MINOR RESEARCH PROJECT REPORT

On

SOIL QUALITY ANALYSIS FOR HUMAN AND ENVIRONMENTAL HEALTH

Submitted by

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INTRODUCTION

All agricultural productions and development depends upon physico-chemical parameters of the soil used for it. Straight off a day's need of soil testing is increased due to interest of the public in the caliber of products obtained from it and different practices carried for their output. The soil quality analysis includes an analysis of parameters and processes which effects on soil to operate efficiently as a component of a sound ecosystem . Soil quality may include a capacity for water retention, carbon sequestration, plant productivity, waste remediation, and other functions, or it may be defined more narrowly.

The objectives of the study are:

- To become familiar with different soil types and varying soil properties.
- To become familiar with the texture and quality of soil in industrial areas.
- To gain experience with the range of the methodologies for measuring soil properties and assessing soil quality.
- Determination of pH, acidity / alkalinity of soil samples in industrial areas.
- Determination of the bulk density, amount of carbon, nitrogen, phosphorus, calcium carbonate, TDS, Electrical conductance and moisture content of different soil samples.
- Comparison of different soil quality parameters in industrial areas.
- Determination and comparison of water samples collected from the wells of the industrial area to check the level of pollution.

EXPERIMENTAL METHODS

The soil samples (depth 0-15cm) were collected randomly and compared for their physico-chemical properties. These results help agronomists, agriculture engineers and farmers for finding the problems related to soil, nature and nutrient status and improve the sustainable agricultural production. The soil samples were dried in oven to 105^0C for about 24 hours and grinded more finely. The samples were tested for, Moisture Content, pH, Density, Calcium Carbonate, Phosphorous Content, Nitrogen Content, Potassium Content, Carbon Content, Oxalate Content, Soluble Salt or Electrical Conductivity, Acidity/Alkalinity, Dissolved Oxygen, Biochemical Oxygen Demand (BOD), Hardness, Chloride content, Chemical Oxygen Demand (COD), Total Dissolved Solids(TDS) etc.

The selected area for doing the First part of the Project is Mala Block Panchayath in Thrissur District, Kerala State which includes Mala, Poyya, Aloor, Annamanada and Kuzhur Panchayats. Second part of the study was carried out in the industrial area of Angamaly, Ernakulam District, Kerala state. Third part included the analysis of water samples collected from the wells of industrial area in Angamaly.

Part I

Soil samples were collected from the paddy field at Ashtamichira where there was no cultivation for long time, Pigments India Ltd. at Kannikkara, the poultry farm area at Kombodinjamakkal, plastic and other waste dumping area at Mala, premises of Nita Gelatin Company (NGIL), at Kathikudam and paddy field at Poyya where there is no cultivation for long time. The comparison of soil properties of different soil types were done.

Part II

Soil samples were collected from the premises of Silver Star Plastic Industry at South Champannoor, Angamaly where plastic covering materials are manufactured, K K Industries at South Champannoor, Angamaly where construction work are in progress, Kathir Food Products at North Champannoor , Angamaly where curry powders and rice powders are manufactured , Alpha Paints, a well known paint company at Angamaly, Pigments India Limited at Kannikkara, where red pigments are manufactured, Associated Rubber Chemicals (Kochi) Private Limited at Angamaly, Malabar Anhydrous Ammonia Industry at Angamaly which is a supply office of ammonia, Surya Metals Industry at Angamaly, where asbestos and other metal works are going on, Boxer Company at Canal Palam, Chalakudy where football, jersey and other sports materials are manufactured , Thettayil Thread Rubber Industry at Champannoor south, Luciya Paper Board Industry at Angamaly, where paper boards, cardboards etc are manufactured andVajra Rubber Industry at Kodungallur. 4 samples each were collected from each site and then mixed well.

Part III

The selected area for our study is industrial area of Angamaly, in Ernakulam District, which is located in Kerala State, India. Angamaly has many industries like Silver Star Plastic Industry, K K Industries, Kathir Food Products, Alpha Paints, Associated Rubber Chemicals (Kochi) Private Limited, Malabar Anhydrous Ammonia Industry, Surya Metals Industry,

Boxer Company, Thettayil Thread Rubber Industry, Luciya Paper Board Industry etc. In the present study, 20 samples were collected from 5 sampling stations. Manual sampling with a plastic container in acquiescence with established standard norms was adopted. Labels were used to prevent sample misidentification. Sample preservation was done in tune with minimum possible time lapse between collection and analysis.

RESULTS AND DISCUSSION

PART 1

ANALYSIS OF PHYSICOCHEMICAL PARAMETERS OF SOIL IN MALA BLOCK PANCHAYAT, THRISSUR, KERALA

The comparative trend of the data is given in the following table

Soil sample	Moisture Content %	Phosphorous content mg/g	pH	Electrical conductivity dSm^{-1}	Nitrogen content mg/g	$CaCO_3$ %
1	0.08	0.28	6.4	0.15	0.84	2.31
2	0.17	0.34	6.5	0.22	.76	2.89
3	0.21	1.27	7.2	.42	.68	4.85
4	0.08	0.21	6.2	.28	.90	2.14
5	0.14	0.21	5.7	1.34	.52	1.88
6	0.12	0.22	6.2	0.25	0.87	2.21

- **MOISTURE CONTENT**

Absorption of the nutrient by soil is largely depends on moisture content of the soil moisture of soil also shows its effect on the texture of soil. Moisture content of soil samples vary from 0.08- 0.21%.

- **PHOSPHOROUS CONTENT**

The phosphrous is a part of every living cell in plant. Every activity of plant such as growth, respiration and reproduction depends upon phosphorous levels. Average amount of available Phosphorous of the soil samples vary from 0.21 to 1.27mg/g.

- **SOIL pH**

The pH of the soil provides information regarding the potency of toxic substances present. pH of the soil samples vary from 5.7-7.2. The pH range of 6.8 to 8.0 has been recommended optimum for plant's growth. One of the samples are acidic, three of them were slighty acidic and two of them were neutral. Soil sample 5 is not good for cultivation of crops.

- **ELECTRICAL CONDUCTIVITY**

Low value of EC is found to be appropriate for growth of plants indicating higher fertility. Proper amount of pH and EC leads to the maximum availability of the nutrients, reduced accessibility of the toxic elements and increased activity of micro-organisms. The electrical conductivity of soil samples varied from 0.15 -1.34dSm^{-1}. The electrical conductivity may be ascribed to the leaching of salts to lower horizons. Most of the soil samples except sample 5 have low conductivity. This low EC values indicate that the area is not prone to salinity threats and the soils will support many crops; but sample 5 is not good for cultivation.

- **NITROGEN CONTENT**

In most of the soils, the available nitrogen is found to be in organic form. It could be recalled that the presence of nitrogen enhances plant growth, quality of yield, seed and fruit production. Nitrogen content vary from 0.52 – 0.90 mg/g of soil samples. Nitrogen content is minimum in sample 5 and is not good for plant growth. .

- **CALCIUM CARBONATE CONTENT**

Calcium carbonate gives the measure of alkalinity of soil which is suitable for plant growth. The calcium carbonate content of samples vary from 1.88 – 4.85 % .

PART II

ASSESSMENT OF SOIL QUALITY OF INDUSTRIAL AREA IN ANGAMALY, ERNAKULAM DISTRICT, KERALA, INDIA

The physical and chemical quality parameters of the soil samples were determined and the average values are reported. The quality parameters show considerable variation from sample to sample. The results of the analysis are given in the following table. Based on the tabulated values the following observations are made.

Sample No	Moisture Content (%)	Bulk Density (gcm^{-3})	pH	Calcium Carbonate Content (%)	Oxalate Content (g)	Carbon Content (%)	Conductivity (dsm^{-1})
1	1.459	1.056	7.3	5.01	3.02	0.22	0.11
2	0.179	1.223	7.3	4.95	5.62	0.18	0.24
3	0.787	1.178	7.5	5.95	5.84	0.13	0.15
4	1.061	1.513	7.2	6.205	1.82	0.1	0.02
5	0.82	1.172	7.4	2.733	1.76	0.1	0.02
6	1.578	1.163	5.4	21.5	4.12	0.69	0.79
7	0.089	1.137	7.7	1.75	4.84	0.21	0.08
8	1.031	1.095	6.4	15	5.13	0.21	0.07
9	0.458	1.1363	6.8	11.14	3.11	0.16	0.03
10	1.094	1.395	7.2	9.91	3.15	0.13	0.04
11	1.066	1.053	7.3	4.95	3.64	0.12	0.09
12	0.253	1.103	7.1	10	3.92	0.07	0.34

- **COLOUR**

Soil colour can provide information about different constituents or composition of the soil. The following are the colour and appearance of soil samples. Colour of soil samples are different indicating the source from which it was collected.

- **MOISTURE CONTENT**

Absorption of the nutrient by soil is largely depends on moisture content of the soil. Moisture of soil also shows its effect on the texture of soil. Moisture content of soil samples vary from 0.089- 1.578 %. Sample 6 has more moisture content and sample 7 has least moisture content. Sources of moisture loss are drainage from industries and dumping of waste raw materials. Absorption of the nutrient by soil is largely depends on moisture content of the soil moisture of soil also shows its effect on the texture of soil.

- **BULK DENSITY**

Variation in densities of soil samples are given in the graph below. Density depends on soil organic matter, soil texture, the density of soil mineral (sand, slit, clay) and their packing arrangement. Variation in bulk density is attributable to the relative proportion and specific gravity of solid organic and inorganic particles and to the porosity of the soil. Bulk density of the samples vary from 1.053- 1.513 g/cm^3 .

- **pH**

By analyzing the soil pH, it is found that most of the soil samples have a neutral pH ranging from 6.5-7.5. But Sample 6 is acidic (pH=5.4) and sample 7 has alkaline pH (7.7). The low pH of sample 6 may be due to the presence of ammonium ions which release H^+ ions.

- **CALCIUM CARBONATE CONTENT**

Calcium carbonate in various samples are clear from the graph. Sample 6 has more $CaCO_3$ content or alkalinity and sample 7 has less. Low $CaCO_3$ content shows, soil is acidic in nature. It can be increased by adding lime in the soil. Calcium carbonate content varies from 1.75 to 21.5 % .

- **OXALATE CONTENT**

Sample 3 has high oxalate content. Sample 5 has the least. Oxalate content of the soil vary from 1.76 -5.84 .

- **CARBON CONTENT**

Carbon content of various samples vary from 0.1 -0.69%. In most samples, carbon content is greater than 0.11%. Sample 6 has high carbon content.

- **ELECTRICAL CONDUCTIVITY**

Proper amount of pH and EC leads to the maximum availability of the nutrients, reduced accessibility of the toxic elements and increased activity of micro-organisms. The electrical conductivity of soil samples varied from 0.02 -0.79dSm^{-1}. Sample6 has more conductivity. When conductivity is more, soluble salt is more. Below 0.15dSm^{-1}range is low conductivity, and above 0.65 is high. Only three samples(2,3 &7) are in the normal range; while most of the samples have low conductance, and sample 6 has high conductance. These values indicate the level of pollution caused by soluble salts. Excessive soluble salt cause harmful effect for living organisms in soil.

- **POTASSIUM CONTENT**

Potassium content in various samples are given in the chart. Potassium is an essential element in soil for plants and other microorganisms. Potassium is the third essential fertilizer element. Potassium is essential for photosynthesis, for protein synthesis, for starch formation and for the translocation of sugars. This is important for grain formation and is absolutely necessary for tuber development. All root crops are generally give response to application of potassium. Potassium content of soil samples varied from 0.83 -1.73mg/kg. It is commonly considered as quality nutrient. Sample 11 has more potassium content.

- **NITROGEN CONTENT**

Nitrogen content in various sample is clear from the chart. It is the first essential element for the growth of plants. Nitrogen is the building blocks of proteins, nucleic acids and cellular constituents which are essential for all forms of life. And if mismanaged, can lead to severe environmental problems. Nitrogen content of soil samples varies from 0.3-0.96mg/kg.

- **PHOSPHOROUS CONTENT**

Presence of phosphorus content in various sample is very clear from the chart. Phosphorus is the second essential element in soil. Phosphorus is essential for plant growth. It helps in fruit formation in plants. Phosphorus content in soil samples varies from 0.08-1.43mg/kg. Sample 3 has high phosphorus content.

PART III

ASSESSMENT OF DRINKING WATER QUALITY: A CASE STUDY OF THE INDUSTRIAL AREA IN ANGAMALY

Sample No.	pH	TDS (mg/l)	EC (dS/m)	Alkalinity (mg/l)	Acidity (mg/l)	Hardness			Chloride (mg/l)	D.O. (mg/l)	COD (mg/l)
						Ca	Mg	Total			
1	6.1	70.99	0.11	44.4	248.8	39.83	4.12	43.95	12.41	2.83	4
2	7.5	203.94	0.54	88.8	85.68	48.94	5.91	54.85	159.1	4.62	6
3	7.3	19.23	0.25	82.8	93.84	43.25	5.52	48.77	14.33	4.18	2
4	7.6	165.98	0.48	111	57.04	51.22	6.21	57.43	43.98	4.55	3.8
5	7.6	255.74	0.79	111	58.21	202.9	20.7	223.6	189.65	3.63	3.5

- **pH**

pH value of the samples vary between 6.1 to 7.6 and is shown in the figure 17. it is clear that the pH of the water samples were found to be within the permissible limits of 6 to 8.5.

- **Total dissolved solids and Electrical conductance**

The total dissolved solids of the samples vary between 70.99 – 255.74 mg/l and were also within the permissible limits of less than 500mg/l . TDS value is an indication amount of soluble salts. This data is supported by the electrical conductance measurement whose value lies between 0.11 -0.79 dSm-1. Sample 5 shows higher conductance value which contains more dissolved ions than the permissible limit.

- **Alkalinity**

The alkalinity of different water samples are in the range of 82.8 to 111 mg/l. Sample 4 and sample 5 have maximum alkalinity whereas sample 1 which is acidic has least alkalinity. The maximum permissible alkalinity for drinking water according to BIS as well as WHO standards 600mg/l. All the samples, we have studied comes within the range and are safe to drink. Alkalnity is directly related to hardness. High alkaline water may be hard. So in the view of quite high alkalinity values, the ground water in Angamaly can be considered as hard.

- **Acidity**

Acidity is the quantitative capacity of water or solution to neutralize an alkali. The calculated acidity values of collected industrial water samples vary between 57.04 – 248.8 mg/l.

- **Hardness**

Hardness of the samples were determined by complexometric titrations which vary between 43.95 – 223.6 mg/l. The maximum permissible limits of Ca and Mg hardness is 100 mg/l and 30mg/l respectively. All the samples except sample 5 showed hardness within the limits set by BIS as well as WHO standards. But hardness of sample 5 exceeds the permissible limit which in turn showed that the water is hard and can't be used for washing purpose. It can be used after softening process.

- **Chloride content**

Chloride content of all samples never found to be exceeding the permissible limit of 250mg/l in the study area and vary between 12.4 – 189.65 mg/l.

- **Dissolved oxygen**

Dissolved oxygen levels indicates the ability of water to purify itself through biochemical process. The permissible levels of DO according to BIS as well as WHO standards is 4-6mg/l. DO of the samples vary from 2.83 – 4.62 mg/l was greater than the permissible levels except for sample 1and sample 5. The low amount of dissolved oxygen in water indicates the presence of high amount of impurities. In the view of DO, sample1 and sample 5 are polluted.

- **Chemical Oxygen Demand**

COD determination is reliable and fast for the determination of organic pollutants as well as for the assessment of the quality of water. The COD of good and palatable drinking water should not be more than 20mg/l. COD of samples vary between 2 -6 mg/l is within the permissible limit.

LIST OF PUBLICATIONS

1. Princy K.G. and Neethu Sunny, Comparative study of soil and water quality in the industrial area of Angamaly, Kerala, India; *EPRA International Journal of Multidisciplinary Research(IJMR),* Volume 4, Issue 7, July 2018.
2. Princy K.G., A comparative study on the physic-chemical parameters of soil in Mala Block Panchayat, Thrissur, Kerala, Carmel Blaze, Vol.9, Issue 1, July 2017.
3. Princy K.G., Comparative study of soil quality of industrial area in Angamaly, Ernakulam District, Kerala, India, Research Journal of Chemistry and Environment- Manuscript ID: RJCE-2018-0172. (communicated)