

# PHYSICOCHEMICAL AND MICROBIOLOGICAL ANALYSIS OF SOIL SAMPLES OF FOUR DISTRICTS OF MAHARASHTRA (MUMBAI, NAVIMUMBAI, PALGHAR AND THANE)

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## **ABSTRACT**

Soil analysis is a set of various chemical processes that not only determine the amount of available plant nutrients in the soil, but also chemical, physical and biological soil properties important for plant nutrition or “soil health. chemical soil analysis determine the content of basic plant nutrient:- Nitrogen(N), Phosphorous(P<sub>2</sub>O<sub>5</sub>), Organic matter, Sodium, Potassium(K<sub>2</sub>O), Chloride, trace elements and other physical characteristics (pH value, density, conductivity, water holding capacity etc.). whereas the microbiological analysis helps to understand the abundance of micro-organisms, species richness and functional diversity of soil. The main aim of this study was to understand the status of soil of the selected areas by studying the various physicochemical and microbiological parameters of soil. The soil sample were collected from different areas i.e., Residential, Commercial, Industrial, Roadside and along Rail tracks (where agricultural activities are carried out) of Mumbai, Navi Mumbai, Palghar and Thane district during monsoon & post-monsoon; and was analyzed for different parameters as per the standard procedure. The result obtained from the study indicates the clear differentiation in the values of the parameter in the monsoon and post-monsoon season. Also the values at different locations differ from each other due to the various activities carried out around that area. Certain parameters exceeded the desirable limit while some parameters show less content as compared to their desired value range in the soil. The results were also analyzed using software SPSS version 20.

Key-Words: Soil, physicochemical, microbiological, monsoon, post-monsoon, SPSS 20.

### **Introduction:**

The earthy material in which the plants grow is known as soil, which has been derived from the Latin word “solum”. Soil is also defined as an independent body in nature with a unique morphology from the surface down to the parent material as expressed by the sample profile (Tan; 1995). Soil is the thin layer of material covering the earth’s surface and it is formed from the weathering of rocks. It is made up mainly of mineral particles, organic materials, air, water and living organisms- all of which interact slowly yet constantly. Most plants get their nutrients from the soil and they are the main source of food for humans, animals and birds. Soils have the ability to remove impurities, destroy disease causing agents (pathogens) and degrade contaminants. Soil absorb oxygen and methane and release carbon dioxide and nitrous oxide. It is from the soil that plants get physical support, air, water, temperature moderation, and nutrients and protection from toxins. The conversion dead organic matter into nutrients for plants and animals, takes place in soil. Therefore, most living things on land depend on soil for their existence. Soil is a valuable resource that needs to be carefully managed as it is easily damaged, washed or blown away. Soil is a valuable resource that needs to be carefully managed as it is easily damaged, washed or

blown away. If we understand soil and manage it properly, we will avoid destroying one of the essential building block of our environment and our food security. Soil is comprised of various components; the composition and proportion of these components greatly influence soil physical properties like including structure and porosity. These properties influence air and water movements in soil and thus the ability of soil to function. Soil quality can be determined by quantifying the physical, chemical and biological parameters that has a major impact on agricultural productivity and sustainability. [2]

The study area includes residential area, commercial area, industrial area, roadside area and along the rail tracks (where the agricultural activities are carried out) from all the four districts (Mumbai, NaviMumbai, Palghar and Thane). The soil samples were collected from each area during monsoon and post monsoon season.

### Materials and Methods:

The soil samples were collected randomly from residential, commercial, industrial, roadside and railway side area of the entire four district with the help of sterile equipment. The soil surface was dig up to 15cm depth, the soil was mixed thoroughly and it was packed in a zip-locked plastic bag and it was taken to the laboratory for further analysis. The sampling was done twice that is during the monsoon period in the month of august and after monsoon that is in the month of December. The sample that were collected and brought to the laboratory for analysis was divided into 2 parts, one part was kept in freeze for microbiological test and moisture content determination and another part was oven dried and sieved for the other physicochemical parameter. The soil samples were then tested for different parameters like pH, conductivity, water holding capacity, moisture content, available potassium, available nitrogen, sodium, chloride, available phosphorous and enumeration of bacteria according to the standard procedure given in Maiti 2014. The instruments used for the study pH meter, Conductivity meter, Autoclave, Hot-air Oven, Spectrophotometer, Colorimeter, Magnetic Stirrer and Flame Photometer.

### Results and Discussions:

#### 1) pH

The pH of most of the soil sample ranges from 6-8 in both monsoon as well as post-monsoon season. The correct balance is when the soil pH is between 5.5 and 7.5. The highest pH in the monsoon as well as in post-monsoon was recorded in the industrial area of the Palghar district that was 7.26 in monsoon and 7.85 in the post-monsoon season and the lowest pH was observed in the soil sample collected along railway tracks from Navi Mumbai where agricultural activity is carried out and it was found to be 4.96 in monsoon and 5.80 in post-monsoon season. The reason for slightly high pH of industrial area could be due to discharged of effluents from the industry. Industrial emissions of contaminants are released into the atmosphere which is finally deposited on soil or dumping of industrial wastes on disposal land could be the reason for it. The lowest pH in the soil along railway tracks where agricultural activity is carried out could be due to application of fertilizer such as crushed sulfur and some ammonium based nitrogen fertilizers that lower pH and make soil more acidic. Conductivity

The conductivity of the all soil sample was found to be medium to high. The highest conductivity among all the sample during monsoon was found in the railway track side soil of palghar that is 2.27  $\mu\text{mho/cm}$  and in the post-monsoon it was found at the commercial side of Mumbai district that is 4.82  $\mu\text{mho/cm}$ . whereas the lowest conductivity during monsoon was found at the industrial area of Mumbai that is 0.10  $\mu\text{mho/cm}$  and in post-monsoon season it was found at the commercial area of navi Mumbai that is 0.17  $\mu\text{mho/cm}$ . Factors influencing the electrical conductivity include the amount and type of soluble salts, porosity, soil texture, soil moisture and soil temperature.

#### 2) Water holding capacity

The maximum water holding capacity among all the soil sample during monsoon was found to be at residential area of thane that is 22.09% and that to in post-monsoon it was observed in the residential area of navi Mumbai that is 87.45%. The lowest value during monsoon was observed in roadside soil of thane that is 11.59% and in post-monsoon it was found in the industrial area of navi Mumbai that is 20.86%. The reason for the highest or lowest water holding capacity could be the kind of soil or texture of soil present at the respective site. Different soil particles have different water holding capacity. The residential area could be having more clay particle in the soil which has the maximum capacity to hold the water. This is because it is rich in organic matter and

provides a large surface area for water retention. Soil organic matter (SOM) is another factor that can help increase water holding capacity. Soil organic matter has a natural magnetism to water. If the farm increases the percentage of soil organic matter, the soil water holding capacity will increase.

### 3) Moisture content

The maximum moisture content capacity during monsoon was found in the residential area of the navi Mumbai that is 23.45% and in post-monsoon it was observed in the railway side soil of Mumbai that 33.04%. The lowest value of moisture content during monsoon was observed at the commercial area of thane that is 10.70% and in the post-monsoon it was observed at the industrial area of navi Mumbai that is 12.48%. One obvious way to conserve soil moisture is to remove any weeds, particularly deep-rooted perennial weeds. The more plants drawing on the soil's reserve of moisture, the quicker it will dry out, so by removing all plants except those you're trying to grow, the longer that soil moisture will last.

### 4) Organic matter

The maximum organic content during monsoon was observed in the soil sample collected from the commercial area of thane that is 3.255% and in the post-monsoon the maximum organic matter was found in the residential area of Mumbai that is 4.988%, the lowest content was found in the industrial area of palghar in monsoon it was 0.261% and in the post-monsoon it was found to be 0.748%. The organic matter content of almost all samples was found to be low to medium. Less content of organic matter indicates that the soil lacks micro flora and fauna which ultimately results in organic matter.

### 5) Chloride content

The chloride content was found to be medium i.e., between 10- 20 ppm during monsoon season and much higher content was observed during post monsoon season (more than 20 ppm) as per the standards. The highest chloride content during monsoon was found at industrial area of thane that is 148.9 ppm, whereas in post-monsoon it was observed in the railway side soil of palghar district that is 287.15 ppm. The lowest chloride value in monsoon found at the industrial area of Mumbai that is 3.54 ppm and in the post-monsoon it was observed in roadside soil of navi Mumbai that is 12.4 ppm. High levels of chloride in the soil solution will result in chloride toxicity in the plant elevated chloride levels. When allowed to exist, may directly result in plant toxicity, or reduce the quality of the harvested part of the plant.

### 6) Available phosphorous

The available phosphorous content of all the sample was found to be lower than the desired limit. Among all the soil sample the higher phosphate content in the monsoon season was found at railway side soil of palghar district that is 3.109 kg/ha, whereas in post-monsoon season it was found at various places like in the commercial area of navi Mumbai and palghar, roadside soil of thane district that is 8.06 kg/ha. The lowest phosphorous content in monsoon was observed in the commercial site of Mumbai that is 0.609 kg/ha and in post-monsoon it was observed in industrial and commercial area of palghar and Mumbai respectively, that is 1.658 kg/ha. The high level of phosphorous content could be due to application of fertilizers or due to runoff. The best way to increase the phosphate content is to increase the organic and humus.

### 7) Available potassium

As per the standards, almost all the soil samples showed medium to high potassium content. The maximum value of potassium content was observed in the railway side soil where agricultural activities are carried out in both the season that is in monsoon and post-monsoon of thane that is 367.36 kg/ha and in the palghar district that is 1321.6 kg/ha respectively. The lowest potassium content in the monsoon was found in the roadside soil of thane district that is 100.8 kg/ha, in the post-monsoon it was observed in the commercial area of thane that is 154.11 kg/ha. Abundance of organic matter, excessive application of fertilizers or weathering of minerals in soil for example feldspar and mica causes increase in potassium content.

### 8) Sodium

The high sodium content during monsoon was observed at the commercial site of palghar district that is 323.01 kg/ha and in post-monsoon it was found in the railway side soil where agricultural activity is carried out of Mumbai district that is 847.62 kg/ha . the lowest content was found in the residential area of palghar , in monsoon it was 66.84 kg/ha and in post-monsoon it was found to be 73.11 kg/ha. The high content of sodium in the agricultural soil could be due over application of fertilizers or the runoff from upper region which carry all the ions along with it and gets deposited in the lower area where the study area is located. The sodium content

can be decreased by increasing the organic matter, leaching the excess sodium with gypsum and clean water or by increasing the soil microbiological activity by inoculating the soil with sodium-eating microbes.

#### 9) Available nitrogen

The maximum nitrogen content was found in railway side soil of thane district that is in both monsoon as well as post-monsoon season, that is 6.475 % in monsoon and 6.735 % in post-monsoon. The lowest nitrogen content was observed in the commercial area of palghar district that is 0.002 % in monsoon and 0.01 % in post-monsoon season. This unseasonable heavy rain we are experiencing can cause significant nitrogen (N) loss due to leaching and sediment loss due to surface runoff.

#### 10) Enumeration of bacteria

The maximum activity of bacteria during monsoon was observed in the roadside soil of Mumbai district that is  $27 \times 10^3$  cfu/ml, whereas in post-monsoon it was observed in the railway side soil of Mumbai district that is  $35 \times 10^3$  cfu/ml. The lowest value during 12monsoon was observed in the railway side soil of palghar district that is  $1 \times 10^3$  cfu/ml, and in post-monsoon it was observed in the industrial area of Mumbai that is  $13 \times 10^3$  cfu/ml. The more the microbial activity in the soil, the more good is soil condition. The microorganism activity in soil depends on many factors like soil moisture content, temperature, texture, availability of nutrients etc. Soil microorganisms are vital for the continuing cycling of nutrient and for driving above ground ecosystems.

### STATISTICAL ANALYSIS

SPSS version 20, software, was used to analyze the data and compare the value of all the parameter in monsoon and post monsoon season. A paired t test was carried out at the 0.05 level of significance to check whether there is significant difference in the parameter of soil in monsoon and post monsoon season. The value of t is less than 0.05 hence the null hypothesis is rejected stating that there is no significant difference in the physicochemical value of soil in monsoon and post monsoon and the alternative hypothesis is accepted stating that there is a significant difference in these value in different seasons i.e. in monsoon and post monsoon. There is a difference in the value of each parameter at each location in monsoon and post monsoon season.

### Conclusion and Recommendation:

The results of soil analysis of palghar, Mumbai ,navi mumabi and thane district indicate that the soil quality is affected due to either anthropogenic or natural activities as it shows imbalance in the nutrient content at few locations. Most of the parameters are within the desirable limit given by different authorities. But certain parameters exceed the desirable limit, for example, potassium shows very high level in almost all soil samples. As the activities carried out differ from place to place the soil conditions varies according to it, for example the result of pH indicates that the industrial effluents and the fertilizers do have impact on the soil at the industrial and railway side area (where agricultural activity is carried out) respectively. This analysis also clearly indicates that the soil parameter varies according to the season; the post-monsoon readings are higher as compared to monsoon. As water flows during monsoon it carries the nutrients along with it down to the river stream or water bodies and hence nutrient level in the soil decreases. The study also reveals the status of soil along the railway tracks where the agricultural activities have been carried out, it shows the abundance of essential nutrients in the soil which may ultimately reach to the food chain through plants. N,P,K are the important nutrient, that has to be present in soil for proper growth but famers sometimes additionally put the fertilizer in the soil that contains these nutrients in order to fasten the crop growth but excessive application lead to accumulation in soil and ultimately in plant, and anything in excess is toxic. So care has to be taken while growing the plant and regular soil checking has to be done in order to determine the quality of soil. As the sampling was done just twice during the project period and only representative places were selected for the analysis of soil from respected district which can be considered as a restricted data and hence the overall soil condition of each district can not be drawn from this data. This data can be only considered as a representative of the district and for the proper analysis, continuous sampling and analysis from each location of district has to be done. Also some recommendations are given which can be applied to maintain the soil quality especially where the agricultural activities are carried out.

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