# COMPARISON OF WATER QUALITY ASSESSMENT BETWEEN INLAY LAKE AND SAMKHA LAKE (SAMKHA INN), NYAUNG SHWE TOWNSHIP, SHAN STATE

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## Abstract

Increasing population and its related conditions are posing to the environmental degradation and causing contamination around the world, lake and reservoir are also included. Lake (Inn) is source of food for the local people, home for biodiversity, water recharge area for groundwater, etc. Inle Lake and Samkha Inn is situated in Nyaung Shwe Township, Southern Shan State. Although Inle Lake is formed naturally, Samkha Lake (Samkha Inn) is created by the construction of Myobye Dam, which are connected with lower Nam Belu Stream. The local people depend on these two lakes for their livelihood such as fishing, agriculture as a source of water. Population is increasing year after year; the quality of water might be more and more degradation in this area. Therefore, the research question is raised for this study, how are the quality of water in these two lakes due to human activities. The objectives of this study are to assess the status of water quality in Inle and Samkha lakes, to analyze the spatial and temporal variation of water quality in these two lakes, to support the information of water quality for conserving of these lakes in future and contributing of UN- SDGs. To fulfill the question of this study, water is tested on field measurement and laboratory test from these two lakes. Based on these results, the spatial and temporary assessment of water quality was done with the aid of GIS technique.

**Keywords:** *water quality assessment, Inle Lake and Samkha Lake, Nyaung Shwe Township, Shan State*

## Introduction

Clean water is one of the most important things for all form of life including human and it assessment and monitoring is also crucial. Water quality assessment is the overall process of evaluation of the physical, chemical and biological nature of the water and water quality monitoring is the collection of the information (1996. UNESP, WHO, UNEP)

The Inle Lake, the second largest Lake in Myanmar, is one of the destinations for domestic and international tourism. Inle Lake became as a Biosphere Reserve Area UNESCOs Biosphere Reserve Area in 2015 and Myanmar's fifth Wetland of International Importance Ramsar Site in 2018 which is important for biodiversity as well as socioeconomic development of local people. According to the Davis et.al (2004), Inle Lake is one of the most important lakes in Southeast Asia for fish endemism; it has very high cultural and scenic values, high water plants diversity and is one of the highest located lakes in Myanmar.

In the lower part of the lake, the Belu Chaung (Belu Stream) flow down just a little distance and is created as Samkha Inn (Lake) due to construction of Myobye Dam for Lawpita Hydroelectricity Power Plant which is one of the important power plants in Myanmar. Sankha Lake (locally named as Samkha Inn) is also important for the local people for their livelihood and it is connected with Inle Lake with Belu Stream. It can be said that the water source is the almost the same with Inle Lake except two more streams entern to the Samkha Inn (Lake) Based on these facts, it is necessary to assess how relationship the water quality between Inle Lake and Samkha Inn. The conservation and protection of these lake is very important not only residents but also for visitors. At present, the water quality of lake water quality is impacted by human activities from

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the catchment area and within lake. Therefore, water quality assessment is necessary on these two lakes for aquatic ecosystem as well as socioeconomic condition of the local people.

**Research Question and Objectives of the Research**

   It is therefore, the main problems of this study are could use to address the following basic question of "How does the water quality vary in Inle Lake and Samkha Lake due to human activities?" Therefore, the main purposes of the study area are to assess the status of water quality in Inle and Samkha lakes, to analyze the spatial and temporal variation of water quality in these two lakes and to support the information of water quality for conserving of these lakes in future and contributing of United Nations Sustainable Development Goals.

**Methodology**

   To fulfill the research question, on field measurement and laboratory test was taken on the water quality from Inle Lake and Samkha Lake which were considered on different sample sites within these two lakes. Regarding with sampling sites, nine samples sites were selected for Inle Lake water quality and five sample sites for Samkha Lake in this study. The reasons for sampling sites were considered on inflowing water, outflowing water, the middle part of the lake, the settlement area, agriculture area, the starting point that entering to the lake from streams. In respect with choosing parameters, 14 parameters were decided to measure by human activities taking place in this area and water sample was measured and collected in April and October, 2018 and January 2019 for three seasons.

   In term of field work, on field measurement was taken on the variables of pH, turbidity, EC, DO (Dissolved Oxygen), temperature and TDS (Total Dissolved Solid) for three layers (a: surface layer, b: one meter depth of the lake, c: the bottom of the lake). Moreover, lakes water were systematically collected with bottles and tested at the laboratory on the variables of Nitrate, Phosphate, Arsenic, Lead, Coliform which is assessed by WHO Drinking Water Quality and Portable Water Quality Standard. Based on these results, the spatial and temporal variation of water quality assessment of these two lakes was done with the help of GIS technique (interpolation Method) in this study.

**Study Area: Inle Lake and Samkha Lake**

   Inle Lake and Samkha Inn Lake are situated in the Nyaung Shwe Township, Southern Shan State. It fall between Latitude 19° 58′ 0″ and 20° 43′ 05″ North, Longitude 97° 46′ 30″ and 97° 55′ 30″ East. Inle Lake is situated at the central part of the Nyaung Shwe Township, which is about 883.92 Meters (2900 ft.) above Mean Sea Level. Samkha Lake (Samkha Inn) is in the lower part of the Inle Lake which is connected with Belu Chaung (Stream). Figure1.
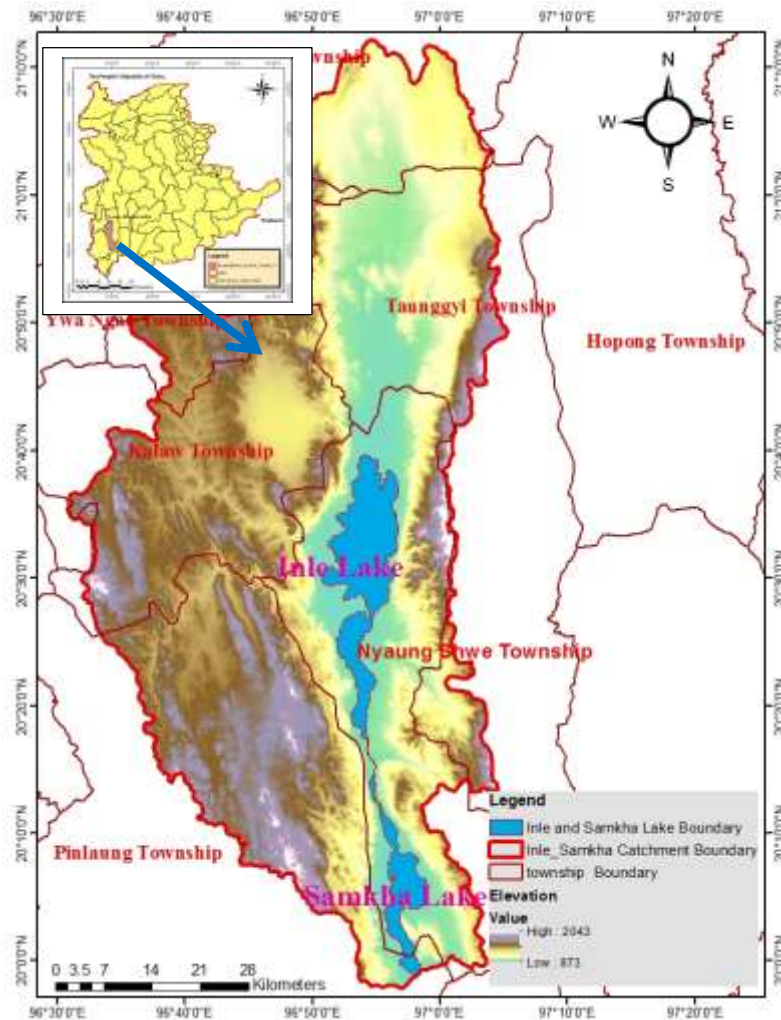
**Source:** Digitizing on UTM Map and DEM (Digital Elevation Model

**Figure 1** Study Area: Inle Lake and Samkha Lakes, Nyaung Shwe Township, Shan State, Myanmar

In Inle Lake and Samkha , Occupy the central part of a trough between two mountain ranges which run from North to South direction and  1219.2 meters (4000ft ) – 1524 meters (5000 ft) above Mean Sea Level. Of 29 streams which enter into the lake, 4 major streams are entering into Inle Lake (named Namlat, Thandaung, Inndein and Yepae Streams) but some are very short and some are dried up in the dry season, particularly from the eastern part of the lake and 2 main streams (named Nam Tin and Nam SinStreams) flow into Samkha Lake. In the watershed, there are five townships and their rainfall influence to the lake's and total annual rainfall is between 60'' (1524 mm) to 80'' (2032 mm). Similarly, the water via inflowing water and runoff to these two lakes as well as human activities from catchment area also influence to the lake water quality.

## Findings and Discussions

As above mentioned, in order to obtain the status of water quality in Inle Lake and Samkha Inn Lake, 13 water quality parameters of physical, chemical and biological characteristics were chosen and 14 sampling sites were chosen by different reasons including inflowing, outflowing and main body of lake water. It was analyzed for variation of water quality for spatially purpose and three seasons for temporary changes within two lakes.

Among them temperature is varied with vertically in the lake.  Generally, a layer is highest temperature in Inle Lake but b layer (1meter depth) is the highest temperature in Samkha Lake. The temperature profile was not significant because Inle Lake is a shallow Lake but Samkha Lake is a little deeper than Inlake Lake.

### i.     Spatial and Temporal Variation of pH Value in Inle and Samkha Lakes

In Inle Lake, the pH value is between 7.2 and 8.9. The highest value is found in   Sample 2,3,4,7 and 8 which are the main water body of the lake due to being in limestone area in nature. The seasonal variation was not significant but inflow water quality is more alkaline than body of lake in Rainy Season. Similarly, the pH value was between 7.1 and 8.1 in Samkha Lake and there is no variation within seasonally. Therefore, it is no significant variation within these two lakes and acceptable level to compare with WHO drinking and portable water quality standard. See in Figure 3.

### ii.    Spatial and Temporal Variation of Conductivity in Inle and Samkha Lakes

In term of Conductivity (EC), it was not obviously varied spatially and the value was between 200 and 500 mg/L in Inle Lake, but it is fluctuation seasonally which was decreased in the Rainy Season and increased in the Hot Season and the Cold Seasons. In Samkha Lake the conductivity was a little bit higher than Inle Lake between 270 and 500 mg/L. Similarly with Inle Lake, Conductivity was high in Hot and Cold Season but it was low in Rainy Season but it was not much variation in spatially. WHO drinking water quality of Conductivity is between 0.15 mg/L and 15 mg/L and portable water quality is between 400 mg/L. Based on the analyzed data, all sample sites in Inle Lake and Samkha Lakes were beyond acceptable level of WHO drinking and portable water quality level particularly in Hot Season and Cold Season. See in Figure 3.

### iii.   Spatial and Temporal Variation of Total Dissolved Solid in Inle and Samkha Lakes

Total Dissolved Solid is an important parameter for the lake. Total Dissolved Solid is varied from 200 ppm to 300 ppm in Inle Lake which was decreased value in the Rainy Season but was increased in the Hot and the Cold Season. The highest was found in Sample 1 which is inflowing water in the Hot Season. In Samkha Lake, Total Dissolved Solid was varied between 180 ppm and 300 ppm there which can be said that the value was lower than Inle Lake where the sample 4 (inflowing water) was the highest. Therefore, Total Dissolved Solid is more significant in inflowing water from the catchment. To comparison with WHO drinking water quality (1.0 ppm) and portable water standard (50-1500 ppm), all the sample sites in Inle and Samkha Lake are beyond the drinking water quality but acceptable level for portable water quality. See in Figure 3.

### iv.    Spatial and Temporal Variation of Turbidity in Inle and Samkha Lakes

Similarly with TDS, Turbidity is also important parameter for Inle Lake. Turbidity was significantly varied between 3 NTU – 1000 NTU in Inle Lake, the highest Turbidity was found in Sample 1 and Sample 3 (inflowing water) in Rainy Season and deposited at the mouth of the stream. In all season, Turbidity was high in the western part of Inle Lake where there is delta accretion due to deposition process. In Samkha Lake, Turbidity was between 1 NTU and 100 NTU and the value was generally lower than Inle Lake. In addition, it was not much varied seasonally as well as spatially. WHO drinking water quality and portable water quality for Turbidity is 5 NTU and 25 NTU. Therefore, Turbidity is beyond the limit of WHO standard in some samples and some were acceptable range within these two lake. Figure 3.

**v.    Spatial and Temporal Variation of Nitrate in Inle and Samkha Lakes**

Nitrate and Phosphate are important water quality variables for lake which indicate the level of eutrophication stage. In Inle Lake, the concentration of Nitrate was between 7 ppm and 19.6 ppm. The highest Nitrate concentration was found in Sample 1 and Sample 3, which are especially from inflowing water from catchment area. In Samkha Lake, Nitrate was between 8 ppm and 12 ppm which varied seasonally and spatially but the concentration was high in Rainy season. WHO drinking water quality standard, Nitrate is 10 ppm is acceptable and portable water quality standard, 50 ppm is permissible level. In these two lakes, Nitrate in the Rainy season was generally higher than Dry period. Based on the analyses of Nitrate concentration in Inle is higher than Samkha Lake because Inle Lake has bigger catchment and more human activities. See in Figure 3.

**vi.    Spatial and Temporal Variation of Phosphate in Inle and Samkha Lakes**

The natural level of PO4 usually range in surface water is 0.005 mg/L to 0.05 mg/L. In Inle Lake, Phosphate is ranged between 0.02 mg/ L to 0.5 mg/L. In Inle Lake, the highest Phosphate was found in Sample 5 (inflowing water from the eastern part of the lake) in the Hot Season and Sample 9 (outflowing water) in the Rainy Season. But there is no phosphate content in the Cold Season. In Samkha Lake, Phosphate was varied from 0.02 mg/L to 0.04 mg/L which can be found almost in the Rainy Season and one sample in the Hot Season. Normally, Phosphate content in Inle Lake is higher than Samkha Lake but there is no Phosphate in the Cold Season within these two lakes. See in Figure 3.

**vii.    Spatial and Temporal Variation of Dissolved Oxygen in Inle and Samkha Lakes**

Dissolved Oxygen is varied with collection time and aquatic growth condition. In Inle Lake, Dissolved Oxygen level was decreased in the Hot Season and it was increased in the Cold Season particularly in the b layer where Dissolved Oxygen was varied 1.24 mg/L to 40.24 mg/L. In Sam Kha Lake, Dissolved Oxygen was decreased in the Rainy Season and was increased in the Cold Season especially in b layer. Normally, Dissolved Oxygen was decreased in the Hot Season in Inle Lake because it is shallower than Samkha Lake. Figure 3.

**viii.    Spatial and Temporal Variation of Biological Oxygen Demand in Inle and Samkha Lakes**

Biological Oxygen Demand is important for aquatic life in lake.  Biological Oxygen Demand was ranged between 0 mg/L to 14 mg/L Inle Lake. But, in some sample was not found Biological Oxygen Demand value in the Hot Season and the value was normally high in the Rainy Season. Similarly, Biological Oxygen Demand was ranged between varied 0 mg/L to 19 mg/L in Sam Kha Lake which is almost found in the Rainy Season. Therefore, it can be said that Biological Oxygen Demand value was not much varied between Inle and Samkha Lake. See in Figure 3.

**ix.    Spatial and Temporal Variation of Chemical Oxygen Demand in Inle and Samkha Lake**

In Inle Lake, Chemical Oxygen Demand was varied between 2 mg/L to 24 mg/L and the highest value is found in Sample 2, 8 and 9. Chemical Oxygen Demand value was varied spatially and seasonally in Inle Lake. In Samkha Lake, Chemical Oxygen Demand varied 3 mg/L to 14 mg/L, like Inle Lake, Chemical Oxygen Demand value in Samkha Lake was varied spatially and seasonally. WHO portable water quality standard for Chemical Oxygen Demand is 10 mg/L. Some samples site is beyond the limit of WHO standard in Inle Lake. For Comparison of Chemical

Oxygen Demand in these two Lake, the value in Inle Lake was higher than Samkha Lake. See in Figure 3.

**x.    Spatial and Temporal Variation of Arsenic and Lead in Inle and Samkha Lake**

In Inle Lake and Samkha Lake, there was no Arsenic content in every sample and every season.  Likewise, there was no Lead content in every sample and every Season in Inle Lake and Samkha Lake. See in Figure 3.

**xi.   Spatial and Temporal Variation of Coliform in Inle and Samkha Lake**

Coliform is a biological characteristics in Water Quality Assessment. In term of Coliform variable in Inle Lake and Samkha Lake, it was found every sampling site. The amount is varied spatially and seasonally but it was normally high in the Hot Season. Based on the analyses on Coliform, Inle Lake is much more value than Samkha Lake due to more human activities and settlement in Inle Lake. WHO drinking and portable water quality is 1.  Therefore, Coliform is beyond the WHO standard in all sample sites in Inle and Samkha Lake. See in Figure 3.
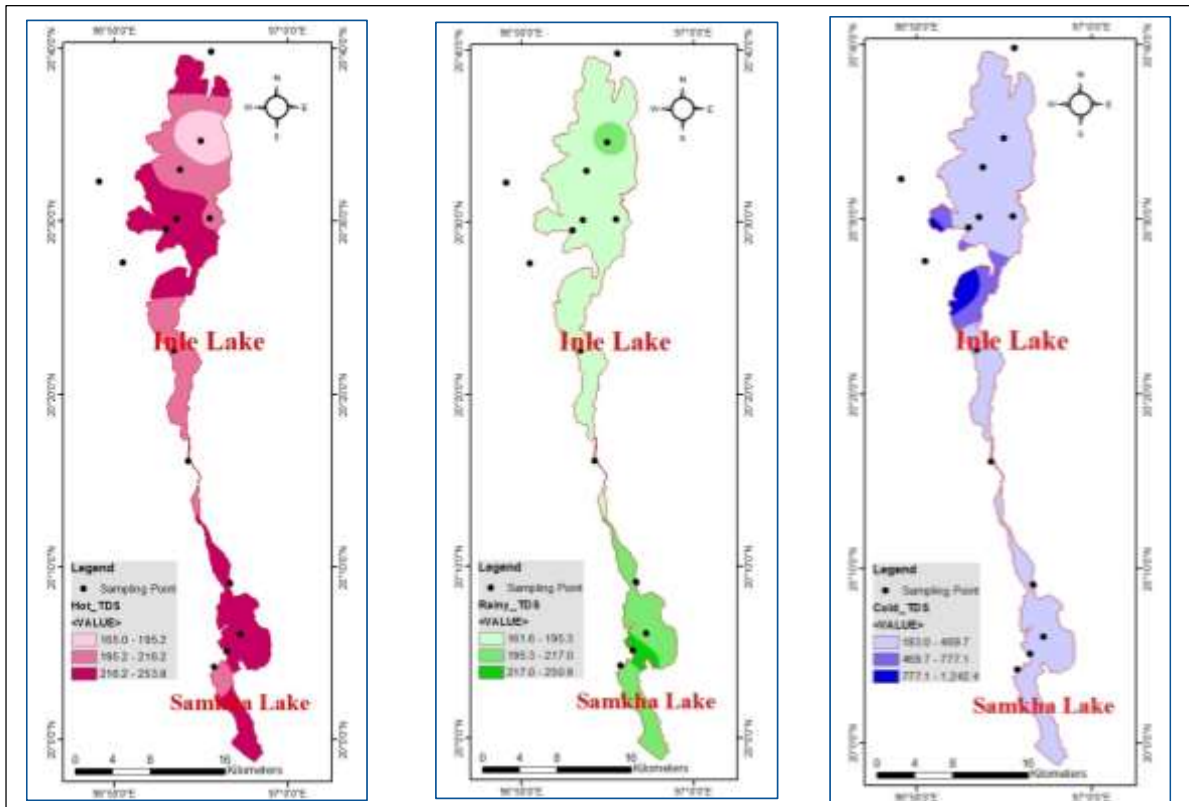
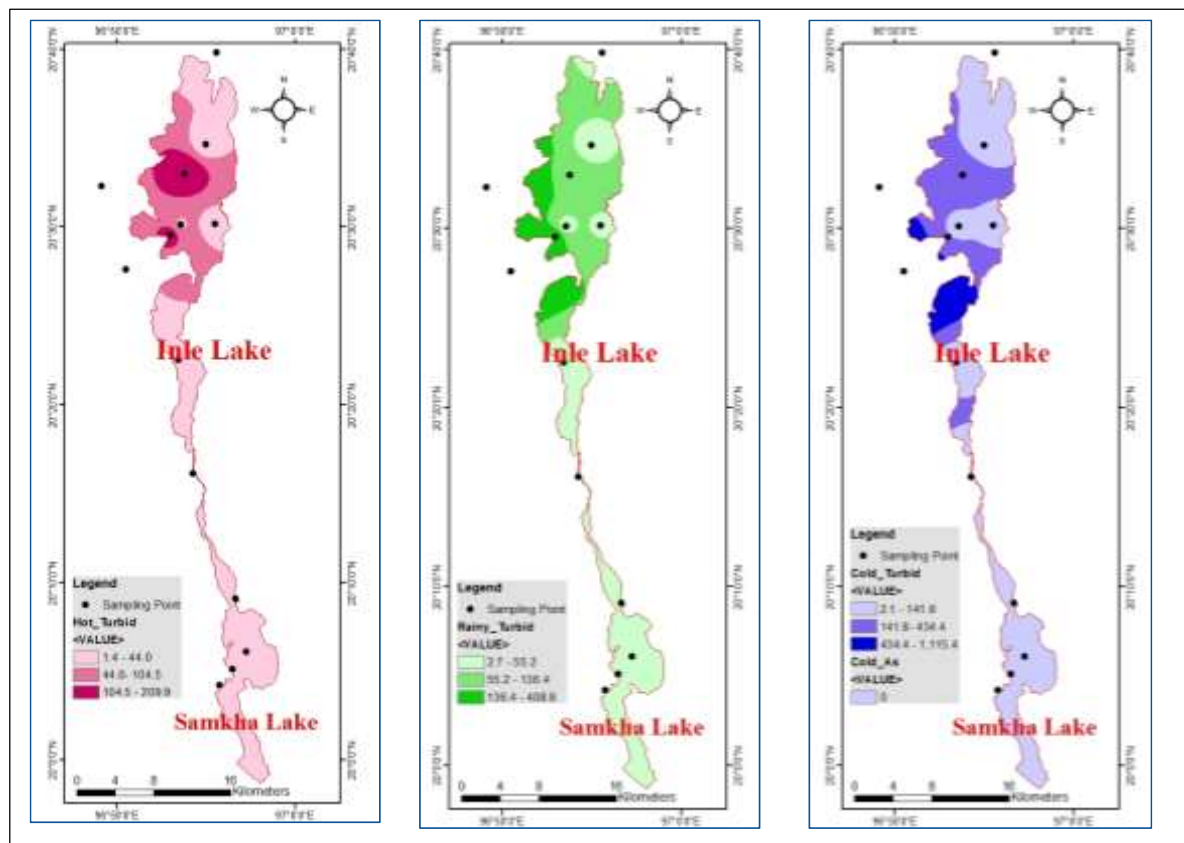**i.  pH :  for 14 samplings Sites and 3 Seasons**
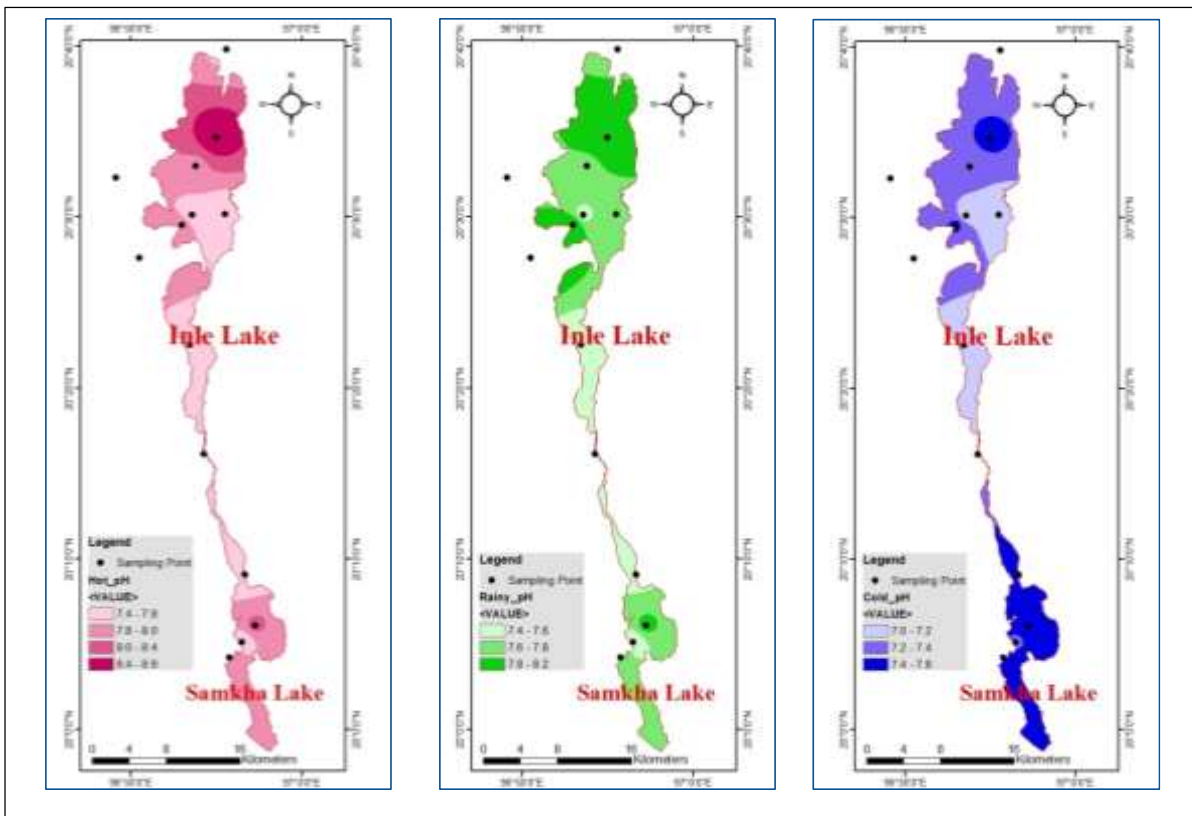
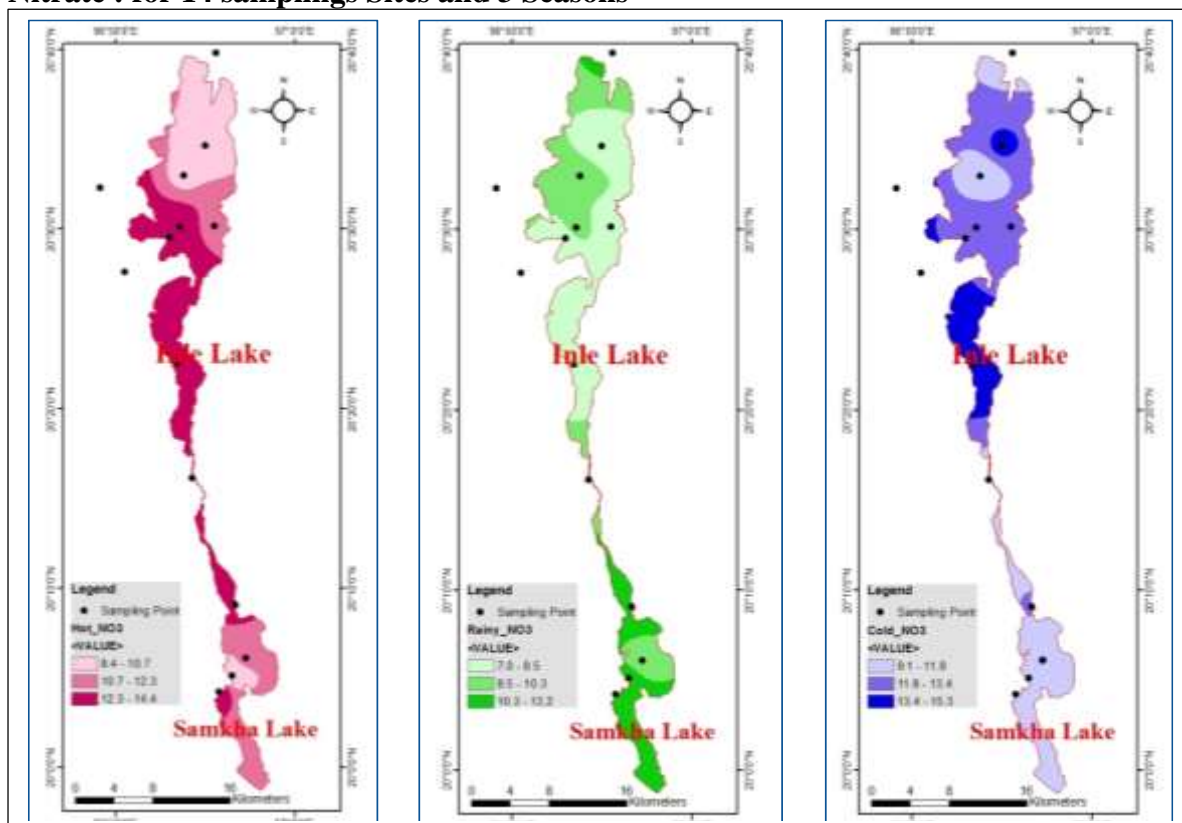## ii. Conductivity:  for 14 samplings Sites and 3 Seasons
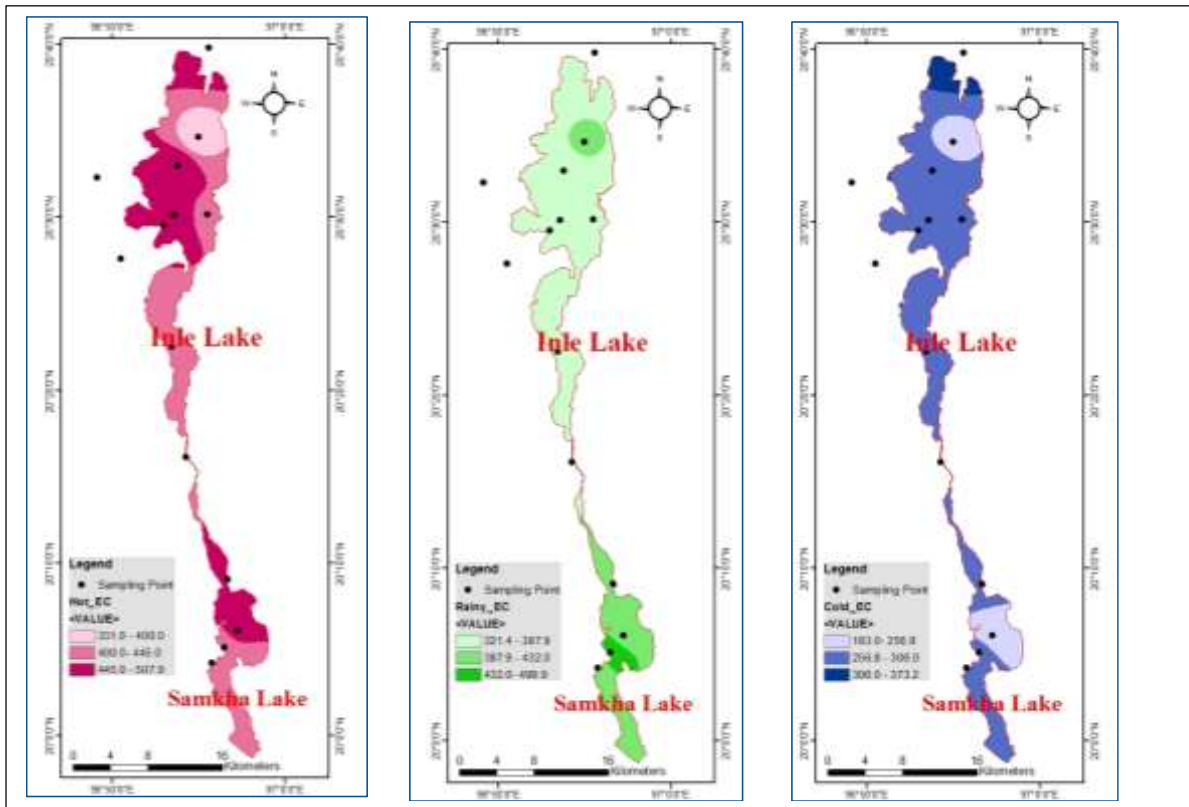


## iii. Total Dissolved Solid (TDS): for 14 samplings Sites and 3 Seasons
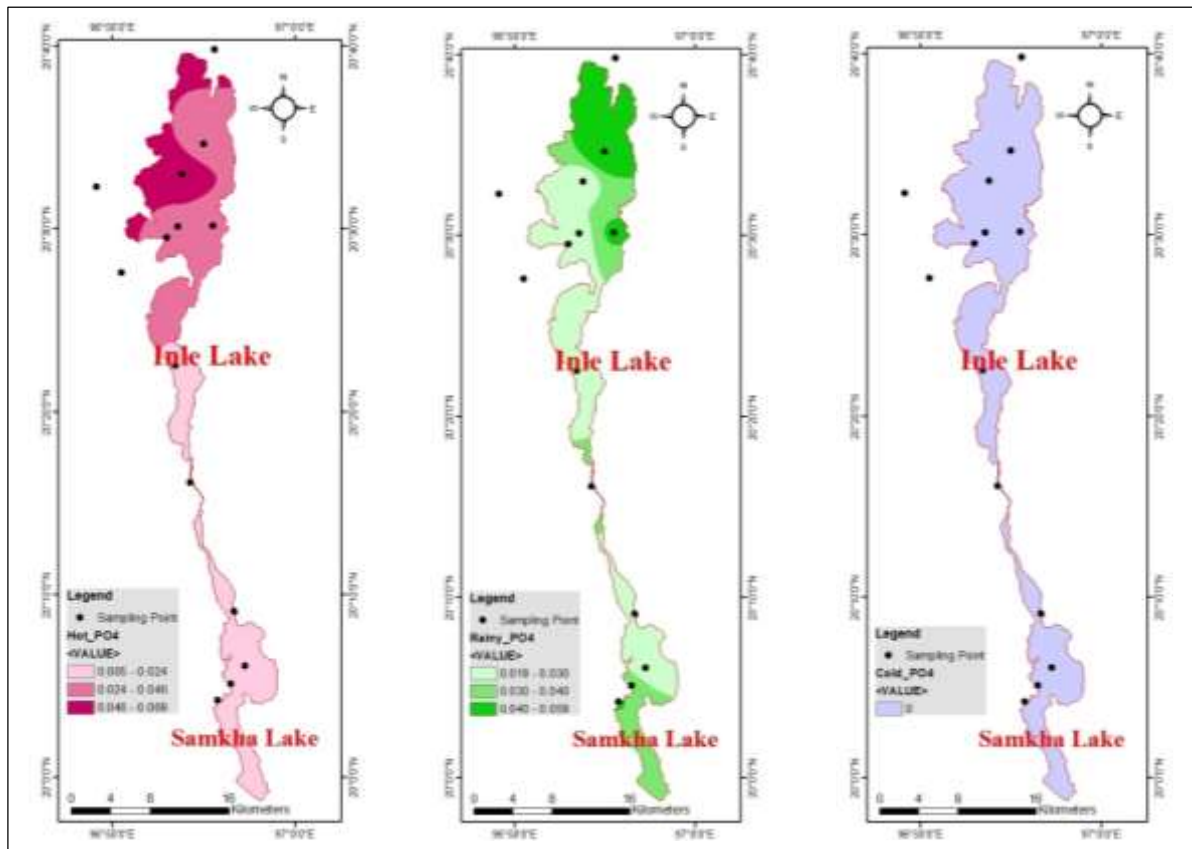
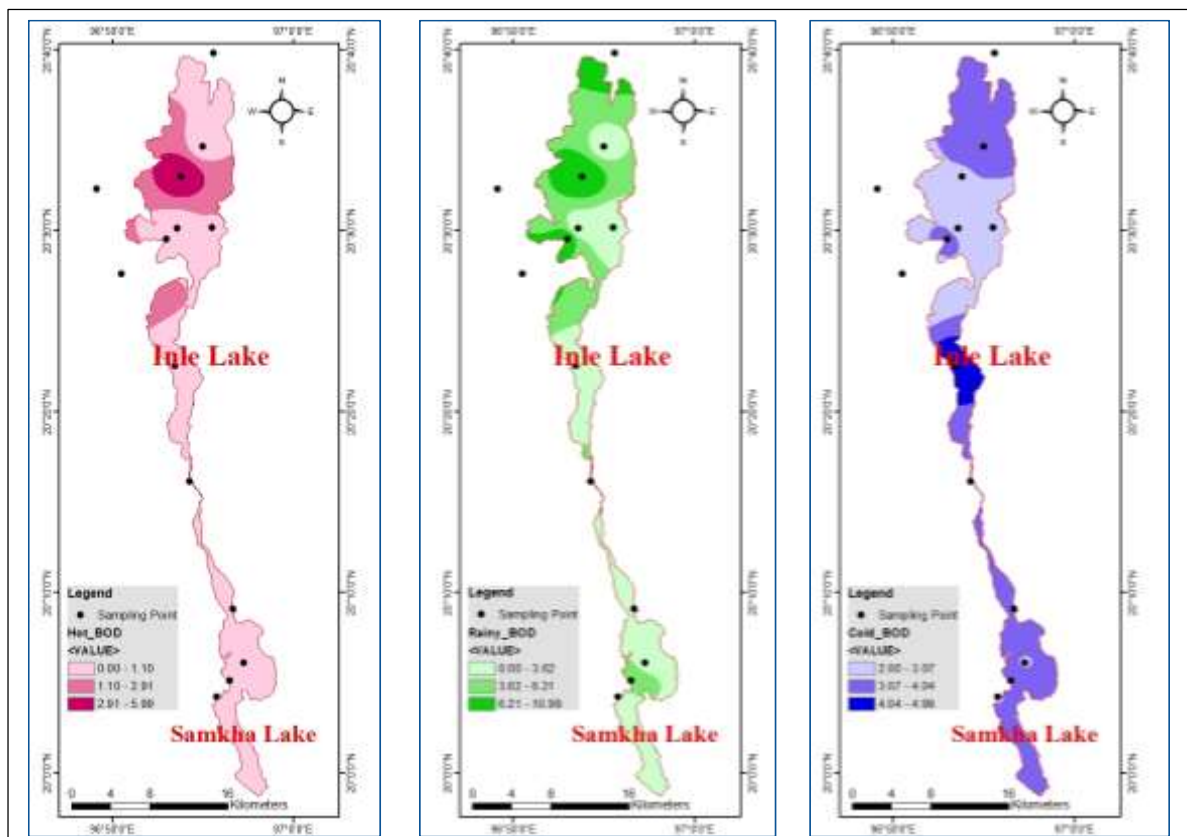**iv. Turbidity: for 14 samplings Sites and 3 Seasons**



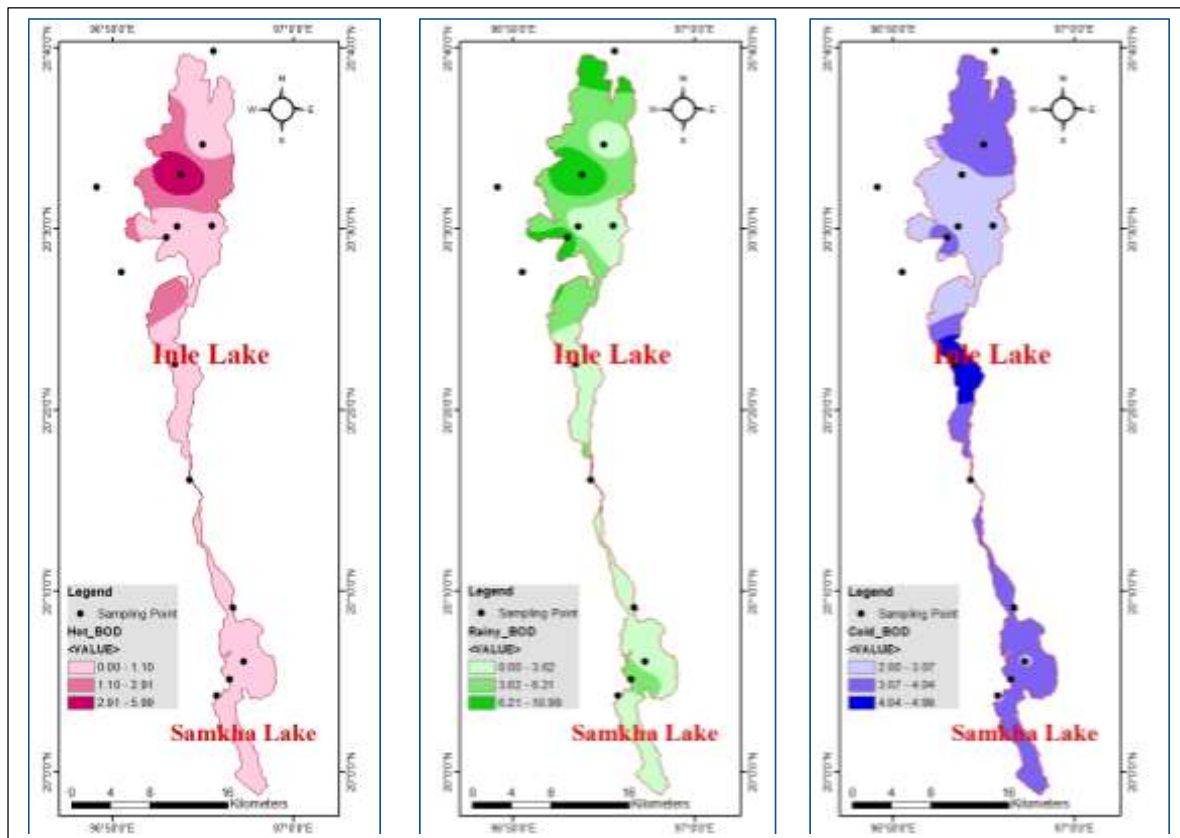**v. Nitrate : for 14 samplings Sites and 3 Seasons**

**vi. Phosphate: for 14 samplings Sites and 3 Seasons**
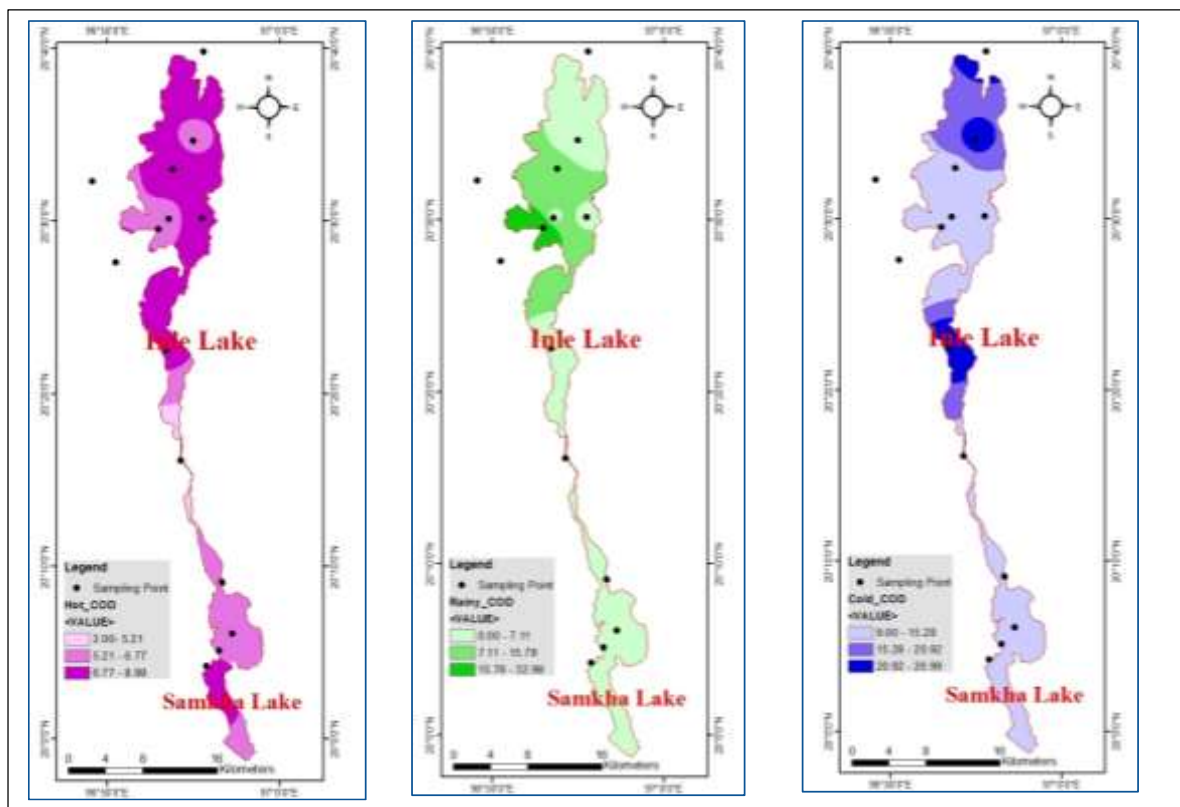


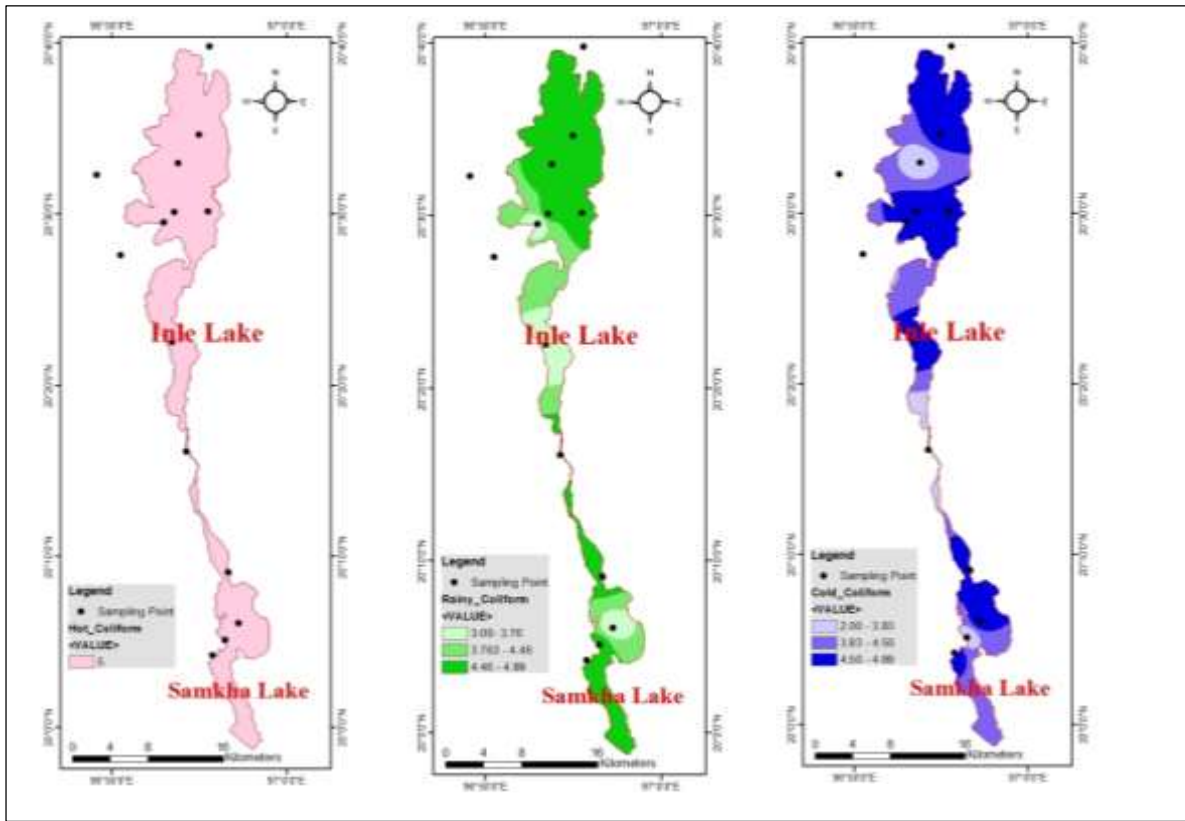**vii Dissolved Oxygen (DO): for 14 samplings Sites and 3 Seasons**

**viii. Biological Oxygen Demand: for 14 samplings Sites and 3 Seasons**



**ix. Chemical Oxygen Demand (COD): for 14 samplings Sites and 3 Seasons**

**x. Coliform: for 14 samplings Sites and 3 Seasons**



**Source:** Field Measurement, 2018

**Fgure 2** Spatial Assessment of Water Quality in Inle and Samkha Lake

**Table 1. Spatial and Temporal Water Quality Measurement in Inle and Samkha Lake**

| WQ | Season | I.S.1 | I.S.2 | I.S.3 | I.S.4 | I.S.5 | I.S.6 | I.S.7 | I.S.8 | I.S.9 | S.S.1 | S.S.2 | S.S.3 | S.S.4 | S.S.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tem | Hot | 26.3 | 27.2 | 23.3 | 26.4 | 27.7 | 26.6 | 23.8 | 25.8 | 25 | 27.4 | 26.6 | 26.3 | 25.2 | 27.4 |
| ( °C) | Rainy | 24.8 | 25.2 | 24.1 | 24.1 | 25.1 | 19.8 | 26.2 | 21.2 | 28.3 | 27.1 | 26.7 | 26.2 | 24.2 | 26.2 |
| | Cold | 22.6 | 19 | 24.2 | 18.5 | 22.7 | 19.8 | 20.7 | 21.2 | 19.9 | 21.5 | 20.9 | 20.5 | 20.8 | 20.1 |
| pH | Hot | 7.65 | 7.56 | 7.48 | 7.85 | 7.92 | 8.06 | 7.7 | 7.61 | 8.04 | 8.11 | 7.53 | 7.53 | 8.04 | 8.04 |
| | Rainy | 7.57 | 8.12 | 8.4 | 7.85 | 7.61 | 7.37 | 8 | 7.8 | 7.84 | 7.97 | 7.58 | 7.44 | 7.4 | 7.6 |
| | Cold | 7.15 | 7.53 | 7.45 | 7.01 | 7.02 | 7.08 | 7.53 | 7.25 | 7.83 | 7.68 | 7.56 | 7.4 | 7.2 | 7.2 |
| EC | Hot | 405 | 484 | 427 | 331 | 494 | 388 | 426 | 560 | 515 | 420 | 450 | 479 | 441 | 420 |
| | Rainy | 224 | 366 | 360 | 364 | 378 | 388 | 375 | 401 | 383 | 393 | 389 | 400 | 500 | 374 |
| | Cold | 519 | 392 | 386 | 433 | 379 | 4.3 | 383 | 307 | 538 | 378 | 274 | 423 | 510 | 393 |
| TDS | Hot | 202 | 240 | 214 | 165 | 205 | 222 | 213 | 280 | 258 | 211 | 224 | 240 | 220 | 211 |
| | Rainy | 112 | 184 | 181 | 182 | 187 | 194 | 187 | 200 | 191 | 197 | 194 | 200 | 251 | 168 |
| | Cold | 364 | 277 | 274 | 307 | 269 | 286 | 272 | 218 | 382 | 268 | 183 | 300 | 305 | 279 |
| Turbid | Hot | 7.43 | 34.8 | 13.1 | 6.57 | 210 | 138 | 10.2 | 12.3 | 5.91 | 3.79 | 4.69 | 32.6 | 1.48 | 3.79 |
| ity | Rainy | 1023 | 198 | 317 | 99.9 | 23.2 | 3.6 | 4.19 | 2.32 | 19.2 | 6.87 | 3.34 | 11 | 5.14 | 2.68 |
| | Cold | 1005 | 178 | 309 | 89.9 | 21.2 | 3.1 | 3.95 | 10.1 | 17.5 | 5.87 | 3.21 | 9.98 | 4.79 | 2.51 |
| DO | Hot | 6.45 | 5.56 | 6.5 | 7.2 | 7.0 | 1.27 | 8.02 | 8.1 | 6.99 | 7.4 | 7.6 | 18.8 | 2.9 | 7.6 |
| | Rainy | 7.9 | 7.54 | 8 | 6.3 | 6.6 | 1.27 | 1.85 | 8.14 | 6.99 | 0.18 | 6.35 | 0.1 | 0.12 | 6.5 |
| | Cold | 29.7 | 42.5 | 34.2 | 21.7 | 38.1 | 35.7 | 4.37 | 40.2 | 19.6 | 8.9 | 8.8 | 19.7 | 7.3 | 3.3 |

| WQ | Season | I.S.1 | I.S.2 | I.S.3 | I.S.4 | I.S.5 | I.S.6 | I.S.7 | I.S.8 | I.S.9 | S.S.1 | S.S.2 | S.S.3 | S.S.4 | S.S.5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NO3 | Hot | 11.2 | 7 | 7.7 | 9.8 | 7 | 9.8 | 7 | 7 | 11.2 | 13.3 | 8.4 | 12.6 | 11.2 | 9.8 |
| | Rainy | 17.5 | 12.6 | 15.4 | 9.1 | 11.9 | 13.3 | 15.4 | 14 | 10.5 | 9.8 | 11.9 | 11.9 | 10.5 | 11.2 |
| | Cold | 19.6 | 14 | 14 | 9.8 | 11.2 | 14 | 13.3 | 8.4 | 9.8 | 14 | 11.2 | 13.3 | 8.4 | 8.4 |
| PO4 | Hot | 0.1 | 0.04 | 0.05 | 0.07 | 0.03 | 0.04 | 0.02 | 0.03 | 0.05 | ND | 0.02 | ND | ND | ND |
| | Rainy | 0.02 | 0.019 | 0.02 | 0.02 | 0.045 | 0.02 | 0.025 | 0.06 | 0.05 | 0.042 | 0.02 | 0.018 | 0.038 | 0.035 |
| | Cold | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| DO | Hot | 6.45 | 5.56 | 6.51 | 7.22 | 6.59 | 1.27 | 8.02 | 8.14 | 6.99 | 7.35 | 7.55 | 18.8 | 2.88 | 7.35 |
| | Rainy | 7.9 | 7.54 | 8 | 6.3 | 6.59 | 1.27 | 1.85 | 8.14 | 6.99 | 0.18 | 6.35 | 0.1 | 0.12 | 6.5 |
| | Cold | 29.7 | 40.05 | 34.2 | 21.5 | 38.1 | 35.7 | 4.37 | 40.2 | 19.6 | 8.92 | 8.75 | 19.65 | 7.34 | 3.34 |
| BOD | Hot | 0 | 0 | 4 | 11 | 6 | 0 | 1 | 2 | 9 | 13 | 0 | 2 | 0 | 0 |
| | Rainy | 2 | 9 | 14 | 11 | 6 | 8 | 1 | 2 | 9 | 19 | 3 | 2 | 0 | 4 |
| | Cold | 2 | 4 | 6 | 3 | 2 | 2 | 3 | 4 | 4 | 3 | 3 | 4 | 4 | 3 |
| COD | Hot | 4 | 6.5 | 8 | 8 | 9 | 6 | 7 | 6.5 | 8 | 8 | 5.5 | 6 | 6.5 | 6.5 |
| | Rainy | 21 | 33 | 11 | 10 | 5 | 5 | 8 | 8 | 7 | 7 | 6 | 8 | 8 | 3 |
| | Cold | 2 | 10 | 5 | 14 | 9 | 8 | 27 | 24 | 24 | 14 | 14 | 12 | 10 | 14 |
| Pb | Hot | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | Rainy | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | Cold | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| As | Hot | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | Rainy | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | Cold | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Coliform | Hot | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 |
| | Rainy | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 |
| | Cold | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 | 5/5 |

**Source:** Field Measurement on April , October 2018 and January 2019

## Findings and Conclusion

Based on the results from water quality measurement in Inle Lake and Samkha Lake, the water in Inle Lake and Samkha Lake are more alkaline in nature because they are situated in limestone area. The parameters of pH, Total Dissolved Solid (TDS) and Biological Oxygen Demand (BOD) value is almost the same condition. But, Turbidity, Nitrate ($NO_3$), Phosphate ($PO_4$), Coliform in Inle Lake is higher than Samkha Lake. The Conductivity (EC) in Samkha Lake was higher than Inle Lake. Lead (Pb) and Arsenic (As) was not found in two lakes. In Inle Lake and Samkha Lake, Nitrate ($NO_3$) amount is the highest in the Rainy Season, $PO_4$ was not found in the Cold Season, DO value is decreased in the Hot Season, Coliform is the highest in Hot Season. To Comparison with WHO drinking and portable water quality, Conductivity (EC), Chemical Oxygen Demand (COD), Turbidity, Coliform is beyond the limit of WHO portable WQ Standard.

When the average concentration of soluble inorganic nitrogen exceeds 0.30 ppm and the soluble inorganic phosphorus content exceeds 0.01ppm, algae populations may explode (1985, Oliver S.Owen). Nitrates usually indicate pollution by human or animal waste and fertilizer run-off. In case of extreme pollution, concentrations may reach 200mg/l. In lake concentration of nitrate in excess of 0.2 mg/l -1 tend to stimulate algae growth and indicate possible eutrophication conditions (1992, UNESCO, WHO, UNEP). Therefore, nitrogen and phosphate nutrients indicated that the algae population is under explosion and the lake is starting towards eutrophication. Normally, if Nitrate exceeds  0.03 mg/L and Phosphate exceed 0.01 mg/L, algae population may

explode. Therefore, the results from measurement in this study indicate that some sample sites exceed these condition, these lakes might be started to eutrophication.

All these above measurement represent spatial and temporal variation of water quality status in Inle Lake and Samkha Lake during 2018 and 2019 which will support to the conservation and sustainable development of these lakes in the future and contribute to the United Nations Sustainable Development Goals No. 6.

## Acknowledgements

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