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FLOOD MITIGATION MEASURES IN RIVER JHELUM BASIN

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ABSTRACT:

Floods are probably the most recurring, widespread, disastrous and frequent natural hazards of the world. India is one of the worst flood-affected countries. In India the Himalayan Rivers account for maximum flood damage in the country. The problem of flood in the state of Jammu and Kashmir is well known and has become a recurring problem to the entire region. The plains of Jhelum catchment are some of the most susceptible areas in India, prone to flooding. Recently in September 2014 a severe flood hit the valley due to the five days of incessant rainfall leaving almost whole of Srinagar city inundated which is the capital of Jammu and Kashmir. Flood forecasting and flood warning are the quite effective non-structural procedures in managing the floods and that decrease the risks and the disasters along with the structural measures which aim at prevention and mitigating the flood impacts.

In view of this an attempt has been made in present work to suggest some non-structural and structural measures keeping in view the Indus Water Treaty. This study introduces to the main drawbacks of current and previous measures. The results obtained from the September 2014 floods are interpreted in a way to find the causes of flood inundation in September 2014 and proposing a solution to save the Srinagar city from floods in future.

Key words: Flood, River jhelum, Mitigation etc.

1. Introduction to floods in Jhelum river

Kashmiris have faced floods since the very beginning of life in valley. Over the years, many measures were adopted to confine floods, but it is unfortunate that the authorities never devised a serious strategy to safeguard the lives and property. The last deluge of September 2014 is one such instance that highlighted lapses in state government’s preventive measures.

With series of floods again occurring in 1960’s and 1970’s , a long-term flood mitigation plan was formulated by the State Government in consultation with National & International Experts, where under, a new Supplementary Flood Spill Channel (SFSC) from Dogripora to Wullar, for diverting excess flood discharges away from City, was finally proposed to be taken up on priority and accordingly a full-fledged Flood Control Directorate headed by a Chief Engineer with a Flood Control Circle and a number of Spill Channel Divisions & Subdivisions , were created in late 1970’s to implement this vital project but unfortunately due to lack of political will and insensitiveness shown by successive Governments, this critical project never saw the light of the day but was soon shelved with permanent winding up of Flood Control Directorate .Thereafter, no initiatives were taken to revive this Project of utmost public importance.

Later on in 2007, earnest steps were initiated for revival of dredging of OFC and a DPR for “Flood Management of OFC of River Jhelum from Ningli to Gantmulla Baramulla” was submitted in 2009 at a cost of Rs 281.14 Crores, which was later on made a part of main draft DPR for “Integrated Flood Management Plan of Jhelum Basin” and submitted to CWC – MoWR, GoI in 2009-10 at a cost of Rs 2083Cr. This DPR, however, till date is yet to be approved / implemented and instead flood management plan for Rs 97.46 Cr was approved by Central Government in 2010, which included Rs 27 Cr for dredging of OFC from Ningli to Khadanyar, whereafter two small dredgers were purchased by the I&FC deptt. and dredging of OFC was formally started in 2011 after a gap of about 25 years, which has mainly helped in saving the areas of Sopore / Baramulla along OFC during 2014 floods.

Despite facing devastating floods in 2014, the department of Irrigation and Flood control has not been able to meet the target laid down by the Jammu and Kashmir government for dredging of river Jhelum from Anantnag to Baramulla.

Under the Prime Minister's Rehabilitation and Reconstruction Programme 2015, 'Priority Works- Comprehensive Plan for Flood Management Works on Jhelum-Phase-I' costing Rs 399.29 crore for implementing 'Comprehensive Plan for Flood Management Works on Jhelum' has recently been sanctioned by the Centre.

The Governor noted that as of February 29, against targets till end March 2016, the cumulative dredging work done in the Jhelum river stretch from Khannabal Bridge to Halamulla was 2,86,123 cubic meter against a target of 3,59,700 cubic meter; for Sethar to Sempora stretch of the river, it was 1,28,419 cubic meter against a target of 1,79,166 cubic meter; for Lasjan to Shalteng stretch, it was 92,380cubic meter against a target of 1,04000 cubic meter; For Shalteng to Panzinara stretch of the river it was 34,580 cubic meter against a target of 60,500 cubic meter; for Panzinara to Banyari stretch of the river it was 1,65,950 cubic meter as against a target 2,72,500 cubic meter.

Similarly, for the outfall channel at Baramulla from Pohru to Janbazpora, it was 32,090 cubic meters till February 2016 against a target of 38000 cubic meters.

On the flood spill channel from Padshahi Bagh to Wullar, the cumulative achievement was 1,02,050 cubic meter as against a target of 1,34,150 cubic meter.

A swollen Jhelum had breached its embankments, causing devastating floods. Moreover, the silt carried by the deluge chocked the river, reducing its carrying capacity to a large extent. Dredging has been completed to the extent of 20,230 cubic meter against target of 20,250 cubic meter envisaged to be done in the Flood Spill Channel from Padshahibagh to Wullar.

The September floods have proven beyond doubt the callous attitude of authorities in understanding the problems prior to augmenting solutions. On a closer look at Google images of the river path between March 18, 2010 and November 22, 2014, one apprehends a major flood in the near future if corrective actions are not initiated on a war footing. Silt deposition can be seen all along the path from Khanabal, Sangam to Srinagar. Pampore area including most of Srinagar's Municipal areas are under immense threat as silt will be easily transported along the river bed slope due to high water velocity.

Parvaiz Ahmed Taili(2011) Assessed the land use/land cover change in Upper Jhelum Catchment from 1961 AD to 2001.Determined the impact of land use/land cover change on flood occurrences in terms of magnitude and frequency.

Kamaljit Ray, S. C. Bhan and B. K. Bandopadhyay .(2015)An observational analysis of the catastrophic rainstorm during 4–6 September 2014 over Jammu and Kashmir (J&K) presented in this study shows that the event was unprecedented in terms of the 24, 48 and 72 h accumulated rainfall. The 24 h accumulated rainfall exceeded the previously determined one-day severe rainstorm limits of 20 cm for a number of stations on 5 and 6 September 2014.

Dr.Latief A.Sofi (2015) As per this analysis heavy rainfall occurred at few concentrated places. Taking advantage of this concentrated nature of rainfall, the peak flow in river Jhelum can be brought down by taking effectives measures at these places in the catchment .There are various methods to decrease the peak flow by discouraging the excessive surface runoff . Afforestation, conservation of existing flora, soil conservation and increase in infiltration of rain water may play vital role to bring down peak flow in river .

Azmat Hussain , Sumaira Jan (2016) The objective of the research was to identify the strategies and technologies to restore the damaged bridges. The damaged bridges are studied keenly and their cause of the failure is studied. Then the possible retrofit solution is analyzed. As on September 2014, the valley of Kashmir suffered huge loss and about 60 major and minor roads were dammed and over 30 bridges were washed away. Some bridges were only 11 year old and yet they fail in the floods. The flood was worst since 109 years and it damaged the infrastructure badly. The necessity of this research is to analyze one of the failed bridge and also to find the cause of their failure. The possible methods to retrofit the bridge are also explained.

Abid Fayaz (2015) Study was carried out to mitigate the floods .

For the flood management of Jhelum basin, the whole work was first of all divided into two steps.

1. Flood Frequency analysis.
2. Flood Management .

Flood Frequency Analysis For the flood frequency analysis the 50years discharge data was collected from planning and designing sub division of irrigation and flood control department and data was analysed for 50, 100,1000 years return period by GUMBEL distribution method in Microsoft excel, as follows.

Gumbel's Distribution; Gumbel' s probability distribution a widely used method has been used for analysis of 40 years data collected at three gauge stations of river Jhelum situated at Sangam, Rammunshi Bagh & Asham.

Dr. Farooq A Jan , Dr. Shahnawaz Hamid, Dr. Malik aubid (2015-16) The devastation of healthcare system of the state was probably the biggest casualty of the floods. As floodwaters entered the hospital premises and submerged several floors of four out of the five major hospitals situated in Srinagar. They were completely shut down. From these hospitals the early evacuation was started and patients were shifted to functional hospitals in the city, mainly Sheri-Kashmir-Institute-of-Medical-Sciences (SKIMS) - which is a large tertiary care teaching hospital in the J&K. (6) . Some patients were shifted to 50-bedded Gupkar Nursing Home and 30 bedded Maternity Hospital Sanatnagar. Shri Maharaja Hari Singh (SMHS) hospital, one of the large premier hospitals of the state was completely defunct for over two weeks as the hospital beds, medical and diagnostic equipment and hospital transport were rendered useless due to the floodwaters.

Flood plain of Jhelum

The Jhelum drains through the valley floor and is characterized by gentle gradient and meandersacross a broad flat valley floor over its own deposited sediments. The average widthof the Jhelum reach from Sangam to Wular Lake is>>311.7 ft, but the river narrows to >>200 ft atSrinagar.The active channel width of Jhelum in the Sangamstretch varies from 384.45 ft to 293.14 ft and near Srinagar the width decrease up to 164 ft.

Similarly, near the Wular Lake, the width of the river varies 311.68 ft to 216.54 ft.

The areas falling in the flood plain of Jhelum from sangam to wullar lake are:

Sangam
Awantipora

Hatipora
Kandizal
Pampore
Panthachowk
Flood spill channel (including bemina)
Shivpora
R M Bagh
Safakadal
Mujigund
Rabitar
Sumbal sonawari

2. Types of floods:

River Flood
Just like it sounds, a river flood occurs when a river overflows its banks. This happens for a few different reasons. One, lots of rain. Whether it's tropical systems (tropical storms, hurricanes, etc.) reaching land and dumping all its contents relatively quickly, or prolonged rain from thunderstorms in the same area, this kind of precipitation can cause rivers to flood. Melting snow can cause rivers to rise quickly, too.

Coastal Flood Coastal floods are caused by higher than average high tide and worsened by heavy rainfall and onshore winds." Lower elevation also plays a factor in coastal water flooding up on land.

Storm Surge
Storm surges are caused by severe storms. Strong winds, large waves, and low atmospheric pressure all help the tide rise abnormally high. Combined with high tide, storm surges can raise water level by 30 feet or more. A surge of ocean water come crashing over land can cause some wide-spread flooding. Storm surges are one of the biggest threats to life and property during hurricanes. At least 1500 persons lost their lives during storm surge and many of those deaths occurred directly, or indirectly, as a result of storm surge.
Inland Flood
There are a few different scenarios in which inland flooding can occur, although the end result is pretty similar. Steady rain over several days or intense precipitation in a short period of time can both cause the soil to become so saturated with moisture that it can't hold. Rivers overflowing is another cause of inland flooding. But no matter what the cause, virtually any area is susceptible to this kind of flood. Even homes built on hills can be effected by inland flooding.
Flash Flood Flash floods are heavy rainfall in a very short amount of time. Flash floods usually take place after less than six hours of rain, and are usually characterized by raging torrents that rip through river beds, urban streets, or mountain canyons sweeping everything before them. Even without heavy rainfall, flash floods can come rushing in unannounced. These surprise visits can occur due to a dam failure, or after water is suddenly released, such as the breaking up of an ice jam.

3. Methodology

The flood control measures are broadly classified into two groups viz Structural methods and Non-Structural methods. Mainly our focus will be governed by the non-structural measures despite knowing that the efficiency of the structural measures is good because of the restrictions imposed by the Indus Water Treaty.

3. 1. STRUCTURAL METHODS:

a) Construction of storage reservoirs that aims to store excess water during floods and release it when flood subsides. Generally, it is constructed on the upstream of the area to be protected or on the head reach of the river.

b) Confining the flow of river by construction of earthen embankments or levees.

c) Channel improvement works is the work performed to increase the discharge or the velocity of the stream or to decrease the stage and duration of flood. It includes increasing the cross section by widening and excavation of stream bed.

d) Construction of Diversion works and Flood Walls.

3. 2. NON-STRUCTURAL METHODS

Non-structural measures such as preparedness, response, legislature, financing, environmental impact assessment, reconstruction and rehabilitation planning, and their component techniques, contribute directly towards reducing losses of life

and damage to property. Non-structural measures play an important role in reducing not only the catastrophic consequences of residual risks, but also adverse impacts on the environment. Following strategies are adopted:
1. Flood and Compensate.
2. Underground floodwater tunnel
3. Channelization

CHANNELIZATION IN RIVER JHELUM

Channelization is a method of river engineering that widens or deepens rivers to increase the capacity for flow volume at specific sections of the river. As a result, during flood times watercourses can move more efficiently and facilitate more water, which results in less damage to banks. Furthermore, channelization can provide erosion control and the rehabilitation of watercourses. Despite these benefits, channelization can cause damage

further downstream where efforts to widen or deepen the river were not undertaken.

In case of alluvial channels (**like Jhelum river**), the channel surface consists of alluvial soil which can be easily scored. Moreover, the velocity is low which encourages silting. Therefore, in an alluvial channel, both scouring and silting may occur if the channel is not properly designed. The quantity of silt transported by water in an alluvial channel varies from section to section due to scouring of bed and sides as well as due to silting (or deposition). If the velocity is too high, scouring may occur. On the other hand, if the velocity is too low, silting may occur.

If the scouring of channel occurs, the silt scoured may deposit in the section where velocity of flow is very low , hence the capacity of channel will be decreased because due to silt deposition section gets reduced. Therefore, the alluvial channel should be designed such that neither scouring nor silting occurs. The velocity at which this condition occurs is called as **critical velocity.** such an alluvial channel is called a stable channel. Therefore, a stable channel is one in which banks and bed are not scoured and also in which no silting occurs. Even if there is some minor scouring and silting, the bed and banks of a stable channel remains more or less unaltered over a long period of time.

So in river Jhelum the critical velocity can be obtained by the concept of channelization. In channelization we identify some sections which need to channelized so that critical velocity is obtained, by obtaining critical velocity of river Jhelum we can easily increase water carrying capacity of river, which can be very much helpful in flood like situations.

Applying this method to the river Jhelum,we need channelization at various sites(sections) of river Jhelum from south to central Kashmir. We have selected some sites where channelization needs to be done. These sites are as follows;

1. Sangam (in south Kashmir). In sangam the width of Jhelum is very less (85.56m), so we need to channelize the section to broaden the flood way, so that water carrying capacity is increased.
2. Awantipora (in south Kashmir). In awantipora the river Jhelum Is meandered to a very high degree, so we need to channelize the section that is we need to decrease the degree of meandering, this can be done by realigning the section so that the effect of turbulence is minimized which ultimately decreases the erosion in the river. By decreasing the erosion, the silt formation will be less.
3. Pampore (in south kashmir). In pampore the width of the Jhelum is very less (73.22m), so we need to channelize the section to broaden the flood way, so that water carrying capacity is increased. As we are aware of 2014 flood in which whole pampore was submerged in the flood water.
4. Pantha chowk (in central Kashmir). Here the width of river Jhelum is also less(70.1m).

4. Results and discussion

The main aim of the project is to study the causes of floods and to mitigate and manage the same. The results of the project after thorough study of the basin are expressed as; since the capacity of the river Jhelum prior to the floods of 2014 was 35,000 to 40,000 cusecs and it reduced to less than 25000 cusecs due to the heavy siltation of the main channel of the river. Siltation of the river is a major cause of the flooding, hence the main aim of our study was to find the measures to reduce the silting of river Jhelum, but it was found out that in addition to the contribution of heavy silt from the tributaries entire catchment contributed to the addition of the silt into the river jhelum. Thus it was of no importance to construct a debris dam or to install the slit curtains on the major tributaries. Hence there is no alternative but to dredge out the slit from the channel time to time. The floods of 2014 resulted in a discharge of 1,15,000 cfs the proposition of this project is to prepare the basin to accommodate a volume of 547 Mm^3 and to discharge at a constant rate of 38,000 cusecs therefore the floods such as of 2014 caliber can be managed for an approximate time of 3.98 days. The impact of the project is such that it helps to mitigate the floods without the involvement of any sophisticated structural construction. For flood and compensate there may be the need of relocation of some population but that is what can be allowed keeping in view the damage caused by the devastating floods. The flood water can be accommodated in the proposed sites and the extra water is to be released in a controlled manner. If the flood waters are so enormous then the underground flood channel having a discharge capacity of 130 cumecs and the FSC of capacity 481 cumecs are used to divert the flood water, then the floods of 115000 can be mitigated for a time of approximately 3.98 days thereby saving the area of Srinagar from inundation.

5. Conclusion

Flood compensation method can be used to mitigate the flood water quite effectively. The site for the compensation has already been identified using software like Google Earth and Expert GPS. The carrying capacity of Jhelum under normal conditions is 38000 cusecs and the underground flood channel that we have proposed from Lasjin to Mujgund can carry flow of 5000 cusecs. 56000 cusecs out of total 1,15,000 cusecs need to be mitigated. The demarcated land can compensate to the demarcated land for 3,44,643 seconds (3.98 days).

The particle size analysis that we carried out at various sections have led us to the conclusion that the major portion of the soil in Jhelum basin is silty. Using the silt coefficient for silty soil and using Lacey's and Kennedy's regime theories we have obtained critical velocity at different cross sections. If we are able to maintain this critical velocity we can minimize both scouring and silting. Thus, the huge amount of money that is presently used for dredging can be put to use in a more effective and beneficial manner through our work, if adopted.

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