International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

STUDY OF ANTHROPOGENIC IMPACTS OF SILTATION IN WULAR LAKE (JAMMU AND KASHMIR)

Dr. Asiya Nazir

Deptt. Of Environmental Science, Govt. College For Women, M.A.Road,

Cluster University Srinagar, J & K (India)

ABSTRACT

The state of Jammu and Kashmir is the northernmost state of India and is bordered by the Himalayan mountain ranges. The topography of the Jhelum valley, the provenance of its sediments and their types suggest polycyclic phases of the mountain building activity. The palaeo-geological evidences are all suggestive of structural and lithological controls over the formation of a thick pile of varied lithology (Valdiya, 2001). During these episodes, there have been major deformations including tilting, thrusting and drainage modifications. But, due to simultaneous continuum of erosion, deformation and deposition, there is no single regional imprint of the palaeo-sedimentological processes.

The Wular Lake is the largest freshwater lake within the Jhelum basin and plays a strategic role in the hydrography of the Kashmir valley, by acting as a huge absorption basin for its flood waters. This study was undertaken to understand the cause of the floods within the Jhelum basin, especially in the vicinity of the Wular Lake. This study is, therefore, aimed at studying the relation between the structural, geomorphological, geochemical and anthropogenic factors which bring about flooding and to assess their effect on the siltation process within the lake. In this paper only anthropogenic impacts have been discussed so that awareness is generated and simple steps are taken in the first phase to alleviate complex situations arising out of it.

Keywords: Anthropogenic, Geomorphological, Hydrography, Lithology, Palaeo-Geological

I INTRODUCTION

Rivers have been called as life lines for the humanity because of their life giving utility and have been worshiped by man since mythological times. Most major civilizations in the world have emerged on the banks of major river systems. As a result, rivers have occupied a very prominent place in every stage of human development. Over thousands of years, these rivers have not only provided water for domestic needs and irrigational purposes, but have also enabled people to navigate along their banks.

The lake Wular in Kashmir is the largest of all wetlands of the Jhelum basin. It is perched in the midst of the lofty Himalayan mountain chains and is blessed with lush meadows, a beautiful climate and pure and transparent water bodies. It has inspired countless philosophers, poets and scientists who have visited its heavenly environs.

The Jhelum basin is a bowl-like depression within the northwestern complex of the Himalayan Mountains. Its complex structure, geology and evolution have intrigued many scientists even today. Its geomorphology is marked with unusual relief variations and drainage modifications. Due to its rich flora and fauna, the snow-capped hills, pleasant weather and sky blue waters, its countryside has been known a PARADISE, for the stressed city folk. However, there is a flip side to this paradise. In the past and even today, the valley is threatened with immense destruction of life and property due to floods, earthquakes and famines. These three natural disasters revolve around the important natural component of the environment of the Kashmir valley - the Jhelum Basin.

The Jhelum basin is dotted with wetlands which play an important role in maintaining the hydrological balance of the entire valley. Dal, Anchar, Manasbal and Wular Lake are some of the largest wetlands of the basin. Extensive marshes also exist in the lower areas of the basin through catchment drainages, particularly between Srinagar and Sopore. Major marshes include Rakhs, Asham, Nowgam and Malgam and recently a large portion of these has been drained and reclaimed for agriculture and settlements.

The lake Wular, along with its associated swamps, plays a critical role in maintaining the uniformity of water flow in the River Jhelum. During the peak summer months, these wetlands store the excess river water and thereby prevent the valley from floods. During lean flow season, from November to March, these wetlands and marshes release the stored water. As a result uniformity of flow in the River Jhelum is maintained within the valley.

The present study has been undertaken to review the environmental status of the Lake Wular. This wetland is also an important habitat for migratory water birds, along the Central Asian Flyway, which supports its rich biodiversity. The lake is a major fishery resource in the valley, supporting a large population living along its fringes. It also generates revenue to the state government through fisheries and auctioning of water chestnut, fodder and other economically important products. The catchment of the lake supports coniferous forests and alpine pastures, adding to the natural beauty and biodiversity of the wetland area. Recognizing the importance of Lake Wular for its biodiversity and socio- economic values, it was designated as a **Wetland of International Importance** under **the Ramsar Convention** in 1990.

Presently, the lake Wular is being heavily silted due to natural erosive processes, as well as, by man's activities. The valley of Kashmir has also been constantly threatened by earthquakes and floods due to its location in the midst of a tectonically active Himalayan terrain. These two natural threats and man-made interference has endangered the human settlement in the valley. In view of these facts, the need has arisen to systematically study and assess the causal factors for the floods and the pollution hazards and look for their minimization. The major crisis of siltation is, therefore, been dealt in the present study with the main focus on anthropogenic impacts.

II ANTHROPOGENIC IMPACTS

The natural erosive processes have been accelerated due to the physical deterioration of the hill slopes around the Wular catchment. The Wular Lake, today, is overexploited due to the land acquisition and is subjected to large siltation rates. It is mainly because of deforestation and creation of residential zones wherever hilly tracts have been affected by man's interference. The very existence of the Wular Lake is, therefore, threatened due to overexploitation of resources and encroachment by burgeoning population **(Photo 1.1).**

Photo 1.1 Steep gradient and almost flattened morphology of the Wular lake

The factors affecting and increasing the siltation rates are as described below:

a. **Conversion for agriculture and horticulture development:** A Rapid increase in the population has accelerated the need to bring more area under agricultural and horticultural development at the cost of forests.

b. **Increasing dependence for energy:** Kashmir valley has one of the highest dependence on forest resources and the highest annual average per capita consumption of fuel-wood. However, the regenerative capacity of the forests has come down sharply owing to degradation. As a result, the forests are capable of meeting only 20% of the fuel wood demand. The forest line, therefore, has shrunk along the margins of the lake. In the vicinity of Kuhnis village, situated along the banks of Wular, the forest line has receded by 0.8 km during last 30 years, whereas the women of nearby Panzgam village have to struggle more than2 km more everyday to collect fire wood.

c. Adoption of erosion intensifying agro practices in catchments: The past surveys have indicated that nearly 30% of the area belonging to the Wular catchment, under dryland agriculture, is under severe erosion as these are ploughed across the contours. This has resulted in creation of channels, streams and gullies contributing high sediment load into the lake. High fertilizer intensity in horticultural lands also contributes to the river water pollution, which ultimately drains into the lake Wular.

d. Degradation of high altitude pastures: The pastures under the Wular direct catchment are under constant pressure of the nomadic grazers (**Photo 1.2)** According to the official government reports, 2000 ha of the pasture land, today, is identified as severely eroded, 2,500 ha as moderately eroded and 4,100 ha as slightly eroded (Report, CMAP)

Photo 1.2 Grazing activities in the encroached land within Wular catchment

e. **Quarrying:** Quarrying is an intensive activity in the direct catchment, particularly along the Bandipora-Srinagar road in the Sadarkote sector. During the course of survey, a number of stone quarries in the Wular direct catchment, especially concentrated in Sadarkote Bala were observed (**Photos 1.3** and **1.4)**. These quarries run throughout the year and dislodge tremendous quantity of loose detritus into the lake bed during the monsoon seasons. Besides these, sand and bajri mining is also practiced intensively within the Madhumati river catchment. These activities severely alter the natural siltation profile of the catchment. Degradation of the catchments has contributed to high levels of erosion. Similarly, remote sensing surveys on slopes and land-use patterns reveal that 43% and 19% of the catchment area falls under moderate to high erosion categories, respectively.

Photo 1.3 Mining activities in Pir Panjals.

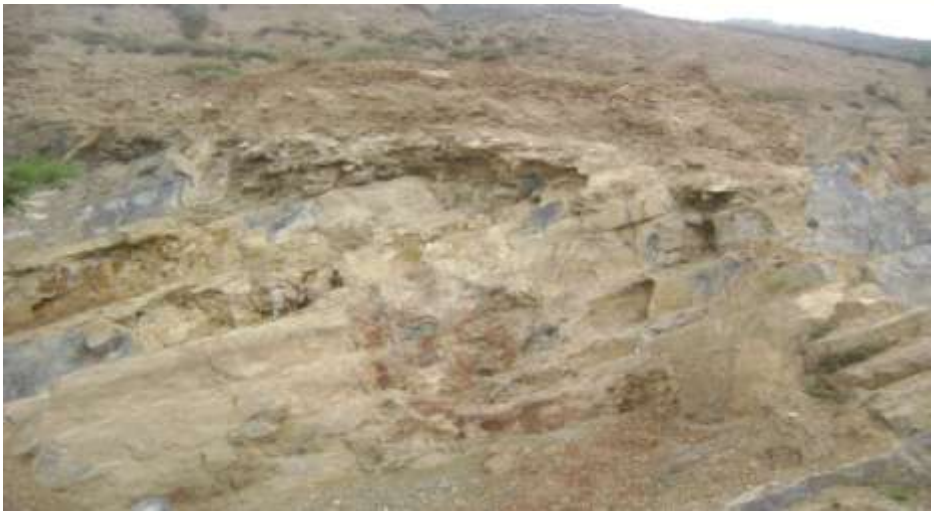

Photo 1.4 Quarrying practices along the steep slopes

f. Poverty: High dependence on natural resources, declining resource base and limited opportunities for occupational diversification have led to high levels of poverty within the communities.

g. **Changes in resource harvesting methods:** Declining resources have forced the communities to adopt more exploitative forms of harvesting, particularly, in case of fisheries. For better yield, fishermen have resorted to use of nylon nets with lower mesh sizes and long gill nets which drastically affect the regeneration of resources. This has also created conflicts amongst various fisher groups within the lake.

h. **Encroachment of Wetland area by various enterprises:** Many government, as well as, private enterprises have encroached upon the wetland catchment, thereby shrinking the original area and making the slopes more vulnerable to erosion, wherever such landforms are occupied **(Photo 1.5 and 1.6).** Such practices should be thoroughly checked by the concerned departments and strict actions should be taken against the parties involved.

Photo 1.5 Encroachment of Tourism Department along the lake catchment which has led to deforestation and unstable hill slopes

Photo 1.6 Encroachment of a Petrol pump within the premises of Wular

2. OTHER FACTORS

Other environmental factors which deteriorate the water environment of the lake Wular include the following:

a. Lack of sanitation facilities: Absence of adequate sanitation and safe drinking water facilities have led to severe health hazards, particularly for the lakeshore communities. There is a sharp rise in the water borne diseases such as gastroenteritis, jaundice and diarrhoea. Presently, less than 2% of the households living in the lakeshore villages have access to safe sanitation facilities and 42% use untreated water from Wular for domestic purposes rendering them highly vulnerable to water borne diseases and infections (**Photo 1.7**).

Photo 1.7 Lavatories with open drains entering the lake area

b. **Problems in lake transportation**: The lake Wular provides an important mode of communication within its shoreline villages. However, silting up of large areas and reduction in water spread has reduced access and increased travel time for several lakeshore settlements, particularly those living in the eastern periphery of the lake.

Following key issues have been identified during the assessment of community profile and resource linkages:

i. **Absence of community participation in resource management:** Although, most of the communities, living around the lake Wular, are dependent on its natural resources, they have little participation in the resource management. The government departments, on the other hand, are largely focused on revenue generation through enhancement of resource extraction. The current resource management system, therefore, is untenable and there is dire need for institutional reorganization, with active participation of the user groups.

ii. **Declining resource base:** There has been a drastic decline in the natural resources, both, within and outside the Wular catchment leading to decline in income and thereby poverty within the communities. There is also a very limited emphasis given on the value addition and post harvest management. Absence of access to economic infrastructure such as banking and credit facilities has rendered the communities vulnerable to money lenders, which lead to lower price recovery, pushing the communities into the debt traps.

iii. **Developmental Activities and their Impacts:** Wular and its associated wetlands provide ecological and economic growth to the entire valley as they assure food (fish and aquatic vegetation) and also serve as centers of tourist attraction. Agricultural growth has been constrained due to limited availability of land and irrigation facilities. Nature-based tourism today dominates the economy, contributing more than 50% of the state income. However, these developmental activities have failed to recognize the immense role of the wetlands and have led to their large scale degradation.

3. LAND-USE MODIFICATIONS

A comparison of the SOI toposheets of 1911 and the imageries of 2007 indicate an overall reduction in wetland area by 45% (157.74 sq km to 86.71 sq km. **{Fig. 1.3 (a,b) and Table 1.1}**

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

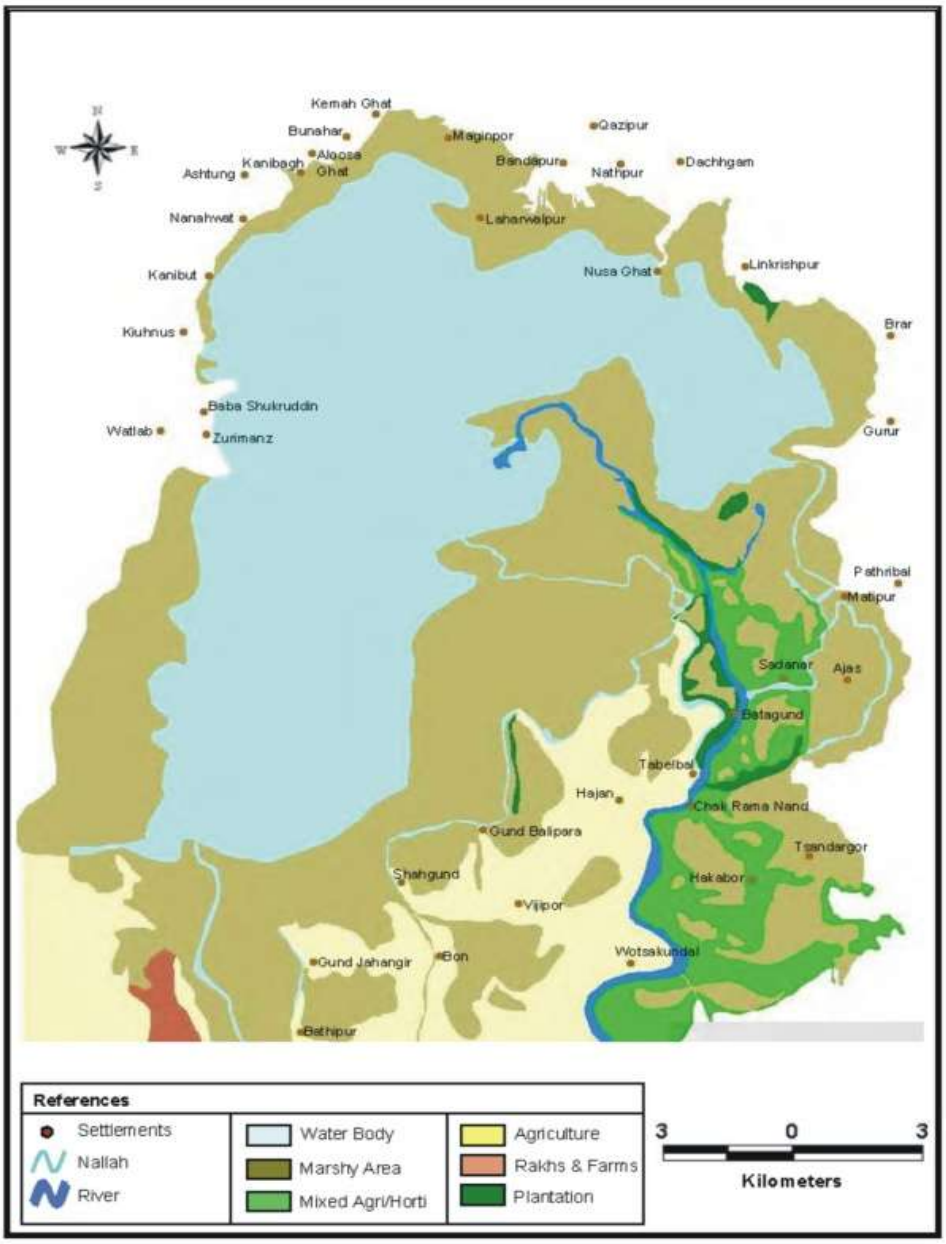

Fig. 1.3 (a) Land-use (1911)

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

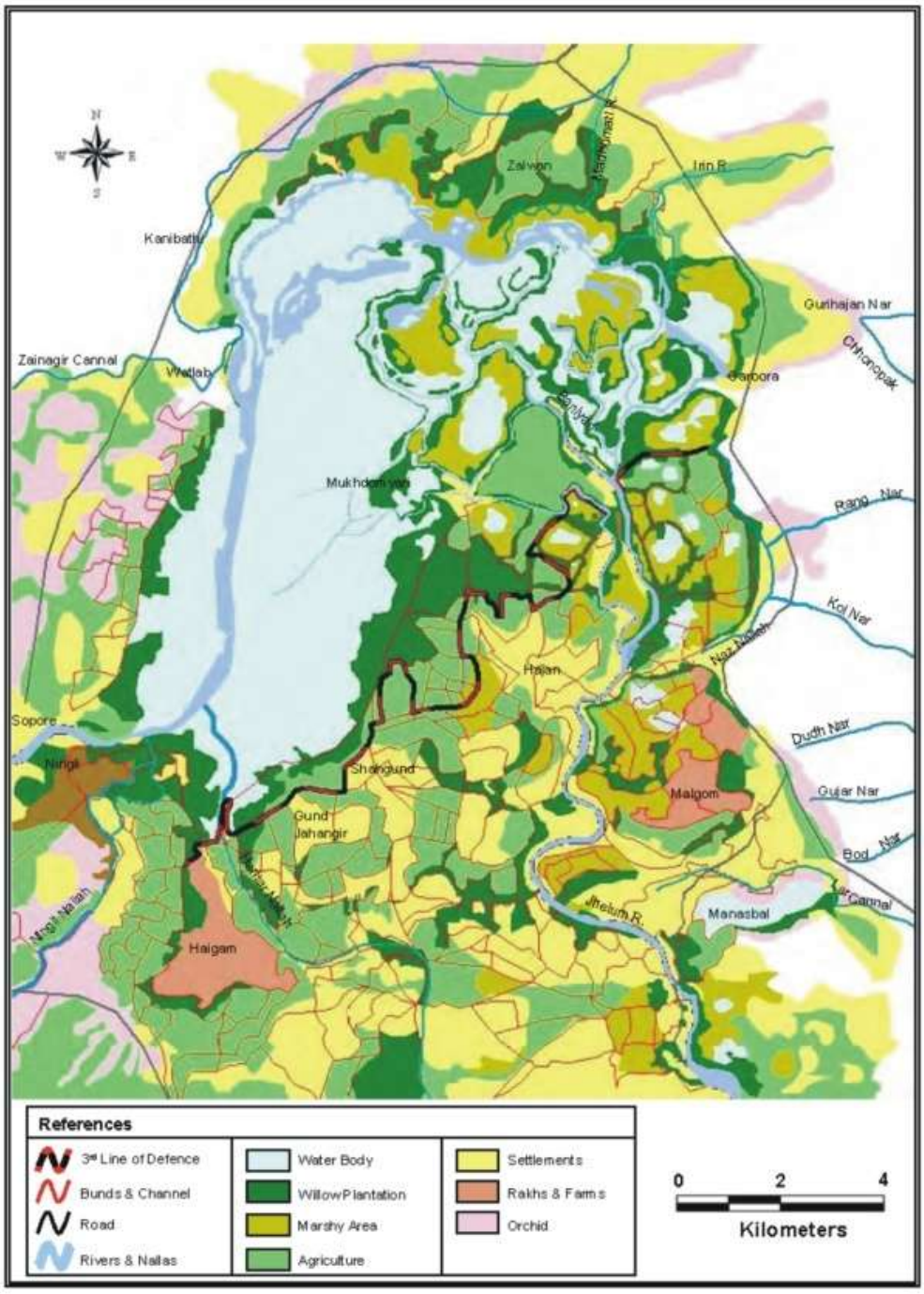

Fig.1.3 (b) Land-use modifications in the lake Wular (2007)

(Source: Comprehensive Management Action Plan, Wetlands International, South Asia)

These changes between various land-use categories within the Wular wetland and associated marshes are presented in **Table 1.1.**

Table 1.1 Land-use modifications in and around Wular

Land-use categories		Area (sq. km)	
	1911	2007	NET CHANGE
Water	91.29	75.23	-16.06
Marsh	66.45	11.48	-54.97
Plantation	0.66	27.30	26.64
Agriculture	0.38	44.25	43.87
Settlements	0.43	0.95	0.52
Total	159.21	159.21	
Associated Marshes	58.67	17.67	-41.00
Net Total	217.88	176.88	-41.00

This shows that the water body and marshy areas of the wetland has reduced from about 91 to 75 and 66 to 11 percent respectively with a subsequent increase in plantation, agriculture and settlements, resulting in an overall change of more than 40 percent.

4. CONCLUSION:

Man-made interferences within the catchment of Wular has thus resulted in

4.1 Shrinkage of wetland area and resources:

Several wetlands of the Jhelum basin have been converted for alternate land-use like

a) Wetland complex of Batmaloo-Bemina has been reclaimed for development of housing complexes.
b) A large chunk of marshes along Bad Nambal, Rakh Ajas, Malgom, Haigam, and Nawgam have been reclaimed for agricultural purposes.
c) Within Wular Lake alone, 71.55 sq km of the lake area has been reclaimed for willow plantation and agricultural development.

Wetland resources, particularly fish, food and fodder support the livelihood of the villages located around Wular. of these resources, the fish and nadroo, have recorded a drastic decline of 87% and 46%, respectively, over the last fifty years. This acute loss of resources has brought about high levels of poverty, within these communities.

A scrutiny of the stage volume relationship derived for the Ningal Barrage Project, indicates a loss of 91.56 Mcum of capacity at 1579 mts amsl elevation (max water level) over a period of effectively 30 years. Thus, about one fifth

of the water holding capacity has been lost which is equivalent to an annual lake sedimentation rate of 2470 acre ft. In addition to the reduction in water holding capacity, the capacity of the river to carry the flow of water through Srinagar city is also not sufficient to accommodate a flood discharge of more than 35000 cusecs (991.221 cumecs). So, the construction of an additional supplementary spill channel has been proposed at Dogripora to divert a river discharge of 1302.75 cumecs directly into the lake Wular, during floods. But, now it is impossible to allow the extra discharge of river to spill over in these low lying areas as they are highly urbanized and the residents will resist it tooth and nail. A comparison of the Survey of India toposheet of 1911 and the satellite imageries in 2007, indicate an overall reduction in wetland area by 45% (157.74 sq.kms to 86.71 sq. kms) during this period.

4.2 Fragmentation of wetland regimes: The connectivity of wetland complexes within the basin is being progressively reduced, primarily due to the construction of embankments or other structures and siltation of channels. This has resulted in the shrinkage of wetlands. For example, the wetland complex, adjoining the Wular, extending to more than 60 sq km in 1911 has been reduced to less than 14 sq km due to the construction of flood protection embankments and change in land use for agriculture.

4.3 Changes in hydrological regimes:

Due to the modifications in the land use of marshy areas for agriculture and residential zones, the hydrological regimes of the wetlands have been severely altered, leading to reduction of water levels of the River Jhelum and loss of water holding capacity in the upstream reaches of the basin. The hydrological assessments for Wular lake indicate shifts in the water storage period from peak summer months to lean seasons, thereby reducing the capacity to regulate flow regimes. This has affected the overall water availability within the basin, leading to more frequent occurrence of droughts and floods.

4.4 Decline in water quality:

The water quality of the wetlands has significantly deteriorated due to uncontrolled dumping of sewage and solid waste by human settlements. The situation is severe in Wular Lake where the domestic waste is dumped into the river, leading to high incidences of water borne diseases in the local communities.

4.5 Loss of biodiversity:

Several native fish species have been reported to be declining due to deteriorating water quality. The water-bird population has also declined due to declining food availability and shrinkage in water spread area.

The Jhelum system is unique and does not exhibit the characteristics of other Himalayan rivers. It is in a well established meandering form and has not changed its course since the last several decades.

The river simultaneously provides water for irrigation use and for other allied lifeline measures. It plays an important role for the economy of the valley. The numerous water bodies, streams, springs and the lakes of the valley are intertwined with the main river, thereby, seriously affecting its alignment, water levels and discharges. The presence of a large number of marshy lands adjacent to its banks helps in providing large space during floods.

4.6 Insufficient Flood Mitigation Measures

The mitigation measures regarding flood hazards in the Jhelum river have been carried out since historical times. Spillways were dug to divert the flood waters away from the residential zones. Avantivarman's engineer minister, Suryya (855-83 A.D.), carried out de-silting of the river bed between the Wular lake and Baramulla, to speed-up the water discharge from the valley. But, it also gave way to the reclamation of large tracts of land for cultivation. He had also changed the course of the Jhelum to irrigate the dry and barren zones of the valley.

A pragmatic development of any basin requires appropriate management of land, water, energy and green cover. In order to find a tangible solution to floods various proposals were put forth (R.E.Parves, Mr. Tulsi Dass, Mr. D.G.Harris and Dr. H.L.Uppal, 1956). Some of their important suggestions are:

- Improvements of Out Fall Channel (OFC) by

a) Diversion of Ningal into Wular Lake,
b) Diversion of sediments of Pohru Stream into Wular lake,
c) Removal of Ningli plantation above Sopore,
d) Removal of debris from Out Fall Channel,
e) Diversion of detritus brought by the streams away from the Out Fall Channel,
f) Construction of revetments along meandering zones of the river from Sangam to Banyari for deepening of river beds, etc.

The other measures include

(i) Increasing the discharge capacity of flood spill channel,
(ii) Improving of city channels by raising bunds
(iii) Increasing the length of the Pohru stream for saving expenditure on dredging
(iv) Reducing silt transportation,
(v) Raising of river banks from Khanabal to Srinagar by 0.91 to 1.22 mts above maximum flood level
(vi) Providing escapes at different places for discharging spill water into the valley,
(vii) Raising and strengthening of banks through Srinagar by above Highest Flood Level,
(viii) Improving the capacity of the old channels from Shadipora and Asham to Ningal and Muj-Gund to Wular,
(ix) Strengthening the bunds and construction of supplementary flood channel from Dogripora to Wular.

In 1959, a Master Plan was prepared in collaboration with the Central water and Power Commission. This was mostly based on the data collected and proposals framed by Dr. Uppal. Because of limited financial resources, the proposed works of Master Plan,1959 were confined to improvements of the outfall channel only.

Therefore, a High Level Flood Committee was set up in 1975 to recommend measures to be adopted for the flood control in the valley.

The committee submitted the following recommendations and proposals:

a. To construct free boards on the southern and northern banks to allow a flood discharge of 2548.85 cumecs at Sangam.

b. Implementation of anti-erosion works on tributaries.

c. Prohibition for plantations on embankments and in water ways of rivers and removal of existing plantations by enforcing the Embankment Act.

d. Implementation of a Central Flood Protection Scheme for the valley and to ensure integrated execution for completion of the project.

e. Provision of automatic gauge stations wherever required.

f. Provision of necessary equipments & apparatus for recording cross-sections, velocities and sediment load observations especially during floods.

g. Establishment of a suitable organization for conducting regular observations of cross-sections and studying of the behavior of the river, FSC and major tributaries.

In the year 1976, the State Irrigation and Flood Control Department, the Central Water and Power Commission and the State High Level Flood Advisory Committee under the chairmanship of Dr. Uppal framed a master plan for the flood management of the river Jhelum at a cost of 15.00 crore, which is in addition to construction and strengthening of river embankments and recommended reactivation of flood spill channel.

The present status of these schemes still lie in redundant, due to lack of community support and political will. These problems may be tackled effectively only by participatory management of the government and efforts by the local population. The major thrust will have to be borne by the activities, such as

- Afforestation along the hill slopes, beginning with creepers on deserted slopes,
- Ban on further acquisition of land within the lake,
- Soil conservation measures in the catchment
- Rehabilitation of those civilians residing within the flood-prone areas.
- Small bunds or embankments will have to be constructed all along the lower order streams in order to minimize the sediment transport towards the lower reaches of the streams and
- Periodic de-siltation must be carried out in order to prevent the choking of the main rivers.

One such attempt in 1904, to reduce the intensity of floods, was made when a spill channel was excavated through the swamps of the Wular lake to carry flood water at some distance away from the main channel. Such spillways may be designed in future considering the open spaces and the rapid increase in the urbanization zones.

REFERENCES

1. Valdiya, K.S. (2001), dynamic Himalaya, JNCASR, University press, (India), ltd, 178 pp
2. Kundangar, M. R. D., Sarwar, S.G., and Shah, M.A., (1992) Ecology and conservation of wetland of Wular Lake (Kashmir). Final report submitted to the Minstry of Environment and Forest, Govt. of India.
3. Agrawal, D. P., Rekha D., Kotlia, B.S. and Sahni, A. (1989) The Plio-Pleistocene geologic and climatic record of Kashmir valley: A review and new data., In: Paleogeography, Paleoclimatology, Paleoecology 73 (3-4): 267-286.
4. Singh I.B. (1982) Sedimentation pattern in the Karewa Basin, Kashmir Valley, India, and its geological significance. Pal. Soc. India, 27, 71–110
5. .Zahoor – Ul – Hassan (2009) Anthropogenic Impacts on the Wular Catchment: M.Phil Dissertation Submitted to the University of Kashmir (unpublished).
6. Wilkinson, H. (1963) Man and Natural Environment, Department of Geography, University of Hull, V- 1, pp 33.
7. Pandit, A. K., (1978) Geography of Jammu and Kashmir state. Light & Life Publ, New Delhi, (Updated by Bamzai P.N.K.) pp 200.
8. Sarwar, S.G., Kundangar, M.R.D and Shah, M.A. (1992) Abiotic Environment of Wular Lake, Kashmir: Current Trends in Fish and Fishery Biology and Aquatic Ecology. pp 213 – 215. (Published by P.G.Deptt. of Zoology, University of Kashmir)
9. Valdiya, K.S. (1992) Main boundary thrust in Himalaya, Annales Tectonoae, V- 6, pp 54- 84.
10. Stein, M.A. (1961) Kalhana's Rajtarangini (Translated with an introduction, commentary and appendices) V-11, pp 386 – 431.,Motilal Banarsi Dass (Publ), Delhi.
11. Ramsar Sites of India (1994) A Project Report on Wular Lake, Jammu and Kashmir, Published by World Wide Fund For Nature, India. pp 4 – 28.
12. Project Report On Floods by Deptt. of Irrigation and Flood Control, Govt. of Jammu and Kashmir, Srinagar, India.
13. Raza et al. (1978) The Valley of Kashmir – A Geographical Interpretation, Vol 1- The Land, Vikas Publishing House, New Delhi, pp 10 – 12, 24 – 25, 38, 44 – 45, 58.
14. Uppal, H.L. (1956) Flood control, drainage and reclamation in Kashmir Valley, Central Water and Power Commission (Publ)., pp 467.

.