Economic Appraisal of Water-Ecosystem in Jammu and Kashmir: India

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ABSTRACT

Aims: The aims of the current paper is to provide a comparative analysis of the water ecosystem in the state of Jammu & Kashmir in India and to highlight economic potentiality of the two nerve tributaries; Dal lake and river Jhelum to the farmers and other communities of the Kashmiri society.

Study design: The temperate region of Kashmir valley is bestowed with many water bodies in the form of springs, lakes and rivers. Kashmir region is world famous for its lakes viz; Dal lake, Wulur lake, Mansbal lake, Anchar lake, Nigeen lake; springs viz; Kokarnag, Verinag, Achabal and river Jhelum etc. Dal lake and river Jhelum are known to be the nerve tributaries of the valley and various communities are dependent on these water bodies for their livelihood.

Methodology: Contingent valuation method and willingness to pay techniques were used to analyse the data and interpret the results.

Results: The results revealed that economic value associated with the selected water bodies was worth millions of US$. Most of the population in the valley depends on these water bodies for their livelihood. In addition, the results reveal that over the years, pollution and encroachment of these water bodies has increased manifold reducing the width, depth and recreational value of these water bodies. Though every stakeholder is willing to pay for the restoration of these water bodies, however, little or no attention is being paid by the local government towards their, management, sustenance and conservation.

Conclusion: The study conclude that over the years due to growth of population in the valley along with the ever increasing influx of floating population in terms of tourist arrivals. The selected water bodies (Dal lake & river Jhelum) came under heavy stress, culminating into the deterioration of their aesthetic and recreational value besides drastic reduction in their revenue generation for their poor water quality and mismanagement. The restoration of these water bodies, which in addition of providing employment to the stakeholders in huge numbers also generate revenue worth millions of US$, demands devising a pragmatic policy by the government towards their conservation and restoration of their lost glory through efficient management and monitoring system.

Keywords: *Ecosystem, livelihood, recreational value, economic value, evaluation, restoration*

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1. INTRODUCTION

Water resource is of immense importance owing to its uses in agriculture, industry, household, recreation and environmental activities, besides its significant role in addressing the priority Millennium Development Goals (MDGs) of reducing hunger and poverty by providing food directly through its natural state and indirectly through nourishing our landscapes. Water systems are very sensitive to human activities in their surrounding drainage basins. Lakes, for example, are sinks for inputs of water, and the materials and pollutants carried in it, thereby being sensitive barometers of human activities in their surrounding watersheds [1]. Experts insist that dumping of biological waste, irrational exploitation of biodiversity and increased eutrophication etc., lead to the disturbances in the physical, chemical and biological properties of water bodies which in turn result in degraded ecosystems and loss of biodiversity. [2-6]. This deterioration of natural resources is a potential threat to the existence of mankind and is largely attributable to humans themselves. Among the various forms of water resources, rivers and lakes are dynamic with high degree of physical and biological complexity. Being the centre point of human settlement for ages, such water bodies are perhaps the most affected ecosystem on the planet [7]. Even today, they continue to be heavily exploited for meeting societal needs stemming from urbanization, industry, and emergence of tertiary sectors. The most reported anthropogenic activities leading to water ecosystem degradation are deforestation, changing land-use dynamics (from desired to undesired ecology), industrial pollutants/pesticides/wastes, water withdrawals, climate change/temperature increase, extinction of exotic species, and overharvesting/overfishing [8-10,7, 10-13, 7,14,10,15-16]. In an effort to sustain the water ecosystem, the world community is struggling hard to arrest deteriorating ecosystems and its services for our future generations. Thus valuation of the goods and services provided by the ecosystem, along with the estimation of the economic value of both use and non-use values would clear links between ecology, environment and economies. The scenario of water ecosystems, however, differ widely across different regions/locations. Himalayan region in the J&K occupy 62 per cent of the total Himalayan glaciers which besides providing fresh glacial water to meet the needs of the downstream population, supports adventure tourism, winter sports, recreation, generation of hydro-power, irrigation of agricultural fields and livelihood security to most of the people living in the upper reaches of the state that remain cut off from rest of the state/country during harsh winters. Water, either in glacial form or in springs/rivers and lakes reflects the nature's ultimate beauty in Kashmir. Dal lake and river Jhelum being twin lifelines of Kashmir valley, represent valuable environmental resource with consequent high preservation, conservation and utilization value [17]. River Jhelum originates from Verinag spring which is housed within the Pir Panjal range of inner Himalayas. Several freshwater streams starting from the Pir Panjal Mountains meet with Arpal, Bringi and Sanderen streams to form river Jhelum at Khanabal (Anantnag). The river is joined by about 21 major tributaries on either side of its entire route of 239 kilometres from Verinag to Uri, and flows further 753 km's beyond Uri into Pakistan. The river flow is sluggish in nature and its width varies across its length, from 150 ft. at Khanabal (Anantnag) to 692 ft. at Asham (Baramullah). Jhelum contributes significantly to the state's agricultural economy by irrigating about 83 thousand hectares of land. Besides providing the services of extending safe and fresh drinking water, generating

hydroelectricity, it also provides livelihood opportunities through sand extraction, transportation and fishing to number of families residing alongside of the river as shown in fig 1(a) & (b). Dal Lake, a Himalayan urban lake is located in the Srinagar city of Jammu and Kashmir (J&K) at an altitude of 1,775 m with a mean latitude of 3407 N/and of 74052 E/longitude. By the year 1980's, the area of lake reduced to 25km^2 from 75km^2. Yet again, owing to drastic geographical change this lake now stretches barely over a surface area of 11.4 km^2 [18]. The shore line of the lake, about 15.5 km long, is encompassed by a boulevard lined with Mughal era gardens, parks, houseboats and hotels. At the periphery of the lake there are floating gardens, known as 'Rad' in local Kashmiri language. The Dal Lake is also an important source for commercial operations like fishing and water plant harvesting. Floating gardens of the Dal Lake [19], resemble the 'Chinampas' of old Mexico. Dal lake has four basins; Gagribal, Lokut Dal, Bod Dal and Nagin (also considered as an independent lake). Lokut-dal and Bod-dal each have an island in the centre, known as Rup Lank (or Char Chinari) and Sona Lank, respectively. The houseboat site is a prime tourist attraction, especially for foreign and outside valley tourists. A barge known as Doonga and Shikara services that each houseboat carries are used to provide to and fro water transport services to the tourists. Both, river Jhelum and Dal lake provides a range of direct and indirect services with substantial economic values. Cities and towns have been established on the banks of these water bodies over centuries to avail goods and services including sanitation, transportation, water for drinking, agriculture, livestock, and fishing. However, for the past one and a half century, the added services from these wetlands including hydropower generation, sand extraction, water transport, water sports and irrigation for the crop lands, etc. have invited attention of more stakeholders to take advantage of this rich natural resource and its services. Independent of these direct uses, both the water bodies have 'existence' or 'passive use' values commonly referred to as non-use values. (These are the value placed by any individual on a particular environmental asset simply because it exists and gives him/her satisfaction, and a desire to bequeath this asset for future generation). Persons deriving non-use value, not only express their concern towards clean environment but are also willing to pay for its conservation [20]. The tributaries and wetlands of Jhelum and Dal have been the focus of environmental and ecological research in Kashmir, the economic aspects of their use and non-use services have, however, hardly been estimated. Studies highlighting long term trends in the physical and chemical properties of water and biodiversity of the river are, either scarce or absent. The meagre and scattered evidence available, reveal a significant human led interventions in the water quality parameters, biodiversity and changing hydrological regimes of these Water bodies [21-23]. In this regard, this paper conducts a comprehensive evaluation of the services/goods provided by these two water bodies to justify an integrated ecosystem approach for their preservation on a sustainable basis. It also attempts to estimate the total economic value of these wetlands by calculating their use and non-use values along with assessing the tourist behaviour, chemical health and the returns that accrue to stakeholders in and around these rich natural resources.

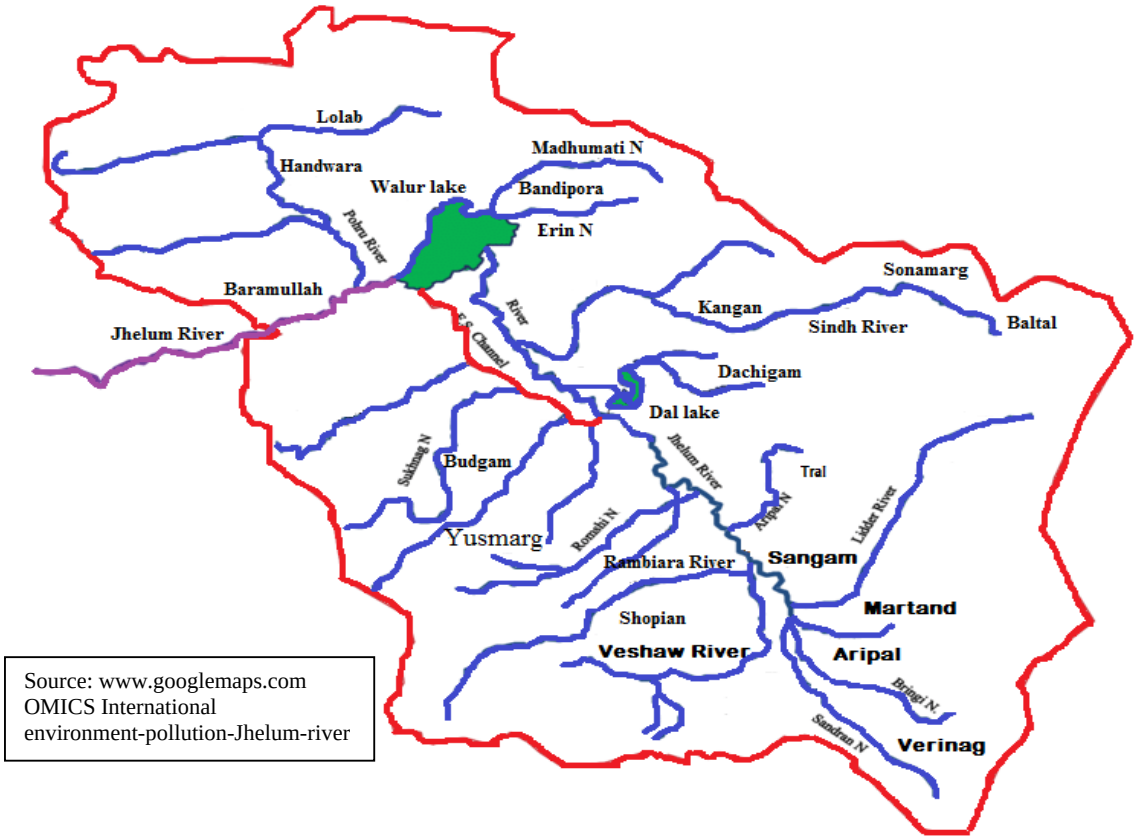
1.1 DAL LAKE AND ASSOCIATED PROBLEMS

Dal, a natural lake is located in the Srinagar city, the summer capital of Jammu and Kashmir (J&K) at an altitude of 1,584 masl. With a mean latitude of 34071 N and of 740521 E longitude. In 1,200 AD,

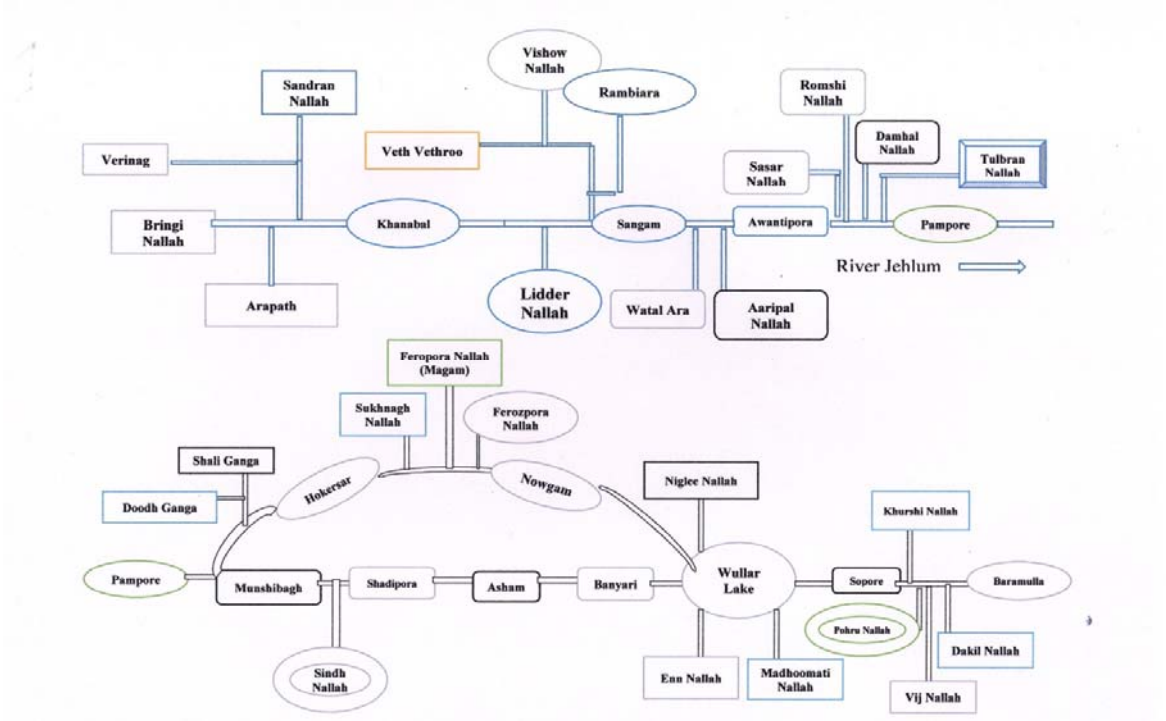
the lake covered an area of 75 km^2 and by the 1980s; it has shrunk to a mere 25 km^2. Yet again, owing to drastic geographical change this lake now stretches barely over a surface area of 11.4 km^2. The Lake figures among the age old national heritages of the country, having multi-faceted ecosystem. Its magnificence is inviting the attention of tourists all around the world. The lake with a wonderful recreational potential invites a great global tourism. Not only this, the lake is having a great commercial potential for fishing and in supplying drinking water to a sizable population. Besides, huge number of activities carried out within the lake itself, the blossom of lotus flowers during July and August provides livelihood to the dal dwellers and serves equally as a great recreation for tourists and also additional earnings to the Dal dwellers. Dal has four basins; Gagribal, Lokut Dal, Bod Dal and Nigeen (which is also considered as an independent lake). Lokut-dal and Bod-dal each have an island in the center, known as Rup Lank (or Char Chinari) and Sona Lank respectively (fig 2 (a) & (b)). Over the last 30 years the lake is facing many problems like encroachment, siltation of fine mineral particles, waste disposal, deposition of pollutants and depleting water quality to hold on to its existence. The problems began primarily in the 1980s, when encroachments started coming up around the lake area. Similarly, the growing tourist influx resulted in the construction of hotels on its banks and houseboats within the lake in big way which contributed negatively towards sustenance of Dal. Waste materials from these commercial units through underground drainage system is disposed in to the lake directly contributing significantly to the eutrophication of Dal. During the recent times, with the growing number of hotels, new sewage lines were also constructed in Srinagar and, as per reports (Green Kashmir) approximately 12 to 15 outlets dispose untreated sewage directly into the lake.

1.2 RIVER JHELUM AND ASSOCIATED PROBLEMS

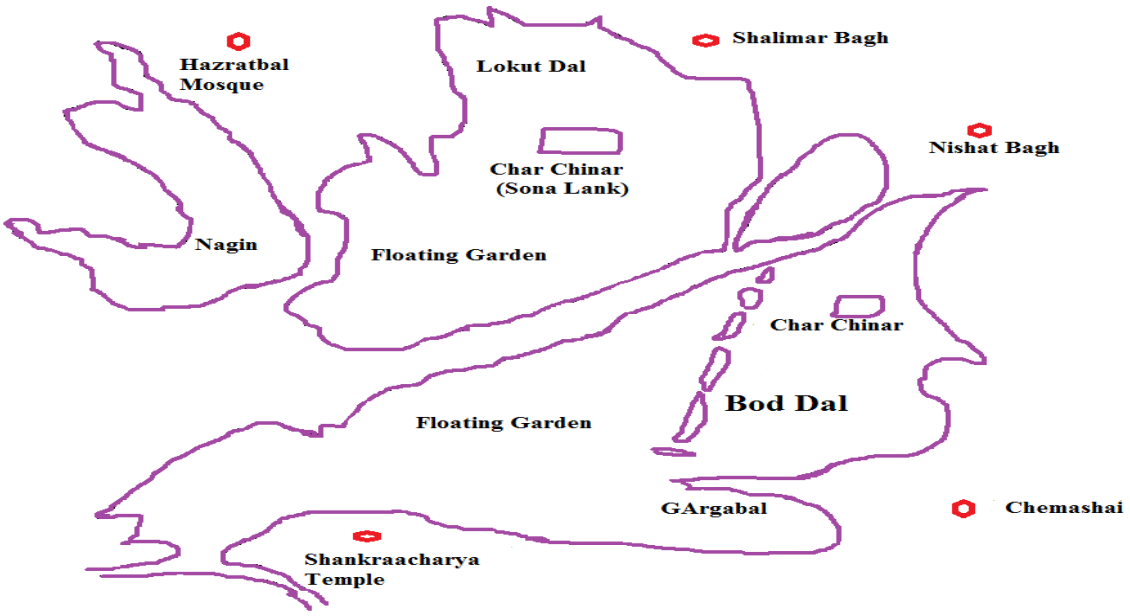
Famous for its beauty and a main source of hydropower and irrigation, the river Jhelum plays a major role in the socio-economic upliftment of the people. The embankments of the river Jhelum are used by the Department of Tourism as perfect sites for camping or trekking and promises relaxing cruises down the river. The river flows 263 kms. along entire Kashmir before it enters into Pakistan. Along its course of flow, the river is facing the threats of encroachment, pollution and siltation. Maximum deterioration of the river was observed between 1990s to 2005, owing to less institutional attention towards its management during the turmoil/disturbed conditions in the Indian state of Jammu & Kashmir. Similarly, the un-authorised encroachment of the river added more to pollution and siltation that resulted in floods of 2014-2015 incurring a trillion loss to the state. Triggered by siltation, encroachment of the Jhelum and change in land use, ranging from rampant deforestation to unplanned urbanisation and reckless use of agriculture chemicals, deteriorated the water quality of the Jhelum, which is turning unsafe for consumption by every passing day and needs immediate attention for its proper management.



131
132 **Fig 1(a): Map of the river Jhelum**



133
134 **Fig 1(b): Diagrammatic Outline of the river Jhelum**



Source: ww.googlemaps.com
Dal Lake | Rangan Datta
rangandatta.wordpress.com

Fig 2(a): Map of the Dal Lake

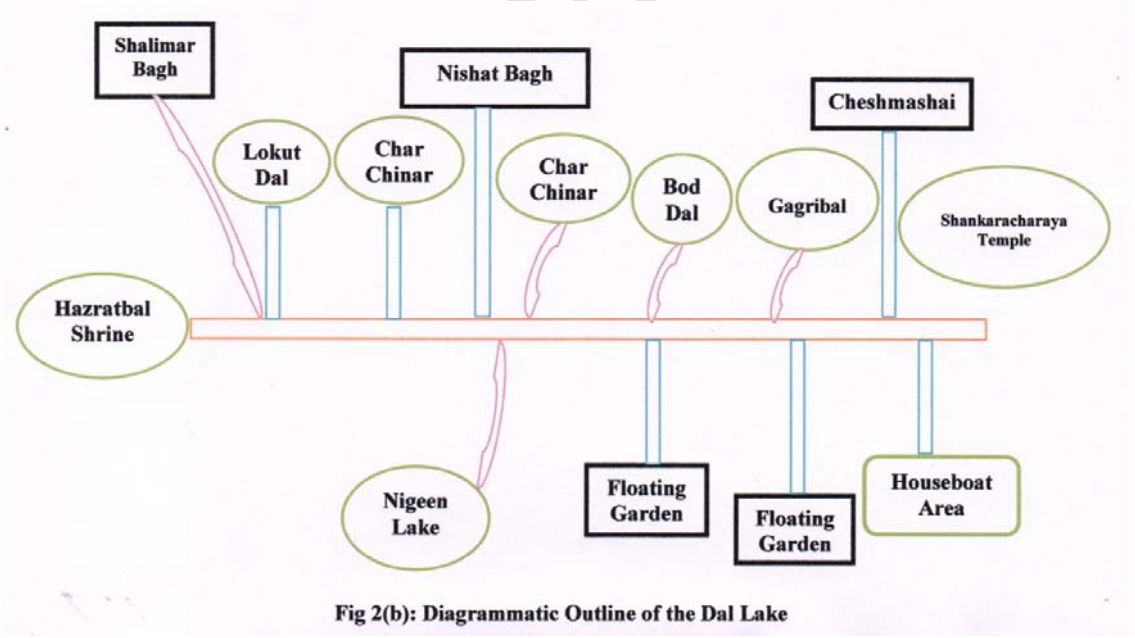


Fig 2(b): Diagrammatic Outline of the Dal Lake

2. METHODOLOGY

The study is based on both primary and secondary data. While the secondary data was collected from various official reports of Government of Jammu and Kashmir, the primary data was obtained through a well-designed pre-tested schedule from various stakeholders, viz agriculturalists, houseboat owners, shikara owners, hoteliers, transporters, parking owners, sand extractors, fishermen, laundry

service providers, NGO's, visitors etc. The averages and percentages were worked out to interpret the results. The main feature of the study was to create awareness among general masses and the stakeholders about the status of the deterioration of the selected water bodies which had a direct bearing to the economy of the state as also the livelihood of the stakeholders. The Contingent Valuation Method (CVM) which elicits consumer preferences of goods and services that are not traded directly to the consumer in the market was used for estimating monetary values of the environmental goods and services that are established through the setting up of a 'hypothetical' market. A survey question is used to elicit willingness to pay (WTP) for a hypothetical provision of environmental goods and services. Contingent Valuation Method is a tool to place an amount or value on any goods and services that are typically not exchanged in the market place [24] was applied in estimating both use values and non-use values of environmental goods [25, 26]. One of the most important concepts in Contingent Valuation Method is willingness to pay (WTP), which refers to an amount consumers are prepared to pay for a good or service [27, 28], to enjoy the recreational facilities [29] was also used to estimate the amount stakeholders could pay for the restoration of the selected water bodies which could serve as a guideline for the government to formulate policies.

3. RESULTS AND DISCUSSIONS

Various types of communities are living along side of both the water bodies in Kashmir Valley. Both the water bodies are providing livelihood to many communities, be they skilled or unskilled in nature. The educational setup of the respondents associated with two water ecosystems in Jammu and Kashmir is directly proportional to the efficient use of resources at the command of the stakeholders as such was found most important determinant for income generation. The results on educational status are presented in Table 1. Dal lake located in the Srinagar city reported 16.18 per cent of the agriculturists with primary level of educational attainment as compared to 55.56 per cent along Jhelum. Similarly, 11.11 per cent of the agriculturists acquired higher education along Jhelum as against 1.16 per cent around Dal. About 12.77; 50.79 and 11.11 per cent of houseboat owners within Dal ecosystem acquired education at primary, secondary and graduation level, compared to 46.67; 30.33 and 23.00 per cent along river Jhelum respectively. Fishermen community were seen concentrated along Jhelum water ecosystem and were having primary level of education (75.00%) compared to 9.09 per cent of the fisherman along Dal lake. The educational attainment of transport owners was highest along Jhelum water ecosystem as 50 per cent of the transport owners acquired education upto secondary level compared to 21.21 per cent in Dal lake transport owners. There are a few services like sand extractors, laundry service, that were relevant to Jhelum water ecosystem which mostly had primary or secondary level of education.

Table 1. Educational setup of different stakeholders*

Education in (%)	Primary level		Secondary level		Graduation & above	
	Dal dwellers	Jhelum dwellers	Dal dwellers	Jhelum dwellers	Dal dwellers	Jhelum dwellers
Agriculturists	16.18	55.56	13.29	33.33	1.16	11.11
Houseboat owners	6.35	46.67	50.79	30.33	11.11	23.00

Shikarawala	12.77	58.33	24.47	41.67	14.89	0.00
Fisherman	20.33	75.00	3.38	25.00	0.00	0.00
Transport owners	9.09	10.00	21.21	50.67	36.36	39.33
Sand Extractors	-	66.67	-	33.33	-	0.00
Laundry service providers	-	40.00	-	60.00	-	0.00
Visitors	-	10.00	-	50.67	-	39.33

*Source: Primary survey

3.1. REVENUE GENERATION ALONG THE RIVER JHELUM AND DAL LAKE: VALUE OF GOODS

River and Lake ecosystems have the potential to provide a wide range of benefits to society. Many social benefits derived from Rivers and Lakes are dependent on their health, including cultural aesthetic values, and provision of livelihood opportunities such as habitat for inland fisheries and agriculture. Economic benefits, such as those derived from commercial agriculture or hydropower generation in river ecosystem, also tend to rely on their health (including flow, depth etc.). Table 2 shows the annual net revenue generated by different stakeholders associated with the two water ecosystem in Jammu and Kashmir. Sand extraction activity is associated only with Jhelum ecosystem and the annual net revenue generated by the stakeholders was 40 million US$. The net revenue generated by the fisherman community from the two water ecosystems was 0.4 million US$ and 2.35 million US$ respectively from Dal lake and river Jhelum. Shikara owners within Dal lake ecosystem earned 1.5 million US$ annually, but this activity was not found applicable in river Jhelum ecosystem. Laundry services in Jhelum ecosystem produced annual revenue of 4.02 million US$. Transporters from both the water bodies generated annually a revenue of 1.3 and 2.36 million US$ in Dal and Jhelum respectively. The houseboats in both the water bodies were usually stationary and anchored at the edges of the water body. The houseboats were usually rented out to tourists and a section of society was observed to be dependent on the houseboats for their livelihood. The revenue generated by the houseboat owners from the two water bodies was 22.0 and 36.11 million US$ in Dal and river Jhelum respectively. Generation of revenue from hotels and restaurants was mainly limited to cities and towns. The revenue generated by the hotels and restaurants around the Dal lake in Jammu and Kashmir was highest to the tune of 85.1 million US$ annually.

River Jhelum-the backbone of Kashmir valley's agricultural sector. Apart from irrigating the agricultural fields, the river and its tributaries/wetlands act as a natural drain to the catchment areas in times of excessive rains, and serves as a reservoir in times of dry spells. Earlier the river Jhelum alone irrigated about 42 per cent to the total irrigated area in the valley. Since most of the agricultural fields are on higher elevation than Jhelum, a lift irrigation system was introduced during 1970s; which brought more area under irrigation. Currently, the river irrigates more than 90 thousand hectares of agricultural land in the valley. The annual revenue generated by the agriculturists around the river Jhelum accounts for 149.2 million US$ and the revenue generated from the agriculture activities carried around and within Dal lake estimate turned to 0.7 million US$ of vegetables and 0.3 million US$ Nadroo cultivation. Hydro-power generation the most important activity from river Jhelum in terms of economic use value, being exploited for the generation of electricity. Out of about 3722 million units (mu) of hydro-power generated within the state, Jhelum contributes about 725 mu

(19.5%). The installed capacity (actual production of the electricity) on Jhelum power houses alone contribute 33 per cent of state's total installed hydro-power capacity. Therefore, lack of capital resource and lack of political will has been a constraint in harnessing full benefits from Jhelum's power generating potential. The estimated revenue generation from the river Jhelum was 62.2 million US$ annually. No. power generation activity was carried out in Dal lake.

Table 2. Revenue generation from Dal Lake and River Jhelum by different stakeholders

Estimated annual net revenue generated by sampled stakeholders		
	Net returns (mUS$)	
Stakeholders	**Dal Lake**	**River Jhelum**
Sand Extraction	-	40.55
Fishing	0.4	2.35
Shikara	1.5	-
Laundry Services	-	4.02
Transport	1.3	2.36
Houseboat	22.0	36.11
Hotels	85.1	-
Agriculture		149.2
Vegetables	0.7	-
Nadroo (Nelumbonaceae sp.)	0.3	-
Hydro power	-	62.2

3.2. WILLINGNESS TO PAY: A CONTENGENT VALUATION

Willingness to pay (WTP) is the maximum amount an individual is willing to hand over to preserve an ecosystem and to procure a product or service. Every stakeholder in the study showed willingness to pay for preserving ecosystem, which pushes the non-use value of ecosystem beyond its use value. The respondents reveal their willingness to pay for clean water, beautified river-banks and increased fish population. Every visitors for restoring the glory and environmental health of both the water bodies is on an average willing to pay 8.69 US$ for Dal restoration and 2.65 US$ for Jhelum restoration, respectively. Every hotelier residing along the banks of Dal lake was willing to pay on an average 120.62 US$ for restoring the ecological health of Dal. Fishermen also along both the water bodies were willing to pay 2.50 US$ for river Jhelum and 0.58 US$ for Dal lake as extra fee for fish licensing, whereas, the houseboat owner and Shikara owners within Dal Lake were willing to pay an extra amount of 39.70 US$ and 1.90 US$ if the river is restored. Similarly, residents, NGO's, Conscious citizens & Scientists/Intellectuals were willing to pay 9.05; 25.09; 16.29 & 36.11 US$, respectively for the restoration of Dal lake. In general people did not prefer to live near river ecosystem. Since, the river Jhelum flows through residential areas starting from south Kashmir to north Kashmir including the main city of the valley, house price differentials (using the Hedonic

Property Method) reflect that the homeowner's willingness to pay for restoration of river was substantial owing to the reasons, that the property located along banks of the river Jhelum had more value than those away from river owing to the scenic view provided by the river even if these were located far away from main roads and markets. The price differential for river Jhelum banks was on an average estimated to 26041.22 US$ per 1000 sq. ft plot.

Table 3. Willingness to pay by different stakeholders for restoration of waterbodies in Kashmir

Willingness to pay for the restoration of Dal and River Jhelum (US$/respondent)		
Respondent	**Dal Lake**	**River Jhelum**
	US$	**US$**
Visitors	8.69	2.65
Hoteliers	120.62	-
Houseboats	39.70	-
Shikara	1.90	-
Fishermen	0.58	2.5
Transport	2.32	20.6
Residents	9.05	-
NGO's	25.09	-
Conscious citizens	16.29	-
Scientists/Intellectuals	36.11	-
Beautified river Banks	-	21.7
House price differential (per 1000 sq. ft plot)	-	26041.22

(-) denotes non applicability

4. CONCLUSION

The study concluded that Dal lake and river Jhelum are two very important water bodies that play a key role in the economic development of the state. The state is one of the important Himalayan states which provides five different types of prominent ecosystems viz. water ecosystem, forest ecosystem, agri-ecosystem, livestock based ecosystem and horticulture based ecosystem. Among all these ecosystems, agri-ecosystem followed by hydro-power were the two most important contributors towards the revenue generation from river Jhelum while as hotels and houseboats were the two most important contributors from Dal lake ecosystem. The findings of the study were suggestive of the fact that there remains a great potential for exploitation of these water bodies towards exploration of productive gains for the society especially through tourism. However, the study stresses the need to devise a perfect and efficient policy for restoration of these water bodies which apart from generating a lot of revenue, provide employment opportunities to lakhs of people and needs prevention, protection and sustenance.

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COMPETING INTERESTS

There are no competing interests involved in completing this study.

AUTHORS' CONTRIBUTION

This work was carried out in collaboration among all the authors. Author MHW designed the study, wrote the protocol of the study. Author SHB performed the statistical analysis of the data and author AB, wrote the draft of the manuscript, managed the analyses of the study and managed the literature review of the study. All authors equally contributed to the article.

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