined to be a flood risk to nearby communities and property. These zones are characterized on the basis of their severity of risk, and are designated as low-to-moderate risks, high risks, and undetermined risks. Each zone reflects the severity or type of flooding in the specified area. Flood zoning is of prime importance in the River Vishav. Lot of construction activities are taking place in the flood plains of the river especially at places like Kulgam, Mirhama, etc. If the flood plain encroachment keeps on going then the result will be the same as in case of River Jhelum floodplains and future floods may be worse.

ii. Flood Preparedness & Community Level Awareness:

Activities and measures taken in advance to ensure effective response to the impact of floods, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations. These include:

- Identifying Government Bodies which can develop and maintain a Flood Emergency Preparedness Plan (FEPP) that identifies flood hazards, risks and vulnerabilities, identifies and prioritizes mitigation actions, and encourages the development of local mitigation.
- Establishment of Emergency Operating Centers.
- Establishment of Evacuation centers, primary evacuation routes, etc.
- Establishment of specific laws and regulations under the general laws on unified management and assigning responsibilities to concerned ministries/agencies.

River Vishav being a flashy river and being a main contributor in the Jhelum Floods imparts a lot importance to the above measures.

iii. Afforestation:

Afforestation is the opposite of deforestation, and is the planting of trees in an area of non-forest land. This measure can help to reduce soil erosion and surface runoff. While the surface run-off is reduced, infiltration and evapo-transpiration increases. A second impact on water flow is the delay of snowmelt, caused by lower influence of wind and solar radiation. Forests can retain up to twice as much water as grassland areas. Best impact of this measure regarding flood prevention can be reached on soils with low water storage capacity or low permeable geologic formation. In case of the River Vishav, afforestation is possible only in the lower reaches of its catchment. The upper reaches of the catchment consist of Rocky Mountains, thus afforestation is not possible in the upper reaches of the catchment

VII. CONCLUSION

The contribution of the Vishav River in the Jhelum Floods, which is the only drainage of the whole Kashmir Valley, assumes a lot of importance for managing its flashy flows as it results in a lot of load on the river Jhelum Flows during the heavy downpour days. The present study has been aimed at analyzing the contribution of the Vishav River during one of the worst floods that occurred during the month of September 2014 and to suggest certain measures on the basis of field and other study. The measures suggested here above are the possible measures that can be taken up for managing the floods of this mighty tributary of Jhelum River, however for these measures the site selection and other data required for their design/ planning is to be considered with utmost care.

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