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RESEARCH ARTICLE Indian Journal of Animal Research

# A Pioneering Assessment on the Physico-chemical and Health Status of a Small Sub-tropical Reservoir in North-Eastern, India

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10.18805/IJAR.B-5195

## ABSTRACT

**Background:** The water resources of Northeast (NE) Indian reservoirs have been largely overlooked, despite their immense potential in various aspects. A comprehensive analysis of water quality parameters was conducted to assess the physio-chemical changes and health status of Maphou or Mapithel reservoir, Manipur, NE, India.

**Methods:** Sub-surface water samples were collected from June 2021 to May 2022 to assess the spatio-temporal changes. Trophic State Index (TSI), Morpho Edaphic Index (MEI), Maximum Sustainable Yield (MSY) and fish yield potential were calculated. The average water spread area was calculated through Normalised Difference Water Index (NDWI) method.

**Result:** A total of eighteen (18) water quality parameters were examined following Standard Methods. ANOVA analysis indicated that all water quality parameters, except total alkalinity, exhibited significant seasonal variations ($p<0.05$). Spatially, most of the water quality was found to be insignificant, except for Chl-a and depth ($p<0.05$). All the water quality parameters were within acceptable ranges for the growth and survival of aquatic biotic resources. No signs of pollution were observed. The trophic status of the reservoir was found in an oligotrophic state. The MEI was estimated as 8.55 and the average fish yield for the reservoir was 14.98 kg $ha^{-1}$, which is below the national average yield of small reservoir (49.9 kg $ha^{-1}$). The MSY was estimated to be 21.46 kg $ha^{-1}$. Heatmap cluster analysis revealed three distinct clusters of months. The actual average water spread area was determined to be 852.62 ha, hence the reservoir can be categorised as small reservoir.

**Key words:** Average fish yield, Maphou dam, MSY, Oligotrophic, Physico-chemical parameters.

## INTRODUCTION

A reservoir is a dynamic aquatic ecosystem which combines the features of both lentic and lotic environments. Primarily built for hydroelectricity generation, irrigation and water supply, which also served as an important fishery ground in many Southeast Asian countries. These water bodies have been found to hold tremendous potential for fish production. In fact, India is blessed with vast reservoir resources, covering an area of 3.52 million hectares, comprising 19,386 reservoirs (Sarkar *et al*., 2019). Unfortunately, water quality degradation in reservoirs has become a major concern due to anthropogenic activities, particularly urbanization, water abstraction, discharge of and inadequate treatment of untreated domestic and industrial wastewater, *etc*. which poses a serious threat to lives and raises concerns for domestic consumption, agriculture and fisheries use (Teshome, 2020). Eutrophication, in particular, has emerged as a significant global threat to aquatic ecosystems in recent decades (González and Roldán, 2019). Therefore, evaluation of the health status of reservoir becomes crucial for scientific management and implementation of important legislative measures.

Trophic State Index (TSI) is one of the powerful tools for indirectly assessing eutrophication and has been extensively applied in ecological studies and monitoring programs (Carlson, 1977). The trophic status serves as an indicator of anthropogenic impacts on water quality and the ecological functioning of the aquatic ecosystem (Cunha *et al*., 2013).

Henderson and Welcomme (1974) devised the term “Morpho Edaphic Index (MEI)”, which gained popularity and was widely adopted in various regions. It serves as an indicator of both the quantitative and qualitative aspects of fish yields and can be utilized to determine the stocking densities of fingerlings in inland water reservoirs. Sugunan *et al*. (2002) developed equations for the estimation of fish

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**How to cite this article:** Bidyasagar, S., Bedajit, Y., Basudha, C., Deshmukhe, G., Jaswar, A.K., Monalisha, S. and Waikhom, G. (2023). A Pioneering Assessment on the Physico-chemical and Health Status of a Small Sub-tropical Reservoir in North-Eastern, India. Indian Journal of Animal Research. DOI: 10.18805/IJAR.B-5195.

**Submitted:** 17-07-2023 **Accepted:** 12-09-2023 **Online:** 03-10-2023

yield and MSY based on the MEI, which fits the best for the estimation of productivity of the Indian reservoir.

The reservoirs in NE India have generally been overlooked in terms of scientific surveys, with only a few exceptions in Meghalaya (Sharma and Sharma, 2021); Mizoram (Sharma and Pachuau, 2016); Nagaland (Rongsenkumzuk *et al*., 2019); and Tripura (Bhattacharya and Saha, 1986). The Maphou reservoir, Manipur came into its existence in 2015 with the commissioning of the Maphou or Mapithel dam which resulted in the displacement of more than 5000 villagers, submerging 560 ha of cultivable hilly tracks and the loss of many livelihoods. However, it is strongly believed that by harnessing opportunities for fisheries and aquaculture, the reservoir can significantly enhance the economy and improve the alternative livelihoods for the affected people.

Recently, the state and central government has started focusing on enhancing fisheries potential of the reservoir through the state fisheries department, KVKs *etc*., in collaboration with National Fisheries Institutions. However, it is essential to conduct preliminary scientific research to understand the patterns of change in the physico-chemical parameters and trophic status of the reservoir. Though there are many studies on these aspects for many reservoirs from other regions (Sugunan, 2000), but studies in the context of Maphou reservoir, situated in Manipur, India is limited. In this backdrop, the present study was carried out to evaluate the physico-chemical parameters and determine the overall health status of the reservoir so that scientific resource management strategies could be formulated and implemented for the overall development of this important aquatic resource in NE, India.

## MATERIALS AND METHODS

### Study area

The current study was carried out in the Maphou reservoir, situated at coordinates 94°8′33″E and 24°49′30″N, located in the Kamjong district, approximately 36 km away from Imphal, Manipur. The average elevation is 850 meters above the mean sea level (MSL) and has a catchment area of approximately 569 km$^2$. The total length of the reservoir is 10 km stretch over the Thoubal River along the Mapithel hill range, hence sometimes referred to as the Mapithel dam. The study area was illustrated using ArcGIS software Version 10.3.4322 and depicted in Fig 1.

### Sample collection

Monthly water sampling was conducted from June 2021 to May 2022. Eighteen (18) physico-chemical parameters were evaluated. Water temperature (WT), electrical conductivity (EC), total dissolved solid (TDS) and pH were measured using a portable digital handheld device (HM Digital COM-360 Waterproof pH/EC/TDS/Temp Meter), transparency (SD) was measured using a Secchi disc (20 cm diameter), depth (meter) was measured using Depth Trax 1H and while dissolved oxygen (DO) were measured instantly. Additionally, other water quality parameters such as free carbon dioxide (free $CO_2$), total alkalinity (TA), total hardness (TH), total phosphate (TP), nitrate ($NO_3$-N), nitrite ($NO_2$-N), ammonia ($NH_3$), $BOD_5$ and Chlorophyll-a were estimated in Fishery Division, ICAR-Research Centre for NEH Region, Manipur centre's laboratory. All analyses and sample preservation were performed following Standard Methods (APHA, 2012). The gross primary productivity (GPP) and net primary productivity (NPP) were estimated using the "light and dark bottle" method (Gardner and Gran, 1927).

### Heatmap cluster analysis

A heatmap cluster analysis was performed to identify clusters of months that exhibited similar patterns of physico-chemical parameters using average group cluster method and Euclidean distance type as adopted by Setia *et al.* (2021).

### Trophic assessment

The trophic state index (TSI) was estimated following the method of Carlson (1977) modified by Lamparelli (2004) for tropical lake/reservoir, the mathematical equations are given below:

$$TSI\ (Chl\text{-}a) = 10\times(6-[2.04-\{0.695\times ln\,Chl\text{-}a\}/ln\,2])$$

$$TSI\ (SD) = 10\times(6-[0.64+\{ln\,SD/ln\,2\}])$$

$$TSI\ (TP) = 10\times(6-[ln\{80.32/TP\}/ln\,2])$$

$$TSI_{mean} = [TSI(Chl\text{-}a)+TSI(SD)+TSI(TP)]/3$$

Where,

TSI = Trophic state index;

SD = Sacchi disc transparency in meter;

TP = Total phosphate in mg $L^{-1}$ and Chl-a in mg $L^{-1}$.

### Morpho-Edaphic Index and fish yield potential

The MEI was calculated following the method of Henderson and Welcomme (1974). Both mean MSY and average fish yield were estimated following the equation developed by Sugunan *et al.* (2002), solely developed for approximate estimation in Indian reservoirs.

$$MEI_{mean} = [\text{Specific conductivity(mS)}]/[(\text{mean depth (m)}]$$

$$MSY_{mean}(\text{kg ha}^{-1}) = 0.9897 * MEI^{1.3888}$$

$$\text{Fish yield}_{average}\ (\text{kg ha}^{-1}) = 3.984 * MEI^{0.6374}$$

### Statistical analysis

One-way ANOVA analysis was carried out using SPSS (version 25). Heatmap cluster analysis was performed in Origin Pro. 9.9. Average water spread was estimated using ArcGIS version 10.3.4322 with NDWI method. TSI, MSY and average fish yield were calculated using MS-Excel (2013).

## RESULTS AND DISCUSSION

### Dynamics of physicochemical parameters

Descriptive statistics of all water quality parameters are given in Table 1. The ANOVA results revealed significant seasonal variations in water quality parameters at a significance level of $p<0.05$, except for total alkalinity (Table 2). However, spatially, there were no significant differences observed, except for depth and Chl-a, which showed significance at a level of $p<0.05$ (Table 3). The water quality parameters observed were found to be within the standard ranges specified by Jhingran (1990). The water temperature of the reservoir indicated high productivity and a favourable environment for warm water fish culture (Saha *et al*., 2021). Although, the Maphou reservoir is small in size, its mean depth (24.1±11.5 m) resembles that of a medium-sized reservoir due to its location along the Mapithel hill ranges. The mean transparency (2.36±0.59 m) of the reservoir corresponds to good water quality (Lourantou *et al*., 2007). The TDS and EC values were found to be significantly lower than the maximum permissible limits (WHO, 1997). In accordance with Jhingran (1990), the EC value (154.65± 30.8 mS $cm^{-1}$) was within the permissible range, indicating that the reservoir could be classified as a moderately productive reservoir. The average TDS value (77.12±15.3 mg $L^{-1}$) was significantly lower than the maximum desirable limit of 500 mg $L^{-1}$, specified by WHO (1997). The mean DO (9.52 ± 2.13 mg $L^{-1}$) was high due to strong wind action in the prevailing upland region and vigorous mixing of the sub-surface water. The pH range remained within the highest permissible range (Jhingran, 1990). Based on the observed mean pH value (8.17±0.66), the water body could be classified as medium productive and will support good fishery (Das and Nandi, 2001). The pH range in reservoir ecosystems, as stated by Moehl and Davies (1993), can vary from 5 to 10. Alkaline pH is commonly observed in tropical and temperate reservoirs (Mwaura, 2006). It is worth mentioning that other NE reservoirs such as Kyrdemkulai and Nongmahir, of Meghalaya are acidic in nature due to the presence of an acidic bed and catchment area (Sugunan and Yadava, 1991). A typical inverse relationship between free $CO_2$ and pH was observed. The low mean $BOD_5$ value

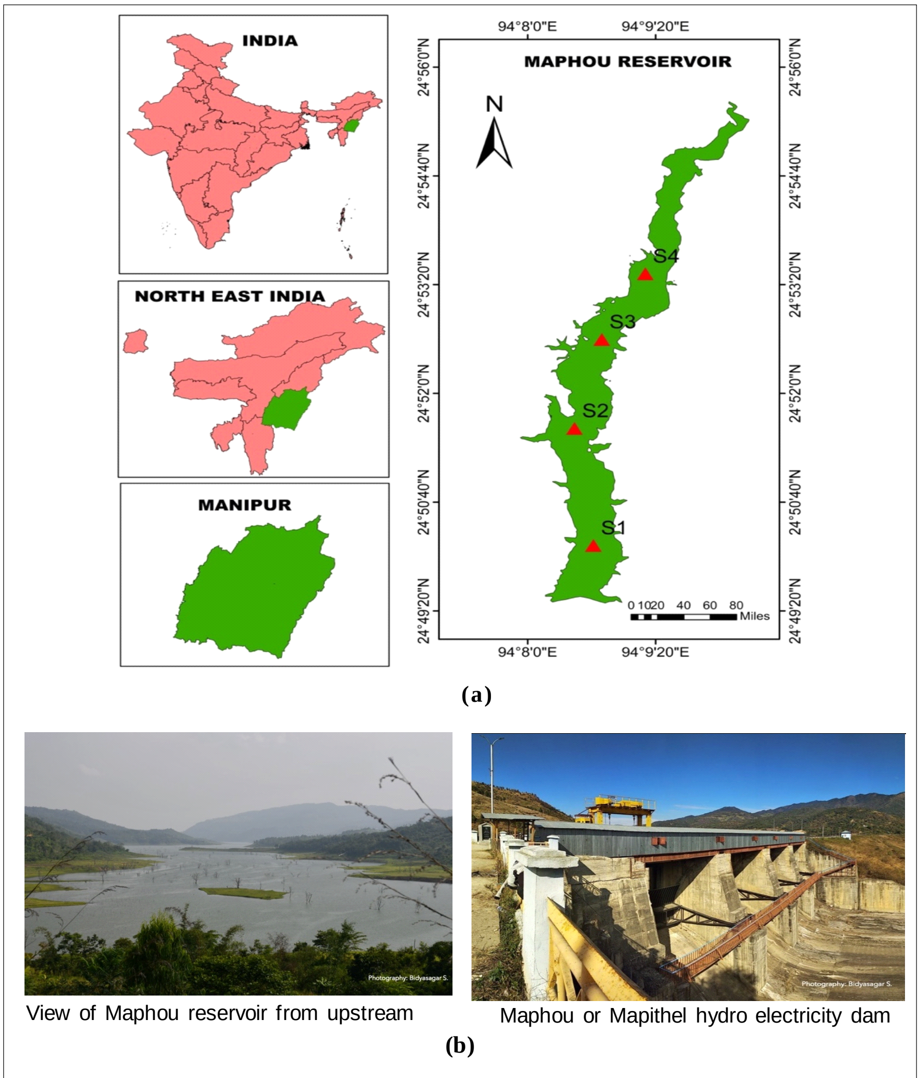


**Fig 1:** (a) Map showing the location of sampling sites in the Maphou reservoir, NE India. S1 = Sampling site near the dam, S2 = Sampling site near cage culture site, S3 = Sampling site near tourist spot, S4 = Sampling site in midstream. (b) Photograph of Maphou reservoir.

**Table 1:** Descriptive statistics of water quality parameters of Maphou reservoir.

| Parameters | Unit | Min. | Max. | Mean | Sd |
|---|---|---|---|---|---|
| WT | °C | 17.800 | 30.200 | 25.138 | 4.005 |
| TDS | mg L$^{-1}$ | 51.900 | 99.000 | 77.123 | 15.368 |
| EC | mS cm$^{-1}$ | 103.90 | 194.00 | 154.650 | 30.844 |
| pH | | 7.000 | 9.180 | 8.178 | 0.664 |
| Depth | m | 6.700 | 51.000 | 24.108 | 11.553 |
| Trans. | meter | 1.120 | 3.490 | 2.360 | 0.593 |
| TH | mg L$^{-1}$ | 52.000 | 96.000 | 72.442 | 8.858 |
| TA | mg L$^{-1}$ | 54.000 | 84.000 | 66.458 | 4.744 |
| Free $CO_2$ | mg L$^{-1}$ | 0.000 | 2.560 | 0.794 | 0.829 |
| TP | mg L$^{-1}$ | 0.003 | 0.022 | 0.011 | 0.004 |
| $NH_3$ | mg L$^{-1}$ | 0.008 | 0.084 | 0.034 | 0.018 |
| $NO_3$-N | mg L$^{-1}$ | 0.004 | 0.078 | 0.039 | 0.022 |
| $NO_2$-N | mg L$^{-1}$ | 0.001 | 0.146 | 0.048 | 0.036 |
| DO | mg L$^{-1}$ | 6.000 | 14.400 | 9.527 | 2.133 |
| $BOD_5$ | mg L$^{-1}$ | 0.210 | 1.200 | 0.638 | 0.270 |
| Chl-a | mg L$^{-1}$ | 0.301 | 4.594 | 2.05 | 0.940 |
| GPP | mgC m$^{-3}$ hr$^{-1}$ | 0.457 | 1.876 | 0.939 | 0.365 |
| NPP | mgC m$^{-3}$ hr$^{-1}$ | 0.089 | 1.251 | 0.504 | 0.260 |

Note: Min = Minimum, Max. = Maximum, SD = Standard deviation.

**Table 2:** ANOVA, Post Hoc test following Duncan test showing seasonal changes in water quality parameters (data expressed as mean±SD).

| Parameters | Mon | Pom | Win | Prm |
|---|---|---|---|---|
| WT (°C)* | 29.32±0.66$^{a}$ | 25.8±2.29$^{b}$ | 19.433±1.48$^{c}$ | 25.992±2.17$^{b}$ |
| TDS (mg L$^{-1}$)* | 71.30±13.17$^{a}$ | 58.358±7.87$^{b}$ | 87.417±1.50$^{c}$ | 91.417±3.39$^{c}$ |
| EC (mS cm$^{-1}$)* | 143.74±27.89$^{a}$ | 116.942±15.76$^{b}$ | 175.250±2.13$^{c}$ | 182.667±5.77$^{c}$ |
| pH* | 7.98±0.49$^{a}$ | 7.933±0.48$^{a}$ | 7.767±0.55$^{a}$ | 9.031±0.13$^{b}$ |
| Trans. (m)* | 2.40±0.73$^{a}$ | 2.838±0.38$^{b}$ | 2.3000.12$^{ac}$ | 1.895±0.54$^{c}$ |
| TH (mg L$^{-1}$)* | 70.00±9.64$^{a}$ | 67±8.11$^{a}$ | 72.500±1.24$^{a}$ | 80.267±8.32$^{b}$ |
| TA (mg L$^{-1}$) | 67.16±6.95$^{a}$ | 64.66±5.06$^{a}$ | 66.00±2.08$^{a}$ | 68.00±3.30$^{a}$ |
| Free$CO_2$ (mg L$^{-1}$)* | 0.80±0.74$^{a}$ | 0.806±0.65$^{a}$ | 1.520±0.87$^{b}$ | 0.050±0.09$^{b}$ |
| TP(mg L$^{-1}$)* | 0.016±0.002$^{a}$ | 0.011±0.003$^{b}$ | 0.007±0.002$^{c}$ | 0.010±0.00$^{b}$ |
| $NH_3$ (mg L$^{-1}$)* | 0.03±0.01$^{a}$ | 0.027±0.01$^{a}$ | 0.056±0.01$^{b}$ | 0.024±0.01$^{a}$ |
| $NO_3$-N (mg L$^{-1}$)* | 0.03±0.02$^{a}$ | 0.013±0.009$^{b}$ | 0.054±0.01$^{c}$ | 0.052±0.01$^{c}$ |
| $NO_2$-N (mg L$^{-1}$)* | 0.04±0.05$^{a}$ | 0.015±0.01$^{b}$ | 0.065±0.02$^{a}$ | 0.068±0.01$^{a}$ |
| DO (mg L$^{-1}$)* | 10.86±1.18$^{a}$ | 10.983±2.35$^{a}$ | 7.292±0.96$^{b}$ | 8.967±1.22$^{c}$ |
| $BOD_5$ (mg L$^{-1}$)* | 0.42±0.11$^{a}$ | 0.606±0.17$^{b}$ | 0.994±0.16$^{c}$ | 0.526±0.20$^{ab}$ |
| Chl-a (µg L$^{-1}$)* | 3.030.99$^{a}$ | 1.30±0.53$^{b}$ | 1.75±0.54$^{bc}$ | 2.12±0.66$^{c}$ |
| Depth (m)* | 28.02±9.07$^{ab}$ | 30.308±14.66$^{b}$ | 19.9759.82$^{c}$ | 18.125±7.74$^{c}$ |
| GPP (mgC m$^{-3}$ hr$^{-1}$)* | 1.27±0.44$^{a}$ | 0.737±0.10$^{b}$ | 0.727±0.14$^{b}$ | 1.016±0.33$^{c}$ |
| NPP (mgC m$^{-3}$ hr$^{-1}$)* | 0.75±0.22$^{a}$ | 0.395±0.13$^{b}$ | 0.290±0.13$^{b}$ | 0.577±0.25$^{c}$ |

MON = Monsoon; POM = Post-monsoon; WIN = Winter; PRM = Pre-monsoon, *Indicates significant difference at $p<0.05$.

**Table 3:** ANOVA Post Hoc test following Duncan test of sitewise depicting only the significant changes in water quality parameters (Data presented as mean±SD).

| Parameters | S1 | S2 | S3 | S4 |
|---|---|---|---|---|
| Chl-a (µg L$^{-1}$)* | 1.60±1.08$^{a}$ | 2.148±0.83$^{ab}$ | 2.064±0.92$^{ab}$ | 2.40±0.82$^{b}$ |
| Depth (m)* | 36.058±9.79$^{a}$ | 29.642±6.75$^{b}$ | 18.050±6.23$^{c}$ | 12.683±4.26$^{c}$ |

S1 = Sampling site near dam; S2 = Near cage culture site; S3 = Near tourist spot; S4 = Mid-stream, *Indicates significant difference at $p<0.05$.

(0.63±0.27 mg $L^{-1}$) suggests unpolluted and healthy water (Chapman, 1992). The annual mean value of total alkalinity of the reservoir was 66.45±4.7 mg $L^{-1}$ which can be considered as a medium productive water body (Jhingran, 1990). The annual mean value of the total hardness (72.4±8.85 mg $L^{-1}$) was found within the recommended range for fishery (Kumar *et al*., 2020) and falls under the category of moderately soft water (Mato, 2002) while, the other reservoirs of Northeast, India were categorised as a soft water (Sharma and Pachuau, 2016; Sharma and Sharma, 2021). The nutrient values *viz*., TP (0.035±0.01 mg $L^{-1}$) and $NO_3$-N (0.039±0.02 mg $L^{-1}$) are low but within the acceptable ranges as per Jhingran (1990). The value of $NH_3$ (0.034± 0.018 mg $L^{-1}$) and $NO_2$-N (0.047±0.035 mg $L^{-1}$) were also lower. Sugunan, (2000) stated that most of Indian reservoirs are low in nutrient level and reservoirs constructed on low-order streams near mountains often experience less flow and lower input of organic matter and nutrients, resulting in sparse plankton. According to the OECD (1982) standard, a Chl-a concentration of less than 3 mg $L^{-1}$ indicates poor nutrient conditions and oligotrophic water, which results in low phytoplankton biomass. In the present study, the mean Chl-a (2.05±0.94 mg $L^{-1}$) of the Maphou reservoir was lower than the recommended value therefore, it could be in an oligotrophic state because the water bodies situated near the mountains typically receive limited nutrients and have lower organic and nutrient inputs (Ward and Stanford, 1983). Both GPP (0.939±0.36 mgC $m^{-3}$ $hr^{-1}$) and NPP (0.504±0.26 mgC $m^{-3}$ $hr^{-1}$) values are greater than the findings of Som Kamla Amba Reservoir (Parmar and Sharma, 2018) and Morwane Dam (Babar and Raje, 2015). Overall, the observed water quality parameters indicated the existence of a healthy condition in the Maphou reservoir.

## Cluster analysis

Heatmap cluster analysis is depicted in Fig 2, based on the result of the month-wise cluster analysis, two major clusters, namely cluster 1 and cluster 2, were identified. Cluster 1 was further divided into two sub-clusters, cluster 1a and cluster 1b, based on differential physico-chemical parameters. Cluster 1a comprised the month of May, June and July. Cluster 1b consisted December, January, February, March and April. Cluster 2 includes the month of August, September, October and November. Therefore, heatmap cluster analysis suggests that the reservoir experienced three distinct seasons due to the marked seasonal fluctuation of water level and rainfall attributed to nutrient supply. However, Sugunan (2000) suggested four seasons in Indian reservoirs based on the plankton dynamics.

## Trophic state index

Seasonal and site-wise variations of TSI were presented in ANOVA Table 4 and 5, respectively. Temporally, all the TSI values were significantly different ($p$<0.05) but spatially only TSI (Chl-a) showed a significant difference ($p$<0.05).

**Table 4:** ANOVA Post Hoc test following Duncan test showing temporal variation of TSI (Data presented as mean±SD).

| TSI variations | MON | POM | WIN | PRM | Annual $TSI_{mean}$ |
|---|---|---|---|---|---|
| TSI (TP)* | 36.40±2.95[a] | 27.19±6.6[b] | 25.42±3.74[b] | 33.78±4.5[a] | 30.7±5.23 |
| TSI (SD)* | 38.39±1.87[a] | 39.84±2.07[a] | 42.488±2.52[b] | 46.09±3.83[c] | 41.7±3.38 |
| TSI(Chl-a)* | 50.10±3.95[a] | 41.20±5.4[b] | 44.87±2.86[c] | 46.71±3.04[c] | 45.72±3.7 |
| Seasonal $TSI_{mean}$* | 41.63±2.92[a] | 36.08±4.69[b] | 37.59±3.04[b] | 42.19±3.79[a] | 39.37±3.0 |

MON = Monsoon; POM = Post-monsoon; WIN = Winter; PRM = Pre-monsoon, *Indicates significant difference at $p$<0.05.

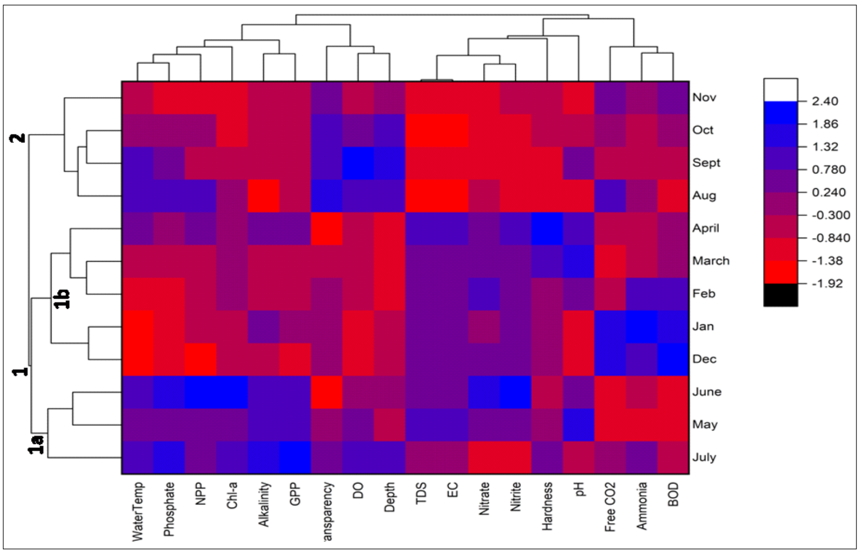


**Fig 2:** Heatmap showing cluster of the months that experienced similar physico-chemical parameters.

**Table 5:** ANOVA Post Hoc test following Duncan test showing spatial variation of TSI (Data presented as mean±SD).

| Sitewise | S1 | S2 | S3 | S4 |
|---|---|---|---|---|
| TSI (TP) | 29.63±5.82[a] | 31.43±8.28[a] | 32.1±5.49[a] | 29.63±6.19[a] |
| TSI (SD) | 41.47±4.17[a] | 40.55±4.54[a] | 42.11±3.34[a] | 42.67±3.78[a] |
| TSI (Chl-a)* | 42.5±6.62[a] | 46.65±3.57[b] | 46.05±4.07[ab] | 47.69±4.19[b] |
| $TSI_{mean}$ | 37.87±3.70[a] | 39.54±3.74[a] | 40.09±2.55[a] | 40.00±3.63[a] |

S1 = Sampling site near dam; S2 = Near cage culture site; S3 = Near tourist spot; S4 = Mid-stream, *Indicates significant difference at $p<0.05$.

According to Lamparelli (2004), aquatic ecosystems can be categorised into ultra-oligotrophic (TSI <24), oligotrophic (TSI 24 to ≤44), mesotrophic (44 to ≤54), eutrophic (54 to ≤74) and hypertrophic (>74). The resultant mean TSI for each four seasons (monsoon = 41.63±2.93; post-monsoon= 36.08± 4.69; winter = 37.59±3.04); pre-monsoon = 42.19±3.79) experienced an oligotrophic state. Most of the studied reservoirs located in the hilly area tend to be oligotrophic in nature (Sharma, 1995; Murugesan *et al*., 2003). Among the TSI, the highest mean value was supported by TSI (Chl-a) (45.72±3.7) followed by TSI (SD) (41.7±3.32) and least by TSI (TP) (30.7±5.23), indicating that the plankton production was contributed by phosphorous and turbidity level of the water. Pre-monsoon and monsoon seasons showed higher average trophic status which might be due to nutrient supply during monsoon rainfall and occasional rainfall in pre-monsoon. The reservoir is best suited for cage culture because of its oligotrophic state.

### MEI, MSY, Fish yield

The MEI, based on electrical conductivity and depth was calculated as 8.55 which is higher than the upland reservoir Pong Dam (Sugunan, 1995) but lower than Gumti reservoir (16.63) of Tripura (Bhattacharya and Saha, 1986). The MEI indicates the reservoir's ecological condition and is an important input for production potential estimation. The estimated fish yield was 14.98 kg $ha^{-1}$, which is lower than the national average yield of small reservoirs (Sugunan, 1995). However, the value is very close to Pong dam (Sugunan *et al*., 2002). The mean MSY (21.46 kg $ha^{-1}$) of the reservoir is close to the upland Pong dam (23.4 kg $ha^{-1}$) of Himachal Pradesh (Sugunan, 1995) and Kabini reservoir (23.86 kg $ha^{-1}$) of Karnataka (Sugunan *et al*., 2002) but lower than Gumti reservoir (50 kg $ha^{-1}$) of Tripura, NE, India (Bhattacharya and Saha, 1986). The average water spread area of Maphou reservoir was 1,215 ha at Full Reservoir Level (FRL) at an elevation of 880.75 meter due to which the reservoir was categorised under medium reservoir (Borah *et al*., 2023), but the actual average water spread area of the reservoir was found to be 852.625 ha in the current study. Therefore, the reservoir can be categorised and validated as a small reservoir (<1,000 ha) based on the classification provided by Ministry of Agriculture, Government of India.

## CONCLUSION

The Maphou water is medium soft and alkaline fit for the growth and survival of aquatic life. In the present study, the overall health status of the reservoir indicated an oligotrophic condition with no evidence of pollution threats. Estimated fish yield production and MSY were lower, however, it can be improved through stock enhancement with suitable fish species and implementation of cages at suitable sites. Educational and awareness programmes should be conducted to disseminate the fisheries status and conservation strategies at the local level. The outcome of this study could serve as a crucial foundation for crafting effective strategies aimed at conserving the reservoir ecosystem. Moreover, these results could contribute to the implementation of ecosystem-based fisheries management with utilization of advanced software tools such as Ecopath with Ecosim (EwE) to gain insights into the intricate web of food chains and energy dynamics that underlie the ecosystem.

## ACKNOWLEDGEMENT

The first author is grateful to the Director of ICAR-Central Institute of Fisheries Education, Mumbai for granting permission to conduct research work in Manipur and extends thanks to ICAR Research Complex for NEH Region, Manipur Centre, Lamphelpat, Manipur for providing the necessary facilities to accomplish the work.

**Conflict of interest:** None.

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