Ind. Jn. of Agri. Econ.
Vol.72, No.1, Jan.-March 2017

ARTICLES

Negative Externalities in Kashmir Lake Fisheries: Transformation in Species Patronage, Use Priorities and Policy

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ABSTRACT

The logit model fitted to eight sets of stakeholders independently and the composite Tobit model addressed the common variables that influenced the Willingness to Pay (WTP) of the stakeholders for restoration of the fisheries of Dal and Wular lakes of Kashmir. Income emerged as the variable that determined WTP of stakeholders in both models. Unavailability of institutional credit, lack of awareness of environmental issues for Dal lake fishers and power shortages, lack of educational institutions for the Wularlake fishers were the major constraints to increasing fish production and restoring balance in the fishery of Dal and Wular lakes.

Keywords: Contingent valuation, Kashmir, Lake fisheries, Multiple stakeholders, *Schizothorax* Fishery and WTP.

JEL: Q11, Q22

I

INTRODUCTION

The importance of lakes and wetlands needs no emphasis. They serve as reservoirs for drinking water, irrigation and recreation. They sustain vital and diverse biological resources which are crucial for maintaining the biological equilibrium in the given biosphere. Lakes and wetlands are central to given civilisation and have been the cradles of human cultural, ecological and socio-economic values (Turner 2003). The Dal and the Wular are the two important lakes of the Kashmir, while the Wular lake is the largest freshwater lake of India, the Dal is the most famous and significant tourist attraction of Kashmir. Despite the fact that these lakes sustain a rich fishery, studies now show a decline in fish production in both these lakes (Kundangar and Abubakr, 2004). Further, a significant decline in the production of *Schizothorax*, the local fish species in these two lakes is attributed to heavy siltation

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The authors are grateful to Director/Vice Chancellor, Central Institute of Fisheries Education, Mumbai, for constant encouragement and support during the entire period of this work

in the Wular lake, compounded by other externalities and the introduction of carps in the Dal lake. The local fish species, *Schizothorax* has declined in these water bodies owing to the introduction of the exotic carps, adverse impact of tourism and commercial vegetable farming in the floating gardens (on the Dal lake) leading to algal blooms (Qureshi and Krishnan, 2012).

From the point of view of the efforts that are being taken by the local state government as well as from the point of view of declining fish production in these lakes, this study attempts to: (1) To assess stakeholders' willingness to pay for sustainable fish production in Lakes of Kashmir, and (2) To suggest suitable policy measures for sustainable lake fisheries in Kashmir valley.

II

DATA AND METHODOLOGY

Since 70 per cent of fish production in Kashmir is generated from the Dal and Wular lakes, these lakes were purposively selected to address the stated objectives.

Among the various methods to address the concerns of the stakeholders in a particular socio-economic phenomenon, the contingent valuation (CV) is the most accepted methodology (Venkatachalam, 2004). The CV is addressed through stakeholders willingness to pay (WTP) and it is based on the argument that individual responses to hypothetical markets are comparable to actual markets (Mitchell and Carson,1989). The CV has also been used for quantifying consumers WTP for reduction of food borne risk (Hammit, 1986). Mitchell and Carson 1989 continued to state that the CV estimates are probably the most accurate predictors of peoples' real response behaviour in the assessment of WTP for sustainability and enhanced fish production of Kashmir lakes.

This study is an improvement over the others since it addressed the stakes of multiple stakeholders for the same problem using CV. Devi *et al.* (2010), Krishnan *et al.* (1999), Bhandari and Heshmati, (2010) have used CV to address only the primary stakeholders.A total of 360 respondents were chosen as a respondent sample for the study which consisted of the primary stakeholders whose income depended directly on the fisheries of Kashmir lakes and who strongly advocated the restoration of traditional composition of the fishery in the lakes of Kashmir and were willing to pay for it and, the secondary stakeholders were those whose interest in the lakes was indirect but who had a committed interest in increasing fish production either from a professional or a traditional angle. The primary stakeholders consisted of fishers, traders, hotels and houseboats. Fifty fishers from Dal and 60 from Wular, 7 and 23 traders respectively from these two lakes and 25 houseboats on the Dal and 5 hotels in the Wular lakes constituted the sample of primary stakeholders. The secondary stakeholders included 50 fish consumers each from Dal and Wular lakes, 30 tourists, 30 staff members of the Department of Fisheries (DoF), J&K and 30 faculty of fisheries, Sher-e-Kashmir University of Agricultural Science and Technology,

Kashmir (SKUAST-K). The primary data were collected through survey using a pre-tested questionnaire during October 2012 to January 2013. The secondary data were collected from various published sources, officials of Department of Fisheries, Srinagar, Sopore and Bandipora. Data were also collected from Lakes and Waterways Development Authority (LAWDA), Srinagar.

III

MODELS

A variate of the logit model, used for estimating the WTP of the different stakeholders affected by increasing pollution in the lakes of Kashmir is given below:

$$Zi = \ln(Odds) = \ln\frac{Pi}{1-Pi} = a + \beta X_i$$

where Z_i is the log odds of WTP/stimulus index and $X_1, X_2, \ldots\ldots, X_i$ are the independent variables.

The determinants of WTP and the maximum monetary contribution that individuals are WTP were estimated by using the Tobit model. The advantage of using this model lies in the fact that it has the capability of giving the probability of WTP and the maximum monetary WTP of the respondents. This advantage is not available in other discrete choice models like linear probability model, logistic and probit. The Tobit model has been defined below following Madala(1997), and Johnston and Dindaro, (1997).

$$MWTP_i* = \beta_o + X_i\beta + \epsilon_i$$
$$MWTP_i = MWTP_i* \quad if\ MWTP_i* > 0$$
$$MWTP_i = 0 \quad if\ MWTP_i* \leq 0$$

where MWTP= vector of willingness to pay which is censored at 0;
X= matrix of explanatory variables that are hypothesised to influence WTP;
B= vector of unknown parameters to be estimated corresponding to the matrices of explanatory variables X;
Є= error term which could be independently and normally distributed with mean zero and common variance sigma square and;

$MWTP_i$* = latent variable corresponding to MWTP.

It may be noted that a value of MWTP is observed when it is greater than zero.

Constraints index (CI) was developed following Majhi (2001). This index was constructed to measure and compare the constraints expressed by the different stakeholders.

$$\text{Constraints Index} = \frac{\text{Severe constraint} \times 2 + \text{Constraint} \times 1}{\text{Total respondents}}$$

There were four sets of constraints namely: (1) Social, (2) Political, (3) Economic and (4) Institutional

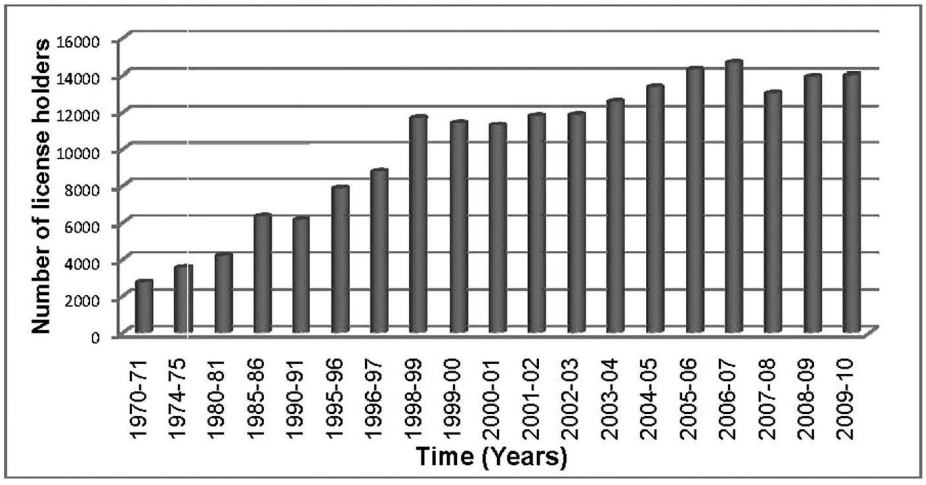
A scale of 1-6 was used for recording the response of the fishers with 1 indicating the most severe and 6 the least.

IV

RESULTS AND DISCUSSION

Even though the introduction of exotic species, carps, in the lakes of Kashmir may have been done with the intention of increasing total fish production in the state, this does not tantamount to maximisation of total economic value since the consumer preferences have been compromised. Therefore, the efforts of LAWDA may have impacted total fish production positively but not in the composition of sale.

The discussion above is reinforced more by political decisions rather than looking at ecosystem as an integral part of the socio-economic and cultural heritage of the Kashmir valley. Short term political gains are evident in the increase in the number of fishing license holders in Jammu and Kashmir (Figure 1). Though the increase in the number of fishing license holders in Jammu and Kashmir does not necessarily reflect an intensification of fishing but reflects a drain on the economic resources that are utilised by the department of fisheries to subsidise these increasing fishing license holders during the off season or fishing ban period in the lakes of Kashmir (Qureshi and Krishnan, 2015).



Source: Department of Fisheries, www.jkfisheries.in

Figure 1. Broad Trends in Number of Fishing License Holders in Jammu and Kashmir.

Table 1 gives the determinants of WTP of primary stakeholders. The model substantiates the basic hypothesis of this paper. It may be noted that the Dal lake fishers were unwilling to pay for the restoration of the fisheries based on the sign and significance of income they derived from the lake as compared to the fishers of the Wular. The income of the fishers of the Dal were more stable owing to the contribution of carp to their income compared to the incomes of the Wular lake fishers which were unstable. Owing to the instability of the income of the Wular fishers, they were willing to pay 3 times more for the sustainability of fishing in this lake by log odds ratio of 3.41 compared to those who spent less time on fishing (Qureshi *et al*. 2014). The value of odds ratio indicate the extent to which the WTP varies (Qureshi *et al*. 2013). Therefore, this analysis indicated that WTP of fishers for sustainability of lake fisheries in Kashmir was inversely proportional to the size and stability of income. With the odds ratio at 0.297 (age) and negative value of beta coefficient, the odds in favour of WTP of Dal lake fishers reduced by 70 per cent.

TABLE 1. FACTORS DETERMINING WILLINGNESS TO PAY OF PRIMARY STAKEHOLDERS

Variables	Dal fishers	Wular fishers	Traders	Hotels/house-boats
(1)	(2)	(3)	(4)	(5)
		LOG ODDS VALUE		
Income (INC)	0.043	0.142	1.002	9.09
Family strength (FS)	8.94	0.33	-	-
Time spent on lakes (TS)	0.216	3.413	-	-
Age (AGE)	0.297	-	0.801	-
Willingness to spend extra time (WTS)	-	0.162	-	-
Type of stakeholder (TYSTK)	-	-	-	0.027

Models

$$Dal\ fishers = \ln\frac{Pi}{1-Pi} = 1.942 - 3.137INC + 2.191FS - 1.532TS - 1.214AGE$$

$$Wular\ fishers = \ln\frac{Pi}{1-Pi} = 4.554 - 1.95INC - 1.819WTS - 1.10FS$$

$$Traders = \ln\frac{Pi}{1-Pi} = -21.813 + 0.002INC - 0.222AGE$$

$$Hotels\ and\ Houseboats = \ln\frac{Pi}{1-Pi} = -25.138 - 3.616TYSTK + 2.207INC$$

where; P_i is the probability of WTP of stakeholders.

The estimates indicated the chasm between the urban and rural locations of the lakes. Above an income of Rs. 15000/month, WTP of Dal lake fishers reduced by 96 per cent (odds ratio 0.043). Similarly, with an income above Rs. 10000/month, the odds in favour of WTP of Wular fishers dropped by 86 per cent (odds ratio 0.142). Qureshi *et al*. (2013) stated that even though income may be the major determinant of WTP for the sustainability of lake fisheries of Kashmir, the latent welfare losses absorbed by the community resulting from a decline in total *Schizothorax* fish production is not reflected.

The size of the family also played an important role in the determination of the income level that determined the WTP. When the family size was lesser than 4 members, higher was the WTP by the Dal lake fishers by as much as 800 per cent but

when the family size was more than 4 members, the WTP of the Wular lake fishers declined by 67 per cent. Therefore, the Wular fishers preferred to address the concerns of their family welfare in the current period rather than make provisions for increase in income from this fishery at a future date. This may be because of the fact that Wular lake fishery suffered from unstable carp and *Schizothorax* fish production. The WTP (odds ratio 0.16) of Wular lake fishers decreased by 84 per cent in terms of their Willingness to Spend (WTS) more time fishing on the lake. The relative instability of fish production in the Wular lake is reflected by the negative and significant contribution of WTS on fishing. The factors that determined the WTP of the fishers with respect to sustainability of lake fisheries of Kashmir included income, size of family and alternative livelihoods based on the results of the logit model that was fitted.

The logit model for traders showed an inverse relationship between WTP and age of the traders (odds ratio 0.80). This indicated that the odds in favour of WTP decreased by 20 per cent as the age of the respondents increased underlying the fact that the awareness of the youth among the traders was heightened in respect of the misplaced priorities of the department of fisheries, compared to their elders. The model also indicated that the odds in favour of WTP increased by 90 per cent with an increase in income of the traders (odds ratio 1.002). This result was similar to the response of the fishers to WTP with increase in income. It must be also noted that the logit model for traders indicated increased awareness for restoration of *Schizothorax* fishery in the lakes of Kashmir.

It is interesting to note that the hoteliers were likely to pay 37 times more compared to the houseboat owners even though the income of the surveyed hoteliers and houseboat owners indicated the odds in favour of WTP by 9 times. This WTP of the hoteliers to pay much in excess as compared to the houseboat owners may be attributed to the fact that their business was more dependent directly on the fishery of the lake than that of the houseboat owners whose income was a function of tourism than recreational fishing. This also indicated that the proportion of income that is generated by the fish cuisine of these hoteliers had a higher permanent contribution to their income compared to the permanent proportion of income contributed by fishery to the income of the houseboat owners. This result also indicated the sub-conscious awareness of the welfare losses of the hoteliers, it also underwrites their interest in the efforts being made for restoration of the *Schizothorax* fishery in lakes of Kashmir.

The models given in Table 2 refers to the second level of respondents which included the fish consumers, tourists and institutional stakeholders. With the odds ratio of 0.254, the model indicated a gender bias in favour of males. This may be attributed to the fact that the males in the Kashmir valley are better educated than the females. In addition to the education of respondents, the frequency of fish consumption also influences the WTP of the consumers. The results also indicate that the tourists who normally consume freshwater fishes were more willing to pay for the restoration of lake fisheries of Kashmir compared to tourists from maritime states. It

is interesting to note that the academia (SKUAST-K) were likely to pay 319 times more compared to other stakeholders for the restoration of the *Schizothorax* fishery. The level of consciousness was so high that the faculty of fisheries SKUAST-K were willing to sacrifice the entire incremental income for the restoration efforts. It may also be noted that WTP of female faculty members was 1.134 times more than their male colleagues. The WTP of the field staff of department of fisheries, Kashmir was more than their colleagues whose job profiles were different. This also showed that the WTP did not bear a direct relationship to hierarchy of positions.

TABLE 2. FACTORS DETERMINING WILLINGNESS TO PAY OF SECONDARY STAKEHOLDERS

Variables (1)	Fish consumers (2)	Tourists (3)	Faculty of fisheries (4)	Department of fisheries (5)
			Log odds value	
Income (INC)	-	1.00	1.00	1.00
Gender (GEN)	0.254	-	1.134	-
Time spent on lakes (TS)	-	-	319.7	-
Age (AGE)	-	1.133	-	0.024
Consumption/month (CONSUP)	2.557	-	-	-
Designation (DD)	-	-	-	3.084
Home town (HT)	-	0.159	-	-
Education (EDU)	1.720	-	-	-
			Models	

1) $Fishconsumers = \ln\frac{Pi}{1-Pi} = -7.88 + 0.939CONSUP - 1.369GEN + 0.542EDU$

2) $Tourists = \ln\frac{Pi}{1-Pi} = -8.928 + 0.00INC + 2.088HT + 0.125AGE$

3) $FacultyofFisheries = \ln\frac{Pi}{1-Pi} = -17.019 + 0.00INC + 7.033GEN + 5.768TS$

4) $DepartmentofFisheries = \ln\frac{Pi}{1-Pi} = 22.237 + 0.00INC + 10.337DD2 - 3.73AGE$

The model is a good fit if the Chi-Square values of all the coefficients are non-significant in the Hosmmer-Lemmeshow test. Table 3 shows that H-L test confirmed the response of different stakeholders.

TABLE 3. GOODNESS OF FIT - HOSMERLEMMESHOW TEST

Hosmer-Lemeshow test (1)	Chi- Square (2)	Degrees of Freedom (3)	P-Value (4)
Dal fishers	1.43	6	0.96
Wular fishers	5.91	7	0.55
Traders	7.69	8	0.46
Hotels and houseboats	14.18	8	0.17
Fish consumers	5.29	7	0.62
Tourists	6.93	8	0.54
Faculty of fisheries	4.94	7	0.66
Department of fisheries	5.37	7	0.61

Note: Non-significant values of Hosmer Lemme show test indicate that models are good fit.

Table 4 gives the sample mean of different variables for the two levels of stakeholders that is primary and secondary. The composite Tobit model was

employed to identify the common variables that showed a pattern in the responses of the stakeholders. The model showed that the income level of the primary stakeholders influenced the WTP of the stakeholders. It showed that the WTP increased by 0.067 units with a unit increase in income of primary stakeholders.

TABLE 4. SAMPLE MEAN OF THE DEPENDENT AND INDEPENDENT VARIABLES IN THE TOBIT MODEL

Sample mean	Primary stakeholders	Secondary stakeholders	Average value
(1)	(2)	(3)	(4)
Dependent variable			
WTP (INR/month)	40	54	47
Independent variable			
Age (years)	41.2	44.4	42.8
Income ('000)	41	137	89
Education (No. of years)	5.5	13.0	9.2
Time Spent on lakes (hours)	10.2	2.4	6.3

Tobit Model for Primary Stakeholders

$$WTP* = 16.58 + 0.401X_1 + 0.067X2 - 0.004X3 - 1.209X4 + 83.3D1 - 1.62D2$$

where X_1 = age, X_2= income, X_3= education and X_4= time spent on lakes D_1= traders, D_2= hotels/houseboats and WTP* = latent variable.

The Tobit estimates of WTP for restoration of the fisheries in Kashmir lakes from the point of view of secondary stakeholders is given in Table 5. Similar to the model for primary stakeholders, age, income, education and time spent on lake emerged as the variables that contributed significantly to the WTP of the secondary stakeholders.

TABLE 5. DETERMINANTS OF WTP OF PRIMARY AND SECONDARY STAKEHOLDERS IN KASHMIR-TOBIT MODEL

	Primary Stakeholders	Secondary Stakeholders
(1)	(2)	(3)
Constant	16.58	-76.48
Age	0.40	0.47
Income	0.06	1.53
Education	-0.004	12.73
Time spent on lakes	-1.21	0.22
Traders	83.3	-
Hotel/houseboats	-1.60	-
Consumers	-	-190.57

Tobit Model for Secondary Stakeholders

$$WTP* = -76.48 + 0.478X_1 + 1.538X2 + 12.732X3 + 0.223X4 - 190.573D_1$$

where X_1 = age, X_2= income, X_3= education and X_4= time spent D_1= consumers.

Again income emerged positive and significant for WTP of consumers and institutional stakeholders. The WTP of these two groups of stakeholders will increase

by 1.53 units with a unit increase in the income. It is to be noted that the variable education emerged positive and significant in the case of secondary stakeholders which in turn influence income as a variable to become positive and significant. The WTP increased by 12.73 units with per unit increase in the number of years of schooling. Therefore, education exerted a major influence on the WTP of the secondary stakeholders. It is also to be mentioned that education was not a significant variable in the case of primary stakeholders. This has very important policy implications.

The response of the consumers had a negative and significant impact on WTP in the ambit of the Tobit model. The WTP of the consumers was 190 units lesser than that of institutional stakeholders. The model also indicated that consumers belonging to lower income strata of the society were more concerned about availability of fish and not really about the species and quality of fish. This indication is available from the size and sign of the coefficients in respect of the consumers. This implies that this particular group of people was not willing to contribute to the restoration of *Schizothorax* fishery in the lakes of Kashmir. This also has important policy bearing in the overall context of sustainable development of fisheries in the lakes of Kashmir. This analysis of the determination of the factors that influence the WTP of the two different levels of stakeholders also showed the versatility of the Tobit model wherein it was possible for the investigator to accommodate the absolute values of the variables to identify the common variables across the two levels of the stakeholders. In the case of the logit model both the absolute as well as the coded values could be used to identify the variables responsible for influencing WTP. Therefore, it is income that emerged as the significant variable that influenced the WTP for sustainable development of fisheries in lakes of Kashmir in both the models.

The composite model therefore substantiated the hypothesis in the case of both primary and secondary stakeholders and the results helped significantly in the development of right policies that are discussed subsequently.

Time spent on lakes had a negative and significant influence in respect of the WTP of the primary stakeholders in the composite model. The size of the responses of the Dal lake fishers for WTP of sustainability and development of *Schizothorax* fisheries in the lakes of Kashmir was very high. Here one unit increase in time spent on lakes led to a decline in WTP by 1.21 units. This result for the Dal lake was substantially over the response of the Wular fishers willingness to spent more time fishing and traders willing to spent more time, trading. The positive and significant response of the WTP of the traders in the overall context of the WTP of the primary stakeholders in the composite model has an important bearing. The traders who occupy the pivotal place in the supply chain of fish in the local market exert considerable influence on the income and consequent responses of the concerned stakeholders to WTP.

While R-square which gives the overall fit of the model has an insignificant role in the logit model, in case of Tobit model it has an important role. In the Tobit model

used in this study, the model explains 49 per cent of variation for both the primary and secondary stakeholders.

Constraints Analysis of Fishers in Kashmir Lakes

Constraints analysis as detailed by Qureshi *et al*. (2013) were divided into institutional, social, economic and political constraints.[1] The sequence of the impact of constraints on the fishers seems to be same in both the lakes. As a percentage of the different factors that constituted the constraints across heads of constraints, the most severe of various types of constraints ranged from 50 per cent to 70 per cent while severe constraints ranged from 20 to 35 per cent, minor constraints ranged from 5 to 10 percent as far as Dal lake was concerned (Figure 2). In the case of the Wular lake (Figure 3) the range was 65 to 82 per cent; 13 to 25 per cent and 2 to 5 per cent for most severe, severe and minor constraints respectively (Qureshi, 2013). Table 6 gives the indices of the most severe constraints that inhibit the Dal and Wular lake fishers. Among the institutional constraints the non-availability of institutional credit for Dal fishers and power and poor roads for the Wular lake fishers were the most severe institutional constraints.

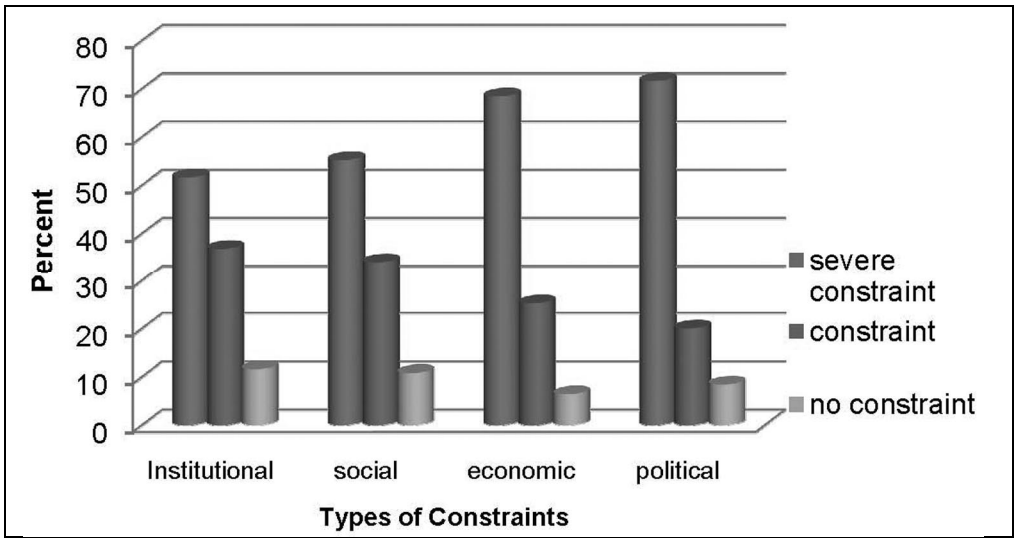


Figure 2. Constraints of Fishers in Dal lake.

Informal credit sources are easy to approach, informal and are part of the community and hence their popularity over bank finance. The state of Jammu and Kashmir needs a complete overhaul with respect to roads and power especially in the far flung districts. Lack of awareness of the environmental issues and educational

facilities were the most severe social constraints for the Dal and Wular lake fishers respectively.

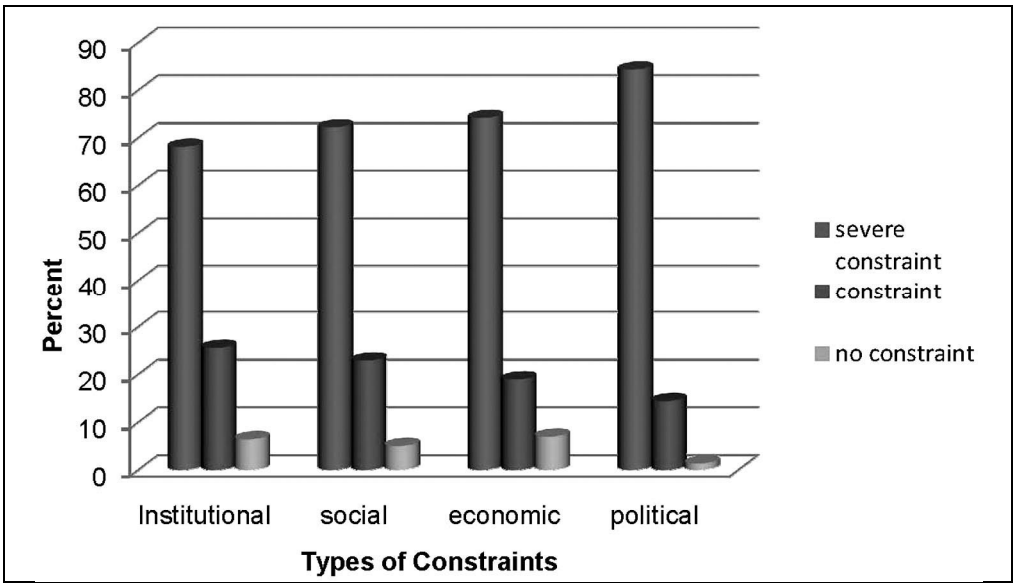


Figure 3. Constraints of Fishers in Wular Lake.

Dal lake being the hot spot of tourism in Srinagar, is frequented by tourists throughout the year. Enforcing pollution control on a floating population of this magnitude needs the development of well thought out plan of action.

Educational facilities in far flung districts of the state of Jammu and Kashmir needs to be improved substantially. In case of economic constraints, the falling fish production and the severity of siltation problems were flagged the most severe in the two lakes. These needs to be addressed urgently. Lack of infrastructural development and non-implementation of government subsidies and insurance schemes were the most severe political constraints in Dal and Wular lakes respectively. Political instability is an inherent ethos of Jammu and Kashmir, the solutions to which are complex and intricate.

TABLE 6. INDICES OF MOST SEVERE CONSTRAINTS FOR DAL AND WULAR LAKES

Constraints		Dal lake	Constraints	Wular lake
(1)	(2)	(3)	(4)	(5)
	Constraint analysis index			
Institutional	Availability of institutional credit	1.96	Electricity and roads	1.90
Social	Awareness of environmental issues	1.76	Educational facilities	1.88
Economic	Fish production trends	1.94	Siltation	1.91
Political	Infrastructure development	1.92	Implementation of subsidies and Insurance schemes	1.95

V

CONCLUSIONS

The logit and the Tobit models reflect the traditional values involved in the management of lake fishery system and also the need for a fresh look at the development priorities of the fisheries of lakes of Kashmir. It is obvious that the Government giving weightage to increase in fish production is misplaced instead of adopting a policy that would lead not only to an increase in fish production but also the restoration of the *Schizothorax* fishery in the Dal and Wular lakes. It is very important that the balance of the stocks of the local species *Schizothorax* need to be given their space in order to set in motion the restoration process. Special lake fishery management plans need to be drawn up to ensure a sustainable and growing stock of local species. Carp culture need to be weaned away from the lakes of Kashmir but may be promoted as a separate fresh water aquaculture activity. Derelict water bodies may be best used for carp culture which would help bridge the gap between demand and supply of fish in the Kashmir markets.

An engaging result that has emerged from analysis is that education underlines the WTP. The positive response of the institutional stakeholders within the framework of the Tobit model contrast with that of the responses of the women stakeholders who had expressed a negative WTP which implied that an improved focus on women education in Kashmir would help raise quality consciousness among the consuming public.

Finally, there is an urgent need to develop hatchery technology for *Schizothorax* and ranching programmes would perhaps help improve the stocks of *Schizothorax* in the lakes of Kashmir and help restore long term sustainable gains in total economic value in the lakes of Kashmir.

Received September 2016. *Revision accepted January 2017.*

NOTE

1. Institutional constraints: institutional credit, extension information, marketing facilities, cold storage facilities, fisheries cooperatives - Social constraints: educational facilities, gender bias, environmental issues, re-locational issues, alternative livelihoods – Economic constraints : Production, fishing fleet strength, marketing problems, illegal gear, poaching – Political constraints: Non implementation of subsidies, non-implementation of centrally sponsored schemes, political instability, infrastructure bottle necks, problems of sanitation and civic amenities.

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