Data Mining Multiple Stakeholders' Responses to Declining *Schizothorax* Fishery in the Lakes of Kashmir

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IIFET, 2014, Brisbane

INTRODUCTION

State of Jammu & Kashmir, India at a glance

Northern most state of India	
Area	2,22,236 sq kms
Location	32º17’ to 36º58’ North and from 73º26’ to 80º30’ East.
Altitude	1600 feet msl
Population (Census 2011)	12548926
Population Density(Sq. Km) Census 2011	124
No. of Districts	22

WATER RESOURCES	
Total inland water bodies (lakh Ha)	0.30
Rivers & canals (Km)	27781
Reservoirs (Lakh ha)	0.07
Tanks & ponds (lakh Ha)	0.17
Flood plain lakes/derelict waters (lakh Ha)	0.06

Source: DoF J&K 2011

BACKGROUND

- Lake fisheries are a multi-dimensional resource & have multiple uses.
- The Dal & the Wular are the two most important lakes of Kashmir.
- Traditionally these have had a flourishing fishery but studies have shown a decline in fish catches
- Floating gardens (where vegetables are farmed) in Dal lake and excessive siltation in Wular lake are the primary negative externalities.
- The declining *Schizothorax* fishery has been caused by not only an inadvertent introduction of carps in the lakes of Kashmir but also by other issues like pollution caused by tourism, vegetable gardens, civic discharges and poor maintenance and up keep of the lake (J&K Tourism 2012 and Lakes and Waterways Development Authority(LAWDA))

MAIN ISSUE

- The problem of fisheries in Kashmir lakes is a double edged weapon.
- While on the one hand the primary stakeholders, the fishers and those who derive the primary income from lake fishery are in favor of *Schizothorax* fishery.
- On the other hand there is an urgent need to increase total fish production from the lakes to meet the ever increasing demand of the local consumers irrespective of the species (Qureshi *et al.,* 2013).
- The priorities get further complicated when we weigh the objectives of DoF vis-a-vis the Department of Tourism (DoT).
- The whole questions boils down to whether the lakes need to serve the interest of the primary stakeholders of the lake ie. the fishers or serve the larger interest of the state economy by generating increased revenue from tourism.

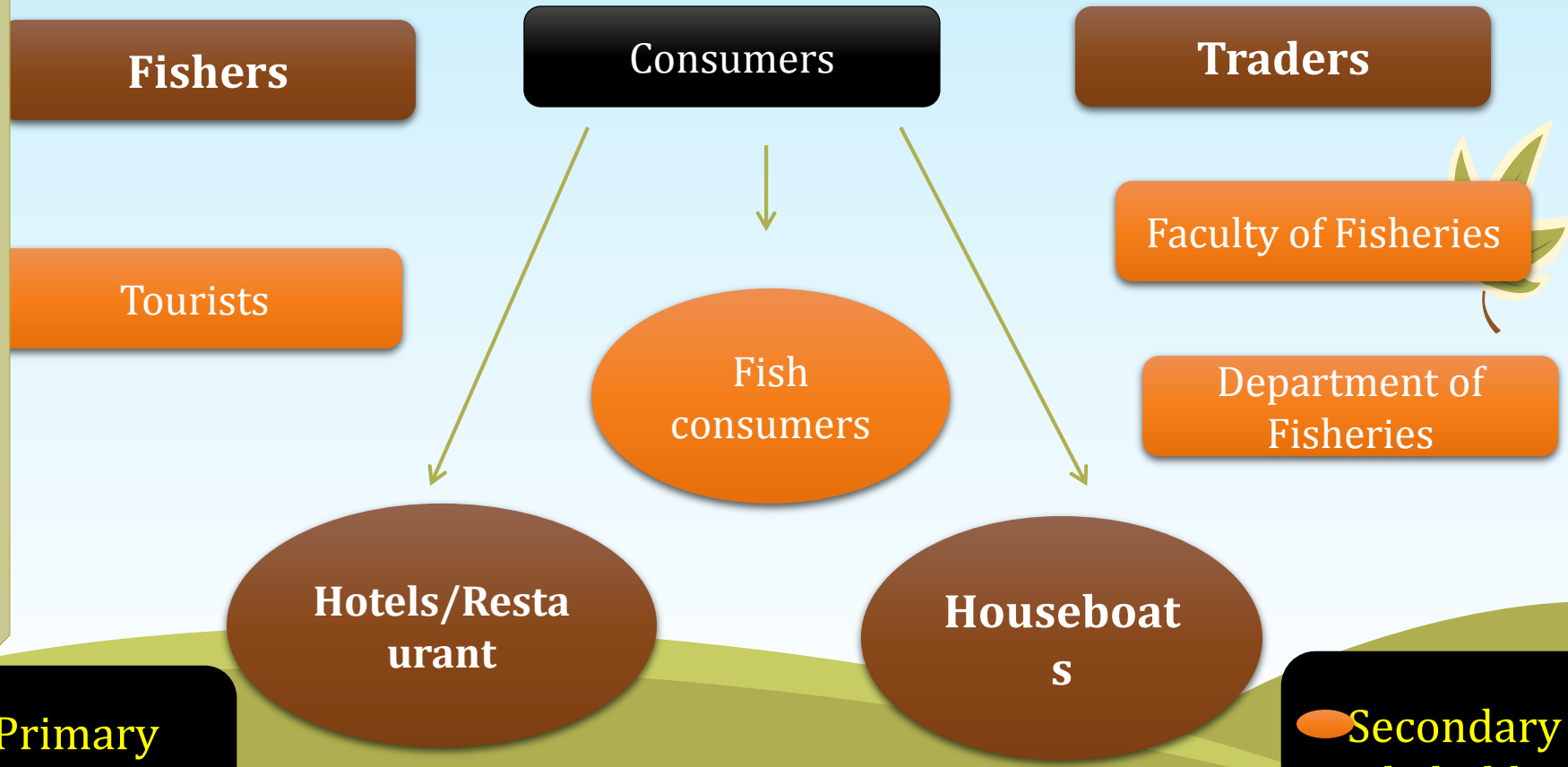
QUESTIONS THIS STUDY ANSWERS

- What are the implications of this inadvertent introduction?
- How do the different stakeholders look at the change it has made to their fish consumption preference schedule?
- What are their reactions to the major causal factors that are augmenting this decline?
- Are they willing to sacrifice a portion of their current income for saving their choice species?
- What are the institutional arrangements that need to be put in place to help overcome the problem and set the balance of lake fishery in order?

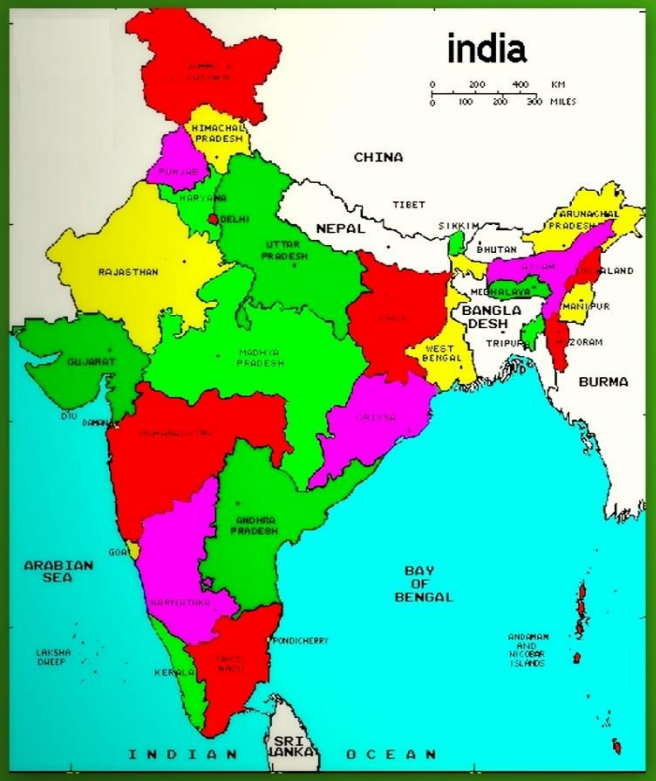
Data, Study area and Stakeholders

Primary and Secondary data

Dal and Wular lakes Kashmir

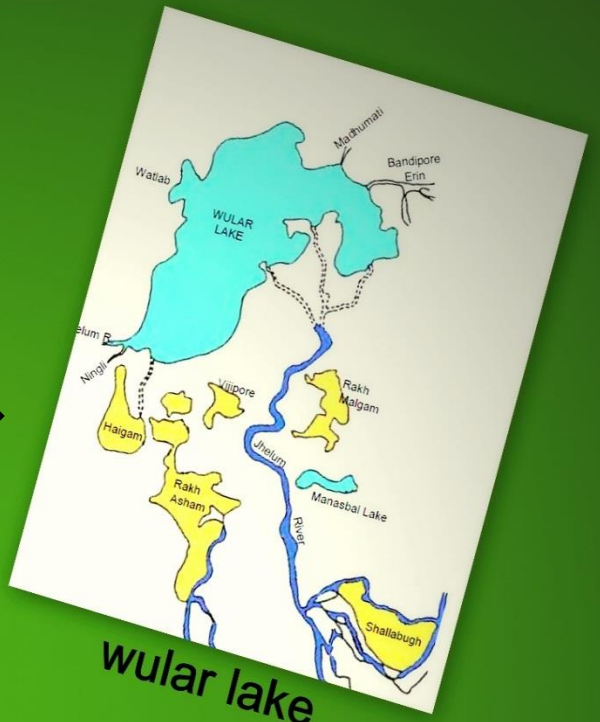


STUDY AREA

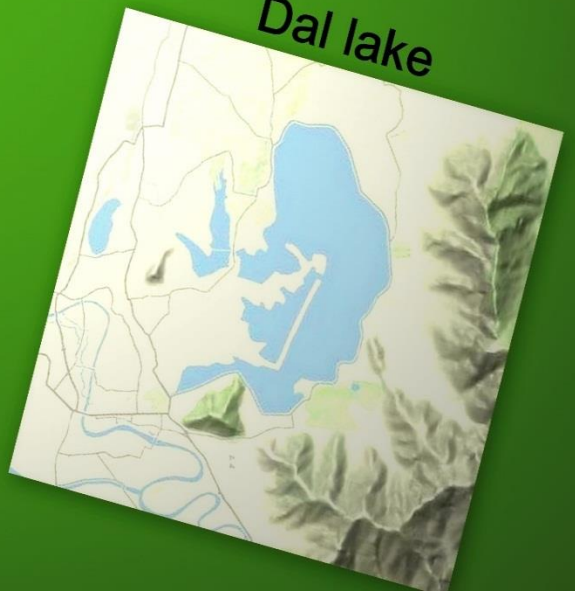


India

Jammu & Kashmir



wular lake



Dal lake

METHODOLOGY
KANE'S CROSS IMPACT ANALYSIS

- Cross-impact analysis is a methodology developed by Theodore Gordon and Olaf Helmer in 1966 to help determine how relationships between events would impact resulting events and reduce uncertainty in the future (Gordon 1994).
- Cross-impact analysis attempts to connect relationships between events and variables. These relationships are then categorized as positive or negative to each other and are used to determine which events or scenarios are most probable or likely to occur within a given time frame.
- The advantage of Kane's CIA is that the cross impacts of one action on another are evaluated which is not the case in trend line analysis where there is only a one to one analysis of one variable against time.
- Kane's cross impact model was utilized for understanding the future trends in total fish ,carps and *Schizothorax* production in Dal and Wular lakes.

- Kane's CIA simulation model is given by:

$$x_i(t+\Delta t) = \{x_i(t)\}^{p_i(t)}$$

$$p_i(t) = \frac{1 + \frac{\Delta t}{2}\sum_{j=1}^{N}(|\alpha_{ij}| - \alpha_{ij})x_j}{1 + \frac{\Delta t}{2}\sum_{j=1}^{N}(|\alpha_{ij}| + \alpha_{ij})x_j}$$

Where;

It can be noted that $p_i(t)$ is

$$p_i(t) = \frac{1 + \Delta t(\text{sum of negative impacts on } x_i)}{1 + \Delta t(\text{sum of positive impacts on } x_i)}.$$

The Kane's matrix was then prepared and a graphical representation of the impact was obtained.

OLS regression coefficients of data values proportioned on assumed maximum values

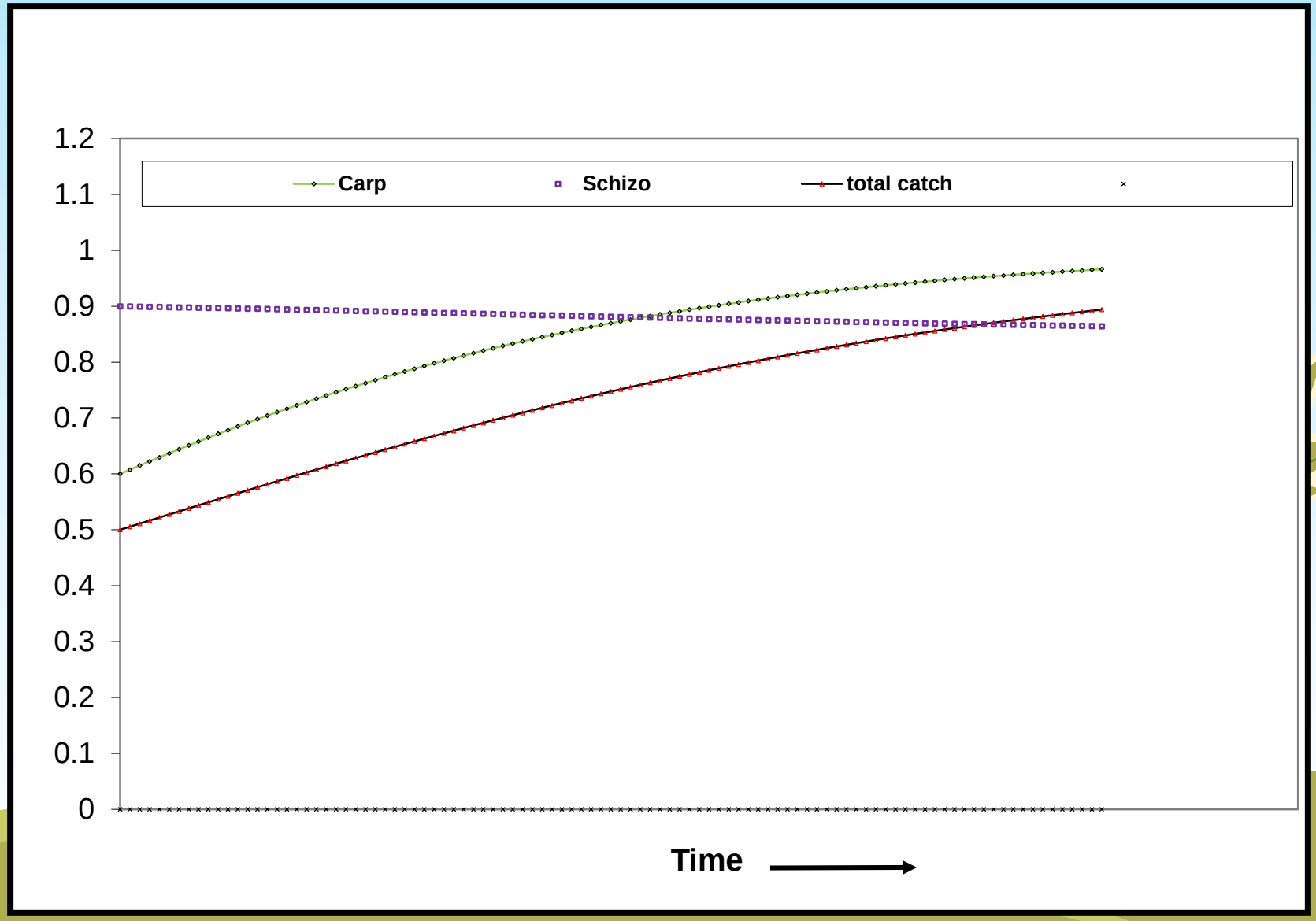
DAL LAKE			
Fish catch in tonnes	Carp catch X_1	Schizothorax catch X_2	Total catch X_3
Carp catch(X_1)	-	-0.07	0.65
Schizothorax catch (X_2)	-5.40	-	4.23
Total catch (X_3)	0.33	0.03	-
WULAR LAKE			
Fish catch in tonnes	Carp catch X_1	Schizothorax catch X_2	Total catch X_3
Carp catch(X_1)	-	0.79	1.25
Schizothorax catch (X_2)	0.53	-	0.85
Total catch (X_3)	0.74	0.75	-

Interaction matrix of species wise fish production in Dal & Wular lake

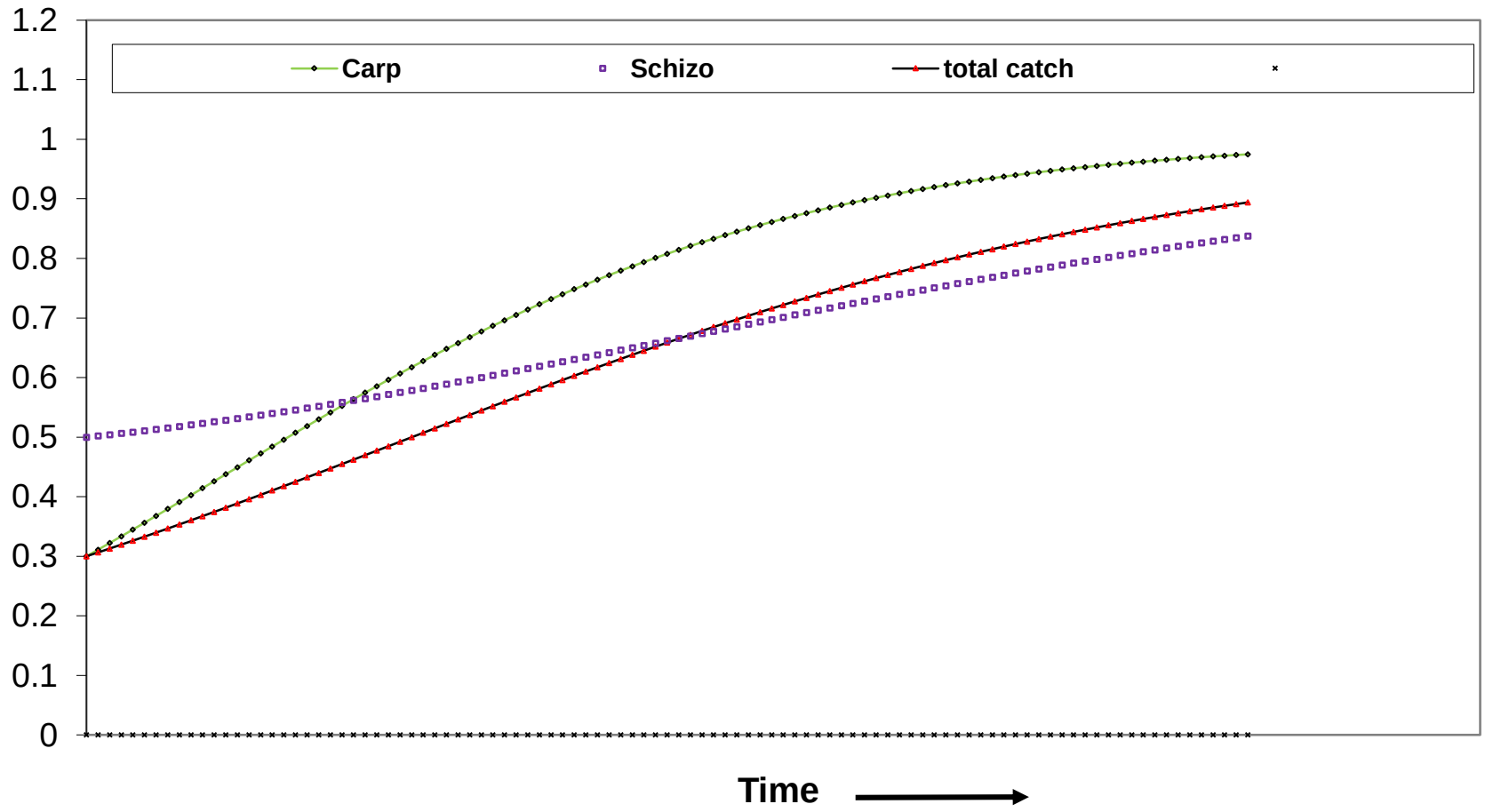
DAL LAKE	Present level	Carp catch X_1	Schizothorax catch X_2	Total catch X_3	External factors
Carp catch(X_1)	60%	0	0	1	2
Schizothorax catch (X_2)	90%	-3	0	3	0
Total catch (X_3)	50%	1	0	0	1

WULAR LAKE	Present level	Carp catch X_1	Schizothorax catch X_2	Total catch X_3	External factors
Carp catch(X_1)	30%	0	1	2	2
Schizothorax catch (X_2)	50%	1	0	1	0
Total catch (X_3)	30%	1	1	0	1

CIA Plot of Fish Production in Dal Lake



CIA Plot of Fish Production in Wular Lake



CLASSIFICATION AND REGRESSION TREES (CART)

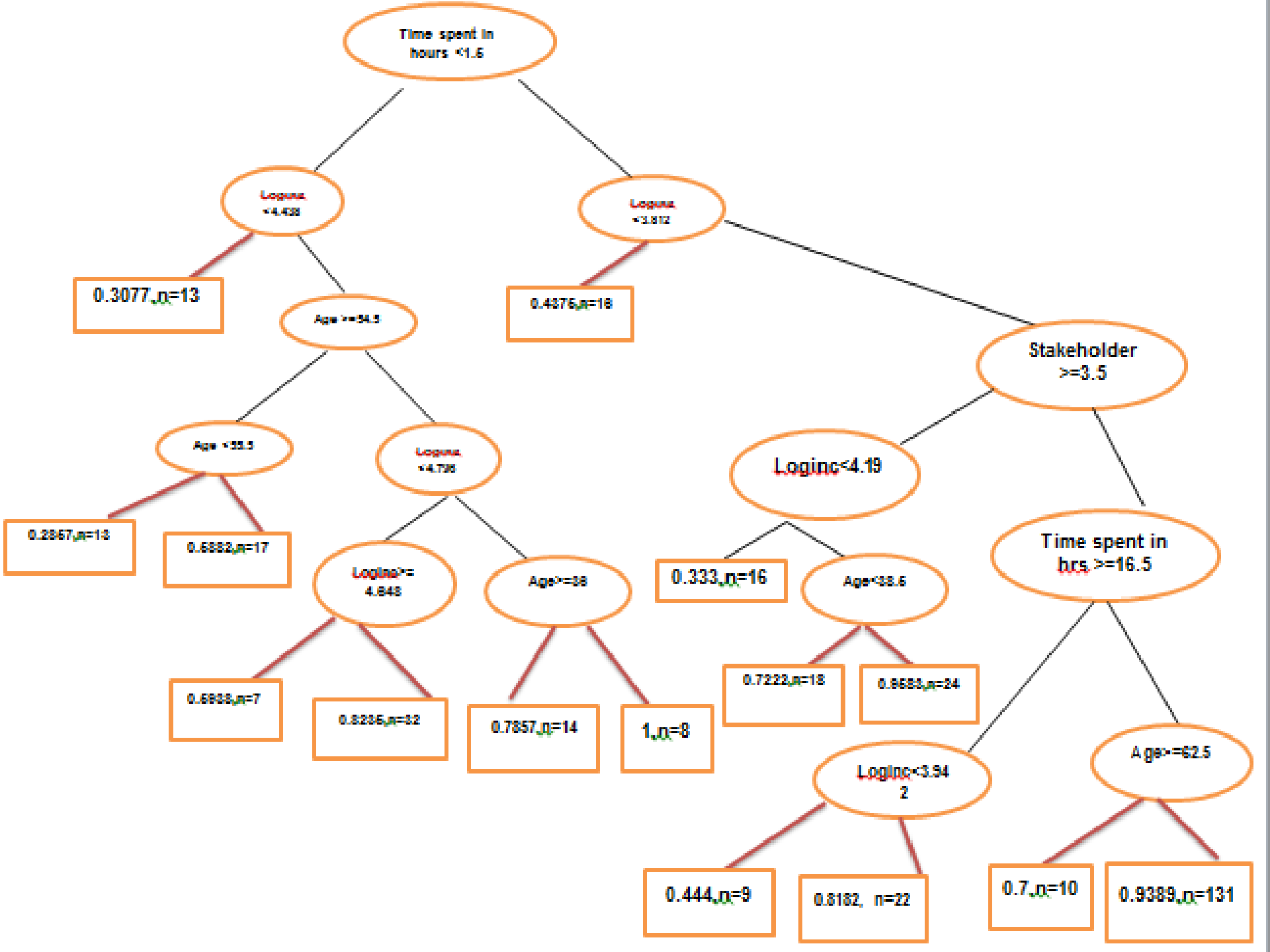
- Classification trees are used to predict membership of cases or objects in the classes of a categorical dependent variable from their measurements on one or more predictor variables.
- Classification tree analysis is one of the main techniques used in data mining.
- The goal of classification trees is to predict or explain responses on a categorical dependent variable, and as such, the available techniques have much in common with the techniques used in the more traditional methods of Discriminant Analysis, Cluster Analysis, Non-parametric Statistics, and Non-linear Estimation.
- The flexibility of classification trees make them a very attractive analysis option, but this is not to say that their use is recommended to the exclusion of more traditional methods.

CLASSIFICATION AND REGRESSION TREES (CART)

- Regression trees as a statistical technique were used for exploring, describing and predicting relationships between multispecies data and environmental characteristics.
- In India, Devi *et al.* (2013) used ANN for assessment of synergy in ornamental fish markets. There are no other references to data mining methodologies used in fisheries data analysis in India. **This work is thus unique in this attempt.**

CART for WTP of multiple stakeholders in lakes of Kashmir

Central Institute of Fisheries Education, Mumbai


Time spent in hours <1.6
Logunc <4.438
Logunc <3.812
0.3077,n=13
Age >=54.5
0.4375,n=16
Stakeholder >=3.5
Age <55.5
Logunc <4.726
Loginc<4.19
0.2857,n=13
0.6882,n=17
Loginc>= 4.848
Age>=38
0.333,n=16
Age<38.5
Time spent in hrs >=16.5
0.6923,n=7
0.8235,n=32
0.7857,n=14
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0.7222,n=18
0.8653,n=24
Loginc<3.94 2
Age>=62.5
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0.7,n=10
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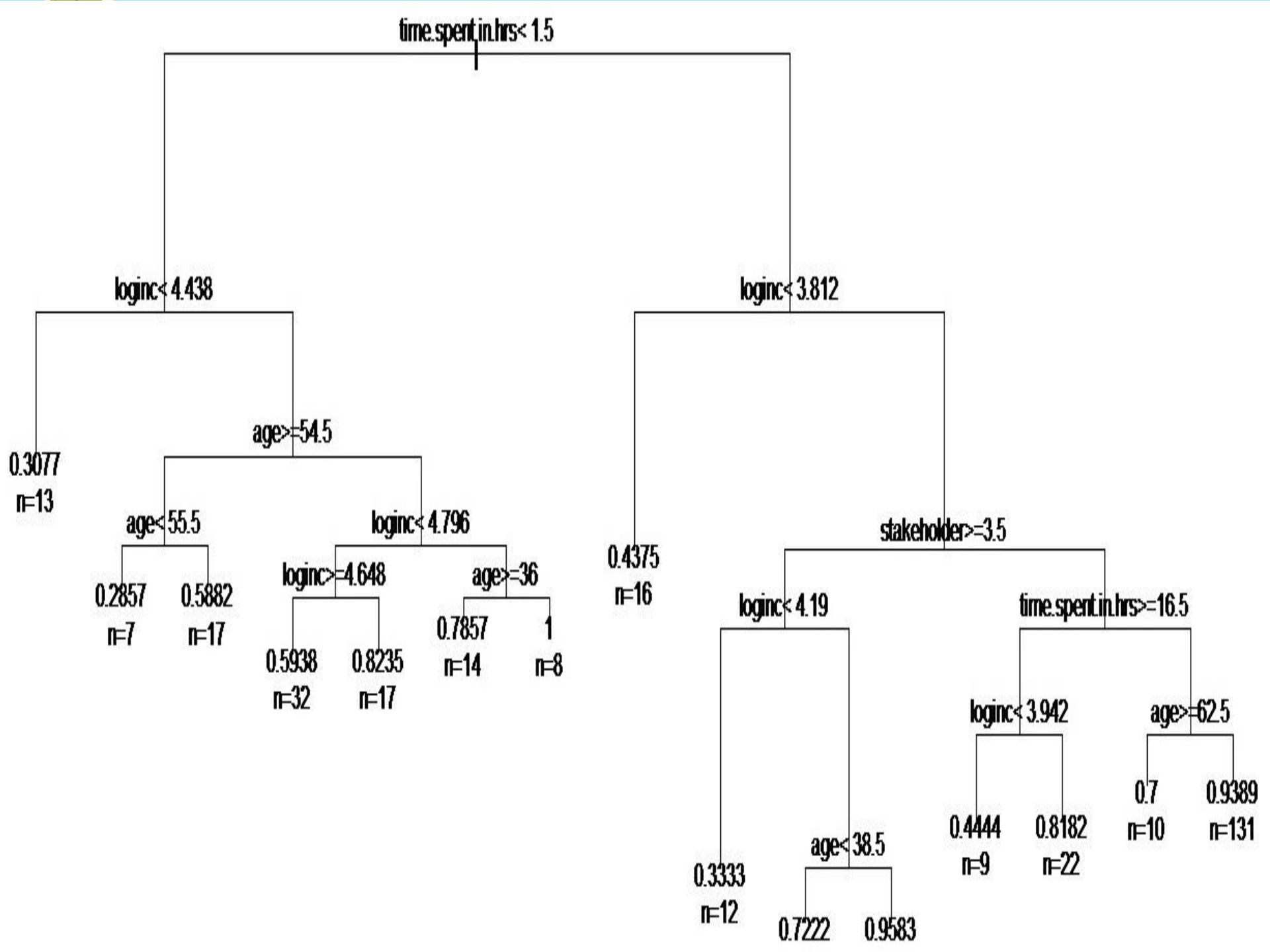
time.spent.in.hrs< 1.5
loginc< 4.438
loginc< 3.812
age>=54.5
0.3077
n=13
age< 55.5
loginc< 4.796
0.4375
n=16
stakeholder>=3.5
0.2857
n=7
0.5882
n=17
loginc>=4.648
age>=36
loginc< 4.19
time.spent.in.hrs>=16.5
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n=32
0.8235
n=17
0.7857
n=14
1
n=8
loginc< 3.942
age>=62.5
0.3333
n=12
age< 38.5
0.4444
n=9
0.8182
n=22
0.7
n=10
0.9389
n=131
0.7222
0.9583

POLICY SUGGESTIONS

- Development of alternative livelihoods
- Public private partnership and corporate social responsibility.
- Strict enforcement of laws for civic discharge into lakes.
- Concerted fisheries development programme
- Management of houseboats.
- Restoration of local indigenous species
- Management of fish marketing
- Consumer awareness has to be improved.
- Focus on women education has to be improved.
- Institutional efficiencies and networking in performance need to be improved substantially and there is a need for a holistic approach in containing the problems that originate in key sub-sectors like tourism impacting the food production system of fisheries.

CONCLUSION

- The WTP for the conservation and development of *Schizothorax* fishery in Kashmir as proved by the models depends not only on time spent on earning their livelihood but also on their total income, the type of stakeholder in the fishery and age of the stakeholder.
- The model also show that a balanced approach is required to be taken by the Government of Jammu and Kashmir, India to make a decision in respect of income, social welfare, socio-economic implications and interactive roles played by different dimensions of the lakes of Kashmir.
- The real value of maintaining an ecosystem in its pristine form far outweighs the monetary gains that would accrue to the government resulting from the exploitation of the ecosystem.
- The WTP of multiple stakeholders for the development of sustainable *Schizothorax* fisheries in the lakes of Kashmir has again re-instated the importance of proper biological, social and political management enabling each one of them to operate at their optimal best.


THANK YOU