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Physico-chemical parameters and fish diversity of river Siang in Arunachal Pradesh: its conservation and management

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Abstract : The present study on fish faunal diversity of River Siang of Arunachal Pradesh was carried out from 2012 to 2013 in different seasons throughout the year. The present Studies on River Siang reveals the presence of different 90 species of fishes belonging to 8 orders, 24 families and 59 genera. Cypriniformes dominates the whole river; Beloniformes and Tetradontiformes are found in less numbers.

The water sample is collected from the Six (6) different parts of the river on the basis of microhabitat and analyzed different types of water parameters. The results of Physico-Chemical Parameters that are recorded in the different stations are compared with the World Health Organization (WHO) and it was found that the water of River Siang may be suitable for drinking and domestic purposes because all the values are between WHO.

This study illustrates the potential application of GIS and Remote Sensing techniques to support the river analysis and its management. Remote Sensing and GIS are familiar as an influential tool to attain this purpose in aid of a well-versed management decision system

Keywords: Fish Diversity, Physico-Chemical Parameters, Mapping of Drainage of River, GIS and RS, River Siang, Arunachal Pradesh.

INTRODUCTION

Fishes are in variable living components of water bodies. These organisms are important food resource and good indicators of the ecological health of the waters they inhabit. However, the rich biodiversity of the freshwater fish of the Indian region has been rapidly dwindling because of increasing degradation of inland water. Out of a total of 2500 species of fish in India, 930 are in freshwaters and belong to 326 genera, 99 families and 20 orders (Talwar and Jhingran 1991)¹. India is one of the Mega biodiversity countries in the World and occupies 9th position in terms of fresh water mega biodiversity (Mittermeier and Mittermeier, 1997)². North-Eastern region of India has been identified as a 'Hotspot' of Biodiversity by the World Conservation Monitoring Centre (WCMC,

1998)³. River with its tributaries is a unique type of ecosystem which generally covers different types of climatic zones, landscapes and bio geographical regions (Das and Kar, 2011)⁴. River is the natural drainage system of the land mass of the earth which move continuously. All north-eastern states have handful resources of fishes as well as other aquatic species in terms of many rivers with their tributaries, streams, rivulets, wetlands, lakes, ponds, tanks etc. Arunachal Pradesh has vast and varied fresh water aquatic resources and it being regarded as one of the richest spot of biodiversity in India (Das *et al.* 2014)⁵.

The distribution pattern of freshwater fishes varies globally (Berra, 2001)⁶. Each continent has a distinctive freshwater fish fauna (Berra, 2001)⁶. Hora (1937, 1942)^{7,8}; Jayaram (1981, 1999)^{9,10}; Yadava and Chandra (1994)¹³; Menon (1999)¹⁴ have described the freshwater fishes of India. Kar studied the fishes of NE, India (2000, 2007, 2013)^{15,16,17}; Kar and Sen (2007)¹⁸. Ecology, diversity, taxonomy and collection of fish in Arunachal Pradesh were

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significantly contributed by Sen (2000)¹⁹; Bagra *et al.* (2009)²⁰; Tesia and Bordoloi (2012)²¹. Nath and Dey (1997, 2000)^{11,12} recorded 131 species of fishes from the drainages of Arunachal Pradesh. Nath and Dey (2000)¹² had reported 74 species of fishes from River Siang system of Arunachal Pradesh.

STUDY SITE

The River Siang, is largest river of Brahmaputra river system, originates from Chema Yungdung Glacier near Kubi at 5150 m in Tibet. In Tibet it is popularly known as Tsang-Po, flows in West–East direction. After traversing a distance of about 1625 km river in Tibet and then it

takes a turn in south direction, enters the territory of India near Tuting in the Upper Siang district of Arunachal Pradesh and flows through North–South direction in East Siang district towards Assam. In East Siang district the river flows as Siang and travels about 52 km from Pasighat at the foothills of the Himalayas and finally it merges with Lohit and Dibang in Assam and it becomes the mighty River Brahmaputra (Das *et. al.* 2014)²². The selection of the location is based the upstream, mid-stream and downstream of the River Siang. The data were collected from six different sites during Monsoon, Post-Monsoon, Winter and Pre-Monsoon for the period since 2012 to 2014.

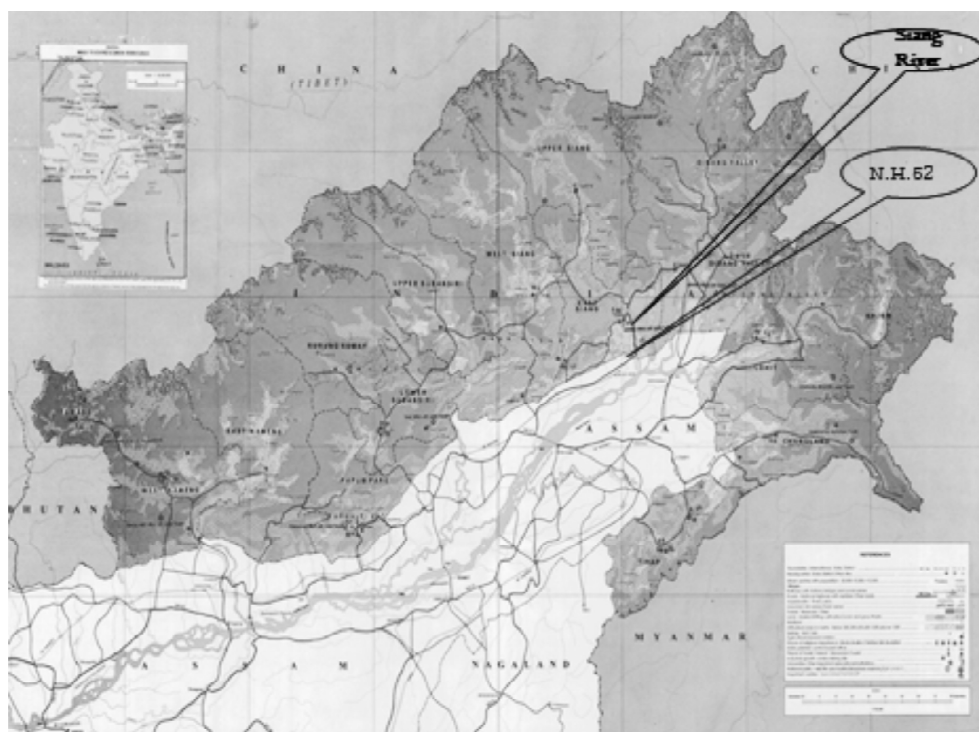


Fig 1: Showing the Location of Siang River in Arunachal Pradesh

MATERIALS AND METHODS

General survey of the fish biodiversity was done using standard procedures (Armontrout, 1990)²³. Fish samples were collected from Siang River during 2012 to 2014 and local people were involved in the netting and also in the fish collection. Fish samples sites were chosen in the survey area based on micro-habitat types, substrate type, water quality, soil quality and the depth of the river. Fish species have been preserved at first in concentrated (100%) formaldehyde in the field. After that the fishes are

transferred to into 10% formaldehyde glass container to preservations purpose. In the laboratory the fish species have been identified after standard literature by following Talwar and Jhingran (1991)¹, Jayaram (1999)¹⁰, Kar (2007, 2013)^{16,17} and Vishwanath (2002)²⁴.

In the present study, water quality of River Siang is reported from six different portion of the river namely Mebo, Bodag, Ranahat, Pasighat, Ponging, and Rottang. The physico-chemical parameters, air temperature (AT), water temperature (WT), turbidity (Turb.), pH, Dissolved

Das et. al. :Physico-chemical parameters and fish diversity of river Siang in Arunachal Pradesh: its conservation and management

Oxygen (DO), Free Carbon-di-Oxide (FCO₂), Conductivity (Cnvt), Total Alkalinity (TA), Total Hardness (TH) were estimated after APHA (1998, 2010)^{25,26}; Kar (2007, 2013) and using Perkin Elmer Atomic Absorption Spectrophotometer (AAS) Model A Analyst -700, Auto Calibrated (Abolude et al. 2009)²⁹.

RESULTS AND DISCUSSION

The present study on fish faunal diversity of River Siang of Arunachal Pradesh was carried out from 2012 to 2014 in different seasons throughout the year. The present Studies on River Siang reveals the presence of different 90 species of fishes belonging 59 genera under 8 order and 24 families. Cypriniformes dominates the whole river; Beloniformes and Tetrodontiformes are found in less numbers.

Most of the fishes (72) that are recorded in Siang River are Least Concern under the Conservation Status; while only 10 species are recorded as Near Threatened and only one is recoded as the Not Evaluated fish species.

The regular flow of water was diminished to a very minimum level which causes the lowering of the ground water level resulting to loss of vegetation due to scarcity of soil water. The drying up of the river will initiate human activities on the river. The existing fish community comprising of terrestrial as well as aquatic and other organism will face the problems of loss of habitat, feeding

sites and breeding grounds as a result of change of vegetation pattern due to change of normal water regime of the river.

The present study of physico-chemical parameters of the River Siang revealed the below mentioned parameters and the parameters are discussed in the below:

1. **Water Colour:** Colour change is not harmful unless it is associated with a toxic chemical but it may be affect the quality of sunlight that penetrates to a given depth inhibiting plant and animal metabolism. The colour of water colour was clear in most of the study sites but the colour is pale green in the mid-stream of the river.

2. **Air Temperature:** The value of air temperature is highest in summer season in the Ranaghat, 35 degree Celsius and minimum in the winter season in Ranaghat 21 degree Celsius.

3. **Water Temperature:** The value of water temperature is highest in Pasighat (summer) 30 degree Celsius and minimum in Mebo (winter) 15 degree Celsius.

4. **pH:** The pH of a water body is very important in determination of water quality since it affects other chemical reactions such as solubility and metal toxicity. During the present study the value of pH is found normal in every portion of the river; the total ranges of value is lies between 6-8. The highest value of pH was recorded as 7.91 in Post-Monsoon season at Rottang and the

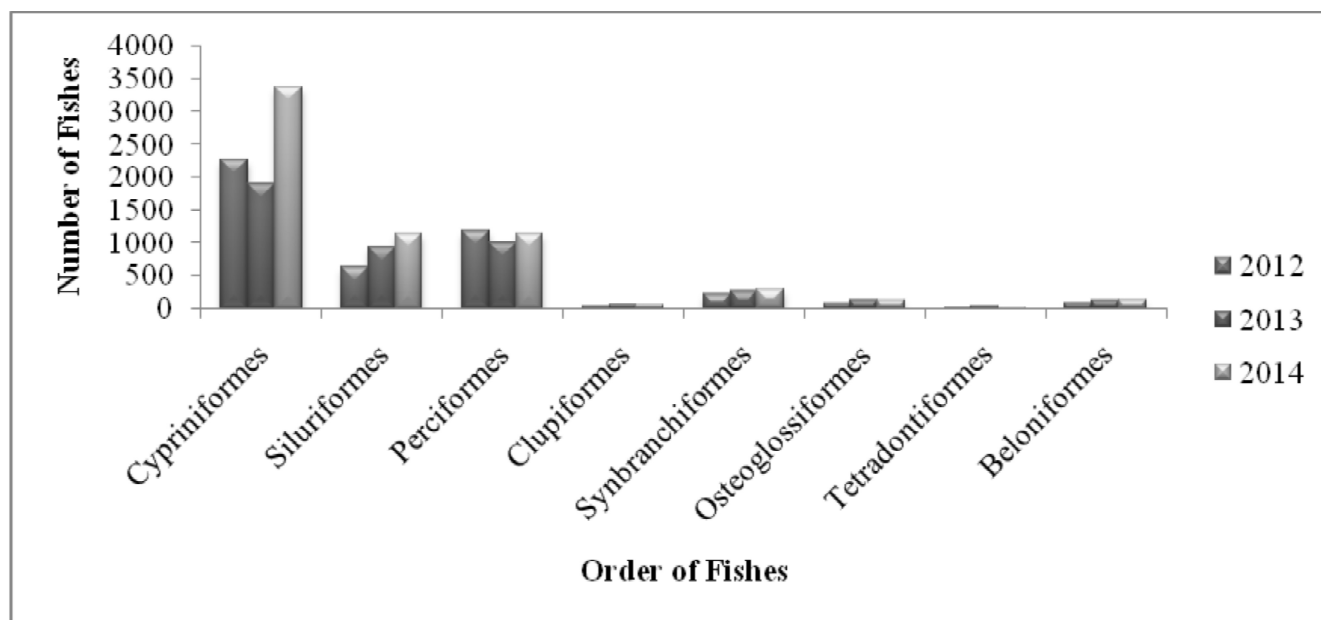


Fig II: Number of fishes on the basis of

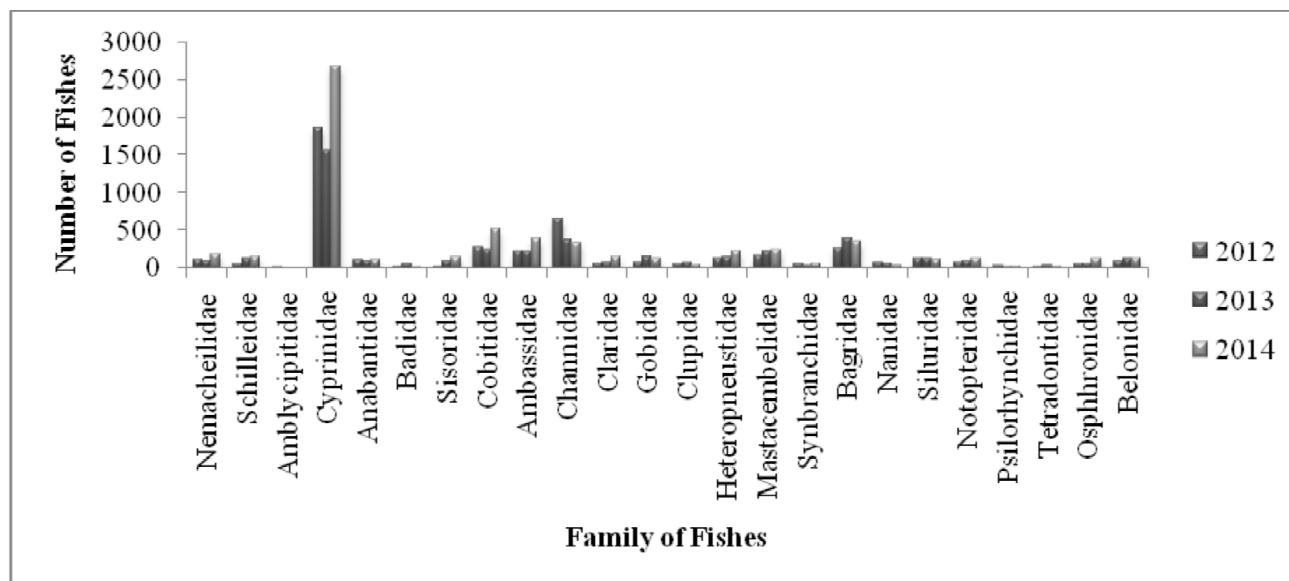


Fig III: Number of Fishes on the basis of Family

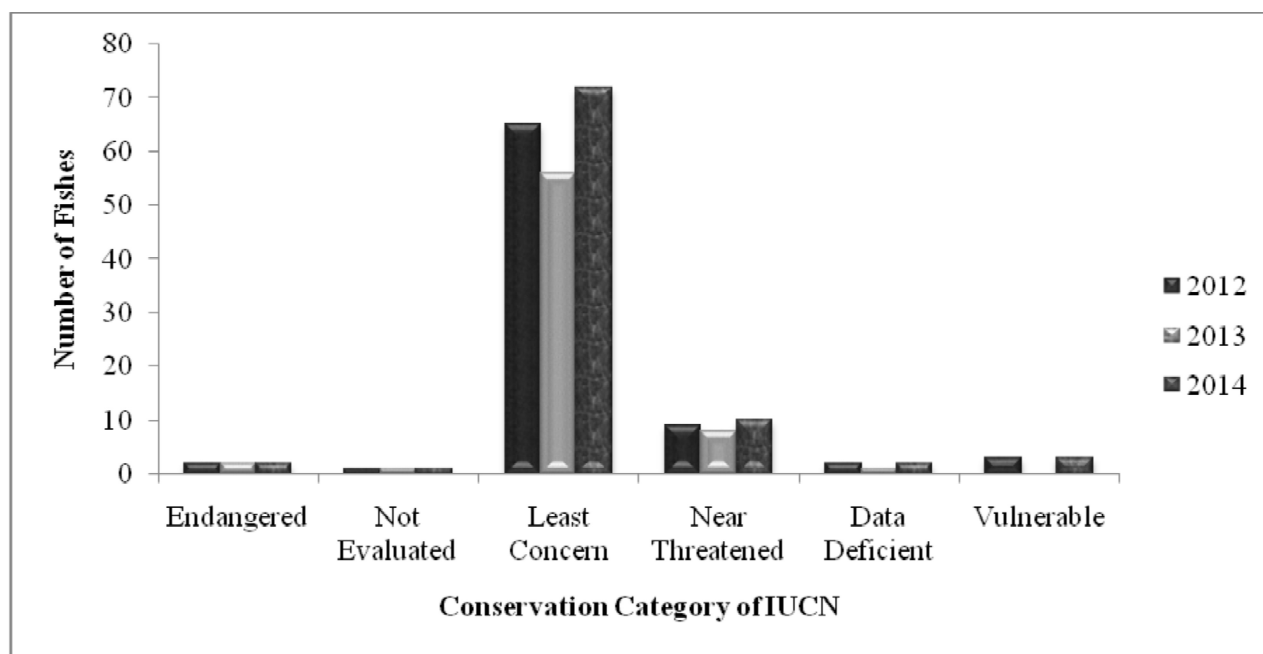


Fig IV: IUCN conservation status of fishes of River Siang in different year

Das *et al.* :Physico-chemical parameters and fish diversity of river Siang in Arunachal Pradesh: its conservation and management

minimum recorded as 6.3 in winter season at Ponging.

5. Dissolved Oxygen: Dissolved Oxygen (DO) is an important limnological parameter indicating level of water quality and organic pollution in the water body. The value of DO is remarkably significant in determining the water quality criteria of an aquatic system. The maximum value of DO is recorded as 8.8 mg/L in summer at Rottang and minimum recorded in minimum recorded as 4.9 in Pre-Monsoon at Ranaghat. The maximum DO value in Monsoon (summer) is due to bright sunlight as it influences the % of soluble gases.

6. Free Carbon-di-oxide: Free carbon-di-oxide (FCO_2) dissolves in water varying amounts and the dissolution depends on partial pressure and temperature. FCO_2 plays an important role in water bodies by producing calcium bicarbonate from calcium carbonate and this gas alters the pH of water by reacting with it to form carbonic acid. It is the basic raw material of photosynthesis in aquatic ecosystems. The value of FCO_2 ranges between 3.4 to 7.1 mg/L. The value was minimum in winter at Ponging while it was recorded as high also in Ponging in post-monsoon season.

7. Conductivity: Conductivity measures the capacity of water to convey electric current. Conductivity of water varies directly with the temperature and it is proportional to its dissolved mineral matter content. The value of conductivity ranges between 7-14 ppm. The value highest at Bodag and the lowest value in Mebo of River Siang.

8. Total Alkalinity: The value of total alkalinity (TA) provides idea of natural salts present in water, Gawas *et al.*, 2006. Natural waters with high alkalinity are generally rich in phytoplankton, especially the blue greens. It is an important factor for productivity of an aquatic ecosystem. Total alkalinity of water is mainly caused by the cations Ca, Mg, Na, K, NH_4 and Fe in combination with either CO_3^{2-} or HCO_3^- or occasionally as OH^- . Total alkalinity of water is due presence of mineral salts in it. It is primarily caused by the carbonate and bicarbonate ions.

9. Turbidity: Turbidity is the material in water that affects the transparency or light scattering of the water. The observed values of the turbidity were within the limit range of WHO standards. The minimum values were recorded at Bodag as 78.1 and maximum values were recorded at Rottang as 99.9. The both minimum and maximum values were recorded in in pre-monsoon season.

Total Hardness: Hardness is the property of water which prevents the lather formation with soap and increases the boiling point of the waters. The value of total hardness is maximum in winter recorded as 88.5 mg/L at Bodag and minimum in pre-monsoon recorded as 64.7 at Mebo of River Siang.

Physico-chemical characteristics of surface water varied according to seasons. Most of the water parameters vary seasonally. The results showed that mid-stream and downstream of the River Siang i.e. Ranaghat Pasighat, Ponging and Rottang are more polluted than that of upstream and downstream because of the sewage and wastage that comes from the Pasighat town. There is no significance chance in the pH value during the observation period. There were significant occurrence in Conductivity and TH which call for caution on discharge untreated waste into River Siang. The physico-chemical characteristic of River Siang in the study area suggested that here was no harmful chemical contamination. If proper measures are taken for the treatment of sewage before discharge and restrictions are out on various anthropogenic activities upstream, the estuary would remain healthy in the long run.

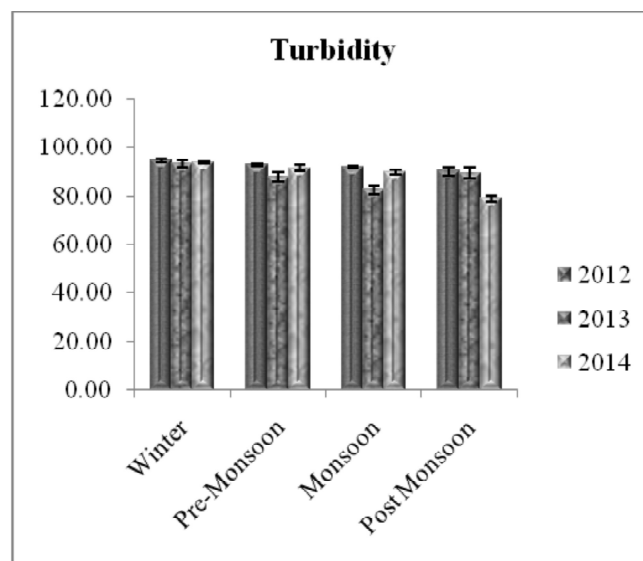
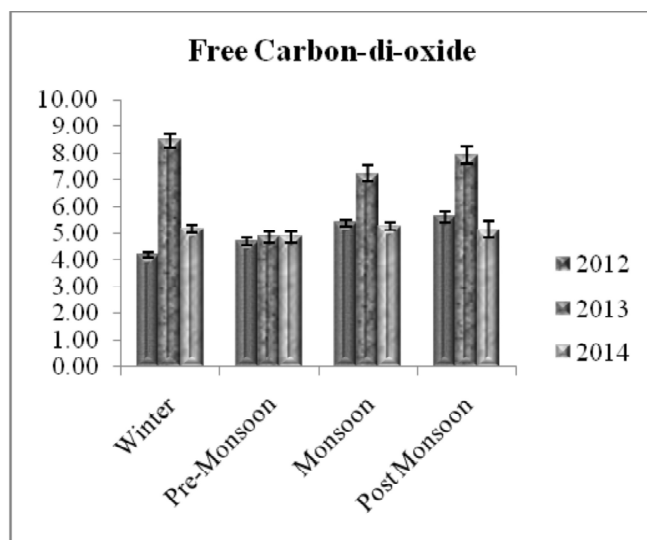
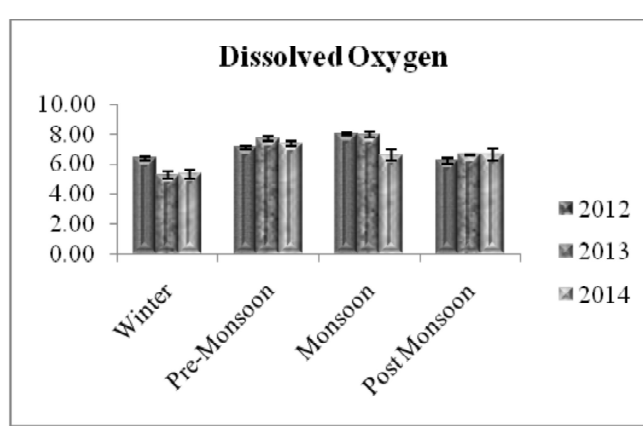
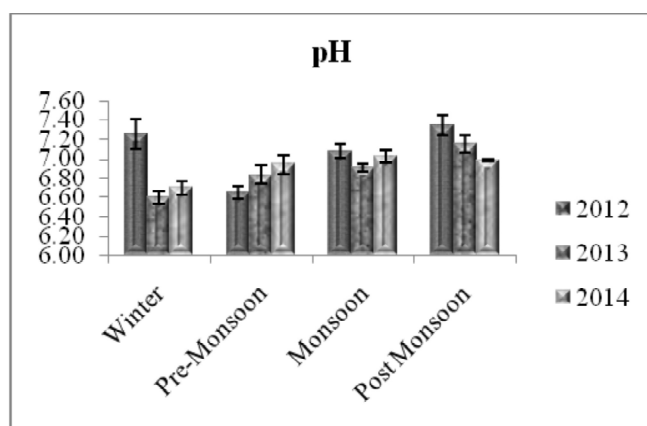
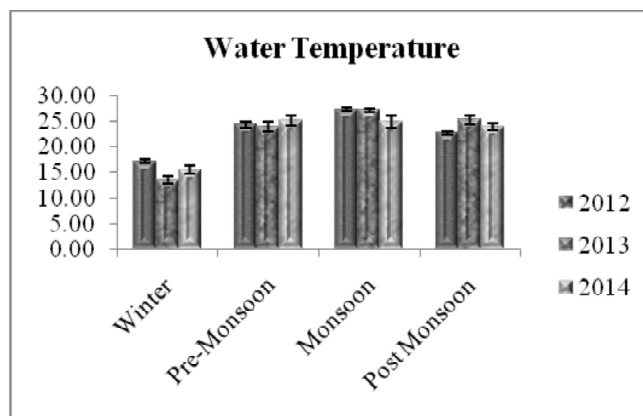
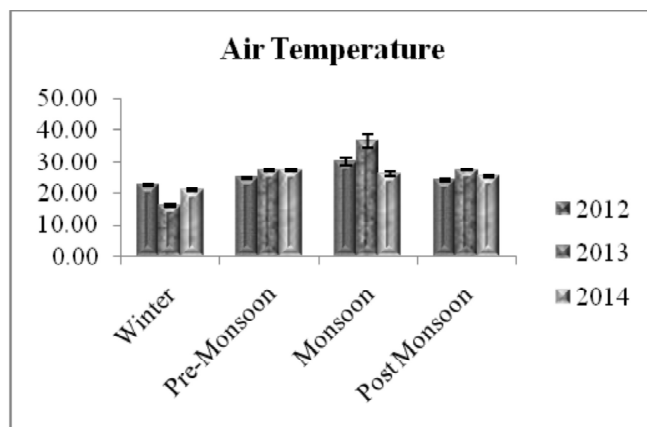
CONSERVATION AND MANAGEMENT

The freshwater fish are the most vulnerable taxonomic group as most of the threatened or endemic freshwater species are found particularly in the river. Therefore these habitats are highly susceptible to various threats such as forest clearance, gem mining, expanding agriculture, large and small scale hydro projects and exposure to chemical pollutants including agrochemicals and sedimentation due to soil erosion. Several species have become threatened during the past few decades due to loss of their habitat, land reclamation or habitat conversion as a result of reservoir projects.

Measures to be taken for better Production of Fishes

1. To make a plan for sustainable development; the Wetland which is a closed Beel can be made available for capture fishery.

2. The major Development of fisheries requires measures involving sustainable exploitation of the existing natural resources and breeding of native and exotic varieties under controlled conditions. Stocking of large varieties of fishes in adequate quantities throughout the year is a prerequisite for exporting directly to the potential



Das *et. al.* :Physico-chemical parameters and fish diversity of river Siang in Arunachal Pradesh: its conservation and management

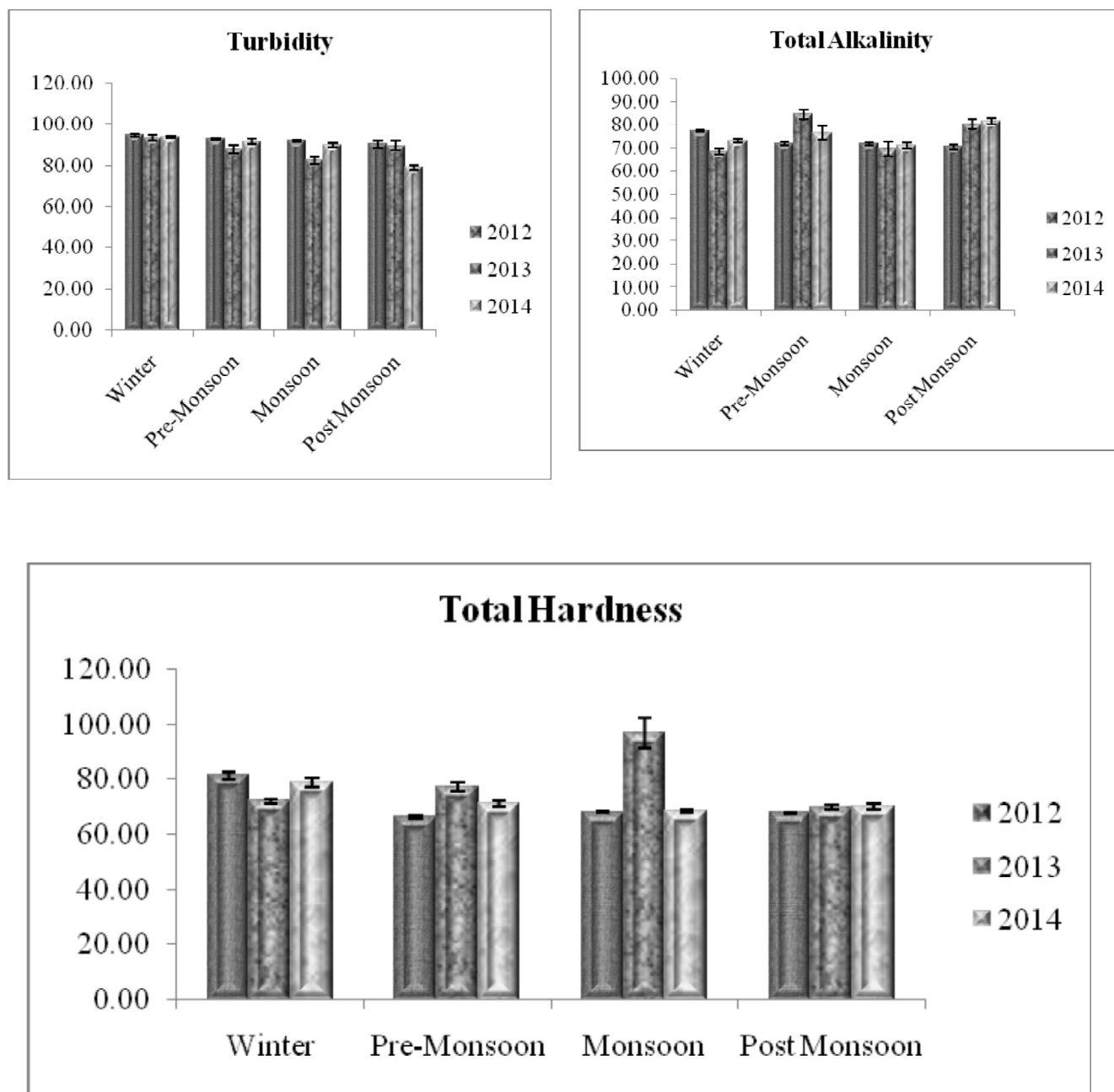


Fig V: Physico-Chemical Parameters of Water of River Siang 2012-2014

destination markets.

3. In order to take advantage of the availability of a large number of varieties, a strong supply chain needs to be established starting from fish collectors, agents, dealers and exporters.

4. Appropriate steps are necessary for the protection of breeding ground like, free migration of the breeders, control of overfishing by optimizing the gears and nets and stock assessment of the populations in the capture fishing improvement.

5. Appropriate action to ensure that the development of the trade should not threaten the sustainability of the riverine ecosystem.

6. Exploitation of species which are not suited for aquarium. This also needs to be avoided by legislation.

7. Regulations to post harvest mortality. Training may be imparted for handling and transportation individuals and transported in suitable containers to avoid post harvest mortality.

8. The impact of exploitation has to be closely monitored by scientific agencies at periodic intervals and required management measures have to be implemented as and when required.

9. Maintain and preserve fish genetic material to conserve endangered fish species.

10. Evaluate indigenous and exotic fish species; and ensure Intellectual Property Protection relating to fish genetic resources.

11. Disease and health of the fishes are to be taken care of, particularly, the virulent Epizootic Ulcerative Syndrome (EUS) in fishes.

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