



## EVALUATION OF PHYSICOCHEMICAL PARAMETERS OF SOIL SAMPLES OF SOME SELECTED PONDS, THIRUVARUR DISTRICT, TAMILNADU - INDIA

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### Abstract

Soil quality is a superior indicator of productivity compared to water quality. The bottom soil of a pond, often referred to as the "storehouse of nutrients," is essential in determining the overall productivity of the pond. In this research paper, we focus on analyzing various physicochemical parameters of soil, such as Organic carbon, Potassium, Phosphorus, Nitrogen, Electrical conductivity, pH, Zinc, Iron, and Boron, in selected ponds located in Thiruvarur District (March 2018- May 2018). The analysis of the parameters mentioned above has provided evidence of soil contamination resulting from anthropogenic activities.

**Keywords:** Soil analysis, parameters, Organic carbon, Pond soil.

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## INTRODUCTION

A combination of environmental and genetic factors influences soil, which is a thin layer of the earth's crust consisting of unconsolidated mineral matter and providing a natural habitat for plant growth. The properties of soil, including its morphology, physical, chemical, and biological characteristics, differ from those of the parent material. Certain unique features related to soils, water, biotas, and ecological functions, like food webs, habitat, biogeochemical cycling, and hydrology can differentiate wetlands from uplands and other ecosystems. The collaboration between the five soil-forming factors, namely the original material, the weather, the living things, the shape of the land, and the time period results in the development of distinct layers, called horizons, in the soil profile, which reflect the unique characteristics related to the formation of soil. Wetland soils experience regular to constant inundation, which creates oxygen-deficient soil conditions and reduces the rate of decomposition, causing the aggregation of organic material. With an increase in the quantity of organic matter present in the soil, there is typically a decrease in bulk density. This is because organic material typically has a lower particle density than mineral soil (Craft, 2000). The growth and population density of aquatic flora and fauna heavily depend

on the existence of vital nutrients in the water, which must be available in adequate and balanced amounts. By examining crucial soil components such as potassium, sodium, sulfate, phosphorus, phosphate, nitrate-nitrogen, chloride, magnesium, calcium, total alkalinity, specific conductivity, and pH, it is possible to evaluate the soil's potential to hold water for aquatic plants and animals, as well as its capacity to furnish necessary nutrients for biological growth. Human activities such as rapid urbanization, and anthropogenic activities, agricultural waste, industrialization, population growth, in and around ponds are major contributors to the contamination of various components of our environment, leading to their decline (Coskun et al., 2006).

## MATERIALS AND METHODS

### Study area

On January 1, 1997, the district of Thiruvarur was created by separating the Valangaiman Taluk from Thanjavur District and the Thirutturaippondi, Mannargudi, Needamangalam, Kudavasal, Nannilam, and Thiruvarur Taluks from Nagappattinam District. Thiruvarur District is located between 10°20' and 11°07' North latitude and 79°15' and 79°45' East longitude, with a total area of 2,377 sq.km.

### Soil samples collected areas in and around Thiruvarur District



Figure. 1 Study area – Thiruvarur District

The majority of soil samples collected for this study were obtained from sandy coastal alluvium in Ponds located in Thiruvarur District. The initial characteristics of the soils were determined by analyzing them after air-drying and sieving. The cultivation study involved utilizing soil-filled jars to measure various parameters, including organic

carbon, pH, electrical conductivity, zinc, potassium, phosphorus, nitrogen, iron and boron. The texture of the soil was identified as sandy loam and it exhibited a calcareous lime status based on the classification. Standard methods were followed in conducting the experiments (Ministry of Agriculture, 2011).

**Table.1:** Physico Chemical analysis of soil Samples

S.No	Soil Characteristics	Symbol	Units	Test Methods
1	Electrical Conductivity	EC	dS m <sup>-1</sup>	Conductivity Meter
2	Boran	B	ppm	AAS
3	Organic Carbon	OC	%	Walkley and Black Method
4	Nitrogen	N	Kg ha <sup>-1</sup>	Kjeldahl Method
5	Iron	Fe	ppm	AAS
6	Zinc	Zn	ppm	AAS
7	Potassium	K	Kg ha <sup>-1</sup>	Flame photometry
8	pH	pH		pH Meter
9	Phosphorous	P	Kg ha <sup>-1</sup>	Olsen's

### Soil organic carbon

The soil organic carbon (SOC) was determined using a modified Walkley and Black technique. A 500 ml conical flask was used to hold a prepared soil sample weighing approximately 1.0 g. 10 milliliters of a 0.1667M K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> solution and 20 milliliters of concentrated H<sub>2</sub>SO<sub>4</sub> containing Ag<sub>2</sub>SO<sub>4</sub> were added to the mixture. After allowing the mixture to react for 30 minutes, it was thoroughly mixed and diluted with 200 ml of water. Following this, 10 ml of H<sub>3</sub>PO<sub>4</sub> was added. Subsequently, diphenylamine indicator and NaF solution were added in the amount of 2 ml and 10 ml respectively. A standard 0.5M FeSO<sub>4</sub> solution was titrated with the resulting solution until an intense green color appeared. A blank without the soil sample was concurrently run as well for comparison.

### pH

The pH meter was adjusted by utilizing a pair of buffer solutions. One buffer solution had a pH of 7.0, which is considered neutral, while the other buffer solution was selected based on the projected pH spectrum of the soil sample under analysis. The buffer solutions were placed in separate beakers, and the electrode of the pH meter was inserted alternately into each beaker to adjust the pH accordingly. Next, a soil sample weighing 10.0g was carefully measured and placed in a 50 or 100 ml beaker. The beaker containing the soil sample was supplemented with 20ml of CaCl<sub>2</sub> solution. Without any agitation, the CaCl<sub>2</sub> solution was allowed to be absorbed by the soil. Following this, a glass rod was used to stir the soil thoroughly for 10 seconds. After ensuring a comprehensive mixture, the suspension

underwent stirring for 30 minutes. The pH meter, which was calibrated, was used to record the pH of the soil solution.

### Electrical conductivity (EC)

A 250 ml Erlenmeyer flask was used to place 40 grams of soil for conductivity measurement preparation. Following that, the flask received an addition of 80 ml of distilled water, and it was subsequently sealed with a stopper before being subjected to an hour of shaking on a reciprocating shaker. A Whatman No.1 filter paper was utilized to filter the resulting mixture. After that, the electrode designed for measuring conductivity was cleansed using pure water and then flushed with a typical KCl solution. The process involved filling a beaker with 25 milliliters of KCl solution and submerging the electrode into the solution for further use or analysis. The reading on the conductivity meter was modified to display 1.412 millisiemens per centimeter, which was calibrated to account for a temperature of 25°C. The filtrate was now ready for measurement of conductivity. In order to determine the salinity status of a soil extract by measuring its soluble salt content, the soil extract was used to wash and immerse the electrode. The reading on the digital display was noted and adjusted to 25°C. The electrical conductivity reading in mS/cm can be interpreted as an indicator of the amount of soluble salt present in the extract. The electrical conductivity is also given as mmhos/cm.

### Total Nitrogen (Kjeldahl Method)

To analyze the soil sample, a Kjeldahl flask was used. The flask was prepared by accurately weighing 1g of soil and then adding it carefully.

Afterward, the mixture was supplemented with 0.7g of copper sulfate, 1.5g of K<sub>2</sub>SO<sub>4</sub>, and 30ml of H<sub>2</sub>SO<sub>4</sub>. The mixture was subjected to gentle heating until the frothing ceased, after which it was boiled vigorously until the solution turned clear. It took at least 30 minutes for the process of digestion to finish. Afterward, the source of heat was deactivated, and the container was permitted to reach ambient temperature. After the mixture had cooled, it was enriched with 50ml of water and then transported into a distilling flask. To accurately measure the acid, 20-25ml of standard acid (either 0.1M HCl or 0.1M H<sub>2</sub>SO<sub>4</sub>) was added to a conical flask as a receiving vessel. It was necessary to ensure that at least 5ml of acid remained in excess. The mixture was prepared for the experiment by adding a few drops of methyl red indicator to it. In addition, water was introduced to conceal the condenser discharge passages. 30ml of 35% NaOH was added to the distilling flask without mixing the contents. To obtain ammonia, the mixture was heated and distilled for a duration of around 30 to 40 minutes. Next, the flask that obtained the substance was taken out, and the tube that dispensed the substance was cleaned by flushing it with a small quantity of distilled water. 0.1M NaOH was used to titrate the excess acid present in the distillate. To ensure accuracy, an equivalent amount of standard acid was added to a conical flask to verify the reagents.

#### **Available phosphorus (Olsen's method)**

To perform the analysis, several steps were taken. Firstly, a 2.5g soil sample was placed into a 100ml conical flask. Then, 50ml of the bicarbonate extractant was added to the flask, followed by 1g of activated carbon. Next, the mixture underwent 30 minutes of shaking on a mechanical shaker, followed by filtration. Following the process of filtration, the mixture's blue hue was quantified using a spectrophotometer, specifically at a wavelength of 660 nanometers. To ensure accuracy, a blank was prepared in the same way, but without the soil. The instrument was set to zero before taking measurements, and the blue color of the mixture was measured 10 minutes after preparation. These steps were followed to obtain reliable and accurate results.

#### **Available Potassium (Flame Photometer)**

Extraction: A 5 g soil sample was placed into a conical flask which was fixed onto a wooden rack. The flask was filled with 25 ml of the extractant solution containing ammonium acetate. After being shaken for a duration of 5 minutes, it was

subsequently filtered. Utilizing a flame photometer, establish the level of potash within the filtrate. Establishing the Standard Curve: To prepare the flame photometer, atomize solutions containing 0 g K/ml and 20 g K/ml, and then take readings at intervals of 0 and 100. Precisely calibrated standard solutions and recorded measurements for intermediate steps.

#### **Zinc, Iron, Boron (Micro nutrients)**

Adding 5 ml of a tri acid mixture containing Concentrated HNO<sub>3</sub>, HClO<sub>4</sub>, and H<sub>2</sub>SO<sub>4</sub> in the ratio 3:1:1, 0.1g of soil samples were measured out using a beaker. In 1978, Lindsay and Norvell described heating the mixture on a hot plate until white fumes were observed, which was done at a temperature of 105°C. The soil sample underwent a filtration process using Whatmann Ashless filter paper No. 42 after being digested. Subsequently, the filtered soil was transferred into a 100ml volumetric flask. After filling the flask to the mark with distilled water, two drops of 1% HNO<sub>3</sub> were added to the sample to preserve it and prevent the elements from precipitating. Heavy metal analysis was performed on the plastic bottles that held the digested samples, using the PG 990 Model atomic absorption spectrophotometer (AAS). Before starting the analysis, the blanks were used to zero the AAS. The process involved taking the working standard solutions of each metal into the AAS, beginning with the least concentrated and ending with the most concentrated. The AAS was fitted with the corresponding metal lamps to record the absorbance values for each metal. Using the AAS equipped with appropriate hollow cathode lamps, the sample solution was aspirated and its corresponding absorbance values were recorded. A baseline measurement of the solvent was also taken. To determine the concentrations of various elements, the Zn, Fe, and B standard calibration curves were examined.

#### **RESULT AND DISCUSSION**

Table-1 presents the results of the physicochemical analysis conducted on the soil in the Thiruvavur district. Farmers and gardeners are familiar with the significance of soil pH because it can impact the preferences of numerous plants and soil organisms for specific acidic or alkaline environments. In addition, the pH level can influence the soil's ability to retain nutrients (Patil, 1991). The measurements of pH values were taken at all sites, and they varied between 6.2 to 7.8. A neutral pH level of 7.1 was measured in the soil sample taken from the pond. Soil EC is a quick and accurate predictor of biological activity,

nutrient cycling, crop performance, and soil quality, as well as a rapid indicator of nitrate-N availability for plants (Patriquin et al., 1993; Johnson et al., 2005; Eigenberg et al., 2002; Doran, 2005;). The EC value fluctuates between 0.13 to 0.77 ds m<sup>-1</sup>. Pond soil's EC value was 0.77 dS m<sup>-1</sup>, which indicates that it is naturally salt-free. Due to residential uses in the research region,

the total nitrogen measured throughout the investigation ranges from 57 to 74 kg ha<sup>-1</sup>. (Kalaiarasu and Pandeewari, 2012) reported the same results. The soil's nitrate content revealed that nitrate levels peaked in the summer and declined throughout the rainy period (Mahajan and Billore, 2014).

**Table 2** Physicochemical soil analysis of some selected ponds in and around Thiruvarur District.

S.NO	SOIL SAMPLES	B (ppm)	Fe (ppm)	Zn (ppm)	EC (dS m <sup>-1</sup> )	OC (%)	N (Kg ha <sup>-1</sup> )	K (Kg ha <sup>-1</sup> )	P (Kg ha <sup>-1</sup> )	pH
1	PSS1	40.13	16.55	0.17	0.69	0.37	63	140	26.9	7.1
2	PSS2	38.00	15.32	0.66	0.77	0.23	57	170	20.0	7.2
3	PSS3	40.45	14.21	0.66	0.14	0.33	61	130	20.6	7.6
4	PSS4	41.20	16.28	0.16	0.74	0.26	58	145	21.3	6.9
5	PSS5	42.40	15.42	0.69	0.22	0.30	60	135	19.4	7.0
6	PSS6	38.50	16.31	0.66	0.41	0.30	60	110	15.0	7.6
7	PSS7	45.00	14.22	0.19	0.16	0.21	57	110	25.0	7.2
8	PSS8	38.30	17.28	0.62	0.47	0.26	58	120	18.1	6.6
9	PSS9	42.50	16.28	0.64	0.54	0.27	60	125	17.5	6.2
10	PSS10	39.50	16.35	0.66	0.14	0.29	61	115	24.4	6.8
11	PSS11	44.50	17.24	0.62	0.68	0.33	60	140	23.1	7.4
12	PSS12	38.00	13.17	0.66	0.13	0.43	66	115	21.9	7.6
13	PSS13	46.00	16.21	0.18	0.25	0.23	57	100	18.1	6.2
14	PSS14	42.50	14.35	0.17	0.28	0.57	74	130	25.0	6.2
15	PSS15	36.50	15.24	0.18	0.64	0.43	66	135	22.5	7.2
16	PSS16	42.40	15.36	0.13	0.34	0.23	57	125	15.0	7.6
17	PSS17	44.50	17.22	0.11	0.37	0.38	63	110	11.3	7.8
18	PSS18	40.20	16.78	0.15	0.42	0.47	68	92	11.9	6.4
19	PSS19	38.50	17.66	0.62	0.32	0.31	70	125	21.9	7.1
20	PSS20	39.50	15.66	0.66	0.66	0.26	61	115	19.4	7.4

## CONCLUSION

During the study period, it was found that the ponds located in the Thiruvarur district had a neutral pH level, but the electrical conductivity measurements indicated slightly saline conditions. Various human activities such as domestic sewage, unregulated construction work, conversion of ponds into wetland, and accumulation of hydrocarbons and heavy metals in and around the area led to high concentrations of potassium, phosphorus, and nitrogen. The depletion of the soil and the modification of its permeability lead to imperviousness, which causes a reduction in soil stability, prevents water infiltration and has a range of environmental consequences. The public must be informed about natural resource management and biodiversity.

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