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Study on Seasonal Variation of Pond Water Quality of Bagatipara Upazila, Natore

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Abstract

Many Bangladeshis will have access to the water they need if the utility of pond water can be increased by treatment, necessitating a higher requirement to monitor changes in pond water quality and carry out routine evaluations of a number of water quality indicators. This study aimed to assess seasonal variation of pond water quality in Bagatipara Upazila of Natore district. A total of 7 pond water samples were collected from five unions which were denoted as Dyarampur (D), Bagatipara (B), Faguerdiar (F), Jamnaar (J), and Pacca (K). All samples were collected during both Post-Monsoon (Oct-Nov 2021) and Pre-Monsoon (May-June 2022) period. Changes in physical and chemical status have been observed after collecting samples. 13 parameters were tested: pH, color, turbidity, EC, TS, TDS, DO, BOD, Nitrate, Temperature, Hardness, Chloride, CO_2, and Fe. The study showed that the pH was increased in DP1, DP2, FP1, and KP1 during pre-monsoon. The pond water DO during the post-monsoon period is not ideal for aquatic life. High levels of chloride have been found in pond water. The color and turbidity of pond water were increased in the pre-monsoon season. The iron of the pond water was significantly increased during pre-monsoon. According to the findings of this inquiry, it is advised that the required efforts be made to raise the ponds' water quality to an adequate level for aquatic life and other uses, and that these steps be carried out while simultaneously protecting the environment.

Keywords: *Pond water, seasonal variation,*

1. Introduction

Freshwater is one of the few remaining natural resources, and due to the rising demand of water for drinking, irrigation, and aquaculture, its conservation is becoming more and more important. Freshwater bodies are essential for the survival of the bionetwork because they have a major impact on how both biotic and abiotic systems develop. Freshwater bodies can be divided into two categories: those that are moving (Lotic) and those that are still (Lentic). Reservoirs, ponds, lakes, and marshes fall within the latter category (Matta et al., 2009). Ponds are essential marshlands located in and around human dwellings as they are generally semi natural ecosystem component for water stagnation as they are man-made or a natural water bodies. Ponds and reservoirs containing fresh water are used for fish culture, aquaculture, navigation and transport, recreation, irrigation hydropower generation, and many other purposes. Aquatic life is influenced directly or indirectly by the physical, chemical, and biological factors and fluctuation in any one of the factors may create a hostile environment for the organisms, affecting their evolution and life phenomena (Matta et al., 2009). Contrarily, human use of aquatic resources continuously disrupts the environment, which frequently leads to significant loss of flora and fauna, fish extinction, changes in physicochemical properties, etc.

The time of day, season, weather, water source, soil type, temperature, stocking density, feeding rate, and culture methods all affect the water quality, which is not constant. For an aquaculture firm to be successful, the dynamics and regulation of water quality in cultural media must be taken into consideration (Kumar, 2017). Our knowledge of pond ecosystems still has a lot of holes. Therefore, it is evident that ponds may provide habitats for large freshwater and terrestrial biodiversity across a variety of landscapes, as well as ecological services needed by society (Hill et al., 2021). The existing reservoirs in Bangladesh are expected to be used for most productive purposes like conservation of biodiversity and agriculture. The water quality index can be used to determine if

water from various surface water bodies in Bangladesh is appropriate for drinking or for use in the home. Many people in Bangladesh will be able to get the water they want if surface water use can be made suitable by treatment (Chowdhury *et al.*, 2012). Bagatipara Upazila of Natore district is situated on the banks of the Baral and Musakha rivers with 5 unions. This Upazila has a lot of agricultural land. So, both surface water and groundwater are equally important to the population. They rely on surface water for numerous household, agricultural, and daily uses as well as groundwater for drinking. The main sources of surface water in this area are rivers and ponds. Bagatipara Upazila still does not have any water supply system. In several areas of the Natore district, improvements are being made to the drinking water and sanitation, according to the Department of Public Health Engineering (DPHE) of Natore. By focusing on preventing surface and groundwater pollution, success is attained (DPHE Natore, 2020). Maximum and effective use of fresh water for various purposes, including fish culture, aquaculture, and irrigation, is achievable if suitable instructions and information about water quality management methods are continuously provided. Different fish infections have been observed as a result of seasonal variations in water quality (Hossain *et al.*, 2007). There had been a lot of research done on water quality in the greater Natore district. However, no research on seasonal variation of pond water quality at Bagatipara Upazila was given significant importance. Hence in the present study attempt has been taken to monitor seasonal variation in water quality parameters for the 7 ponds of five unions of Bagatipara Upazilla, Natore to investigate limiting factors, which could adversely affect the water quality for aquatic plants and animals.

2 Study area

The study area was selected with 5 unions of Bagatipara Upazila including Dayarampur, Bagatipara and Faguardiar, Jamnar and pacca. Bagatipara is located in between 24°15' and 24°22' north latitudes and in between 89°13' and 89°26' east longitudes (Bagatipara Upazila, 2020). In the present study the water samples from 7 pond were collected from five unions of bagatipara upazilla, Natore which were denoted as Dyarampur (D), Bagatipara (B), Faguerdiar (F), Jamnaar (J), and Pacca (K). Sample coordinates were recorded with a GPS device and shown in table 2.1.

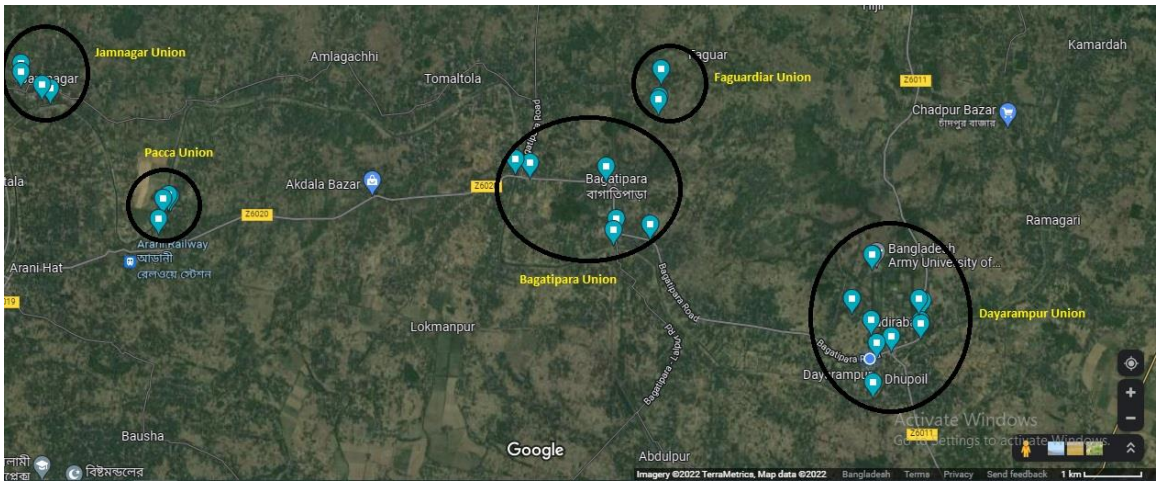


Figure: Five unions of Bagatipara Upazilla

Table 2.1: Sampling points with sample ID and location

Sample ID	Location	Water type	GPS	
			North	East
DP1	Dayarampur	Pond	24°16'56.6"	89°00'59.1"
DP2	Dayarampur	Pond	24°16'56.6"	89°00'17.5"
DP3	Dayarampur	Pond	24°16'44.9"	89°00'29.3"
BP1	Bagatipara	Pond	24°17'40.5"	88°56'10.2"
FP1	Faguardiar	Pond	24°18'49.9"	88°58'16.5"
JP1	Jamnagar	Pond	24°19'5.7"	88°51'39.1"
KP1	Panka	Pond	24°17'55.6"	88°53'11.2"

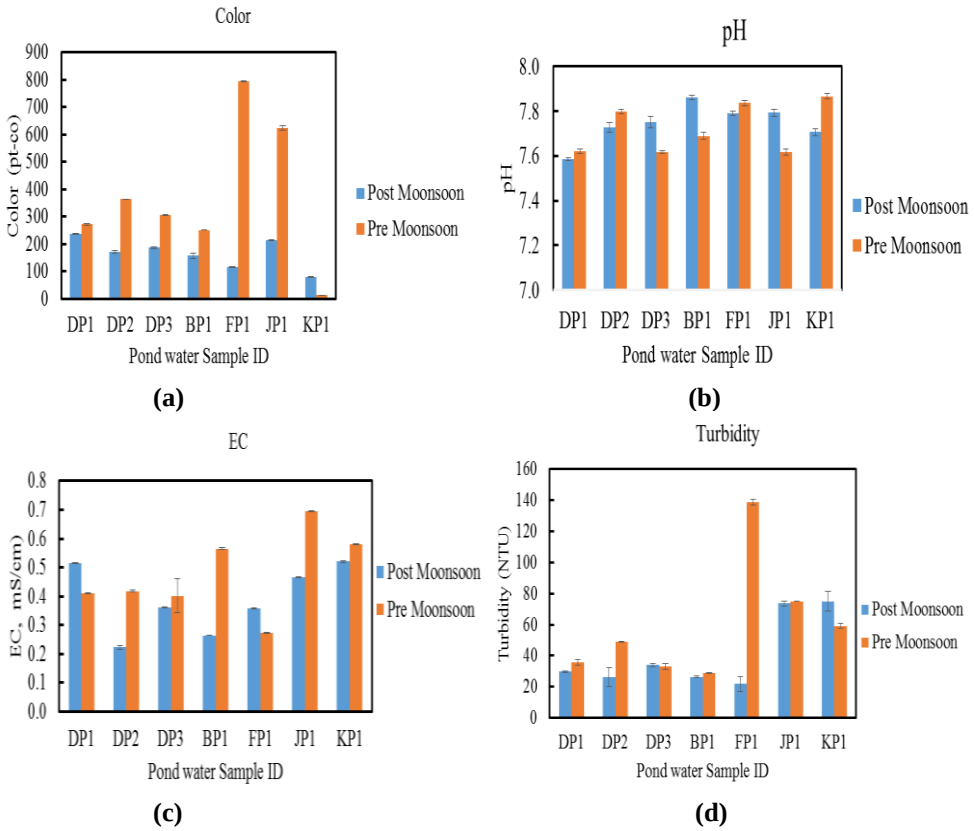
3 Materials and Methods

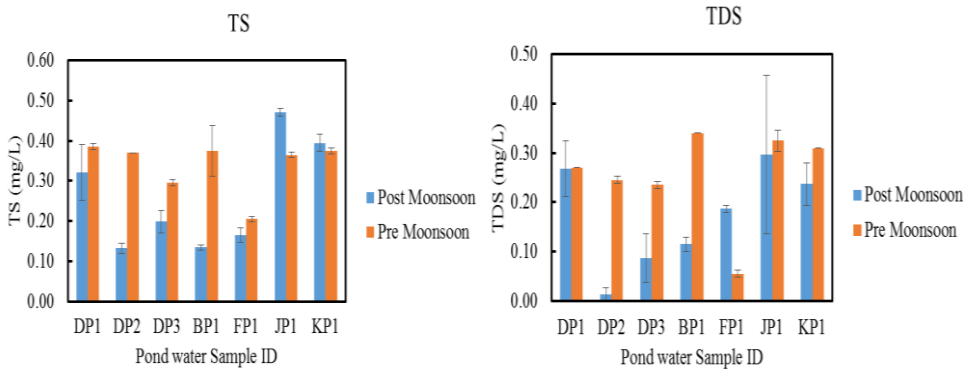
To show the seasonal variation samples were collected during the periods of Oct-Nov, 2021 (Post-Monsoon) and May-June, 2022 (Pre-Monsoon). The collection of samples was done during the morning between 6.30 A.M. to 8.30. A.M. in sterilized sampling bottles and was analyzed for 13 important physical and chemical parameters. A few physical and chemical parameters like pH, free CO2 (mg/l), and dissolved Oxygen (mg/l) were performed immediately and other parameters like turbidity (NTU), Electric Conductivity (mS/cm), Total Solids (mg/l), TDS (mg/l), TSS (mg/l), Total hardness (mg/l), chloride (mg/l), BOD (mg/l), Chloride (mg/l), color (pt-co) and iron (mg/l) were analyzed in the laboratory.
All water quality parameters were tested in the laboratory. pH and Electrical Conductivity (EC) were measured in Lutron pH/ORP, DO, CD/TDS Meter (Model: WA-2015). Dissolved oxygen (DO) was measured by the Azide Modification method (Standard method 4500-O C). Biochemical Oxygen Demand (BOD) was measured by the 5-Day BOD Test (Standard method 5210 B). The color and iron were determined by using a spectrophotometer made by HACH (Model: DR 3900). Turbidity was measured in a Turbidity Meter (Model: TUB-430). The hardness of water was determined through titration with EDTA (HI 3812 Hardness Test Kit). Chloride was determined through titration with Mercuric Nitrate (HI 3815 Chloride Test Kit). Carbon dioxide (CO_2) was determined through the Titrimetric Method for Free Carbon Dioxide (Standard Method 4500-CO2 C). For measuring Total Solids (TS) and Total Dissolved Solids (TDS), Standard Method 2540 was used.

4 Results and Discussions

4.1 Physical parameters

To show seasonal variations some important physical parameters like color, pH, EC, Turbidity, TS, and TDS were tested and seasonal variations of these parameters are represented in Figure 2. Color is an important indicator for any aquatic water body and indicates the cleanliness of the water. The color of six ponds DP1, DP2, DP3, BP1, FP1, and JP1 was found to be maximum during pre-monsoon and their low value during post-monsoon was due to the dilution of pond water with rain water. The level of acidity or alkalinity of a solution is represented by pH, which is the negative logarithm of hydrogen ion concentration. The pH of the water affects aquatic plants' and animals' ability to survive and flourish. During the pre-monsoon, the pH value rose in DP1, DP2, FP1, and KP1. These changes result from plant and animal photosynthesis and respiration (Kumar, 2017).





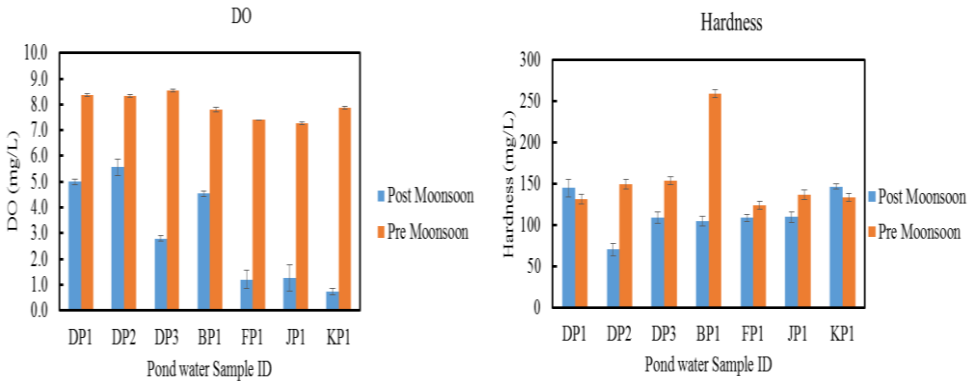
(e) **(f)**

Figure: 2 Seasonal variations of physical parameters (a) color (b) pH (c) EC (d) Turbidity (e) TS and (f) TDS.

The low value during the post-monsoon season may be due to the dilution of rainwater. It has been reported that the pH between 6 and 9 was appropriate for increased fish production and 6.5 to 8.4 for irrigation purposes (Sciences & Extension, 1998). So, the ponds have suitable pH ranges for aquatic life. The Conductivity of water is important because it can show how much dissolved substances, chemicals, and minerals are present in the water. Higher amounts of these impurities will lead to a higher conductivity. Conductivity is an index of the total ionic content of water, and therefore indicates whether the water is pure or not (Acharya et al., 2008). The EC was recorded maximum in DP2, DP3, BP1, JP1, and KP1 during pre-monsoon with a maximum value of 0.70±0.00 mS/cm in the pond JP1 which may be due to the intense human activities enhancing the ionization of most chemical compounds that entered the ecosystem (Oboh & Agbala, 2017) .Turbidity is a measure of the ability of water to transmit the light that restricts light penetration and limit photosynthesis. The turbidity was recorded as maximum during the pre-monsoon season in the ponds in DP1, DP2, DP3, BP1, FP1, and JP1 and this value is minimum during the post-monsoon period. TS values were found to be maximum during the pre-monsoon period in ponds DP1, DP2, DP3, BP1, and FP1. But in the ponds JP1 and KP1 amount of TS was maximum during the post-monsoon. Total dissolved solids are mainly added into water bodies through various human activities such as agricultural rehearses, urban and industrial wastewater discharge etc. The highest values of TDS were found to exist in almost all ponds during the pre-monsoon period except FP1. During the post-monsoon period this value decreases showing the lowest value of 0.01±0.01 mg/l in pond DP2.

4.2 Chemical parameters

To show seasonal variations some important physical parameters like color, pH, EC, Turbidity, TS, and TDS were tested and seasonal variations of these parameters are represented in Figure 3. The DO values in DP1, DP2, DP3, BP1, FP1, JP1 and KP1 varied from 5.00±0.01 to 8.37±0.06, 5.57±0.32 to 8.33±0.06, 2.80±0.01 to 8.53±0.06, 4.53±0.12 to 7.8±0.10, 1.20±0.35 to 7.40±0.00, 1.27±0.50 to 7.27±0.06, and 0.73±0.12 to 7.87±0.06 during post and pre monsoon period respectively. The value of DO content should be above 6.0 mg/l for drinking water and more than 5.0 mg/l is suggested for fisheries, recreation, and irrigation (Munni et al., 2013). So, during the pre-monsoon period, all of the seven ponds showed suitably high values of DO level, and the value gets declined during post monsoon term. The total hardness of water is used to describe the effect of dissolved minerals (mainly Ca and Mg), determining suitability for domestic and industrial purposes which is attributed to the presence of bicarbonates, sulfates, chlorides, and nitrates.



(a) **(b)**

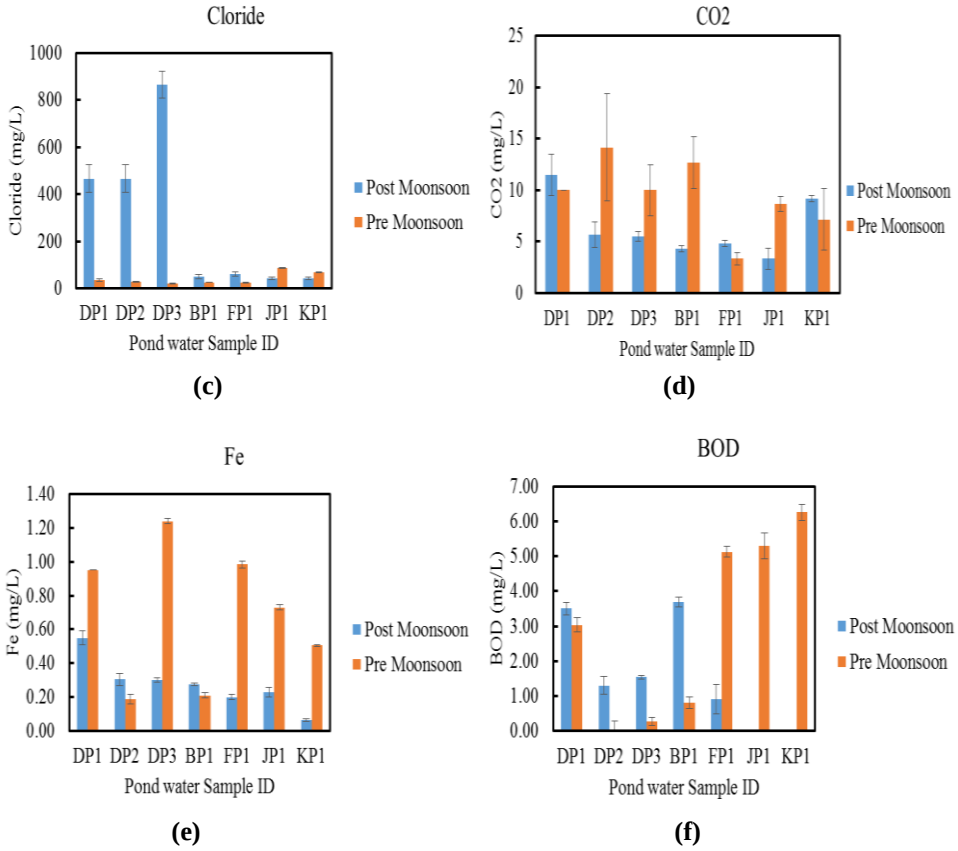


Figure: 3 seasonal variations of Chemical parameters- (a) DO (b) Hardness (c) chloride (d) CO_2 (e) Iron and (f) BOD.

The hardness value for ponds DP2, DP3, BP1, FP1 and JP1 were maximum during the pre-monsoon. Higher values of hardness can be due to low water levels and high rate of evaporation of water and the addition of calcium and magnesium salts (Kumar, 2017). Chloride ion is a common constituent of all natural water but the Chlorine gas is highly toxic. High concentration of chlorides is an indication of pollution from sewage, industrial or intrusion of seawater or saline water (Shyamala et al., 2008). The chloride was recorded maximum during the post-monsoon in ponds DP1, DP2, Dp3, BP1 and FP1. Carbon dioxide is of vital importance in the life of plant and microorganisms which is produced as a result of respiration of aquatic organisms. As free CO2 is highly soluble in water, it is found to be larger amount in polluted water as compared to fresh water bodies. High level of free CO2 in the pre-monsoon season noticed in DP2, DP3, BP1, and JP1 could be due to the decline in the water level and increased load of organic matter. In the present study highest free CO2 concentration was found to be 14.17±1.26 mg/l during the pre-monsoon in DP2 pond and was found lowest with 3.33 ±1.04 mg/l in JP1 pond during post-monsoon. Iron concentration in pond DP1, DP3, FP1, JP1 and KP1 was found considerably high during the pre-monsoon. Reverse scenario is observed for DP2 and BP1. Highest value of Fe was noticed 1.24±0.01 mg/l in pond DP3 and lowest value 0.51±0.01mg/l was observed in pond KP1 during pre-monsoon. The BOD is direct measure of biodegradable organic matter. It is an indicator parameter to know the presence of biodegradable matter in the wastes and express degree of contamination. BOD is lower in unpolluted water while it is high in case of polluted water. It depends on temperature, the extent of biological activity, the concentration of organic matter and microbial population such as bacteria and fungi (Yadav et al., 2013). The maximum demand of oxygen in the water was recorded during Pre-monsoon season was 6.27±0.23 mg/L in the pond KP1. BOD value in the pond FP1 and JP1 was also considerably high during pre-monsoon period with 5.23±0.15 and 5.30±0.36 mg/l respectively. The possible addition of high amount of waste along with rainwater from the surrounding and addition of organic waste in pond by certain human activities might also be responsible for the increase in BOD in the ponds DP1, DP2, DP3 and BP1 during post monsoon.

5 Conclusion

In order to maintain a healthy and sustainable planet, environmental monitoring of water quality is crucial. Poor water quality has an impact on the ecology around it in addition to aquatic life. Results of this study showed that

routinely checking water parameters, including temperature, pH, DO, BOD, and COD, can give an indication of how well an aquatic ecosystem is doing. The present study also provides baseline data for pond conservation and monitoring. According to the findings of this study, changes in pond water during and after monsoon season were caused by run-off of organic waste from nearby locations. Seasonal fluctuations affect the concentrations of different water quality measures, and the levels varied slightly over the year. Ponds' DO levels decreased and weren't good for aquatic life during the post-monsoon season. During the post-monsoon season, high chloride levels were discovered in pond water. The pre-monsoon season resulted in an increase in the color and turbidity of pond water as well as a large increase in iron. Pond water quality needs to be regularly monitored, and management actions for conservation of pond water should be taken. If not, it will enter a state that could affect its physico-chemical status and render it unfit for use by humans as well as for the development and survival of any aquatic life that may be present.

References

Acharya, G. D., Hathi, M. V., Patel, A. D., & Parmar, K. C. (2008). Chemical properties of groundwater in Bhiloda Taluka Region, North Gujarat, India. E-Journal of Chemistry, 5(4), 792–796. https://doi.org/10.1155/2008/592827

Hill, M. J., Greaves, H. M., Sayer, C. D., Hassall, C., Milin, M., Milner, V. S., Marazzi, L., Hall, R., Harper, L. R., Thornhill, I., Walton, R., Biggs, J., Ewald, N., Law, A., Willby, N., White, J. C., Briers, R. A., Mathers, K. L., Jeffries, M. J., & Wood, P. J. (2021). Pond ecology and conservation: research priorities and knowledge gaps. Ecosphere, 12(12). https://doi.org/10.1002/ecs2.3853

Kumar, D. G. (2017). Study of seasonal water quality assessment and fish pond conservation in Thanjavur, Tamil Nadu, India. ~ 1232 ~ Journal of Entomology and Zoology Studies, 5(4), 1232–1238.

Matta, G., Bhutiani, R., Rana, R., & D. R, K. (2009). Analysis of water quality of Paniyala state fish pond with special reference to physico-chemical characteristics.pdf. J. Comp. Toxicol, 6(1), 018–029. https://www.academia.edu/38167410/Analysis_of_water_quality_of_Paniyala_state_fish_pond_with_special_reference_to_physico_chemical_characteristics_pdf

Munni, M. A., Fardus, Z., Mia, M. Y., & Afrin, R. (2013). Assessment of Pond Water Quality for Fish Culture : A Case Study of Santosh Region in Tangail , Bangladesh. 6(2), 157–162.

Oboh, I. P., & Agbala, C. S. (2017). Water quality assessment of the Siluko River, southern Nigeria. African Journal of Aquatic Science, 42(3), 279–286. https://doi.org/10.2989/16085914.2017.1371579

Sciences, A., & Extension, C. (1998). School of Forest Resources Water Quality Concerns for Ponds.

Shyamala, R., Shanthi, M., & Lalitha, P. (2008). Physicochemical analysis of borewell water samples of telungupalayam area in Coimbatore District, Tamilnadu, India. E-Journal of Chemistry, 5(4), 924–929. https://doi.org/10.1155/2008/152383

Yadav, P., Yadav, V. K., Yadav, A. K., & Khare, P. K. (2013). Physico-chemical characteristics of a fresh water pond of Orai, U. P., Central India. Octa Journal of Biosciences, 1(2), 177–184.