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IMPACT OF INDUSTRIALIZATION ON SOIL RESOURCES, A STUDY ON KANJIKODE INDUSTRIAL REGION, PALAKKAD

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ABSTRACT

Soil is linked to everything around us and performs many important roles in sustaining life on Earth. Soil plays seven key roles such as, Providing the basis for food and biomass production, Controlling and regulating environmental interactions- regulating water flow and quality, Storing carbon and maintaining the balance of gases in the air, Providing valued habitats and sustaining biodiversity, Providing a platform for buildings and roads, Providing raw material and Preserving cultural and archaeological heritage. Soil quality is a measure of how well the soil does what we want it to do. And what do we want it to do? Support plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. The quality of a soil is an assessment of how it performs all of its functions now and how those functions are being preserved for future use. Soil quality is important for two reasons.

First, using a soil improperly can damage it and the ecosystem; therefore we need to match our use and management of the land to the soil's capability. Second, we need to establish a baseline understanding about soil quality so that we can recognize changes as they develop. By using baselines to determine if soil quality is deteriorating, stable, or improving, we have a good indicator of the health of an ecosystem. The ultimate purpose of researching and assessing soil quality is to protect and improve long-term agricultural productivity, water quality, and habitats of all organisms including people.

The present soil quality study is carried out in Kanjikode Industrial region, Palakkad District. 20 samples from the Industrial region have been collected with the help of GPS Survey and 7 Parameters of each sample has been analyzed. The Analyzed parameters are pH, DO (Dissolved Oxygen), TDS (Total dissolved salt), EC (Electric Conductivity), Potassium, Nitrogen and Phosphorous. The analyzed quality of the collected samples is plotted on the map with the help of GIS. The statistical analyzes like correlation analysis are made to study the results.

The result proves that the most polluted soil samples are located near to the industrial region and comparatively good quality soils are collected from house hold areas and from the reserved forest areas (Walayar Reserve Forest) located very close to the study area. And the study indicates the effect of environmental degradation causing by the Processes like Industrialization and Urbanization. The polluted or contaminated soil become poisonous through the process of leaching it reaches our drinking water and directly affects the human beings. And the agriculture practise can’t be possible in such areas without the help of chemical pesticides and fertilizers, this also cause to the degradation of soil fertility.

KEYWORDS: GIS; GPS; Soil Quality; Urbanization

INTRODUCTION

Soil is linked to everything around us and performs many important roles in sustaining life on Earth. Soil plays seven key roles such as, Providing the basis for food and biomass production, Controlling and regulating environmental interactions- regulating water flow and quality, Storing carbon and maintaining the balance of gases in the air, Providing valued habitats and sustaining biodiversity, Providing a platform for buildings and roads, Providing raw material and Preserving cultural and archaeological heritage(Jennifer D. Knoepp et al).

Soil quality is a measure of how well the soil does what we want it to do. And what do we want it to do? Support plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. (**Garten, J.C.T et al**). The quality of a soil is an assessment of how it performs all of its functions now and how those functions are being preserved for future use. Soil quality analysis is important for two reasons. First, using a soil improperly can damage it and the ecosystem; therefore we need to match our use and management of the land to the soil's capability. Second, we need to establish a baseline understanding about soil quality so that we can recognize changes as they develop. By using baselines to determine if soil quality is deteriorating, stable, or improving, we have a good indicator of the health of an ecosystem(**Easterbrook, D1999**).. The ultimate purpose of researching and assessing soil quality is to protect and improve long-term agricultural productivity, water quality, and habitats of all organisms including people.

OBJECTIVES

- To analysis soil quality of Kanjikode industrial region and identify soil polluted regions using soil quality index.

METHODOLOGY

Multi- temporal satellite data set observed by LANDSAT 5, Thematic Mapper (TM), LANDSAT 4 and Multi Spectral Scanner (MSS) were used for the analyzing present (2012) land use scenario. The satellite digital data was rectified using Survey of India (SOI) topographic maps; a reconnaissance survey was carried out to collect the ground information. Digital land use/land cover classification through supervised classification method, based on the field knowledge is employed to perform the classification. The image elements were correlated with ground truth verification and the interpretation key was developed. Base maps including road, railway, settlement, village location and watershed boundary was extracted from the topographic sheets. Arc GIS 9.2, Erdas 8.6 were used in the preparation of the thematic maps. This classification is performed based on the classification scheme of National Remote Sensing Center (NRSC), Department of Space, and Govt of India. Soil samples locations are identified using GPS in the KINFRA industrial regions. 30 soil samples are collected from the study region. Soil samples are collected from the Kanjikode Industrial region and the adjacent locations. The samples were collected in Polythene bags. Soil samples collected based on different land use and land cover. The parameters that tested to find out the soil quality are Soil Moisture, pH, EC, Potassium, Phosphorous, Nitrogen, and TOC. Soil quality index are done with weighted overlay technique. Correlation technique is employed in the results of soil and water For examine the relationship between the tested parameters.

RESULTS AND DISCUSSIONS

Soil Quality Analysis

pH

Soil pH or soil reaction is an indication of the acidity or alkalinity of soil and is measured in pH units. Soil pH is defined as the negative logarithm of the hydrogen ion concentration. The pH scale goes from 0 to 14 with pH 7 as the neutral point. As the amount of hydrogen ions in the soil increases, the soil pH decreases thus becoming more acidic. From pH 7 to 0 the soil is increasingly more acidic and from pH 7 to 14 the soil is increasingly more alkaline or basic (**USDA 1998).** In the collected soil samples the range of pH shows 6.8 to 8.47. The largest value (8.47) identified in the soil sample no 3, which collected from a household area of Pudussery. And it followed by the next higher value (8.4) from two different locations, one is from the sample no 14 which collected from area near Malabar cements at Walayar and the second one shows at sample no 19 which collected from the House hold area at Pudussery (Table.1 and Map.3).

EC

Soil electrical conductivity (EC) is a measure of the amount of salts in soil (salinity of soil). It is an important indicator of soil health. It affects crop yields, crop suitability, plant nutrient availability, and activity of soil microorganisms which influence key soil processes including the emission of greenhouse gases such as nitrogen oxides, methane, and carbon dioxide. Excess salts hinder plant growth by affecting the soil-water balance. Soils containing excess salts occur naturally in arid and semiarid climates. Salt levels can increase as a result of cropping, irrigation, and land management. Although EC does not provide a direct measurement of specific ions or salt compounds, it has been correlated to concentrations of nitrates, potassium, sodium, chloride, sulphate, and ammonia. For certain non-saline soils, determining EC can be a convenient and economical way to estimate the amount of nitrogen (N) available for plant growth (**Adviento-Borbe, et al).** In the collected soil samples the least value (130.5) of EC shows at sample no 8 which collected from the Pudussery, and the largest value (1385) shows on sample no 5 it collected from Walayar forest near Walayar deer Park (Table.1 and Map.3).

Moisture

Water contained in soil is called soil moisture. The water is held within the soil pores. Soil water is the major component of the soil in relation to plant growth. If the moisture content of a soil is optimum for plant growth, plants can readily absorb soil water. Not all the water, held in soil, is available to plants. Much of water remains in the soil as a thin film. Soil water dissolves salts and makes up the soil solution, which is important as medium for supply of nutrients to growing plants **(Robert W. Strader et al).** Among the collected soil samples the highest value (10.55) shows at sample no 11 which collected from the river Korayar, near the Paragon Steels private Ltd unit. And the least value (1.7) shows at the sample no 15 which collected from the area behind the PEPSI Co, which located inside the KINFRA Kanjikode. Exploitation of ground water in a huge scale may be the reason behind the low moisture value over here (Table.1 and Map.3).

Total Organic Carbom (Toc)

Total organic carbon (TOC) is the carbon (C) stored in soil organic matter (SOM). Organic carbon (OC) enters the soil through the decomposition of plant and animal residues, root exudates, living and dead microorganisms, and soil biota. SOM is the organic fraction of soil exclusive of non decomposed plant and animal residues. Nevertheless, most analytical methods do not distinguish between decomposed and non-decomposed residues **(Brian A. Schumacher, Ph.D.)**. The highest TOC value show in the collected soil samples is 5.12 which found in the soil sample no 1, collected from the Bank of Korayar River near BEML Kanjikode. And the lowest value (0.35) shows in the sample no 14, from Walayar near the Malabar cements (Table.1 and Map.3).

Potasium

Potassium is an essential plant nutrient and is required in large amounts for proper growth and reproduction of plants. Potassium is considered second only to nitrogen, when it comes to nutrients needed by plants, and is commonly considered as the “quality nutrient.” It affects the plant shape, size, colour, taste and other measurements attributed to healthy produce **(Z. Ciećko et al).** In the collected soil samples the highest value (7.74) shows at the sample no 5 which collected from the Walayar forest near Walayar Deer park. And the lowest value (0.74) shows at 2 places one over the sample no 14 which collected from the Walayar, near to the Malabar cements, and the second one over the sample no 20 which collected from a field at Pudussery (Table.1 and Map.3).

Nitrogen

Nitrogen in the soil is the most important element for plant development. It is required in large amounts and must be added to the soil to avoid a deficiency. Nitrogen is a major part of chlorophyll and the green colour of plants. It is responsible for lush, vigorous growth and the development of a dense, attractive lawn. Although nitrogen is the most abundant element in our atmosphere, plants can't use it until it is naturally processed in the soil, or added as fertilizer(**Gerard Velthof).** After the completion of nitrogen test in the collected soil samples, it shows that the highest value (2.24) shows at sample no 5 which collected from the Walayar forest near to the Walayar Dear Park. And the least value (0.35) shows at sample no 8 from a pond in Pudussery(Table.1 and Map.3).

Phosphorus

Phosphorus (P) is an essential element classified as a macronutrient because of the relatively large amounts of P required by plants. Phosphorus is one of the three nutrients generally added to soils in fertilizers. One of the main roles of P in living organisms is in the transfer of energy. Organic compounds that contain P are used to transfer energy from one reaction to drive another reaction within cells. Adequate P availability for plants stimulates early plant growth and hastens maturity. Although P is essential for plant growth, mismanagement of soil P can pose a threat to water quality **(Dr. Mike Daniels).** After the analysis it reveals that among the collected water sample the sample no 17 have the lowest value (0.022) and the highest value located at the area form where sample no 8 collected. The concentration of P is usually sufficiently low in fresh water so that algae growth is limited. When lakes and rivers are polluted with P, excessive growth of algae often results. High levels of algae reduce water clarity and can lead to decreases in available dissolved oxygen as the algae decays, conditions that can be very detrimental to game fish populations.

Table 1: Soil Quality Parameters Correlates with the Soil BIS Standards

Sl No	Parameter	Standard Value	Mean	Maximum	Minimum	Range	sd
1	pH	6.5 to 8.5	7.7595	8.47	6.8	1.67	1.609856
2	EC	200 to 300	352.27	1385	130.5	1254.5	294.5208
3	Moisture	9 to 11	5.663	10.55	1.7	8.85	2.775127
4	TOC	3to4	2.7557	5.12	0.35	4.77	1.894798
5	Potassium	3 to 4	1.6835	7.74	0.74	7	1.627653
6	Nitrogen	2 to 3	1.1375	2.24	0.35	1.89	0.414981
7	Phosphorous	0.5 to 1	0.10775	0.281	0.022	0.26	0.070501

As per the table shows, the pH value of the all soil samples are comes under the permissible limit. The maximum and minimum values are included within the permissible limit. It indicates that the soil of this region has sufficient amount of pH content. EC test results show that, concentration of EC in the Kanjikode industrial region in higher than the permissible limit. In the case of soil moisture, the soil moisture index of the region is poor. The maximum value of soil moisture is located in south part of the industrial region, and the sample collected from a river bank. The lowest value of moisture shows in the sample that collected from an area, near to PepsiCo. It located inside the KINFRA. Total Organic Carbon in the soils also show fluctuating trend. TOC index of the region is lower than the permissible limit suggested by BIS. The highest value is identified in the sample that collected from the adjacent area of BEML Kanjikode, located inside the KINFRA. Potassium also shows a trend of change throughout the sample locations. Highest value of the parameter identified in the sample that collected from the Walayar Forest, near the Walayar Deer Park. And the lowest value shows in the sample that collected from Walayar itself, near to the Malabar cements.

Correlation matrix was prepared to find out the relation between different parameters are presented in the below Table. The highest correlation is observed between Nitrogen and electrical conductivity (0.706).

Table 2: Soil Correlation Matrix of Various Physico – Chemical Parameters

	pH	EC	Moisture	TOC	Potassium	Nitrogen	Phosphorus
pH	1	-0.40351	-0.27909	-0.44508	-0.41821	-0.24122	-0.17224
EC	-0.40351	1	0.047719	0.356894	0.047719	0.706507	0.516799
Moisture	-0.27909	0.356894	1	0.129729	0.347581	0.328536	0.098007
TOC	-0.44508	0.047719	0.129729	1	0.479454	-0.2428	0.108774
Potassium	-0.41821	0.706507	0.347581	-0.2428	1	0.488354	0.108774
Nitrogen	-0.24122	0.516799	0.328536	-0.2428	0.488354	1	-0.37712
Phosphorus	-0.17224	0.075911	0.098007	0.399967	0.108774	-0.37712	1

Table 3: Soil Quality Index

SQI	Soil Quality	Class	Designation
35-28	Excellent	Class 1	Absolutely clean
27-21	Good	Class 2	Slightly unclean
20-14	Fair	Class 3	Moderately unclean
13-7	Marginal	Class 4	Excessively unclean
6-0	Poor	Class 5	Severely unclean

Table 4: Soil Quality index of Kanjikode Industrial Region

Sample No	GPS DATA		Total Score	Classification
	Latitude	Longitude		
1	10.795 N	76.78083333 E	17	Fair
2	10.78305556 N	76.77472 E	21	Good
3	10.78555 N	76.7930 E	23	Good
4	10.805 N	76.8158 E	25	Good
5	10.826944 N	76.825 E	19	Fair
6	10.785555 N	76.7858 E	17	Fair
7	10.785 N	76.785 E	17	Fair
8	10.78416667 N	76.79166667 E	19	Fair
9	10.78416667 N	76.78694444 E	17	Fair
10	10.79444444 N	76.77 E	15	Fair
11	10.79222222 N	76.7475 E	21	Good
12	10.79527778 N	76.77460833 E	13	Marginal
13	10.79444444 N	76.77548611 E	15	Fair
14	10.85027778 N	76.83810278 E	15	Fair
15	10.78944444 N	76.78 E	17	Fair
16	10.79555556 N	76.76166667 E	19	Fair
17	10.79709722 N	76.73486111 E	19	Fair
18	10.80139444 N	76.73543611 E	15	Fair
19	10.79141667 N	76.73055556 E	13	Marginal
20	10.78391111 N	76.70888056 E	11	Marginal

Based on the soil quality index, the scores for every tested sample are given in the table. Majority of the soil samples are belongs to Fair category. Based on the Soil quality index, it can be included under the designation of moderately unclean soil. Samples that are collected from western part, eastern part and north eastern part of KINFRA are showing Good quality parameters. And these samples can be included in the slightly unclean designation. Only 3 samples are comes under the fair category of soil quality. Those are collected from northern part of the KINFRA. And the remaining two samples are collected from the western part of the Pudussery panchayath, which are located far away from the KINFRA. The remaining 13 samples are comes under fair quality of soil. This shows that soil quality or health of industrial region is declined due to the mismanagement and industrial waste disposal etc.

CONCLUSIONS

In this study the soil from different land uses and land cover areas Kanjikode Industrial region are studied, the output of the study reveals that the quality of the soil of Kanjikode Industrial region is decreasing and the rate of pollution is increasing in a rapid manner. If this condition continues, the soil will became useless, and the remaining agricultural regions of this area as well as the surrounding area will be contaminated.

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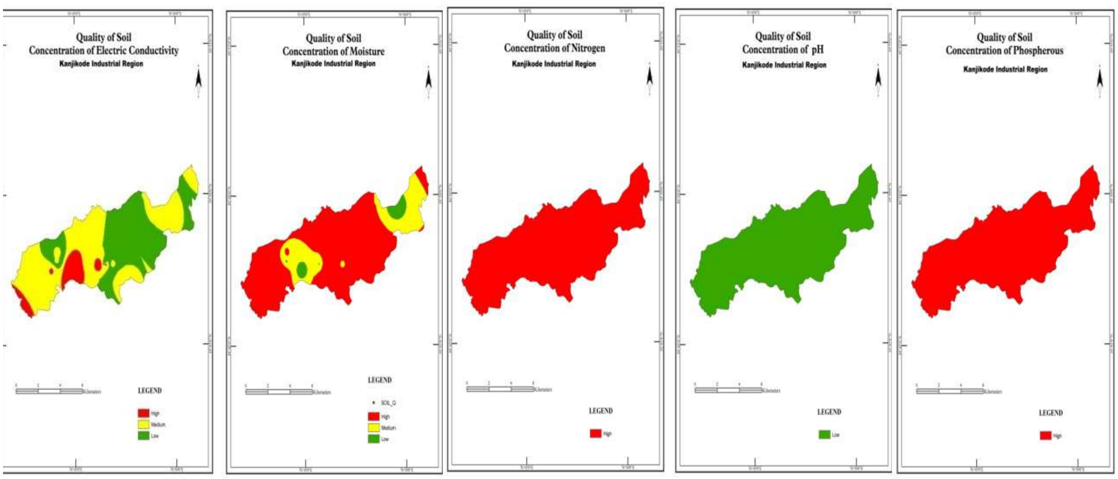
APPENDICES



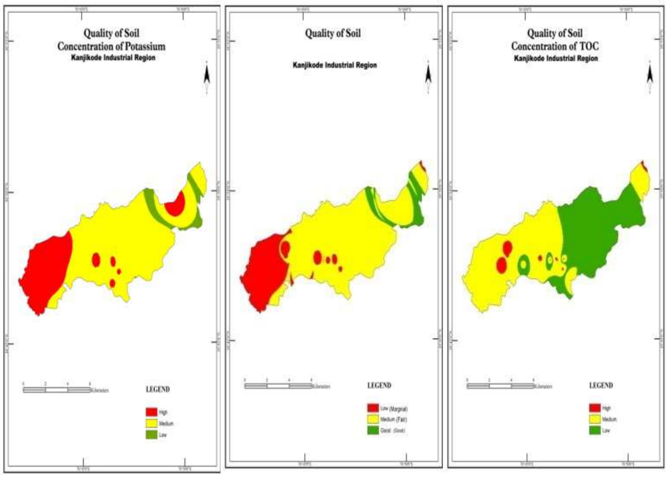

Quality of Soil
Concentration of Potassium
Kanjikode Industrial Region
LEGEND
High
Medium
Low
Quality of Soil
Kanjikode Industrial Region
LEGEND
Low (Marginal)
Medium (Fair)
Good (Good)
Quality of Soil
Concentration of TOC
Kanjikode Industrial Region
LEGEND
High
Medium
Low

Figure 1