International Journal in Management and Social Science
Volume 07 Issue 03, March 2019 ISSN: 2321-1784 Impact Factor: 6.178
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

"LIVELIHOOD AND STATUS OF A FISHING COMMUNITY (HUT-DWELLERS), PHUBALA, MANIPUR – A CASE STUDY"

[1]Ningthoujam Kamala Chanu, and [2]Kh. Rajmani Singh
[1]Research and Development Centre, Bharathiar University, Coimbatore
[2]Department of Zoology (P.G. Section), D.M. College of Science, Imphal
E-mail : *kmlning25@gmail.com*

Abstract

The study site is particularly referred to Hut-dwellers. They almost depend on fishery for their livelihood at the Loktak Lake. The work is done to assess the socio-economic and fishery status of this particular community. The assessment is mainly based on field visit, questionnaire, interaction, etc. seasonally. Traditional fishing crafts and gears such as nets, traps, hooks and lines, small canoe, etc. are mainly used. During April-June, they face problems in fishing due to heavy rain and storms. So, they have to work for daily wages to maintain family. On the other hand, maximum catch is found in rainy season and can earn Rs.1000/day. Fishing and marketing is equally shared by both sexes and processing is mainly performed by women fishers only. They sell both fresh and smoked fishes at Phubala, Ningthoukhong, Moirang and Imphal market. Some commercial species are Channa sps., Notopterus notopterus, Amblypharyngodon mola, Esomus danricus, Puntius sps., Cyprinus sps., Labeo rohita, Cirrhinus mirgala, shrimps, etc. Fortunately, the children got education at primary school and medical care from Phubala Health Centre. Road approaching to the village is kutcha and condition during rainy season is pathetic. A small rivulet separates it from the Loktak lake and its crossing through wooden planks is very risky and dangerous. Physico-chemical characters are recorded as favourable. Sustainable development is the urgent need of the hour for these particular hut-dwellers.

Key words: fishing, Hut-dwellers, livelihood, marketing, processing and smoking.

Introduction

Phubala is a village situated in the Bishnupur district of Manipur around 35 Km from Imphal. The present study site is known as Hut-dwellers. Basically, these people are inhabited on the western bank side the Loktak Lake in small huts. The government gives a land area of 16.88 acre and each family owns 40x60 square meter area. The villagers depend on Loktak for their livelihood. They do only capture fishery. The total number of family is increased to 52 households of around 350 members.

Originally these people groups are the inhabitants in the Loktak lake who dwelt on *phoomdhi*, a floating mass to earn their livelihood. With the effect of clearing of Loktak, these villagers become landless and our government made an alternative arrangement for the welfare of these fishers. The government made some huts in nearby convenient area at Phubala and it is known as hut-dweller. Initially it was provided with only 13 huts and then expanded to 54 houses. No family is allowed to own even a small piece of land. These areas are registered in the name of a society called Loktak Development Hut Dwellers' Co-operative Society. If anyone tried to change into their own, they can be punished. The socio-

economic status of this fishing community is low. Since this area is situated on the periphery of the Loktak lake, their activity mostly depends on capture fishery in it.

The main objective of the study is to assess the fishery status and their involvement in overall fishery related activities such as fishing, sorting, processing, marketing etc. and socio-economic status of this particular fishing community. The study also aims to find out some water parameters to sketch its productivity. It can identify the problems faced by the villagers. The site is selected randomly through information considering the importance of fishery in this particular society that is somewhat underdeveloped. The study covers the fishery activities, their socio-economic status and some water parameters and strictly confined to these hut-dweller family only.

Materials and Method

Primary data was collected through field visit to different houses of this hut-dweller's society seasonally. Group discussions, personal interviews, questionnaires were done along with photographs. Fishery activities such as fishing, processing (mainly sorting, smoking, washing, etc.) were observed personally. Literatures were collected through journals, books, articles, etc. Water parameters such as temperature, turbidity, pH were analysed on the spot but others like following APHA.

Result and Discussion

1. Fishing: Most of the people follow traditional fishing methods using nets, traps, hooks and lines, etc. as reported by many other scientists (Gurumayum and Choudhury, 2009). *El chingba***,** a kind of dip net fishing is mainly operated by women fishers with the help of small canoe whereas Lang thaba (using drag net), khoi thaba (using hooks and lines), Longna thinba (spear fishing), etc. are operated by male fishers. Small fishes are generally caught with the help of small sieve size nets. Sieve size no. 18 is used in catching *Amblypharyngdon mola* and nos. 18 and 20 for *Puntius spp*. Species caught include *Labeo rohita, Cyprinus carpio, Puntius sps., Anabas testudineus, Notopterus sps., Amblypharyngodon mola, Esomus danricus, Trichogaster sps.*, etc.

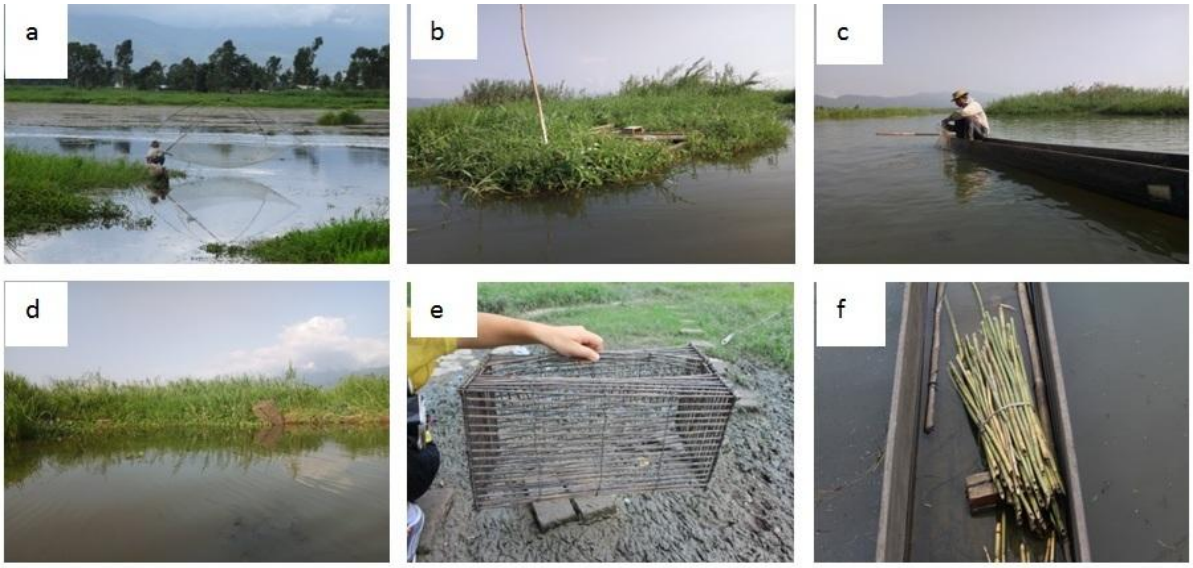

Fig. 1: a. Dip net fishing at Loktak by women fishers (*El-chingba*), b. A small deck used by fishers during fishing, c. Drag net fishing (*Lang thaba*), d. Traps fishing, e. Box trap and f. Hooks and lines.

The availability of species is different according to the season, maximum catch was during rainy season i.e. June-July. On the other hand, the farmers suffer the most this time i.e March, 2018 due to heavy rains and storms. On stormy day, *phumdhi* is floating here and there affecting fishing areas and causes death while fishing in the lake. It is reported that two persons were dead due to sudden heavy storms some years back. Rapid growth of floating *phumdhi* also gave a major threat to farmers as well as the fish habitats. Fish sorting is done by women at home to preserve the quality of fish for selling fresh and proper smoking and preservation process. It is also a time consuming activity. Almost 90% of the population are doing as full-time fishery activities.

Fig. 2: Sorting of fishes at home

2. Fish preservation and processing: The common methods followed by women fishers for fish preservation are smoking, drying, frying, etc. In South East Asia, fermentation, salting, drying and smoking are employed as the principal methods for fish preservation (Vishwanath and Sarojnalini, 1989). Traditional based methods still employed predominantly in the state for fish preservation. Sun drying is reported to lose some nutrients (Kamruzzaman, 1992). Smoking is done with the help of kiln made up of locally available materials along with mud known as *Leirang* and sieve. Washing and cleaning before smoking is needed to prevent it from overlapping. It keeps body texture, shape as usual. It also protects from micro-organisms. Then the fishes are arranged in a definite order to control the shrinkage of muscles. Locally available fire woods and paddy husk are used as fuels.

Fig. 3: a. Kiln used in smoking (*Leirang*), b. A model of smoking of fishes and c. Some smoked fishes

3. Marketing of fishes: Marketing and extension is very important for selling fish and its products. It is a part and parcel of the livelihood of the fishers. It is mainly done by women. Fish trade is a traditional occupation that has been a means of livelihood for thousands in India with the majority of fish vendors being women (Manju and Rama, 2014). Selling is done at home. Some went to nearby markets such as Ningthoukhong, Moirang and Bishnupur market for selling both fresh as well as smoked fishes. Prices vary with different species as well as different seasons. Prices of some species for both smoked and fresh fishes are indicated in table no.1.

Table No. 1: Prices of fishes and its availability per year

Sl. No.	Species	Prices		Availability
		Fresh	Smoked	
1	*Ctenopharyngodon idella*	Rs. 160-180/Kg	X	Occasional
2	*Labeo rohita*	Rs. 180-200/Kg	Rs. 300-350/Kg	Annual
3	*Cyprinus carpio*	Rs. 150-170/Kg	Rs. 280-300/Kg	Annual
4	*Puntius sp.*	Rs. 25/100g	Rs. 50/100 piece	Annual
5	*Channa striata*	Rs. 250-300/Kg	X	Seasonal
6	*Channa striata* (fry)	Rs. 50/200g	X	Seasonal
7	*Channa punctata*	Rs. 20/200g	Rs. 100/250g	Occasional
8	*Amblypharyngodon mola*	Rs. 30/100g	Rs. 60/100 piece	Annual
9	*Esomus danricus*	Rs. 30/100g	Rs. 60/100 piece	Seasonal
10	*Anabas testudineus*	Rs. 400-450/Kg	Rs. 1000-1050/Kg	Seasonal
11	*Glossogobius giuris*	Rs. 350/Kg	Rs. 100/300g	Annual
12	*Trichogaster sp.*	Rs. 30/100g	Rs. 60/100 piece	Annual
13	*Cirrhinus mrigala*	Rs. 180-200/Kg	Rs. 300-350/Kg	Annual
14	*Notopterus notopterus*	Rs. 30-35/250g	Rs. 100/250g	Seasonal

Socio-economic status

Study of socio-economic status is important factor for sustainable management and enhancement of fish production as well as uplifting the rural fisher economy (Ali *et al*., 2014). Studying social status will indicate the potentiality of the particular society. It can predict the overall development of the area. Decision makers can use the socio economic data to better understand the coastal environmental and the human interactions and uses that affect it (Bordoloi *et al*., 2012). Income range and level of education indicate the mental and physical capability of a family. Each and every person of a family needs to be well educated and have an income source for a better society.

Fig.5: a. Poultry and b. Net preparation at home

1. Age and housing status: Age group is categorised as children (0-14 years), young (15-30 years), middle (31-40 years), old (41-60 years) and very old (above 60). Maximum fish farmers belong to the middle aged group i.e. 31-40 years. It covers 50% of total population and followed by 29% for young age (15-30 years). The data shows that middle age persons take major responsibility in the family. 90% of the houses are kutcha. No pucca houses are available there. The condition of houses also indicates the status of fishermen.

2. Family size: Family size is divided into three groups namely small (2-3 members), medium (4-6 members) and large (7-10 persons). Large size family dominates here. Half of the total households include large family followed by 20% of small family.

3. Monthly income and source of income: Monthly income ranges from Rs.1000-10,000 and above. The main source of income is fishing. Fisheries-related activities provide important sources of livelihoods for nearly 7 million people in India (Handbook of Fisheries, 1996). In peak season i.e. June-July, a family can even earn Rs. 1000/day. Some work for daily wages and sometimes poultry is done for extra income source. Preparation of nets is done at home. Some women sold vegetables collected from the Loktak at nearby areas. Family belonging to medium income covers 65%. Only 5% of population are in Government employment or public sector and 15% in private sector. Besides, fisheries sector plays an important role in the Indian economy by contributing to the national income, employment and foreign exchange (Gaurab *et al*., 2015).


Fig. 4: A house

4. Education: Education is a great necessity in everybody's life as it facilitates our knowledge, learning and skill which make us positive attitudes. So, it is necessary to give importance to education. The present study shows that 60% of population are in elementary level. Only 10% clear graduation. Unfortunately 10% of people are illiterate. In Assam, Beki river, 25.73% belonged to the education group upto Lower primary school. 2.17% belonged to pass Matriculation level and 72.10 % respondents belonged to the uneducated category (Gaurab *et*

al., 2015). One Anganwadi centre is there under the supervision from outside community. Fortunately the children got basic education from Phubala High School.

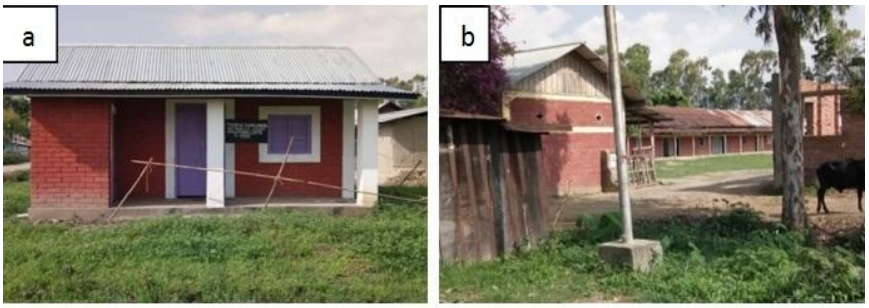

Fig. 6: a. Anganwadi Centre and b. Phubala High School

5. Health and Sanitation: Health is an important parameter to study the socio-economic status of an area. ASHA helps the women in pre and post pregnancy. Phubala Health Centre facilitates for treatment of the local people. They also got treatment from nearby district hospital at Bishnupur and Primary Health Centre at Moirang. Sanitation helps in maintaining good health. Sanitation is not well developed in this society. They are not getting any facility for sanitary latrines from Government. 90% family used kutcha latrines. Drinking water is another problem. They do not get drinking water supply facility other than a local pond where they prefer for drinking and household uses.

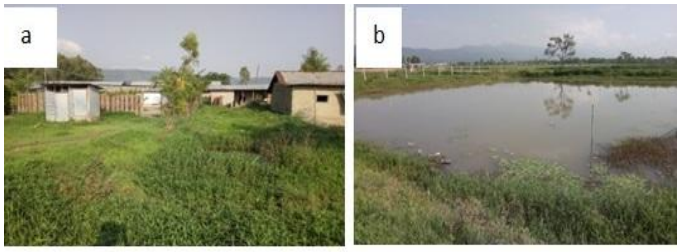

Fig. 7: a. Sanitation and b. A pond used for drinking purpose.

6. Transport and Communication: Phubala village can be reached by pucca road with the help of Tata-magic, bus, etc. Then, people have to go around 500 meters on pedal to reach the current study site. This hut-dweller community is connected by kutcha canal crossing made up of wood and bamboo. Motor vehicles cannot pass through it. With the development of science and technology, each family possesses one mobile phone irrespective of prices.

Fig. 8: a. A crossing made up of wood and bamboo. b. Port where villagers put their canoe for fishing and going to nearby villages. c. A small canal used for drainage from Phubala.

International Journal in Management and Social Science
Volume 07 Issue 03, March 2019 ISSN: 2321-1784 Impact Factor: 6.178
Journal Homepage: http://ijmr.net.in, Email: irjmss@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal

Water parameters

Quality of water is vital concern for mankind because it directly linked with human health (Furhan *et al.*, 2004). Physicochemical properties of water also play an important role in the maintenance of healthy aquatic ecosystem (Venkatesharaju *et al.*, 2010). Poor water quality can result in minor production and less profit by decreasing when production, growth, development due to contamination or even results in death to the cultured species (Stone and Thormforde, 2003). Aquatic ecosystems are affected by several anthropogenic activities that significantly deplete the biodiversity. In the future, the loss of biodiversity and its effects are predicted to be greater for aquatic ecosystems than terrestrial ecosystem (Sala *et al.*, 2000). The physico-chemical parameters of water for the present study include temperature, turbidity, pH, dissolved oxygen (DO), dissolved carbon-dioxide (DCO_2), alkalinity, etc.

Water temperature is an important physical parameter of the ecosystem in the polluted water. It controls the behavioural characteristics of organisms, solubility of gases and salts in water (Ram *et al.*, 2011) and also controls the rate of all chemical processes such as metabolic activities, growth, feeding, reproduction, distribution, immunity and migratory behaviours of aquatic organisms (Khan *et al.*, 2014 and Suski *et al.*, 2006). Drastic temperature alterations can be fatal to fish. Fishes are exothermic, gain heat from their external environment, so when the temperature of external environment fluctuates than the alterations in fish body temperature also occur accordingly (Nelly *et al.*, 2014). The study shows the temperature range between 19-28°C which maximum was recorded during June-July and minimum November-January. The ideal temperature which required for proper growth of fishes lies between 26-32 °C (WHO, 2006). If the temperature become high from the normal growth of microorganism then cause colour change in water and other destructive issues (Shivakumar *et al.*, 2000).

Turbidity is used to describe the suspended particles in water that interferes with the passage of light. It is caused by suspended matter due to the inflow of particles on account of rain or any other influences into the water body ranging the size from colloidal to coarse dispersion w.r.t. the degree of turbulence. It also ranges from pure inorganic substances to those that are highly organic in nature and turbid waters are undesirable from an aesthetic point of view in drinking water supplies (Agbaire *et a.l,* 2014). Turbidity reached its peak in July (Salam *et al.*, 2001 and Ali *et al.*, 2004) and showed higher monsoon values that could be owing to the turbulence arising out of flood like situations observed during the rainy season (Venkatesharaju *et al.*, 2010).

Table No. 2 Physico-chemical characters of water parameter

Parameter → / Time ↓	Temperature (^{0}C)	Turbidity (mg/l)	DO (mg/l)	Free CO_2 (mg/l)	Alkalinility (mg/l)	pH
Feb-March	21	20	8.0	3.0	45	6.8
April-May	27	18	8.2	2.5	65	7.1
June-July	28	30	8.0	1.0	75	6.4
Aug-Oct	24	45	6.4	1.0	40	7.0
Nov-Jan	19	10	7.1	2.5	65	7.5

pH is the negative log of hydrogen ion concentration. It is one of the vital environmental characteristics which decide the survival, metabolism, physiology and growth of aquatic organisms (Ramanathan *et al*., 2005). The lower values of pH may cause tuberculation and corrosion while the higher values may produce incrustation, sediment, deposition and difficulties in chlorination for disinfections of water (Singh *et al*., 2002). The optimum pH of water and soil which habitually favours the growth of fishes ranged from 6.5-9.5 and 6.5 to 8.4 congruently (Borkar, 2015 and Singh *et al.*, 2002). Optimum range of pH for maximum growth and production of shrimp and carp is recommended as 6.8-8.7 (Naeema *et al*., 2015). pH ranges from 6.4-7.5 which shows productive value. Extreme pH negatively distress fish reproduction and growth (Masood *et al.*, 2015). pH higher than 7 but lower than 8.5 is ideal for biological productivity while pH lower than 4 is detrimental to aquatic life (Abowei, 2010). EPA, 2002 recommended water quality criteria that pH should not exceed the established limits for open ocean waters, i.e., the optimal pH range for fish is from 6.5 to 8.5.

Oxygen is an element that is required for all forms of life, including those organisms responsible for the self-purification processes in natural waters. Dissolved oxygen (DO) affects the solubility and availability of nutrients. DO affect the growth, survival, distribution, behaviour and physiology of shrimps and other aquatic organisms (Solis, 1988). DO for the present spot ranged from 6.4-8.2 mg/l which indicates higher productivity. Maximum value recorded in April- May and minimum, August-October.

Free carbon dioxide in aquatic environment increases with decrease of DO (Naeema *et al*., 2015). Free carbon dioxide ranged from 1-3 mg/l. Maximum was found during the month February to March. Due to microbial activity and respiration of aquatic organisms, dissolved CO_2 is accumulated in the water. Carbon dioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism. Its fluxes across the air-water or sediment-water interface are among the most important concerns in global change studies and are often a measure of the net ecosystem production or metabolism of the aquatic system (Gopala *et al.*, 2015).

The alkalinity of natural waters is primarily due to the salts of weak acids (Venkatesharaju *et al.*, 2010) and its values were minimum at the surface increasing at the bottom. It increased during summer due to the concentration of nutrients in the water. 40 mg/l is found as minimum during August to October and 75mg/l during June to July which may the inflow of water along with household nutrients due to rain. Alkalinity is an estimate of the ability of water to resist change in pH upon addition of acid and is a big problem for industries since alkaline water if used in boilers for steam generation may lead to precipitation of sludge, deposition of scales and cause caustic embrittlement (Agbaire *et al.*, 2014).

Table no. 3: Demographic, Social and Economic Status

Sl. No	Feature	Category	%	Sl. No.	Feature	Category	%
1	Fishing	Full-time	90	6	Age	Children (0-14 yrs)	03
		Part-time	10			Young (15-30 yrs)	27
		licence	Nil			Middle (31-40 yrs)	50
						Old (41-60 yrs)	10
						Very old (60 yrs & above)	10
2	Crafts and gear	Traditional	95	7	Education	Elementary level	60
		Motorised	Nil			Higher secondary	20
		No craft	05			Graduate	10
						Illiterate	10
3	Nets, hooks and lines	Net fishing	50	8	Source of income	Fishing	75
		Traps	27			Private	15
		Hooks and lines	20			Government	05
		Spear fishing	03			Other	05
4	Family size	Small (2-3 members)	30	9	Monthly income (Rs./month)	Low (1,000-5,000)	30
		Medium (4-6 members)	50			Medium (5001-10,000)	65
		Large (7-10 members)	20			High (10,000 & above)	05
5	Housing status	Kutcha	90	10	Sanitation	Kutcha	90
		Semi-pucca	10			Semi-pucca	10
		Pucca	nil			Pucca	nil

The area is run under the rehabilitation programme of the Manipur Government and also establishment of the Loktak Development Hut Dweller's Co-operative Society only for land rehabilitation. It is reported that some from nearby village are doing electric fishing in the Loktak occasionally. It will affect in fish natural breeding and proper growth. It is seen that dying small fishes are over the surface which will become one of the most important reason in reducing population in the near future. So, it should be prevented as soon as possible.

Conclusion

The present study site lacks in certain respects and needs to be developed and under constant observation. A crossed bridge is necessary. These people need to grant loan facility and provide modern crafts and gears with low cost. Arrangement of safe drinking water is the urgent need for health and hygiene.

Acknowledgement

The authors are grateful to the Director, Research and Development Centre and the Department of Zoology, Bharathiar University, Coimbatore and also Department of Zoology, D.M College of Science, Imphal for laboratory facility. The authors extend honour to N. Sony Meitei, Assistant Professor, Moirang College for his kind help and those villagers who gave us warm welcome whenever we went for field visit, discussions, etc. sharing the valuable information.

References

Abowei J.F.N., (2010). Salinity, dissolved oxygen, pH and surface water temperature conditions in Nkoro River, Niger Delta, Nigeria. *Adv J Food Sci Technol*. 2(1): 16-21.

Agbaire P.O., Akporido S.O. and Akporhonor E.E., (2014). Water Quality Index Assessment of Borehole Water in the Hostels in one of the Higher Institutions in Delta State, *Nigeria Research Journal of Chemical Sciences*. Vol. 4(7), 77-81.

Ali, M., Abdus, S., Nadeem, A., Bakht., Y.A.K., and Muhammad, Y.K., (2004). Monthly Variation in Physico-chemical Characteristics and Metal Contents of Indus River at Ghazi Ghat, Muzaffargarh, Pakistan. *Pakistan J. Zool*. Vol. 36(4), pp.295-300.

Ali, M.M., M. Hossain, M.H. Belal, Minar, S. Rahman, and Islam, M. Shafiqul, (2014). Socio Economic Aspects of the fishermen of Lohalia River, Bangladesh. *Middle-East Journal of Scientific Research*. 19(2): 191-195.

Bordoloi, R., S.K.S. Abujam, G. Paswan, U.C. Goswami and S.P. Biswas, (2012). Socio-economic status of the fisher folk of upper Bahmaputra River: A case study in Jankhana Village of Jorhat District. *International Journal of Applied Biology and Pharmaceutical Technology*. 3(4): 338-341.

Borkar A.D., (2015). Studies on Some Physicochemical Parameters of Soil Samples in Katol Taluka District Nagpur (MS), India, *Research Journal of Agriculture and Forestry Sciences*. 3(1):16-18.

EPA, (2002). National recommended water quality criteria: 2002. Washington D.C.: EPA; [Online] Available from:http://water.epa.gov/scitech/ swguidance/standards/upload/2008_04_29_criteria_wqctable_nrwqc- 2002.pdf [Accessed on 27th September, 2014]

Furhan I., Ali M., Salam A., Khan B.A., Ahmad M.S., Qamar, (2004). Seasonal Variations of Physicochemical Characteristics of River Soan Water at Dhoak Pathan Bridge (Chakwal), Pakistan. *International Journal of Agriculture and Biology*. 6(1).

Gaurab J.K., Pradip K.S., Priyanuz G. and Srustidhar R., (2015). Socio-economic status of fishermen and different fishing gear used in Beki River, Barpeta, *Assam Journal of Entomology and Zoology Studies*. 2015; 3 (1): 193-198

Gopala K.D., Anwaar I.A., Ameera N.A. & Warda H.B.O., (2015). Studies on

Physicochemical Parameters to Assess the Water Quality. *International Journal of Water Research*. 5(2):29-32.

Gurumayum S.D. and Choudhury M., (2009): Fishing methods in the rivers of Northeast India. *Indian Journal of Traditional Knowledge*. Vol. 8(2), pp. 237-241.

Handbook on fisheries statistics: Government of India., New Delhi, Ministry of Agriculture, Fisheries Division:1996, 220

Kamruzzaman A.K.M., (1992). Qualitative evaluation of some commercially dried fish products of Bangladesh. *M. Sc. Thesis*, Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh, Bangladesh, p.37.

Khan A., Yousafzai A.M., Latif M., Rehman A.U., Khan Q., Zaib A., (2014). Analysis of selected water quality parameters and heavy metals of Indus River at Beka Swabi, Khyber Pakhtunkhwa, Pakistan. *International Journal of Biosciences*. 4(2):28-38.

Manju P.B. and Rama M.M.R., (2014). Fisherwomen of the East Coastal India: A Study. *International Journal of Gender and Women's Studies*. Vol. 2, No. 2, pp. 297-308

Masood Z., Rehman H.U., Rafique N., Jamil N., (2015): Physicochemical Analysis of Water and Soil of Fresh Water Damai Stream of Tehsil Domel of Bannu District with Special Reference to their Impact on Survival of Fishes. *Global Veterinaria*. 14(5).

Naeema E., Quratulan A., Levent B., Farzana Y., (2015). Physicochemical parameters and seasonal variation of coastal water from Balochistan coast, Pakistan. *Journal of Coastal Life Medicine*. 3(3): 199-203

Nelly A., Isyagi .LK., Veverica R., Asiimwe, Daniels D.W.H., (2014). Manual for the Commercial Pond Production of the African Catfish in Uganda, USAID, USA and Cooperative Agreement,.617-A-00- 0500003-00, 222.

Ram, S.L.,Pravin, U.S., Deepali, S.P., (2011). Pollution in water of Kasardi River Flowing along the Taloja Industrial Area of Mumbai, India. *World Environment*. 1(1):6-13

Ramanathan N., Padmavathy P., Francis T., Athithian S., Selvaranjitham N., (2005). Manual on polyculture of tiger shrimp and carps in freshwater. *Thothukudi: Tamil Nadu Veterinary and Animal Sciences University, Fisheries College and Research Institute*. p. 1-161.

Sala, O.E., Chapin F.S.A., Armesto, J.J., Berlow, R., Bloomfield J., Dirzo R., Huber-Sanwald E., Huenneke, L.F., Jackson R.B., Kinzing A., Leemans., R., Lodge D, Mooney H.A., Questerheld, M., Paff, N.L., Sykes M.T., Walker B.H., Walker M., Wall D.H., (2000). Global biodiversity scenarios for the year 2100, Science, 287,1770-1774

Salam, A., Ali, M., Khan, B.A. and Rizwi, M.S., (2001). Seasonal changes in the physico-chemical parameters of River Chenab, Muzaffar Garh. *Pakistan J. Bio. Sci*. 4:299-301.

Shivakumar R., Mohanraj R., Azee P.A., (2000). Physico-Chemical analysis of water

sources of Ooty, South India. *Poll. Res*. 19(1):143-146.

Singh S.P., Deepa P., Rashmi S., (2002). Hydrobiological studies of two ponds of Satna (M.P.), India. *International Journal of Environmental Research*. 8(3):289.

Solis N.B., (1988). Biology and ecology of penaeus monodon. In: Biology and culture of Penaeus monodon. Iloilo: SEAFDEC Aquaculture Department. p. 3-36.

Stone N.M., Thormforde H.K., (2003). Understanding your fish pond water analysis report. *University of Arkansas Cooperative Extension Printing services*. 1-4.

Suski C.D., Killen S.S., Keiffer J.D., Tufts B.L., (2006). The influence of environmental temperature and oxygen concentration on the recovery of largemouth bass from exercise: implications for live-release angling tournaments. *J Fish Biol*. 68: 120-136

Venkatesharaju K., Ravikumar P., Somashekarand R.K, Prakash K.L., (2010). Physicochemical and bacteriological investigation on the river Cauvery of Kollegal stretch in Karnataka. *Kathmandu University Journal of Science, Engineering and Technology*. 6(1):50-59.

Vishwanath, W. and Sarojnalini, Ch., (1989). Changes in the total oxalate content in the fermentation of fish paste Hentak. *Journal of Food Science*. 54(3): 754-755.

WHO (World Health Organization), (2006). Guidelines for drinking water quality. Geneva, Netherlands., 1:491.