



Impact of Agricultural Waste on Ichthyo Diversity of the Pumlen Lake, Kakching District, Manipur, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present research paper highlights the Ichthyo diversity survey conducted and impact of agricultural practices on Ichthyo diversity of Pumlen Lake, Tokpaching, an important lake in Manipur to evaluate the variation and distribution of freshwater fishes for future conservation plan and its effect by agricultural practices around the lake. The fishes are one of the main stable resources of the aquatic ecosystems that provide cheapest source of animal protein. Fishes are one of the leading elements in the economic standard of many nations as they have been a stable item in the diet of many people around the globe. Pumlen Lake locally known as Pumlen pat is the second largest freshwater wetland located in the southern part of the Manipur valley in Kakching District. Fish specimens were counted, photographed and identified to the lowest possible taxon. Fish species were identified and confirmed following standard literature (Jayaram, 1999, Talwar, P.K. and A.G. Jhingran, 1991 & Menon, A.G.K., 1999). Total number of species and total number of individuals were recorded from different locations. Maximum number of species belonged to the order cypriniformes followed by perciformes and siluriformes. During the study period we come

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across 41 species of fishes belonging to 27 genera, under 14 families and 7 orders. Of these, the most abundant is *Trichogaster labiosa* (5.37%), followed by *Amblypharyngodon mola* (4.84%) and *Monopterus albus* was least abundant (0.33%). During our study we came across different types of fish species. Demand of pesticides concentration on agriculture practices can diminish the accessibility of aquatic organisms that in order to serve as food for fish species and another aquatic organism. Impact of pesticides in various agricultural practices also affects the food chain of insect eating birds and also for fish species. It is also observed that the diversity of the fish species has been affected with the variation of agro-chemical and agricultural practices.

Keywords: *Pumlen pat; impact; wetland; agro-chemical.*

1. INTRODUCTION

Fishes are one of the basic important elements in the health, economic development of many countries. It has been a stable item of diet for people around the globe. Human intervention and exploitation has been increasing in the water bodies' day by day. So, the basic information on the occurrence, abundance and distribution of fishes is important to protect and conserve the existing Ichthyo-diversity of the dying Lake.

"The fishes are one of the most exploitable resources of the aquatic ecosystems that provide a cheap source of animal protein". (Singh, N. R., *et al.* 2021).

According to Mineau, P and McLaughlin, A. [1] highlights "different tools and techniques in agricultural activities such as tillage, drainage, intercropping, crop rotation, grazing and extensive usage of chemical based pesticides and fertilizers have significant impact on wild species of flora and fauna of Pumlen Lake. Fish species capable of adapting to the agricultural landscape may be limited directly by the disturbing the whole regimes of grazing, planting and harvesting and indirectly by the abundance of plant and insect foods available. There are number of unwanted environmental impacts associated with fertilizer and pesticide usage". "Water is the most productive resource for pisciculture. Fishes are the group of subphylum-Vertebrata, division Gnathostomata, super class-pisces in the world and are very useful in biological researches. Around the world approximately 22,000 species of fishes have been recorded out of which 11% are found in India, that is about 2,500 species of fishes of

which 930 live in freshwater and 1,570 are marine" [2,3].

"India is one of the mega biodiversity countries in the world and occupies the ninth position in terms of freshwater mega-biodiversity" [4,5].

According to Joychandra, M. 1998, "Pumlen Lake, locally called as Pumlen Pat (Pat in Manipuri) is the second largest freshwater wetland located in the southern part of the Manipur valley. The Lake situated in Kakching District (earlier in Thoubal District) at an approximate distance of 57 km from Imphal city towards the southern lowlands of the valley, on the left side of the Imphal river at the geographical ordinates between 93°50' E to 94°0' E and 24°20' N to 24°35' N, at the elevation of 7676 metres above sea level (a.s.l). Its elevation of water surface is regulated at 768.5 m (a.s.l)" (Fig. 1).

"It is considered as secondary reservoir of Loktak National Hydel Project. The Pumlen Lake receives water from precipitation, surface run off its south-eastern denuded hills, and from the northern agricultural fields, and indirectly from the Sekmai River through Khoidum Pat on northern side and from the impounded Manipur River which runs along the western shoreline" [6].

"Fishing is a very important part of the economic activities in the surrounding villages as fish is a vital source of animal protein for the local diet. Pumlen Lake is a shallow weed- infested lake with 2/3 of its water surface covered with heterogeneous vegetation locally known as Phoom or Phumdi. A drastic change in the ecosystem of Pumlen Lake from its earlier state

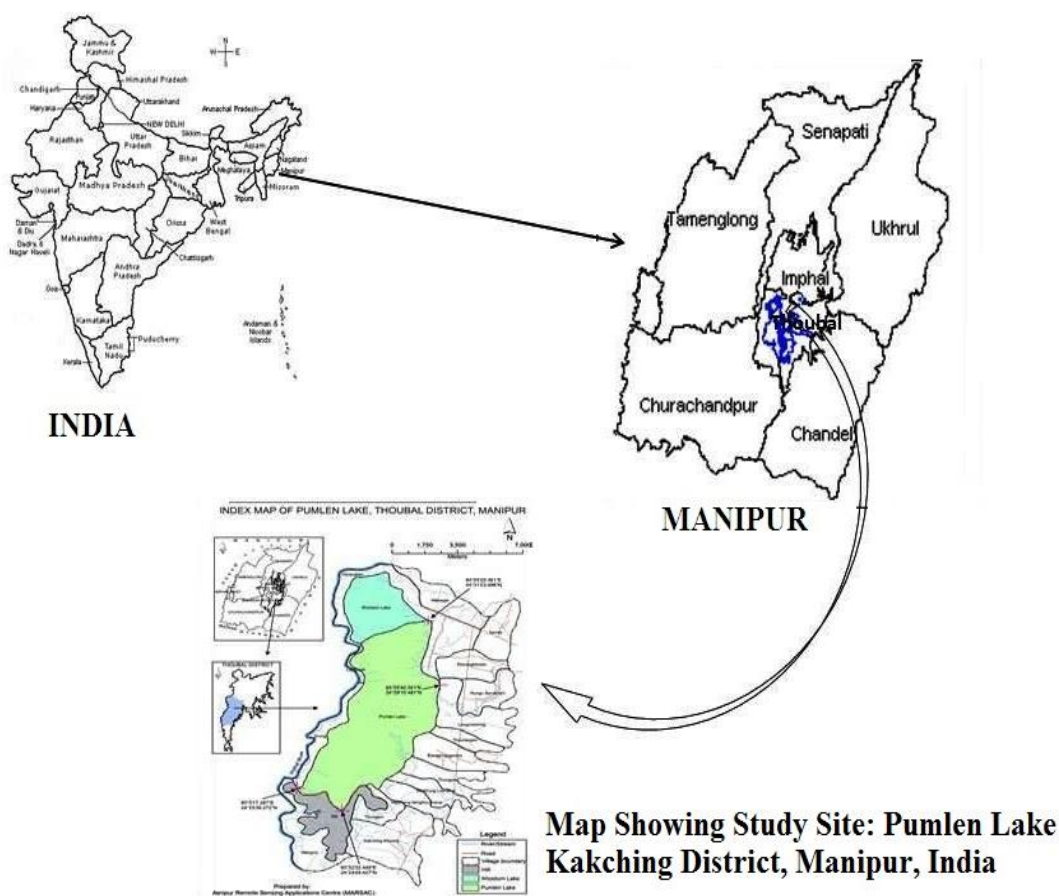


Fig. 1. Pumlen Lake [6]

is said to have occurred since the commissioning of Loktak Hydel Project which uses the Pumlen Lake as a secondary water reservoir” [7].

Fish being one the main item of food for most of the people in Manipur, the demand for fish is high in the state. Most of the people in the state are fish eaters. Fish constitutes major component of diet for the people of North East India especially in Assam and Manipur.

Kar and Sen [8], studied “the systematic list and distribution of fish biodiversity in Mizoram, Tripura and Barak drainage in North East India”.

Kar, D et al. [9-13] studied “the panorama of fish biodiversity in certain rivers and wetlands protected areas in Assam. It is important to document and monitor the status, diversity and distribution of the all the fishes for conservation and management, but little has been reported on Ichthyo-diversity from this lake”.

Hence, the present study was undertaken to investigate the impact of agricultural practices on present status of fish diversity and distribution of the fishes found in Pumlen Lake.

2. MATERIALS AND METHODS

Survey was undertaken between January 2023 to December 2023 during pre-monsoon, monsoon and post-monsoon. General survey of Ichthyo-diversity and distribution was done using standard procedure [14]. NBFGR manual (2000) was also consulted for studying the habitat parameters headwater to down water. Fish specimens were collected by using fishing gears like gill nets, cast nets, triangular scoop nets and variety of local indigenous traps. Camouflaging technique was also used to catch the fishes. Fish specimens were counted, photographed and identified to the lowest possible taxon. Fish species were identified and confirmed following standard literature [14], Talwar, P.K. and A.G.

Jhingran, [15-19]. Total number of species and total number of individuals were recorded from different locations. Fish have been preserved at first in the concentrated formaldehyde in the field itself and then preserved in 10% formalin for further study.

3. RESULTS AND DISCUSSION

Fish being one of the most important items of food for most of the people in Manipur as well as in North-East India, the demand of fish for food is very high in the region. Fish culture is one of the most important sources of income in the north eastern India. Fish farmers took important role for enhancement of the economy of this country. Most of the people in the state are fish eaters. Pumlen Lake has got rich diversity and distribution of 41 species of fishes belonging to

27 genera, under 14 families and 7 orders. Of these, the most abundant is *Trichogaster labiosa* (5.37%), followed by *Amblypharyngodon mola* (4.84%) and *Monopterus albus* was least abundant (0.33%). "A drastic change occurred in the ecosystem of Pumlen Lake from its earlier state is said to have occurred since the commissioning of Loktak Hydel Project which uses the Pumlen Lake as a secondary water reservoir" [6]. "Life on the earth is diverse at many levels, beginning with genes and extending to the wealth and complexity of species, life form and functional roles, organized in spatial patterns from biological communities to ecosystems, regions and beyond" [20-23]. "Biodiversity affects the capacity of living systems to respond to changes in the environment and is essential for providing goods and services from ecosystems nutrient cycling and clean water" [24-26].

Table 1. Fish species diversity and its abundance of Pumlen Lake during January 2023-December 2023

Sl. No.	Name of the fish	Local Name	Order	Family	% (AB)	Threat to Human
1	<i>Amblypharyngodon mola</i> (Hamilton, 1822)	Mukaknga	Cypriniformes	Cyprinidae	4.84%	Harmless
2	<i>Opsarius gatensis</i> (Valenciennes, 1844)	Ngawa	Cypriniformes	Cyprinidae	3.14%	Harmless
3	<i>Labeo catla</i> (Hamilton, 1822)	Bao or Catla	Cypriniformes	Cyprinidae	1.33%	Harmless
4	<i>Cirrhinus mrigla</i> (Hamilton, 1822)	Mrigal	Cypriniformes	Cyprinidae	0.96%	Harmless
5	<i>Ctenopharyngodon idella</i> (Valenciennes, 1844)	Silver Carp	Cypriniformes	Cyprinidae	1.33%	Potential Pest
6	<i>Cyprinus carpio</i> (Linnaeus, 1758)	Puklaobi	Cypriniformes	Cyprinidae	1.67%	Potential Pest
7	<i>Esomus danrica</i> (Hamilton, 1822)	Baluntombi	Cypriniformes	Cyprinidae	2.76%	Harmless
8	<i>Esomus altus</i> (Blyth, 1860)	Lameithanbi	Cypriniformes	Cyprinidae	2.76%	Harmless
9	<i>Labeo angra</i> (Hamilton, 1822)	Ngaton	Cypriniformes	Cyprinidae	1.71%	Harmless
10	<i>Labeo bata</i> (Hamilton, 1822)	Ngaton@Khabak	Cypriniformes	Cyprinidae	3.82%	Harmless
11	<i>Labeo calbasu</i> (Hamilton, 1822)	Ngathi	Cypriniformes	Cyprinidae	1.37%	Harmless
12	<i>Bangana dero</i> (Hamilton, 1822)	Khabak	Cypriniformes	Cyprinidae	1.41%	Harmless
13	<i>Labeo gonius</i> (Hamilton, 1822)	Kuri	Cypriniformes	Cyprinidae	2.16%	Harmless
14	<i>Labeo rohita</i> (Hamilton, 1822)	Rou	Cypriniformes	Cyprinidae	2.27%	Harmless
15	<i>Puntius chola</i> (Hamilton, 1822)	Phabounga	Cypriniformes	Cyprinidae	1.78%	Harmless

Sl. No.	Name of the fish	Local Name	Order	Family	% (AB)	Threat to Human
16	<i>Systomus sarana</i> (Hamilton, 1822)	Phabounga	Cypriniformes	Cyprinidae	1.45%	Harmless
17	<i>Pethia ticto</i> (Hamilton, 1822)	Phabounga	Cypriniformes	Cyprinidae	0.88%	Harmless
18	<i>Pethia meingangbi</i> (Arunkumar & Tombi, 2003)	Phabounga	Cypriniformes	Cyprinidae	2.61%	Harmless
19	<i>Anabas testudineus</i> (Bloch, 1792)	Samjet or Ukabi	Perciformes	Anabantidae	0.41%	Harmless
20	<i>Syncrossus berdmorei</i> (Blyth, 1860)	Sareng Khoibi	Cypriniformes	Cobitidae	0.24%	Harmless
21	<i>Lepidocephalichthys guntea</i> (Hamilton, 1822)	Ngakijou	Cypriniformes	Cobitidae	0.09%	Harmless
22	<i>Lepidocephalichthys iorrorata</i> (Hora, 1921)	Nganap	Cypriniformes	Cobitidae	0.86%	Harmless
23	<i>Schustura sikmaiensis</i> (Hora, Ngatup 1921)		Cypriniformes	Balitoridae	1.75%	Harmless
24	<i>Chanda nama</i> (Hamilton, 1822)	Ngamhai	Perciformes	Ambassidae	0.28%	Harmless
25	<i>Parambassis ranga</i> (Hamilton, 1822)	Ngamhai	Perciformes	Channidae	0.96%	Harmless
26	<i>Channa orientalis</i> (Bloch & Schneider, 1801)	Meitei Ngamu	Perciformes	Channidae	2.73%	Harmless
27	<i>Channa striata</i> (Bloch, 1793)	Porom	Perciformes	Channidae	0.09%	Potential Pest
28	<i>Channa punctata</i> (Bloch, 1793)	Ngamubogra	Perciformes	Channidae	5.39%	Harmless
29	<i>Clarias batrachus</i> (Linnaeus, 1758)	Ngakra	Siluriformes	Claridae	0.77%	Potential Pest
30	<i>Trichogaster fasciata</i> (Bloch & Schneider, 1801)	Ngapemma	Beloniformes	Belontiidae	1.71%	Harmless
31	<i>Trichogaster labiosa</i> (Day, 1877)	Ngapemma	Beloniformes	Belontiidae	1.94%	Harmless
32	<i>Glossogobius giuris</i> (Hamilton, 1822)	Nainon Ngamu	Perciformes	Gobiidae	0.33%	Harmless
33	<i>Heteropneustes fossilis</i> (Bloch, 1794)	Ngachik	Siluriformes	Heteropneustidae	1.60%	Traumatogenic
34	<i>Mastacembelus armatus</i> (Lacepede, 1800)	Ngarin	Synbranchioidei	Mastacembelidae	1.18	Harmless
35	<i>Monopterus albus</i> (Zuiew, 1793)	Ngaprum	Synbranchioidei	Synbranchidae	0.86%	Harmless
36	<i>Mystus bleekeri</i> (Day, 1877)	Ngasep	Siluriformes	Bagridae	1.37%	Harmless
37	<i>Notopterus notopterus</i> (Pallas, 1769)	Ngapai	Osteglossiformes	Notopteridae	1.29%	Harmless
38	<i>Ompok bimaculatus</i> (Bloch, 1794)	Ngaten	Siluriformes	Siluridae	0.84%	Harmless
39	<i>Wallago attu</i> (Bloch & Schneider, 1801)	Sareng	Siluriformes	Siluridae	0.22%	Traumatogenic
40	<i>Pangio pangia</i> (Hamilton, 1822)	Ngamhai	Cypriniformes	Botinidae	0.99%	Harmless
41	<i>Oreochromis mossambicus</i> (Peters, 1852)	Tunghanbi	Perciformes	Cichlidae	5.12%	Potential Pest

The list of fish species of Pumlen Lake has been listed in Table 1. A total of 41 fishes, belonging to twenty-seven genera (27), seven (7) different orders and fourteen (14) families were studied. Maximum number of fish species belonged to the order cypriniformes followed by perciformes and siluriformes. Cypriniformes represented by 22 species of fishes was found to be the most dominant order followed by perciformes with 8 species of fishes and siluriformes with 5 species of fishes. Cyprinidae was the richest family (17 species of fishes) followed by Bagridae (5 species) and Schilbiidae (4 species). (Table 1). Out of 41 fish species studied in this research paper fishes like *Ctenopharyngodon idella*, *Cyprinus carpio*, *Channa striata*, *Clarias batrachus*, and *Oreochromis mossambicus* are considered as potential pest while species like *Pangio pangia*, and *Heteropneustes fossilis* are Traumatogenic in nature. The remaining 33 fishes are harmless according as fish base report (Table 1).

4. CONCLUSION

During the study period, less number of indigenous fishes is found due to the introduction of exotic fishes on pisciculture as well as extensive use of chemical based pesticide and fertilizer. It is important to realize that the impact of agricultural inputs varies greatly among regions on fish species diversity. Fishes are considered as pollution indicator for healthy environment but reduced in number of aquatic organism that means our lake is not the right place for fishes because of extensive exploitation of habitat as well as extensive used of agro-chemicals in agricultural practices around & nearby area of the lake.

Agricultural activities providing food security for a growing global population. The agricultural practices have contributed to the loss of biodiversity, salinity, as well as the introduction of emerging contaminants into aquatic ecosystem of Pumlen Lake. It is a high time to think about the dying lake so that our next generation can enjoy a joyful life by enjoying resources as earlier provided by the lake in the form of plants, animals, fishes and many more.

The multifaceted challenges posed by the impact of agriculture on aquatic ecosystem and water quality require a comprehensive approach that combines sustainable farming practices, technology, and policy interventions. By prioritizing responsible agricultural practices and the protection of water resources, a healthier

future can be ensured for both people and environment.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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