ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 11, Issue, 11, pp.8480-8495, November, 2019

DOI: https://doi.org/10.24941/ijcr.37363.11.2019

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

SOIL ANALYSIS OF SURROUNDING AGRICULTURE ON KHARICUT CANAL – EFFECTS OF THE THESE CROPS ON HUMAN HEALTH AND CATTLE

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ARTICLE INFO

Article History:
Received 15th August, 2019
Received in revised form
28th September, 2019
Accepted 05th October, 2019
Published online 26th November, 2019

Key Words:
Climate change, Soil,
Water, Health,
Analysis, Kharicut.

ABSTRACT

Majority of our country still depend upon the agriculture for the food but due to climate change a major area of our land is getting affected by the change in soil, air, temperature and rainfall. While these factors make changes in our crop productions and duration for them. This paper tells about the soil analysis of kharicut canal on the surrounding agriculture and evaluates the effects of these crops that grow in this region on cattle and human health. The use of chemical fertilizers & dumping of effluents from industries that affect the water and ultimately soil is also explained by analyzing the pH of samples and their electrical conductivity, turbidity and other compounds that are present in the water.

Citation: Alaykumar N Mehta, Palak Sapra and Prof. Himanshu A. Pandya. **2019.** "Soil analysis of surrounding Agriculture on Kharicut canal – Effects of the these crops on human health and Cattle", *International Journal of Current Research*, 11, (11), 8480-8495.

INTRODUCTION

Soil is termed as a thin layer of earth's crust which serves as a natural medium for growth of plants. They serve as a reservoir of nutrients and water for crops, also provides mechanical anchorage. There are many soil classification systems. The two major systems are vernacular system and scientific system. In vernacular system soil can be categorized as red soil, black soil, yellow soil, hot soil, etc. In scientific system the soil can be categorized according to the development or the amount of substances present in the soil. As there are various systems to classify soil, it means soil classification is not static. Categorizing soil or dirt by the size of particles is most common. This classification helps to understand the basic properties of soil and helps to conclude if the type of soil is good enough for gardening or farming. Soil types are classified according to many more factors. The committee appointed by the Indian Council of Agricultural Research (ICAR), classified the Indian soil in the following, Alluvial Soils, Black Soils, Red Soils, Laterite Soil, Mountain Soils, Desert Soils.One of the biggest known causes of climate change has been the burning of fossil fuels such as coal and oil.

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These substances release carbon dioxide and other gases, ultimately build up in the atmosphere and trap more of the sun's energy. This is often called the 'greenhouse' effect, and causes global warming. Soil is one of the largest sources of carbon in the world. It is primarily accumulated through plants which 'fix' the carbon from carbon dioxide in the air; the soil then directly absorbs the carbon as the plants decay. Additionally, dead leaves and animals are broken down by microbes in the soil and carbon is accumulated.

Impacts of Climate on Soil: Climate Change has large scale impacts on soil. The unique balance between the different soils of the world and the climate, affects the nature and also the distribution of the world's natural and semi-natural ecosystems. The rapid changes in the climate are affecting the soil's ability to support current ecosystems - this will lead to changes in the communities of plants growing in different parts of the world. The biggest single change in soils are expected as a result of these postulated forcing changes would be a gradual improvement in fertility and physical conditions of soils in humid and sub humid climates. Another major change would be the pole ward retreat of the permafrost boundary (Goryachkin and Targulian, 1990).

Agricultural Patterns: Solar radiation, temperature, and precipitation are the main drivers of crop growth; therefore agriculture has always been highly dependent on climate patterns and variations.

Climate change is projected to have significant impacts on agricultural conditions, food supply, and food security. In recent years, agricultural growth has slowed, with wide year-to-year fluctuations. In the early 1990s, agricultural growth was substantially below that of the non-agricultural sector, and the gap is widening. The difficulty of improving agricultural productivity on a sustainable basis is further compounded by increasing pressure on natural resources and the environment, the vulnerability of agriculture to external shocks like climate change, and the fragmentation and small scale of Indian farms.

Crop Patterns: Cropping system level study is not only useful to understand the overall sustainability of agricultural system, but this also helps in generating many important parameters which are useful in climate change impact assessment. Nevertheless, at farmers' level, potential productivity and monetary benefits act as guiding principles while opting for a particular crop/cropping system. Warmer temperatures may make many crops grow more quickly, but warmer temperatures could also reduce yields. Higher CO_2 levels can increase yields but some factors may counteract these potential increases in yield. For example, if temperature exceeds a crop's optimal level or if sufficient water and nutrients are not available, yield increases may be reduced or reversed. Due to climate change, pests and fungi thrive under the conditions like warmer temperatures, damp soils, and increased CO_2 levels and to reduce pests and fungi we have to increase the use of pesticides and fungicides, which can lead to have negative effects on human health.

Heavy metals in food crops: The standard set for heavy metal concentration in plants, according to the SEPA (2005), the maximum permissible limits of Cd, Cr, Cu, Ni, Pb, and Zn for vegetables and fruits are 0.1, 0.2, 0.5, 20, 10, 9, and 100 mg/ 1kg, respectively, on a dry weight basis. Heavy metal concentrations in plants grown from wastewater-irrigated soils were compared with the plants grown in reference soils, in China.

- The Cd concentrations ranged from 0.39 mg/kg to 0.93 mg/kg in the plants grown in wastewater-irrigated soils, were significantly higher (P =0.001) than plants grown in the reference soil exceeded the SEPA limits.
- The Ni concentrations were also significantly higher (P < 0.01) especially the samples of *Raphanussativus*L., *Zea mays, Brassica juncea*L., *Brassica oleracea*L, *Brassica napus, and Lactucasativa*L than plants grown in the reference soils, and exceeded the SEPA limit for Ni (10 mg/kg).
- The Pb concentrations varied between 2.55 mg/kg and 4.50 mg/kg, were significantly higher (P= 0.001) than plants grown in the reference soil, and exceeded the SEPA limit for Pb (9 mg/kg).
- Cu and Zn concentrations were substantially lower than the SEPA limits in all food crops grown in wastewater-irrigated soils but still significantly higher than the plants grown in the reference soil. The trends of heavy metal concentrations in different vegetables were in the order of *Lactucasativa*L> *Brassica* spp.>*Raphanussativus*L. >*Spinacia*spp.

Similarly, Pearson's correlation analysis was also performed to identify the relationships between the metal concentrations in soils and edible parts of the plants. For Cd, Cu, Pb, and Zn, significant positive correlations were detected between heavy metal concentrations in soils and plants.

Study Area: The climatic conditions of Ahmedabad vary from season to season. Located at an altitude of 55m above the sea level, Ahmedabad city primarily experiences extreme type of climate. The present study area is Kharicut canal around the Ahmedabad District. Kharicut canal starts from Khari River in Raipur village and passes through Vatwa area of Ahmedabad which is located at south east direction of Ahmedabad city at Longitude from 22˚ 56'13" North to 22 0.56'13" North and Latitude from 72 0.37'11" East to 72 0.38'46"East near Ahmedabad- Mahemadabad state highway. (Kumar *et al,* 2012)

Collection of Soil Sample from the Study Area: Each sample collected must be a true representative of the area. In general, sampling is done at the rate of one sample for every two hectare area or at least maximum one sample should be collected for five hectares. Soil and sediments samples are collected with the help of manual auger and khurpi tools. Some methods may require drying (either air drying or oven drying) of the sample. After drying the soils are arranged in the trays for easy testing of the parameters. The various instruments are set at proper places and reagents are prepared. Following points were considered during collection of soil samples.

- In the standing crop, collect samples between rows.
- Sampling at several locations in a zigzag pattern ensures homogeneity.
- Fields which are similar in appearance and production, grouped into a single sampling unit.
- Collect separate samples from fields that differ in color, slope, drainage, past management practices like liming, gypsum application, fertilization, cropping system etc.
- Avoid sampling in dead furrows, wet spots, areas near main bund, trees, and manure heaps and irrigation channels.
- For shallow rooted crops, collect samples up to 15 cm depth. For deep rooted crops, collect samples up to 30 cm depth. For tree crops, collect profile samples.
- Removal of the surface litters at the sampling spots is considered to be most important step in sample collection. Drive the auger to a plough depth of 15 cm and draw the soil sample than mix the samples thoroughly and remove foreign materials like roots, stones, pebbles and gravels.
- Collect the sample in a clean cloth or polythene bag after label the bag with information like name of the farmer, location of the farm, survey number, previous crop grown, present crop, crop to be grown in the next season, date of collection, name of the sampler etc.
- Dry the sample collected from the field in shade by spreading on a clean sheet of paper after breaking the large lumps, if present. Spread the soil on a paper or polythene sheet on a hard surface and powder the sample by breaking the clods to its ultimate soil particle than collect the material passing through the sieve and store in a clean glass or plastic container or polythene bag with proper labeling for laboratory analysis after that field moisture content must be

estimated in un-dried sample or to be preserved in a sealed polythene bag immediately after collection.
- Estimate the moisture content of sample before every analysis to express the results on dry weight basis.

Procedure for Soil Testing

Bulk Density: To measure bulk density for the present study Core Method is used. The sample is dried to constant weight in an oven at 110 degree Celsius in Hot air Oven and weighed in weighing balance. The weight is W in gms. Put the same soil sample in Measuring cylinder, note down the volume in milliliters, that is V/ml.

If weight is W and volume is V, bulk density = W/V = BD in g/ml.

pH:

pH Meter is basically a scale that tells us whether a substance is an acid or a base, the pH scale is directly proportional to OH- ion and inversely proportional to H+ ion if substance is acidic the its pH level will be less than 7 and if it is basic then it will have a pH more than 7.There is following procedure use for soil.

- Take 20 gm Soil Sample in 100 ml beaker then add 40 ml distilled water and seeking five times for half an hour after that pH meter calibration 7.0pH, 4.0pH, & 9.0pH then take pH reading.

EC (Electrical Conductivity): Following procedure was used for soil analysis. Take 20gm Soil Sample dissolve it in 40 ml distilled water seeking five times for half an hour after EC meter calibrate 0.01N Potassium Chloride Solution- 1.41 (µS/cm per mg/L.). The last step is to take EC reading.

Chloride: To estimate the Chloride availability to plants depends on the crop's rooting characteristics, as well as the cropping system, soil type, precipitation or frequency of irrigation, and drainage (Fixen, 1993).The assumption that Chloride ions, like nitrate (NO_3) and per chlorate (ClO_4) ions are adsorbed on positive sites of clay particles is carried through electrostatic attraction (Borggaard, 1984). As Chloride concentration increases, Chloride replaces more OH^- than H_2O, release of OH^- ions, during specific adsorption of Chloride decreases upon removal of the free iron oxides. This hydroxyl ion release, caused by specific adsorption of Chloride, increases the soil pH value in chloride solution. Following are the reagents used in test.

- Silver nitrate, 0.02 N: dissolve 3.4g of dried $AgNo_3$ in distilled water to make 1 litter of solution and keep in a dark bottle.
- Potassium chromate 5%: dissolved 5g of k_2cro_4 in 100ml of distilled water.

Procedure for soil is as follows: Take 50ml of sample in a conical flask and add 2ml of k_2cro_4 solution. Titrate the contents against 0.02N $Agno_3$ until a persistent red ring appears.

Potassium: Potassium is present in igneous, sedimentary, and metamorphic rocks and comprises about 25 g kg-1 of the earth's crust (Sheldrick, 1985). In mineral soils, K generally ranges between 0.4 and 30 g kg-1 (Sparks, 1987) with most agricultural soils containing between 10 and 20 g kg-1 (Jackson, 1964; Xie and Hasegawa, 1985). Following are the reagents used in Soil test.

- 20, 40 and 60 ppm Sodium and Potassium standards.
- Distilled water, Stock potassium solution.
- Weigh 1.907g Kcl, dried at 110ºC and cooled in desiccators. Transfer to 1L volumetric flask and make to 1L with water; 1mL = 1.00mg K.

Procedure for soil is as follows. Select the Test. Click and drag each of the standard solution below the Capillary tube and click on the "Aspirate" button to calibrate the Digital Flame Photo Meter. Drag the standard solution to place it in the original position. After calibration select the sample solution from the list. Click and drag the fruit juice sample below the Capillary tube and click on the "Start Test " button to measure the concentration.

Phosphorus: The term available phosphorus refers to the inorganic form occurring in soil solution which is almost exclusively 'Orthophosphate'. This can be represented as:

Phosphorus absorbed in soil phase ⇌ P in soil solution ⇌ Precipitated P

The phosphorus absorbed by plants from soil comes from the soil solution in which it exists as an inorganic Orthophosphate ion H_2PO_4-, HPO_{42}- and PO_{43}-. The most accessible ion is $H_2PO_4^-$.Procedure for soil test is as follows.

- 2.5 gm of Soil sample in 100 ml conical flask than add 1 gm of P-free activated charcoal
- Add 50 ml, 0.5M P-free Sodium bicarbonate Solution.(Adjust pH 8.5)
- Shake for 30 min and filter through Whattman No.-1 filter paper
- Take 5 ml filter Solution into a 25 ml volumetric flask.
- Add 5.0ml Ammonium molybdate Solution.
- Add 1.0 ml Sncl2 stock solution.
- Add distilled water up to 25 ml. volume spectrophotometer take blank without soil sample at 660nm and Take reading.
- Up to 25 Kg. /ha. Low
- 26 To 60 Kg. /ha. Medium
- 60 Kg/ha. to above High

Phosphate:

Following reagents are used in test.

- Sulphuric acid, Dilute 5N, 70 ml conc. H_2SO_4 to 500 ml with distilled water.
- Potassium antimony titrate solution: Dissolve 1.3715g K (SbO) C4H4O6.1/2 H2O in 400 ml distilled water and dilute to 500 ml, store in glass-stopper bottle.
- Ammonium molybdate solution: Dissolve 20g (NH4)6 Mo7O24.4H2O in 500 ml distilled water, store in a glass stopper bottle.

- Ascorbic acid, 0.1M: Dissolve 1.76g ascorbic acid in 100 ml distilled water, keep at 4ºC and use within a week.

Preparation of reagents: Mix 50 ml of 5N, H_2SO_4 with 5 ml potassium antimony. Titrate, 15 ml ammonium molybdate solution, and 30 ml ascorbic acid solution, in the given order at room temperature. Stable for 4 hours, Stock phosphate solution, Dissolve 219.5mg anhydrous KH_2PO_4 in distilled water and dilute to 1 L; 1 ml = 50µg PO_4- P. Standard phosphate solution: Dilute 50 ml stock solution to 1L with distilled water; 1 ml 2.5µg P. Ascorbic Acid Spectro-photometric method is used in the present study. Procedure is as follows. Take 50 ml sample into a 125 ml conical flask, add 1 drop of phenolphthalein indicator. Discharge any red colour by adding 5N H_2SO_4. Add 8 ml combined reagent and mix, Wait for 10 minutes, but not more than 30 minutes and measure absorbance of each sample at 880nm. Use reagent blank as reference. Prepare a sample blank by adding all reagents except ascorbic acid and potassium antimony titrate to the sample. Subtract blank absorbance from sample absorbance reading. Preparation of calibration curve: Prepare calibration from a series of standards between 0.15-1.30 mg/l range (for a 1 cm light path). Use distilled water blank with the combined reagent. Plot a graph with absorbance versus phosphate concentration to give a straight line. Test at least one phosphate standard with each set of samples.

Organic Carbon: Technique for determination of (SOC)
Following technique was use for determination of SOC. For the present study technique of estimating carbon used is Walkley and Black method of digestion which is wet digestion method followed by titration or measurement of evolved CO_2. In this method, the C present in the soil organic matter is measured by the titrimetric method using a strong oxidizing agent ($K_2Cr_2O_7$)) in the presence of H_2SO_4. In this reaction carbon is oxidized by the dichromate ion. Excess dichromate ion is then back titrated with ferrous ion.

Dichromate ion reacts with carbon as follows:

Cr_2O_{72} 3Co+ 16H+ $4Cr_3$ + $3CO_2$ + $8H_2O$

Ferrous ion reacts with dichromate as follows:

$6Fe_2$+ + C

Procedure for test is as follows. Weigh 1g soil into a 500 ml conical flask. Add 10 ml. of 1N potassium dichromate solution. Add 20 ml. sulphuric acid and mix by gentle rotation for 1 minute, taking care to avoid throwing soil up onto the sides of the flask. Let it stand for 30 minutes. Dilute to 200 ml with Distilled water. Add 10 ml. phosphoric acid, 0.2g ammonium fluoride, and 2 to 4 drops diphenylamine indicator than Titrate with 0.5N ferrous ammonium sulphate solution until the colour changes from dull green to a turbid blue. Add the titrating solution drop by drop until the end point is reached when the colour shifts to a brilliant green. Prepare and titrate a blank in the same manner. Prepare one duplicate sample and one quality control sample with each set of samples analyzed.
% Organic Matter = 10[1(S÷B)] X 0.67

Where, S = sample titration

B = blank titration

Nitrogen:

The dried and homogenised material is digested in a suitable Kjeldahl tube with sulphuric acid. To raise the temperature potassium sulphate is added and titanium dioxide/copper sulphate is used as a catalyst. After adding sodium hydroxide to the digestion solution the produced ammonium from all nitrogen species is evaporated by distillation as ammonia. This is condensed in a conical flask with boric acid solution. The amount is titrated against indicator with sulphuric acid.

Digestion: Place a test portion of the dried and grinded sample, of about 0.2 g (expected nitrogen content ≈ 0.5 %) to 1g (expected nitrogen content ≈ 0.1 %) or wet sample with the corresponding dry matter to the nearest of 0.1% accuracy was taken in the digestion flask or tube. 10 ml sulphuric was added acid and swirled until the acid was thoroughly mixed with the sample. It was allowed to stand for cooling. Than 2.5 gm of the catalyst mixture was heated until the digestion mixture became clear. Mixture was gently boiled for up to 5 h so that the sulphuric acid was condensed about 1/3 of the way up to the neck of the flask or the end of the tube. The time of boiling period differed with sample.

Titration: After completion of the digestion step, allow the flask or tube was cooled 20 ml of water was slowly added while shaking. Then the flask or tubes insoluble material turned into suspension and was transferred to the distillation apparatus. It was rinsed three times with water to complete the transfer. 5 ml of boric acid was added to a 200 ml conical flask and was placed under the condenser of the distillation apparatus 20 ml of sodium hydroxide was added to the funnel of the apparatus and was ran alkali slowly into the distillation chamber. About 100 ml of condensate was taken few drops of mixed indicator was added to the distillate and was titrate with sulphuric acid to a violet endpoint. The content of nitrogen, (w/N), in milligrams per gram, was calculated using the formula:

$$w/N = \frac{(V1 - V0) \times c(H+) \times MN \times 100}{m \times mt}$$

Where,

- V1 is the volume, in ml, of the sulphuric acid used in the titration of the sample
- V0 is the volume, in ml, of the sulphuric acid used in the titration of the blank test
- C (H+) is the concentration of H+ in the sulphuric acid in moles per litre (Ex. if 0.01 mol/l sulphuric acid is used, C (H+) = 0.02 mol/l)
- MN is the molar mass of nitrogen, in grams per mole (=14)
- M is the mass of test sample
- Mt is the dry residue, expressed as g / 100g on the basis.

Nitrate

The following method was used for making standard solution. Stock solution 0.25 g/L NO_3-N (=250mg/L, 250 ug/ml). In a 1.0L, standard flask containing approximately 600mLwater, 1.805 g potassium nitrate. Dissolve KNO_3.

Following procedure is used. Pipette an aliquot (e.g. 0.25 ml) of extract or standard into a 50-ml Erlenmeyer flask was mixed thoroughly with 0.8 ml of 5% (w/v) salicylic acid in conc. H_2SO_4. After 20 minutes at room temperature, 19 ml of 2 N NaOh was added to raise the pH above 12.Samples cooled to room temperature absorbance were measured at 410 nm.

Sodium: The following reagents were used. Standard sodium solution, and Intermediate sodium solution, diluted with 10 ml stock sodium solution with water to 100 ml. There are certain methods for measure Sodium. We have use Flame Emission Photometric method blank was prepared and sodium calibration standards were followed with in the applicable ranges, 0-100, 0-10, or 0-1 mg Na/L. Instrument was set to zero with standard containing no sodium. Emissionwas measured at 589nm.

Calcium: There are following reagents uses. NaOH, 1N, Murexide (ammonium purpurate) indicator: Mix 200 mg, Dye with100 g solid NaCl. Grind to 40 to 50 mesh size, Standard EDTA titrate, 0.01M, Standard calcium solution, Calcium Carbonate $CaCO_3$, Ammonium hydroxideNH_4OH. There are certain methods for measure Calcium. EDTA Titrimetric Method was used. 50 mlwas taken sample Samples which contained alkalinity greater than 300 mg/L were neutralised with acid, than it was boiled for 1 min and cooled before titration.2 ml NaOH solution added. After addition of the alkali than immediately titration was started. To that 0.1 to 0.2 g indicator mixture added. Titration is done with EDTA solution, along with continuous mixing, till the colour changes from pink to purple. End point was checked by adding 1 to 2 drops excess titrate to make certain that no further colour change occurred.

$$Ca/L = \frac{A \times B \times 400.8}{\text{ml sample}}$$

Where:

A=ml titrate for sample

B = ml of standard calcium solution taken for titration ml EDTA titrate

Sulphate: There are certain methods for measure Sulphate Spectro-photometry method were used. The desired wavelength was setusing dark. Filter was set to zero percent transmittance. Filter wheel was chosen in order to cut off filter insert reference and then reading was taken in (Absorbance) mode.

Fluoride: The following procedure was used. Electrode was prepared by filling the electrode filling Solution. The required numbers of standards were prepared and were adjusted to necessary ph by adding ionic strength adjuster. Calibration of the instrument was carried out using the prepared standards. Readings were taken in measurement mode and readings were obtained directly in mg/l.

RESULTS AND DISCUSSION

Assessment of soil quality presumes procedure to measure it and standards have been to determine the relative quality of soil under various land uses and management system. We have also attempted to discuss the assessment of soil quality at various levels with different parameters like pH, Ec. and estimates of Micro and Macro Nutrients.

Table No.2.1. Fact File

Geographical location	72 0.37'11" East (longitude)
	22 0.56'13" North (latitude)
Length of Kharicut Canal	61.3 Km

pH:

The pH or acidity of the soil is also important to measure, since the pH affects crop growth, and has an influence on the availability of both macro and micronutrients. A pH near neutral or 6.0 to 7.0 is optimal for most crops, and also is the range in which most nutrients are available.Our estimates for pH ranges from between 6.9 to 8.5 for all surface sample and 7 to 9 pH ranges for all subsurface Samples.

Electrical conductivity (EC): High electrical conductivity values are typically associated with soils that contain high levels of soluble salts (soluble nutrients or otherwise). Excess of soluble salts can adversely affect plant life by changing a plant's water balance and basic function, resulting in wilting or scorching. A good quality soil should have an electrical conductivity value within the range of 100-1500 uS/cm. Our estimates of Ec range from between 0.1 to 1.1 for all surface soil and 0.1 to 0.6 for all subsurface samples.

Organic Carbon in %: We can conclude from the above graph that amount of organic carbon % in Surface and Sub surface samples the ranged from as low 0.24 and 0.27 % and high as 1.88 and 2.12%. Organic Carbon% standard range is between 0.5 to 1.0 %.Soil organic carbon is the basis of soil fertility. It releases nutrients for plant growth, promotes the structure, biological and physical health of soil, and is a buffer against harmful substances. Organic matter formation and stability is largely related to long-term moisture and temperature trends. With higher average temperatures, soil organic matter decreases. As moisture increases, soil organic matter increases. Higher temperatures lead to more rapid and complete organic matter decomposition to soluble products which can leach from soil. Increasing moisture causes more plant growth, resulting in more organic residue as you move south and east in the Great Plains.(http://passel.unl.edu)

Nitrogen %: We concluded from the above graph that amount of Nitrogen % in Surface and Sub surface samples the ranged from as low 0.05 and 0.04 % and high as 0.16 and 0.18 percent.

Chloride (cl): We concluded from the above graph that amount of Chloride in Surface and Sub surface Soil samples maximum ranged 90.8 and 71 and Minimum Ranges 12.78& 10 .The sources and concentrations of chloride in nature are listed. Four basic factors determine the amount of cl available to crops growing in well drained soils: (1) the Chloride concentration in the soil solution; (2) atmospheric deposition of Chloride; (3) the Chloride concentration in the irrigation water; and (4) the content of Chloride in fertilizers and manure The amount of cl added to a field via the irrigation water (fresh or treated municipal effluents) depends on farm activities. Water of low to medium salinity contains 100-300 g **(**Goos, 1987**).**

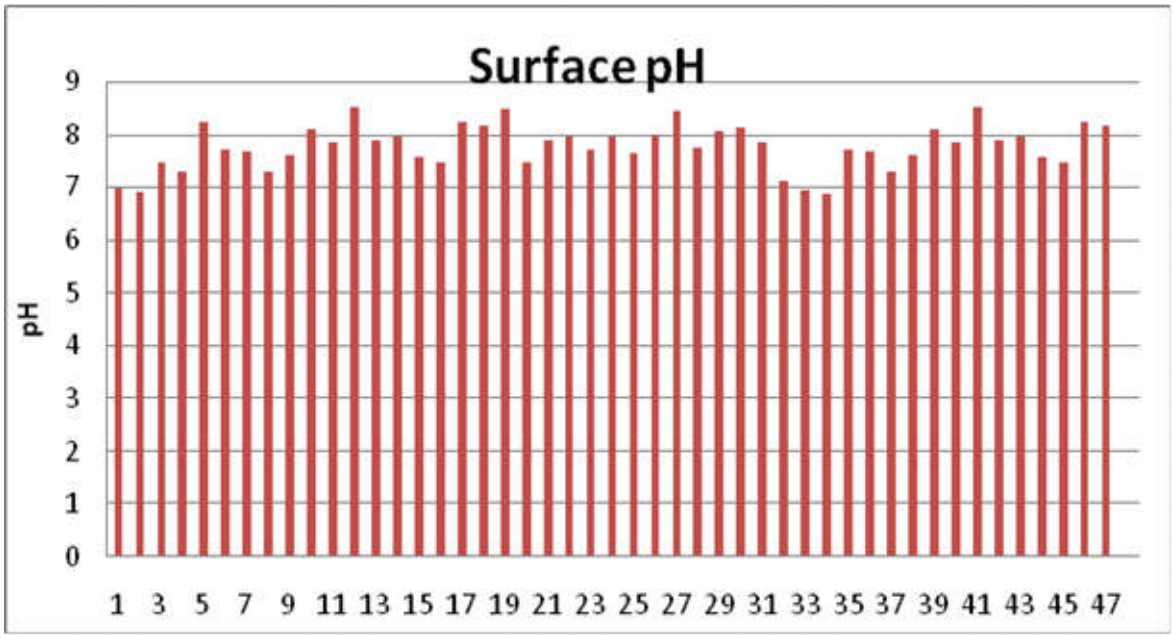
Phosphorus (P): Much higher concentration of Phosphorus was found in sites 7, 14 & 15 at surface level and sites no 24 & 32 at subsurface level.

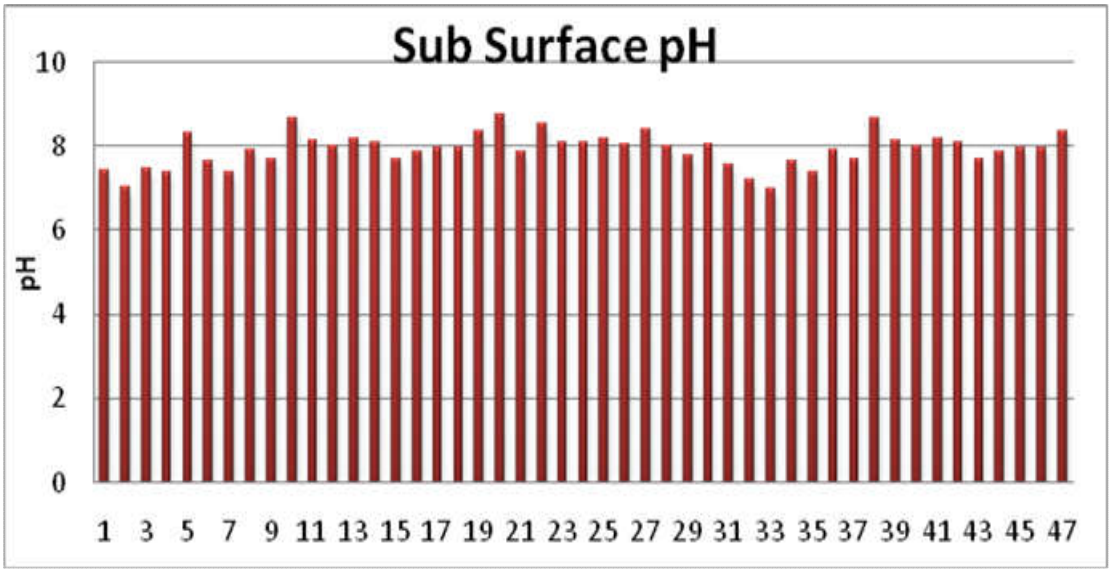
Table 3.2. Surface Soil Analysis

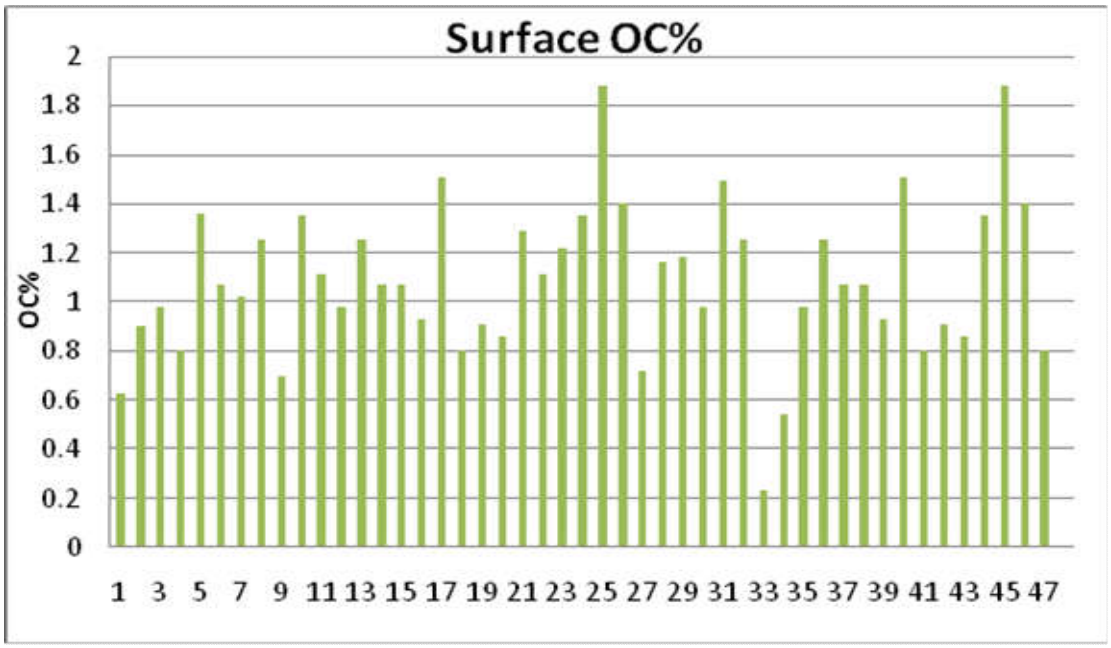
Site No.	pH	EC	OC%	Nitrogen%	Potassium	Phosphorus kg/ha	Chloride	Iron ppm	Zinc ppm	Copper ppm	Manganese ppm	Bulk Density
1	7	0.29	0.63	0.05	282	50	29.82	10.34	1.55	0.6	1.5	0.8
2	6.9	0.13	0.9	0.07	269	35	34.08	10.88	2.49	0.76	2.3	0.83
3	7.5	0.03	0.98	0.08	202	45	45.44	12.43	2.89	1.26	4.56	0.93
4	7.3	0.03	0.8	0.06	242	55	35.5	10.45	3.2	2.44	3.45	0.89
5	8.2	0.48	1.36	0.07	390	25	35.5	14.34	3.4	1.2	6.75	0.83
6	7.7	0.16	1.07	0.12	457	50	31.24	10.67	3.2	1.14	9.78	0.83
7	7.7	0.04	1.02	0.06	349	60	35.5	10.89	2.87	0.2	3.56	0.87
8	7.3	0.07	1.25	0.06	202	45	35.5	11.3	3.9	0.3	4.09	0.89
9	7.6	0.17	0.7	0.1	202	40	45.44	13.49	2.75	0.5	7.28	0.83
10	8.1	0.92	1.35	0.06	497	25	42.6	12.8	2.4	1.5	6.45	0.92
11	7.9	0.4	1.11	0.11	175	50	28.4	13.26	3.67	1.14	2.78	0.91
12	8.5	0.2	0.98	0.09	121	30	17.04	12.88	3.04	1.44	3.56	0.88
13	7.9	0.2	1.25	0.07	376	50	28.4	12.45	1.45	0.1	2.34	0.92
14	8	0.65	1.07	0.08	269	60	30.42	13.65	2.09	2.2	5.78	0.84
15	7.6	0.88	1.07	0.1	363	60	34.08	11.23	4.06	4.56	10.05	0.9
16	7.5	0.6	0.93	0.07	349	25	90.8	10.45	5.7	0.5	4.45	0.92
17	8.2	0.26	1.51	0.09	161	35	28.4	13.24	3.05	0.4	2.04	0.9
18	8.2	0.56	0.8	0.07	309	50	25.56	11.3	1.9	1.4	3.78	0.92
19	8.5	0.17	0.91	0.09	148	55	35.5	20.9	3.34	2.05	2.2	0.92
20	7.5	0.4	0.86	0.07	632	26	46.88	12.24	3.2	0.4	3.09	0.91
21	7.9	0.04	1.29	0.11	403	48	73.84	11.54	1.06	0.6	7.33	0.92
22	8	0.32	1.11	0.1	296	35	12.78	12.45	2.25	3.78	6.55	0.92
23	7.7	0.1	1.22	0.12	269	40	17.04	12.8	2.35	3	2.06	0.92
24	8	0.04	1.35	0.1	269	27	35.5	10.64	3.9	1.4	2.5	0.91
25	7.6	0.1	1.88	0.11	417	40	39.76	9.34	2	2	9.92	0.92
26	8	0.2	1.4	0.16	309	46	42.6	11.78	2.12	0.4	3.2	0.92
27	8.5	0.13	0.72	0.12	134	32	75.26	10.55	4.05	1.14	4.22	0.92
28	7.7	0.09	1.16	0.06	336	40	59.64	12.32	4.34	0.49	2.6	0.91
29	8.1	0.1	1.18	0.09	242	45	25.56	11.87	3.49	0.5	3.4	0.92
30	8.1	0.09	0.98	0.1	228	30	42.6	12.84	3.23	1.34	6.76	0.75
31	7.9	0.03	1.49	0.09	269	40	28.4	11.55	3.42	1.05	2.8	0.83
32	7.1	1.09	1.25	0.15	161	45	40	10.64	4.3	2.44	2.06	0.89
33	6.9	0.4	0.23	0.14	94	50	34.5	12.88	2.32	1.2	9.92	0.93
34	6.9	0.46	0.54	0.11	134	35	21	12.84	3.98	1.14	4.22	0.89
35	7.7	0.16	0.98	0.09	145	40	23.6	10.67	3.2	1.14	4.5	0.83
36	7.7	0.04	1.25	0.07	349	60	35.5	10.89	2.87	0.2	3.56	0.83
37	7.3	0.07	1.07	0.08	202	45	35.5	11.3	3.9	0.3	4.09	0.87
38	7.6	0.17	1.07	0.1	202	40	45.44	13.49	2.75	0.5	7.28	0.89
39	8.1	0.92	0.93	0.07	497	25	42.6	12.8	2.4	1.5	6.45	0.83
40	7.9	0.4	1.51	0.09	175	50	28.4	13.26	3.67	1.14	2.78	0.92
41	8.5	0.2	0.8	0.07	121	30	17.04	12.88	3.04	1.44	3.56	0.91
42	7.9	0.2	0.91	0.09	376	50	28.4	12.45	1.45	0.1	2.34	0.88
43	8	0.65	0.86	0.07	269	60	30.42	13.65	2.09	2.2	5.78	0.92
44	7.6	0.88	1.35	0.11	363	60	34.08	11.23	4.06	4.56	23	0.84
45	7.5	0.6	1.88	0.1	349	25	90.8	10.45	5.7	0.5	4.45	0.9
46	8.2	0.26	1.4	0.12	161	35	28.4	13.24	3.05	0.4	2.04	0.92
47	8.2	0.56	0.8	0.1	309	50	25.56	11.3	1.9	1.4	3.78	0.9

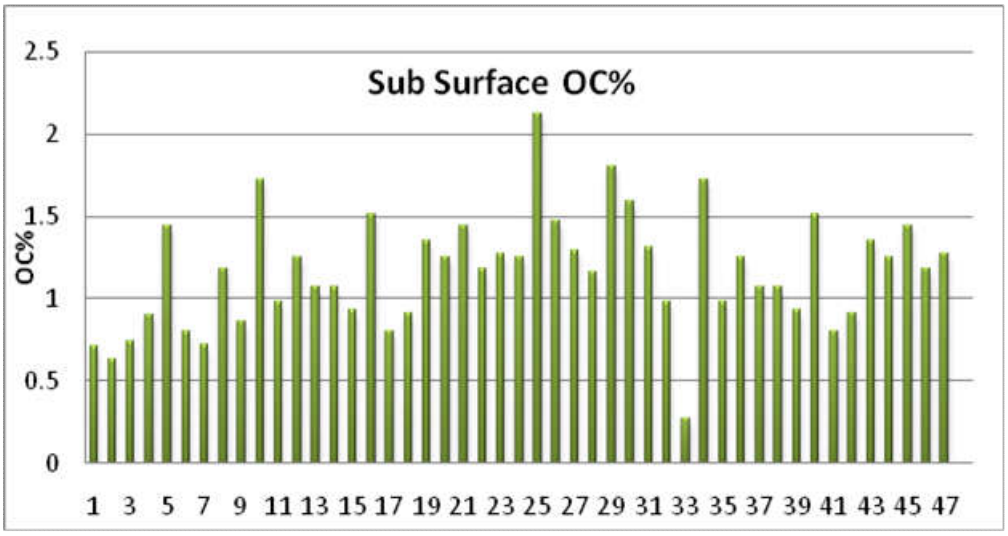
Table: 3.3. Sub Surface Soil Analyses

Site No	pH	EC	OC%	Nitrogen%	Potassium	Phosphorus kg/ha	Chloride	Iron ppm	Zinc ppm	Copper ppm	Manganese Ppm	Bulk Density
1	7.4	0.1	0.71	0.06	255	45	35.5	10.56	2.34	0.8	1.7	0.82
2	7	0.1	0.63	0.05	188	40	34.08	11.23	2.3	1	2.6	0.92
3	7.5	0.1	0.74	0.06	188	30	53.96	12.32	3.01	1.35	4.98	0.87
4	7.4	0.1	0.9	0.07	202	40	28.4	11.47	2.34	0.6	3.57	0.84
5	8.3	0.4	1.44	0.12	336	40	39.76	13.45	3.7	1.44	7.05	0.89
6	7.7	0.1	0.8	0.06	255	40	39.76	9.34	2.4	1.56	10	0.82
7	7.4	0	0.72	0.06	228	40	25.26	11.56	4.07	0.4	3.89	0.97
8	7.9	0.1	1.18	0.1	175	35	31.95	12.43	3	0.6	4.35	0.84
9	7.7	0.1	0.86	0.07	228	35	39.76	10.13	3	0.6	7.54	0.89
10	8.7	0.5	1.72	0.14	390	45	71	10.28	2.74	1.7	6.78	0.92
11	8.1	0.2	0.98	0.08	175	40	42.6	12.68	3.98	1.17	3	0.9
12	8	0.3	1.25	0.1	215	25	51.12	11.68	3.56	1.56	4.05	0.89
13	8.2	0.5	1.07	0.09	255	40	44.96	12.7	1.9	0.5	2.67	0.93
14	8.1	0.2	1.07	0.09	282	45	28.4	14.54	2.56	2.56	5.87	0.9
15	7.7	0.2	0.93	0.09	323	35	42.6	10.66	4.65	4.89	10.5	0.9
16	7.9	0.4	1.51	0.08	242	40	48.28	12.32	6	0.7	4.53	1.12
17	8	0.2	0.8	0.13	188	25	32.66	12.43	3.45	0.4	2.17	0.91
18	7.9	0.2	0.91	0.06	255	45	35.5	21.1	2.3	1.46	3.89	0.84
19	8.3	0.2	1.35	0.07	202	40	39.76	15.35	3.98	2.15	2.23	0.83
20	8.8	0.3	1.25	0.11	282	35	31.24	13.65	3.76	0.34	3.2	0.9
21	7.9	0.1	1.44	0.1	349	50	22.72	9.54	1.45	0.6	7.4	0.91
22	8.6	0.1	1.18	0.12	255	30	21.3	11.89	2.05	3.98	6.67	0.84
23	8.1	0.1	1.27	0.1	188	45	19.88	14.42	2.76	3.2	2.1	0.83
24	8.1	0.1	1.25	0.11	255	60	39.76	14.67	3.43	1.55	2.6	0.9
25	8.2	0	2.12	0.18	376	30	21.3	11.36	2.3	2.2	10	0.91
26	8.1	0.2	1.47	0.1	470	25	49.7	11.23	3.97	0.6	3.35	0.84
27	8.4	0.2	1.29	0.13	161	20	51.12	10.67	4.3	1.44	4.3	0.83
28	8	0.1	1.16	0.11	67	50	10	14.3	3.1	0.98	2.67	0.9
29	7.8	0.1	1.8	0.09	242	45	35.5	10.43	3.3	1	3.7	0.87
30	8	0.1	1.59	0.15	242	50	31.24	13.55	3.02	1.98	6.83	0.94
31	7.5	0.4	1.31	0.14	336	30	36.92	10.23	2.3	1.45	3	0.91
32	7.2	0.6	0.98	0.11	202	75	40	14.42	4.06	0.6	7.28	0.9
33	7	0.4	0.27	0.14	148	25	38	11.68	3.44	1.44	3.2	0.9
34	7.7	0.1	1.72	0.08	255	40	39.76	9.34	2.4	1.56	10	0.82
35	7.4	0	0.98	0.1	228	40	25.26	11.56	4.07	0.4	3.89	0.97
36	7.9	0.1	1.25	0.09	175	35	31.95	12.43	3	0.6	4.35	0.84
37	7.7	0.1	1.07	0.09	228	35	39.76	10.13	3	0.6	7.54	0.89
38	8.7	0.5	1.07	0.09	390	45	71	10.28	2.74	1.7	6.78	0.92
39	8.1	0.2	0.93	0.08	175	40	42.6	12.68	3.98	1.17	3	0.9
40	8	0.3	1.51	0.13	215	25	51.12	11.68	3.56	1.56	4.05	0.89
41	8.2	0.5	0.8	0.06	255	40	44.96	12.7	1.9	0.5	2.67	0.93
42	8.1	0.2	0.91	0.07	282	45	28.4	14.54	2.56	2.56	5.87	0.9
43	7.7	0.2	1.35	0.11	323	35	42.6	10.66	4.65	4.89	10.5	0.9
44	7.9	0.4	1.25	0.1	242	40	48.28	12.32	6	0.7	25.3	1.12
45	8	0.2	1.44	0.12	188	25	32.66	12.43	3.45	0.4	2.17	0.91
46	7.9	0.2	1.18	0.1	255	45	35.5	10.45	2.3	1.46	3.89	0.84
47	8.3	0.2	1.27	0.11	202	40	39.76	15.35	3.98	2.15	2.23	0.83

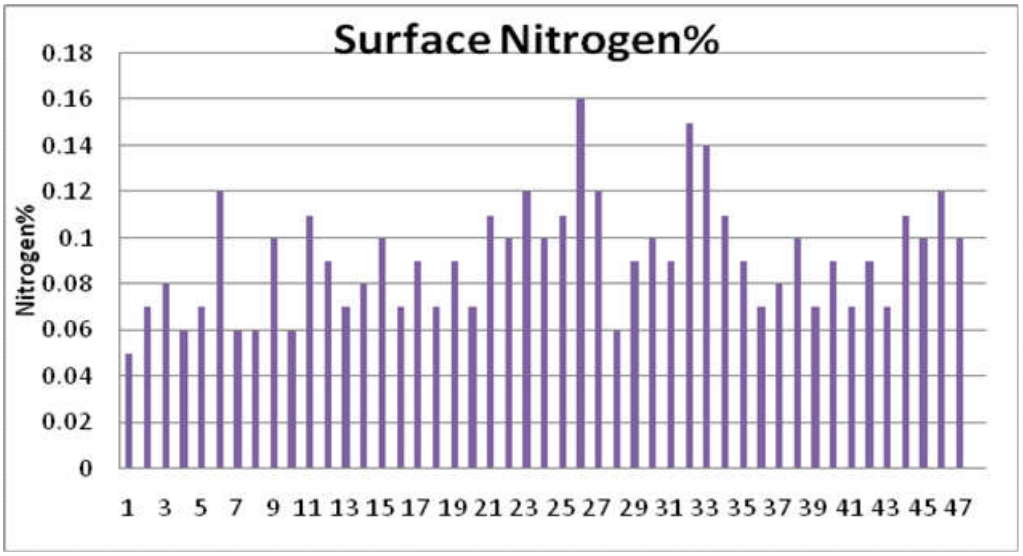

Surface pH
pH
0
1
2
3
4
5
6
7
8
9
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47

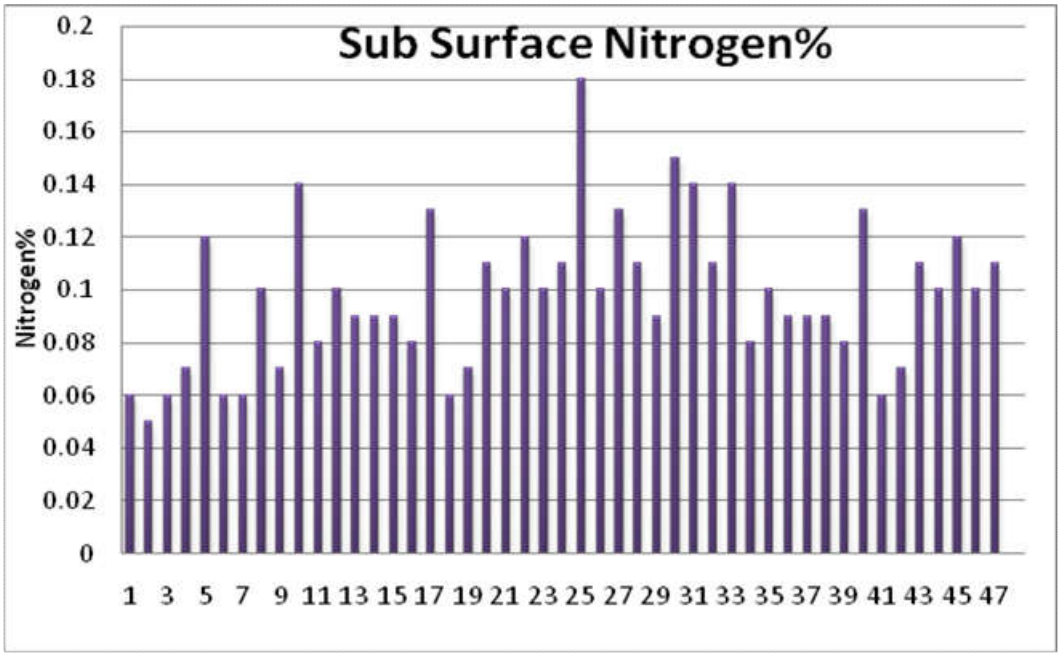

Sub Surface pH
pH
0
2
4
6
8
10
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47


Surface OC%
OC%
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47

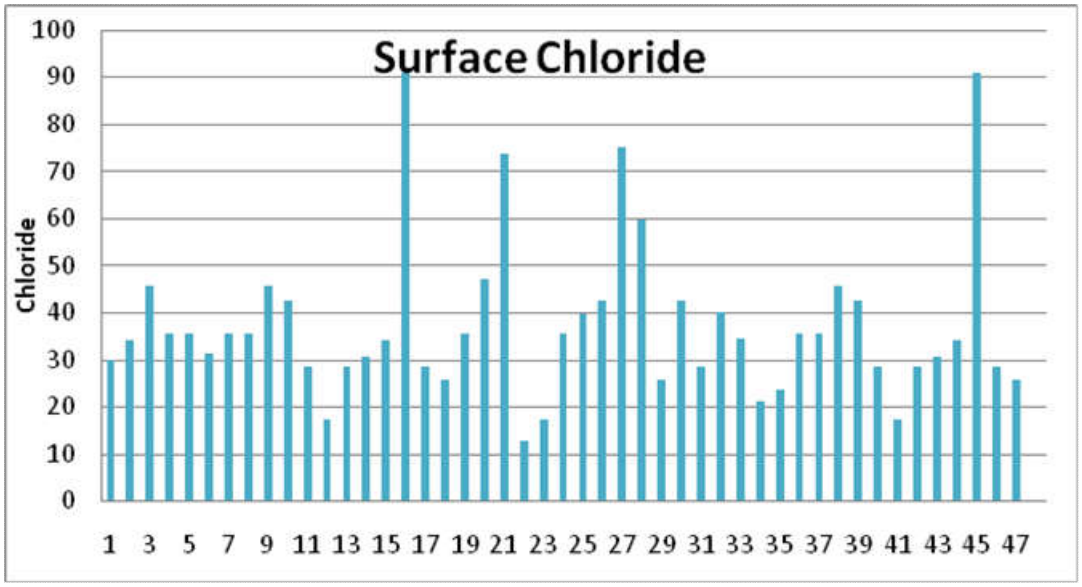


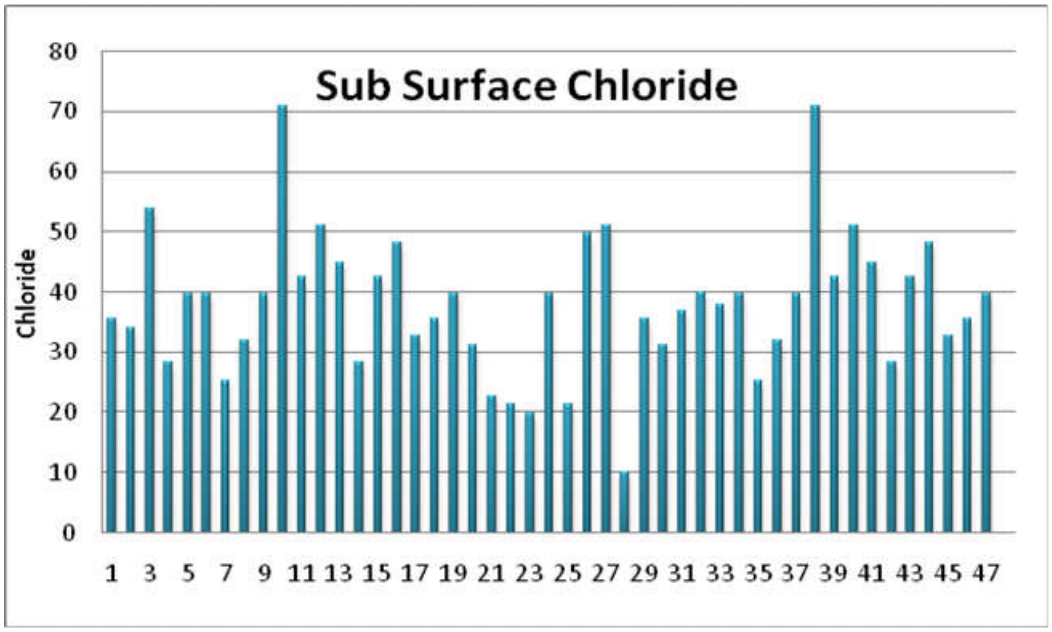
Graph.3.2.3. Organic Carbon% (OC) – Surface & Sub Surface

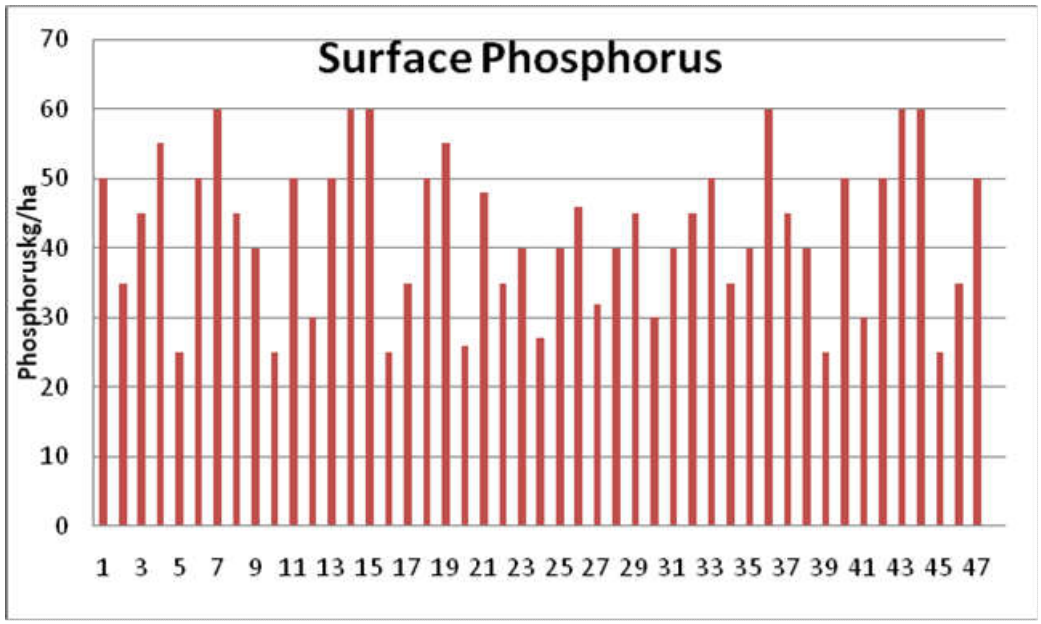


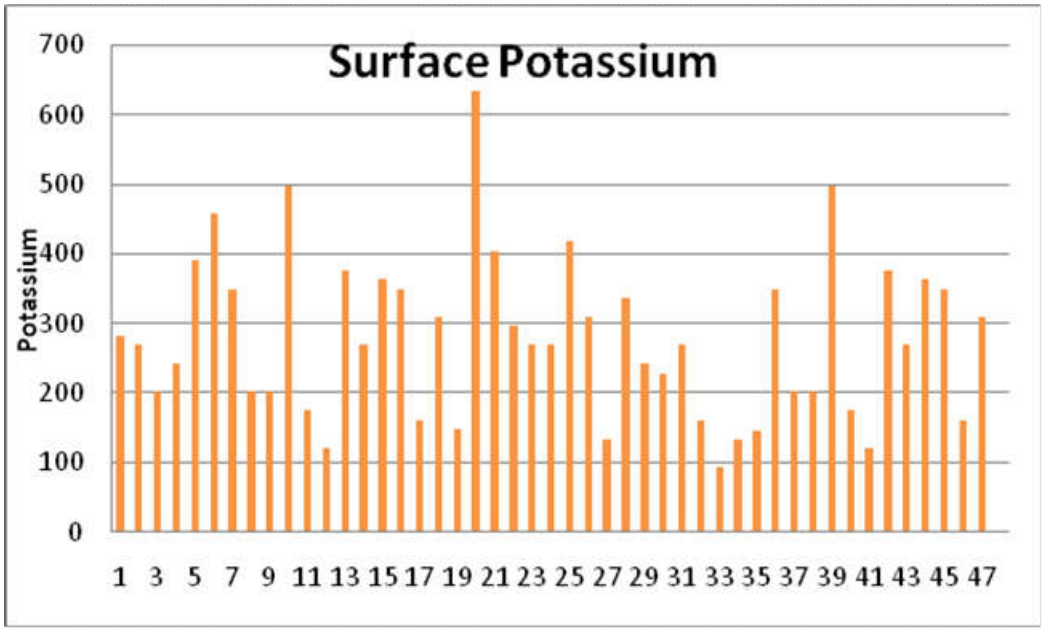


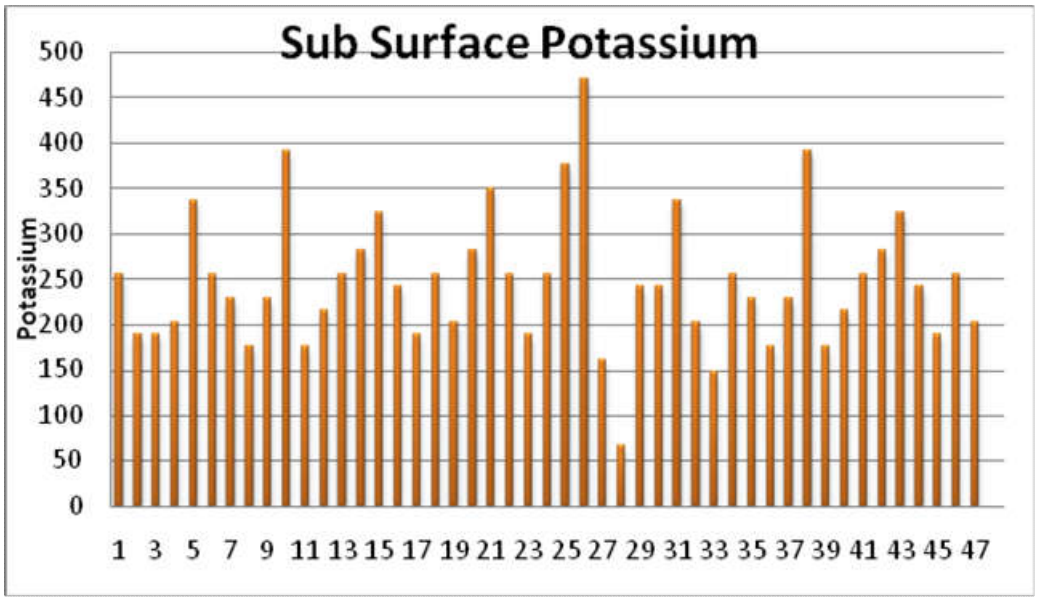
Graph. 3.2.4. Nitrogen % (N) –Surface & Sub-Surface


Surface Chloride
Chloride
100
90
80
70
60
50
40
30
20
10
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47

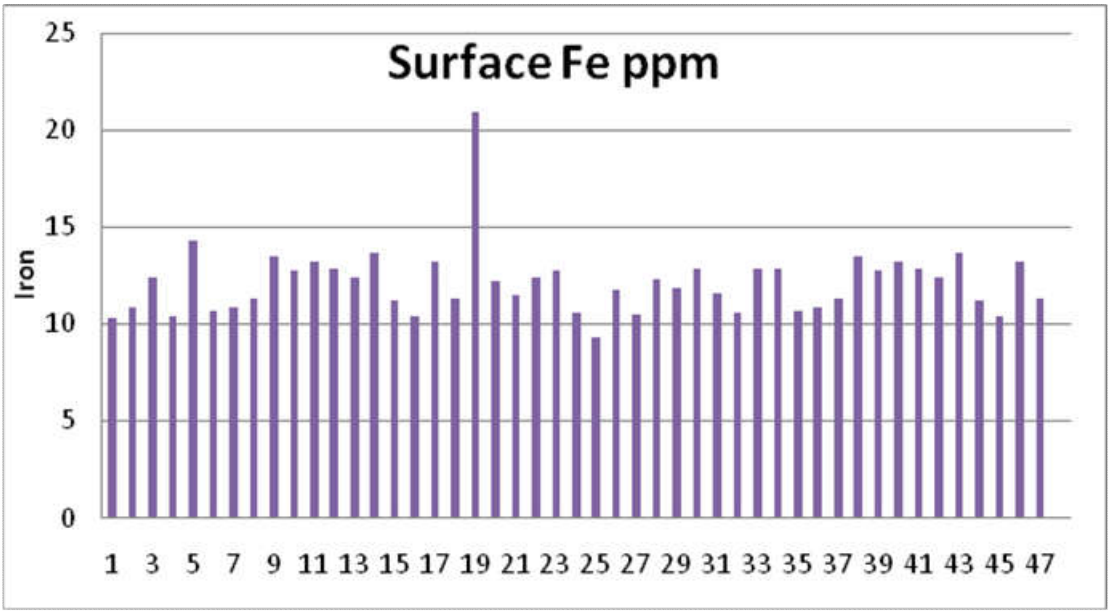

Sub Surface Chloride
Chloride
80
70
60
50
40
30
20
10
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47

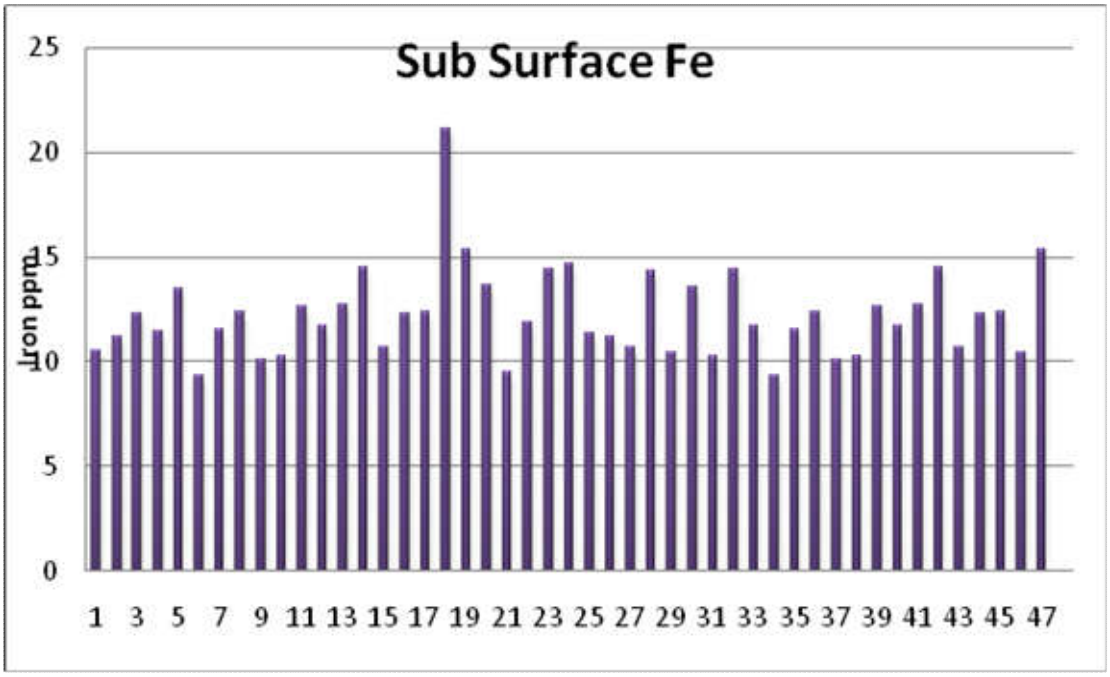

Surface Phosphorus
Phosphoruskg/ha
70
60
50
40
30
20
10
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47



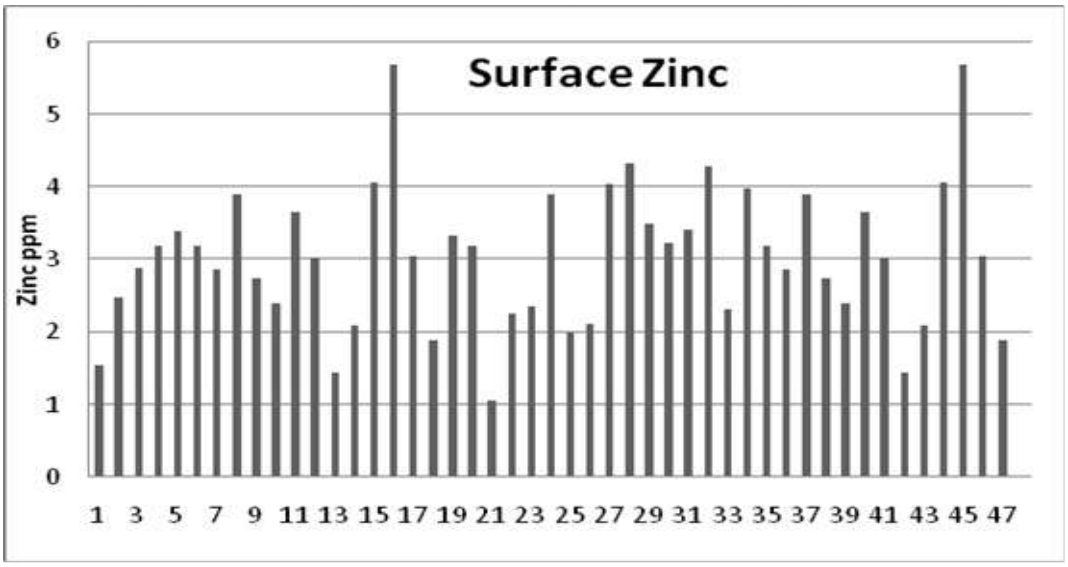


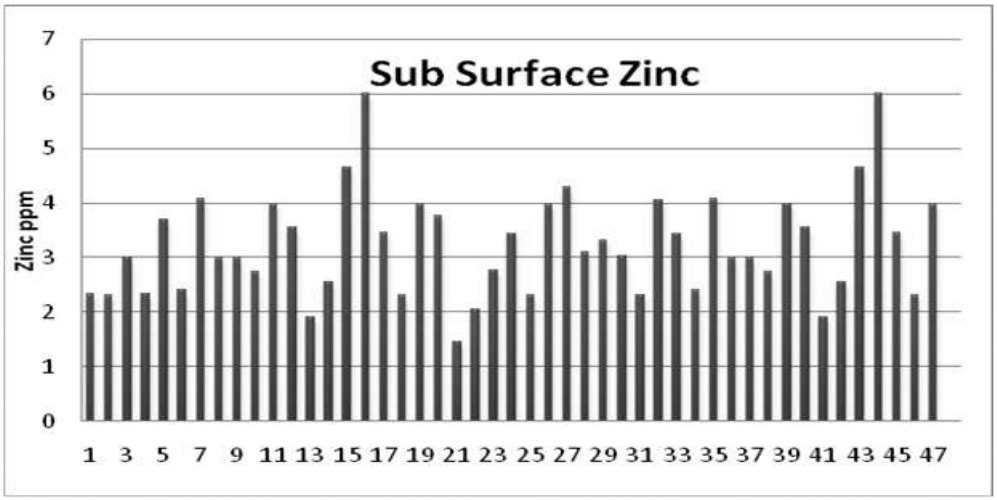
Graph.3.2.7: Potassium (K) – Surface-Subsurface

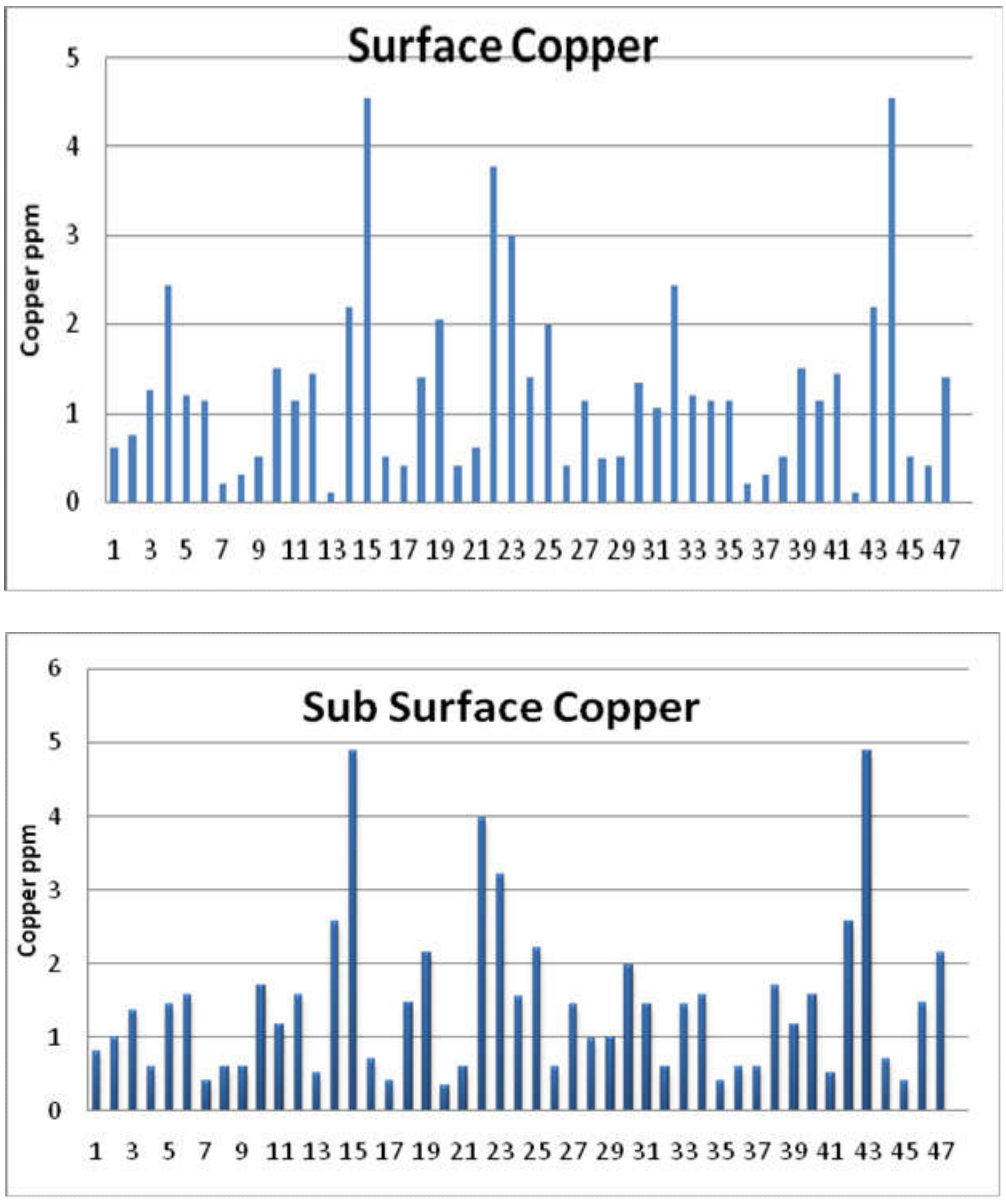




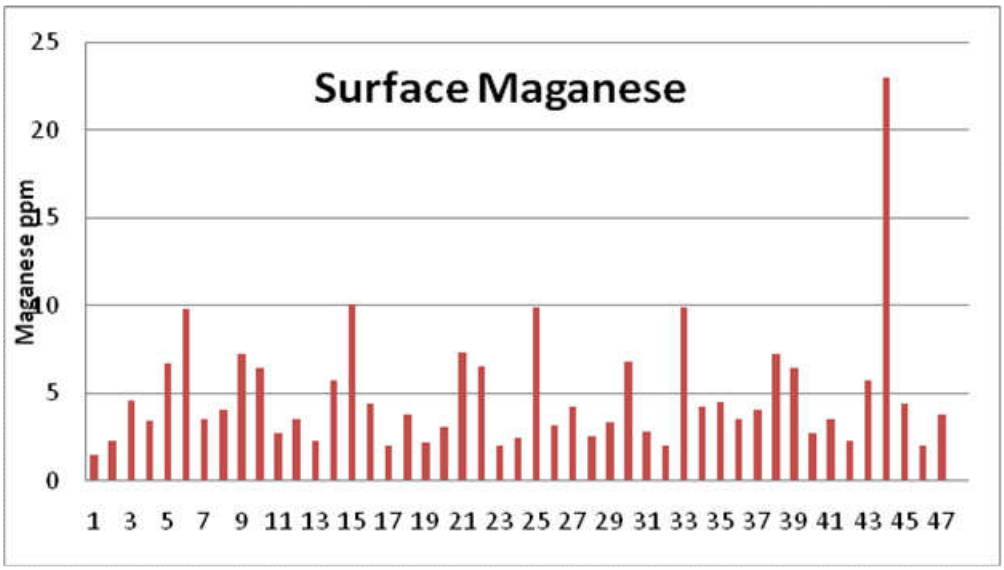
Graph.3.2.8. Iron (Fe) – Surface-Sub-surface

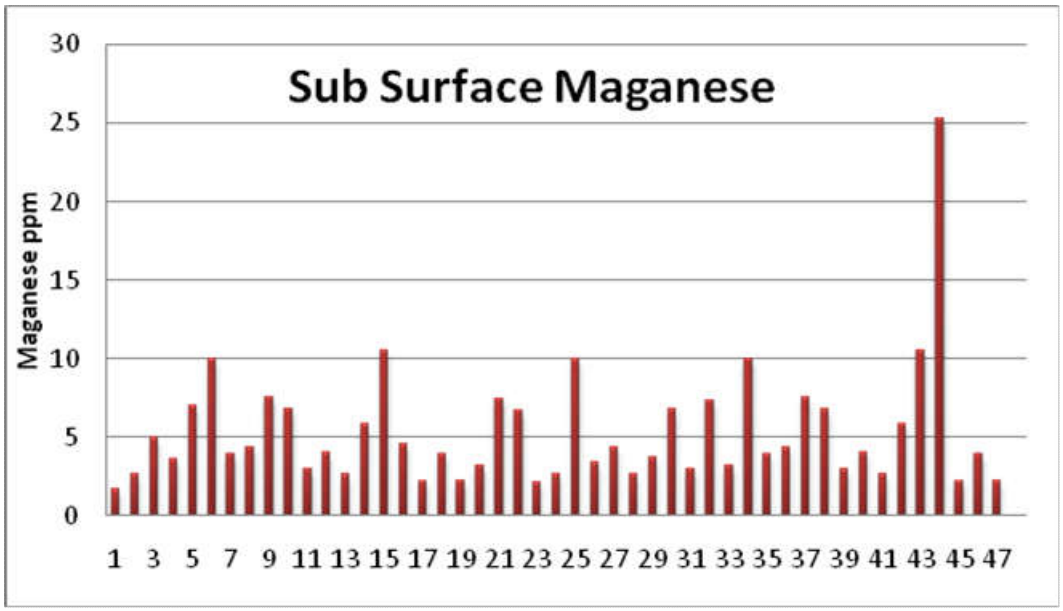


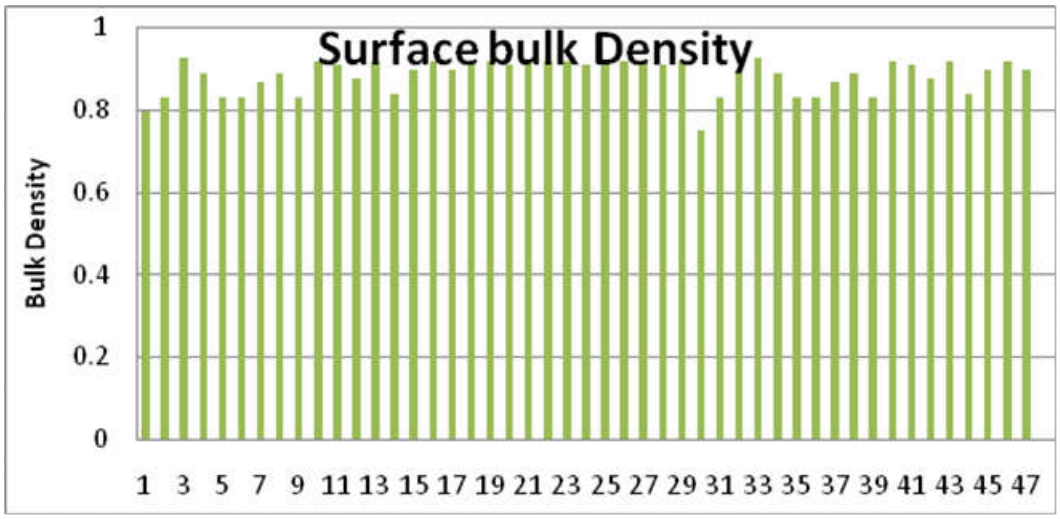




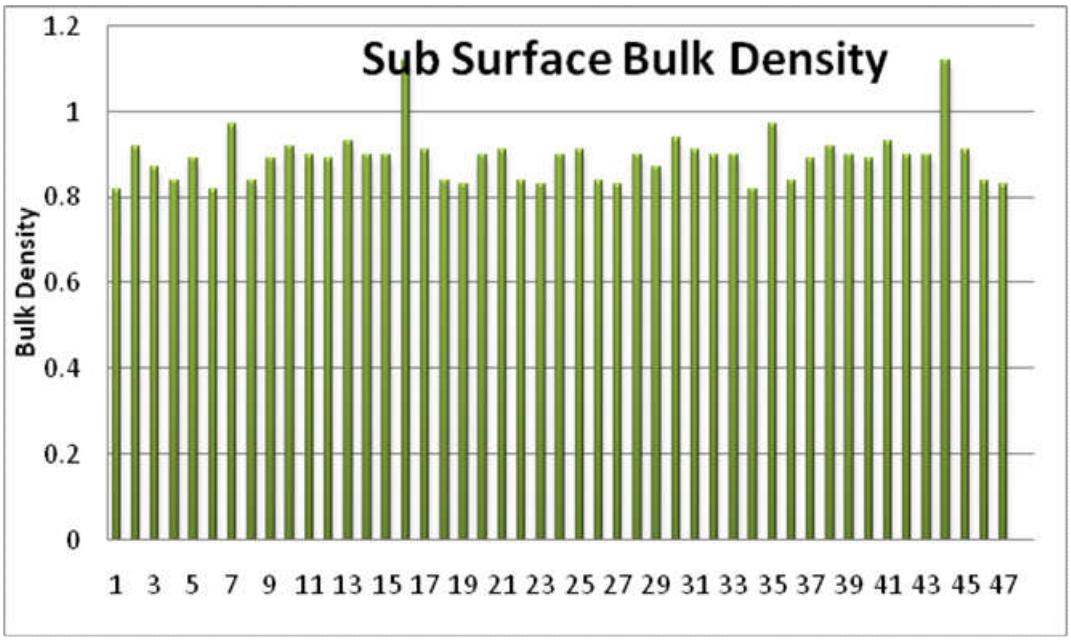
Graph.3.2.10. Copper (Cu) –Surface- Sub-surface







Graph.3.2.11. Manganese (Mn) Surface-Sub Surface



Graph. 3.2.12: Bulk Density – Surface-Sub-surface

And the rest areas had comparatively low concentration compared to other samples. Phosphorus deficiency symptoms often occur as young plants are exposed to cool/wet growing conditions, resulting in a phase where vegetative growth exceeds the roots' ability to supply P. Young plants are especially vulnerable because their root systems are small and P is immobile in soil solution. However, P deficiency reduces yield by delaying maturity, stunting growth, and restricts energy utilization by the plant. (http://www.nrcs.usda.gov**)**

Potassium: Potassium standard ranges between 140-280 kg/ha. We concluded from the above graph that amount of Potassium in Surface and Sub surface Soil samples maximum was 632 to 470 and Minimum Ranged 94 & 67kg/ha. Potassium deficiency symptoms such as thin cell walls, weakened stalks and stems, smaller and shorter roots, sugar accumulation in the leaves, and accumulation of unused nitrogen (N) encourage disease infection. Each of these reduces the ability of the plant to resist entry and infection by fungal, bacterial and viral disease organisms. Potassium plays an important role in keeping the working of brain in normal state. It is of great importance in preventing the occurrence of stroke in human brain Decrease in potassium level causes a drop in blood sugar level. Decrease in blood sugar level causes sweating, headache, weakness, trembling and nervousness **(**Iso et al., 1999).

Iron: Concentration of iron in all the collected soil surface samples ranged between 10 to14.34 ppm and collected soil sub-surface samples ranged between 9.34 to 15.35 ppm In all the soil samples concentration of iron was above the permissible limit set by WHO. It comes into water from natural geological sources, industrial wastes, domestic discharge and from by products. Excess amount of iron causes rapid increase in pulse rate and coagulation of blood in blood vessels, hypertension and drowsiness **[**Gautam Patel et al 2011].It is the most abundant and an essential constituent for all plants and animals. On the other hand, at high concentration, it causes tissues damage and some other diseases in humans. It is also responsible for anaemia and neurodegenerative disorders in human being. (Afzal Shah *et al,* 2013**).**

Zinc: Concentration of zinc in Surface soil samples ranged between 1.06 to 5.7ppm and Sub surface samples ranged between 1.9 to 6.0 ppm. In all the soil samples concentration of zinc was recorded below the permissible limit set by WHO. Zinc is one of the important trace elements. Nevertheless, higher concentrations of zinc can be toxic to the organism. It is the basic component of a large number of different enzymes and plays structural, regulatory, and catalytic functions. It also has very important role in DNA synthesis, normal growth, brain development, bone formation, and wound healing. At high level, Zinc is neurotoxin **[**Afzal Shah *et al.,* 2011**].**

Copper: The permissible limit for copper in the soil is 40 ppm. Concentration of copper in all the soil samples was above the maximum permissible limit set by WHO. Concentration of copper ranged For surface Soil samples between 0.1 to 4.56ppm and sub-surface soil samples between 0.4 to 4.89ppm.Copper accumulates in liver and brain. Copper toxicity is a fundamental cause of Wilson's disease **[**Samuel Zerabruk et al 2011**].** Copper particulates are released into the atmosphere by windblown dust; volcanic eruptions; and anthropogenic sources, primarily copper smelters and ore processing facilities. Being an essential trace element, it is necessary for many enzymes. High concentration of Cu causes metal fumes fever, hair and skin discolorations, dermatitis, respiratory tract diseases, and some other fatal diseases in human beings (Afzal Shah *et al***,** 2013**).**In India Cu deficiency or marginal Cu deficiency has been recorded at 60 farms.

Manganese: Concentration of Manganese in all the collected soil surface samples ranged between 1.5 to10.1 ppm and collected soil sub-surface samples ranged between 2 to 10.5 ppm. In all the soil samples concentration of Manganese was above the permissible limit set by WHO. It is a very essential trace heavy metal for plants and animals growth. Its deficiency produces severe skeletal and reproductive abnormalities in mammals (2013 Afzal Shah et al**.)**

Bulk Density: We concluded from the above graph that amount of Bulk density in Surface and Sub surface Soil samples maximum ranged 0.93 and 1.12 and Minimum Ranged 0.75 & 0.82.Bulk density is an indicator of soil compaction and soil health. Bulk density typically increases with soil depth. We can conclude from the above graph that amount of Bulk density in Surface and Sub surface Soil samples maximum ranges 0.93 and 1.12 and Minimum Ranges 0.75 & 0.82.High bulk density impacts available water capacity, root growth, and movement of air and water through soil. Compaction increases bulk density and reduces crop yields and vegetative cover available to protect soil from erosion.

Conclusion

The impact of Climate Change on soils and its functions were remarkable. In agriculture, climate change will affect crop production as changes in soil, air temperature and rainfall affect the ability of crops to reach maturity and their potential harvest. The study was carried with the objective of water and soil analysis, to know impacts if water quality of Kharicut canal on the surrounding agriculture and evaluate the impacts of the crops grown in this region on human health and cattle and it was observed from the study that certain minerals and heavy metals and physical properties of the study areas soil and water was found above permissible limits due to extensive use of chemical fertilizers, dumping of effluents from the industries into the canal water along with sewage water.

- Our estimates for pH ranges from between 6.9 to 8.5 for all surface sample and 7 to 9 pH ranges for all subsurface Samples. This indicates no subsequent changes in pH of soils in this region.
- A good quality soil should have an electrical conductivity value within the range of 0.1-1.5µs/cm. Our estimates of Electric conductivity ranges between 0.1 to 1.1 for all surface soil and 0.1 to 0.6 for all subsurface samples. The current ec because of excessive use of chemical fertilizer in the region.
- Organic Carbon percentage standard range is between 0.5 to 1.0 %. We can conclude from the above graph that amount of organic carbon percentage in Surface level sample no 25 and Sub surface level sample no 26 was very high and the ranges of surface and sub surface levels sample no 33 is very low. It was due to the presence of agricultural region around the study area

along with constant influx of industrial effluents which bright have entered into the nearby soils.

- Amount of Nitrogen percentage standard range is between in Surface and Sub surface samples the ranges from as low 0.05- 0.04 %, and as high as 0.16 - 0.18%.Hv equipment manufacturing and other metal industries in the vicinity.
- Four basic factors determine the amount of cl available to crops growing in well drained soils: (1) the cl concentration in the soil solution; (2) atmospheric deposition of; (3) the cl concentration in the irrigation water; and (4) the content of cl in fertilizers and manure The amount of cl added to a field via the irrigation water (fresh or treated municipal effluents) depends on farm activities. Water of low to medium salinity contains 100-300 g of Cl^- **(**Goos, 1987**).** The amount of Chloride in Surface and Sub surface Soil samples maximum range is 90.8 and 71 and Minimum Range is 12.78 and 10.This is mainly due to the fertilizers rich in chloride and reaching waters carrying the chlorine to the agricultural fields.
- Much higher concentration of Phosphorus is found in sites 7, 14 & 15 at surface level and sites no 24 & 32 at subsurface level. And the rest areas have comparatively low concentration compared to other samples. This is mainly due to chemical fertilizers intensive farming and the industrial effluents from waste & sewage water dumping upstream.
- Potassium standard range is between 140-280 kg/ha. The amount of Potassium in Surface level soil sample no 10, 20 and Sub surface level Soil samples no 26,38 ranges so high. Surface level soil sample no 28 and Sub surface level Soil samples no. 33 range is very low. The root cause of higher potassium content in the soil is due to the along mentioned reason for N & P, which is extensive use of chemical fertilizers. Along with domestic combination, iron and steel fabrication and production in the region
- Concentration of iron range between 10 to14.34 ppm in all the collected soil surface samples and Collected soil sub-surface samples ranged between 9.34 to 15.35 ppm. In all the soil samples concentration of iron was above the permissible limit set by WHO. It comes into water from natural geological sources, industrial wastes, domestic discharge and from by products
- Concentration of zinc in Surface soil samples ranged between 1.06 to 5.7ppm and Sub surface samples ranged between 1.9 to 6.0 ppm in all the soil samples concentration of zinc was recorded below the permissible limit set by WHO.
- The permissible limit for copper in the soil is 40 ppm. Concentration of copper in all the soil samples was below the maximum permissible limit set by WHO. Concentration of copper ranged. For surface Soil samples, between 0.1 - 4.56 ppm and sub-surface soil samples between 0.4 - 4.89ppm. High concentration of Cu causes metal fumes fever, hair and skin discolorations, dermatitis, respiratory tract diseases, and some other fatal diseases in human beings
- Concentration of Manganese in all the collected soil surface samples ranged between 1.5 to 10.1 ppm and collected soil sub-surface samples ranged between 2 to 10.5 ppm in all the soil samples. It is abundantly found in earth and is not considered as a pollutant just like iron.
- It can concluded from the study Bulk density in Surface and Sub surface Soil samples shows maximum range of $0.93 g/cm^3$ and $1.12 g/cm^3$ and Minimum Range of $0.75 g/cm^3$ & $0.82 g/cm^3$. Which is optimum agriculture as bulk densities greater than $1.6 g/cm^3$ tend to restrict root growth (mckehzie et al., 2004)

Future strategies

- There is need for developing systematic database using GPS for monitoring health hazards from heavy metals pollution and trace elements toxicities in soil, plant, human and animal chain.
- For taking remedial measures by the policy makers, people and planners, Maps of trace element's deficiency and toxicity should be produced to create awareness.
- For crops, specialized fortified fertilizers should be created as per the need for soils of different cropping system and certain agro ecological zones.
- Studying relative supplementation of trace elements from fodders to animals is surely a need of an hour.
- Creating mass awareness about pollutant elements in the water moving in soil-plant and then to animal and remedial measures of the same.
- A multi-disciplinary approach should be adopted where soil scientist, physiologists and medical doctors should be constituted to establish definite quantitative association of soil health and human health.

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