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Comparative Study of Physicochemical Properties and Fertility of Soils in Gwalior, Madhya Pradesh

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Aabstract: Sixteen soil samples were collected (four agricultural, three highway, three industrial, three barren and three market soils) from different locations from the Gwalior city. The samples were investigated for physical and chemical properties. In general, it was observed that the agricultural soil samples were more fertile as compared to other sites selected in the present investigation. However, the industrial soil samples that were analyzed in this study showed a fertility values that were moderate to average when compared with industrial and barren soil samples. The variation in physicochemical properties of the soils seemed to be influenced by the topography to a greater extent in the studied area. The study also concluded that the industries and developmental projects are engulfing the agricultural soil in Gwalior that is a threat for the sustainable development of the agriculture and cause of concern among the farming community.

Key words: Soil · Chemical properties · Micro nutrients · Sustainable development

INTRODUCTION

Soils are natural unconsolidated materials on the surface of the earth and are composed of solid, liquid and gas. They have organic and inorganic matter, which are intimately mixed together by natural processes. That is aggregated into a porous body that accommodates air and water [1]. The truth is that soil is a marvelous substance, a living resource of astonishing beauty, complexity and frailty. It is a complex mixture of weathered mineral materials from rock, partially decomposed organic molecules and a host of living organisms. It can be considered an ecosystem by itself. Soil is an essential component of biosphere and it can be used sustainably, or even enhanced, under careful management. Building good soil is a slow process and under best circumstances, good topsoil accumulates at a rate of about10 tons per ha (2.5 acres) per year enough soil to make a layer about 1 mm deep when spread over a hectare. Under poor conditions, it can take thousands of years to build that much soil. Perhaps one-third to one-half of the worlds current croplands are losing faster than it is being replaced. In some of the worst spots, erosion carries away about 2.5 cm (1inch) of topsoil per year. With losses like that, agriculture production has already begun to fall in many areas.

Soil fertility and plant nutrition are two closely related subjects that emphasize the forms and availability of nutrients in soils, their movement to and their uptake by roots and the utilization of nutrients within plants [2]. Without maintaining soil fertility, it is difficult to boost agricultural production for feeding the alarming population. Therefore, to get optimum, sustained-long lasting and self-sufficient crop production, soil fertility need maintained. The loss of soil nutrients is related to cultural practices like cultivation. The removal of vegetative cover (such as straw or stubble) or burning plant residues as practiced under the traditional system of crop production or the annual burning of vegetation on grazing land are major contributors to the loss of nutrients [3], while the use of chemical fertilizer is also minimal.

There are no specific studies that have focused on soil properties in relation to topography and crop use. Significant areas of Gwalior occur along the Gwalior Chambal region. Indeed our study covered different areas of Gwalior that extend from Badagaon (78° 16' 00" E) to

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Guda Gudi ka Naka (26.221521°N 78.178024°E). These soils were under different land use and annual crops production often with various management practices. The extent of manmade degradation of soils in Northern Province of Madhya Pradesh is not well known, however, no investigation have specifically examined the anthropogenic degradation with respect to soil properties and the mapping of soils in agricultural ecosystem in different regions of Gwalior. Considering this lack of information the present study will document and examine soil properties of the Gwalior soils through pedagogical approach.

MATERIALS AND METHODS

Sixteen soil samples (4 agricultural, 3 highway, 3 industrial, 3 barren and 3 market soils) were collected from different locations in Gwalior Madhya Pradesh region. Root part and other plant residues were removed from the soil and then these soil samples were air dried at room temperature, sieved with <2.0mm test sieve. For analysis of soil organic carbon (SOC) and calcium carbonate, soil samples were further sieved with 0.2 mm test sieve. The pH, EC were determined in 2.0 mm test sieve soil samples. The soil texture, soil moisture, alakalinity, acidity, sulaphte were determined by the standard methods of Gupta, 2005 [4]. The K and Na were measured with flame photometer while the Mg and Ca were determined with atomic absorption spectrophotometer and the nitrate content was determined by titration method.

Total calcium carbonate content was estimated by Back titration method [5] and PH and EC were measured as described by Tandon [6] by preparing (1:2) soil and water solution for one hour were at rotary shaker. Soil organic carbon (SOC) was analyzed by wet digestion method [7].

RESULTS

It is clear from the data in Table (1) that the total amount of electrical conductivity (EC) in the soil sample obtain from agriculture soil at different sites were 0.6±0, 0.6±0, 0.6±0, 0.5±0 at site 1, 2, 3 and 4 respectively. However pH was present in soil samples and range is 9.8 to 10.1 respectively. The concentration of chloride (mg/l) in soil samples were 0, 53.25±4, 53.25±0 and 53.25±0 at site 1, 2, 3 and 4 (Table 1) respectively. During the present investigation the alkalinity content ranged between 50±0.01 to 114±0.05 in the soil samples of agriculture field.

The electrical Conductivity (dS/cm) in the soil sample obtain from agriculture soil at different sites were 0.6±0, 0.6±0, 0.6±0, 0.5±0 at site 1, 2, 3 and 4 (Table 1) respectively. However pH was present in soil samples and range is 9.8 to 10.1 respectively. The concentration of chloride (mg/l) in soil samples were 0, 53.25±4, 53.25±0 and 53.25±0 at site 1, 2, 3 and 4 (Table 1) respectively. During the present investigation the Alkalinity content ranged between 50±0.01 to 114±0.05 in the soil samples of agriculture field.

The total amount of potassium (mg/l) in the soil sample obtain from agriculture soil at different sites were 20±0, 10±0, 10±0, 10±0 at site 1, 2, 3 and 4 (Table 2) respectively. However sodium was not present in soil samples. The concentration of calcium in soil samples were 88±8, 64±4, 60±0 and 40±0 at site 1, 2, 3 and 4 (Table 2) respectively. During the present investigation the Nitrate content ranged between 4.58±0.01 to 34.1±0.05 (mg/l) in the soil samples of agriculture field.

The total amounts of Acidity in the soil sample obtain from Highway soil at different sites were 50±0, 100±0, 100±0 at site 1, 2 and 3 (Table 3) respectively. However, Carbonate and Bicarbonate was present in highway samples and range is 0.152 to 0.305 respectively. The concentration of chloride in soil samples were 887.5±0, 887.5±0 and 138.4±30.4 at site 1, 2 and 3 (Table 3) respectively. During the present investigation the sulphate (mg/l) content ranged between 0.08±0.01to 0.37±0.01 in the soil samples of highway.

The some amounts of sodium (mg/l) in the soil sample obtain from Highway soil at different sites (Table 3) respectively. However, Potassium was present in highway samples and range is 20 to 90 respectively. The concentration of organic carbon (mg/l) in soil samples were 9.20±0, 9.73±0.02 and 9.33±0 at site 1, 2 and 3 (Table 4) respectively.

The total amounts of soil moisture (%) in the soil sample obtain from industrial soil at different sites were 59.3±0.43, 69.2±0.39, 59.2±0.64 at site 1, 2 and 3 (Table 5) respectively. However, pH was present in highway samples and range is 9.7 to 10 respectively. The concentration of chloride (mg/l) in soil samples were 120.7±34.7, 355±0 and 88.7±0 at site 1, 2 and 3 (Table 5) respectively. During the present investigation the sulphate (mg/l) content ranged between 0.04±0.01 to 0.45±0.01 in the soil samples of industrial field.

Table 1: Physicochemical properties of agriculture soils at different sites.

Parameters	Site 1	Site 2	Site 3	Site 4
Soil texture	Loamy sand	Silt loam	Clay loam	Loam
Soil moisture %	72.63±0.37	68.00±0.12	67.27±0.32	69.20±0.32
pH	10.1±0	9.8±0	9.9±0	9.9±0
EC dS/cm (in soil suspension 1:5)	0.6±0	0.6±0	0.6±0	0.5±0
Alkalinity (mg/l)	90±29.15	50±3.16	110±6.32	114±6
Acidity(mg/l)	120±0	120±0	150±0	150±0
HCO_3^- and CO_3^- (mg/l)	0.457±0	0.152±0	0.305±0	0.305±0
Chloride(mg/l)	0	53.25±0	53.25±0	53.25±0
Sulphate (mg/l)	102.6±102.4	0.33±0.01	0.29±0.01	0.21±0.01

Table 2: Fertilizer value of Agriculture soil at different sites

Parameters	Site 1	Site 2	Site 3	Site 4
Sodium (mg/l)	10±0	0	0	0
Potassium (mg/l)	20±0	10±0	10±0	10±0
Organic carbon (mg/l)	9.66±0	9.8±0	9.8±0	9.8±0
Calcium (mg/l)	88±8	64±4	60±0	40±0
Magnesium (mg/l)	85.05	92.34	97.2	133.65
Nitrate (mg/l)	11.88 ±0.03	4.58±0.01	6.28±0.01	34.1±0.05

Table 3: Physicochemical properties of Highway soils at different sites

Parameters	Site 1	Site 2	Site 3
Soil texture	Loam	Sandy loam	Silt clay loam
Soil moisture %	69.99±0.84	68.23±0.09	61.13±0.32
pH	9.5±0	9.8±0	10.0±0
EC dS/cm (in soil suspension 1:5)	0.4±0	0.6±0	0.6±0
Alkalinity (mg/l)	106±2.45	106±4	46±2.45
Acidity(mg/l)	50±0	100±0	100±0
HCO_3^- and CO_3^- (mg/l)	0.305±0	0.305±0	0.152±0
Chloride(mg/l)	887.5±0	887.5±0	138.4±30.4
Sulphate (mg/l)	0.29±0.01	0.37±0.01	0.08±0.01

Table 4:Fertilizer value of soil of Highway soil at different sites

Parameters	Site 1	Site 2	Site 3
Sodium (mg/l)	40±0	0	0
Potassium (mg/l)	20±0	20±0	90±0
Organic carbon (mg/l)	9.20±0	9.73±0.02	9.33±0
Calcium (mg/l)	0	40±0	8.8±0.8
Magnesium (mg/l)	0	121.5±0	36.4±0
Nitrate (mg/l)	27.2±0.14	15.5±0.01	21.7±0.01

Table 5: Physicochemical properties of Industrial soils at different sites

Parameters	Site 1	Site 2	Site 3
Soil texture	Silt clay loam	Silt loam	Silt sand
Soil moisture %	59.3±0.43	69.2±0.39	59.2±0.64
pH	9.7±0	9.7±0	10.0±0
EC dS/cm (in soil suspension 1:5)	0.6±0	0.5±0	0.6±0
Alkalinity (mg/l)	146±2.45	440±10	154±2.45
Acidity(mg/l)	100±0	150±0	150±0
HCO_3^- and CO_3^- (mg/l)	0.457±0	1.372±0	0.457±0
Chloride(mg/l)	120.7±34.7	355±0	88.7±0
Sulphate (mg/l)	0.37±0.01	0.45±0.01	0.04±0.01

The total amounts of soil moisture (%) in the soil sample obtain from nitrate soil at different sites were 3.63±0.02, 19.52±0.02, 2.90±0.01 at site 1, 2 and 3 (Table 6) respectively. However, magnesium (mg/l) was present in industrial samples and range is 0 to 133.6±0 respectively. The concentration of chloride in soil samples were 120.7±34.7, 355±0 and 88.7±0 at site 1, 2 and 3 (Table 5) respectively. During the present investigation the potassium (mg/l) content ranged between 20±0 to 70±0 in the soil samples of industries.

The electrical conductivity in the soil sample obtain from market soil at different sites were same as 0.6±0 at site 1, 2 and 3 (Table 7) respectively. However, chloride was present in market soil samples and range is 35.5 to 248.5 respectively. The concentration of sulphate in soil samples were 0.34±0.01, 0.33±0.01and 0.34±0.01 at site 1, 2 and 3 (Table 7) respectively. During the present investigation the carbonate and bicarbonate (mg/l) content ranged between 0.305±0 to 0.457±0 in the soil samples of market.

The total amounts of organic carbon (mg/l) in the soil sample obtain from market soil at different sites were 8.66±1.03, 8.99±0.02 and 8±0 at site 1, 2 and 3 (Table 8) respectively. However, magnesium was present in market soil samples and range is 55.8 to 97.2 respectively. The concentration of calcium in soil samples were 55.2±9.33, 96±4 and 40±0 at site 1, 2 and 3 (Table 8) respectively. During the present investigation the organic carbon content ranged between 8±0 to 8.99±0.02 in the soil samples of market.

The electrical conductivity in the soil sample obtain from Barren soil at different sites were 0.3±0, 0.6±0 and 0.6±0 at site 1, 2 and 3 (Table 9) respectively. However, sulphate was present in Barren soil samples and range is 0.29 to 0.33 respectively. The concentration of chloride (mg/l) in soil samples were 177.5±0, 53.25±0 and 177.5±0 at site 1, 2 and 3 (Table 9) respectively. During the present investigation the pH content ranged between 9.9±0 to 10.2±0 in the soil samples of Barren land.

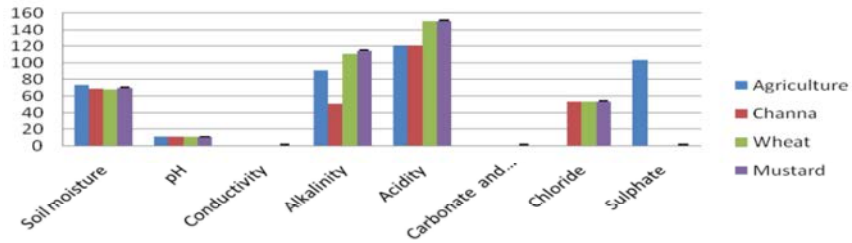

Fig. 1: Physico-chemical properties of agriculture soils at different sites

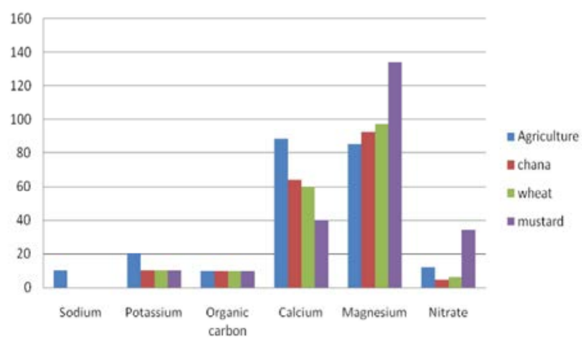

Fig. 2: Fertilizer value of agriculture soil at differents sties

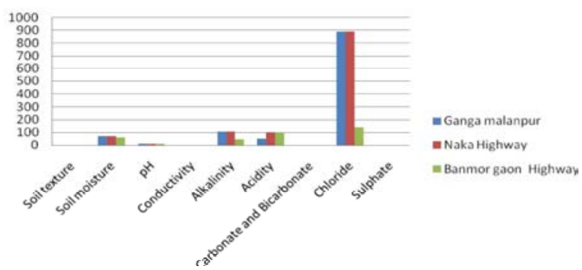

Fig. 3: Physico-chemical properties of Highway soils at different sites

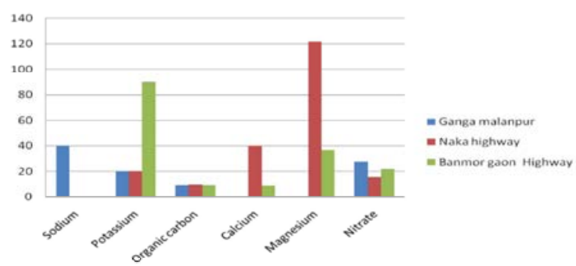

Fig. 4: Fertilizer value of Highway soil at differents sties

The total amount of nitrate in the soil sample obtain from Barren soil at different sites were 1.49±0.02, 4.38±0.01 and 1.49±0.02 at site 1, 2 and 3 (Table 10) respectively. However, magnesium was present in Barren soil samples and range is 124.2 to 126.3 respectively. The concentration of potassium (mg/l) in soil samples were 120±0, 70±0 and 120±0 at site 1, 2 and 3 (Table 10)

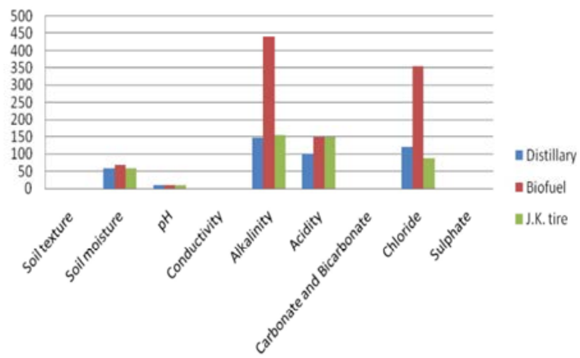

Fig. 5: Physico-chemical properties of Industrial soils at different sites

Table 6: Fertilizer value of Industrial soil at different sites

Parameters	Site 1	Site 2	Site 3
Sodium (mg/l)	10±0	40±0	0
Potassium (mg/l)	70±0	20±0	30±0
Organic carbon (mg/l)	8.23±0.02	6.66±1.03	1.05±0
Calcium (mg/l)	20±0	13.6±1.6	12±0
Magnesium (mg/l)	0	0	133.6±0
Nitrate (mg/l)	3.63±0.02	19.52±0.02	2.90±0.01

Table 7: Physicochemical properties of Market soil at different sites

Parameters	Site 1	Site 2	Site 3
Soil texture	Loam	Silt clay loam	Sand
Soil moisture %	62.73±1.04	66.5±3.35	63.67±0.67
pH	10.2±0	9.8±0	9.8±0
EC dS/cm			
(in soil suspension 1:5)	0.6±0	0.6±0	0.6±0
Alkalinity (mg/l)	152±32	106±4	104±4
Acidity(mg/l)	10±0	10±0	20±0
HCO_3^- and CO_3^- (mg/l)	0.457±0	0.305±0	0.457±0
Chloride(mg/l)	248.5±0	35.5±0	248.5±0
Sulphate (mg/l)	0.34±0.01	0.33±0.01	0.34±0.01

Table 8: Fertilizer value of Market soil at different sites

Parameters	Site 1	Site 2	Site 3
Sodium (mg/l)	20±0	0	20±0
Potassium (mg/l)	90±0	40±0	110±0
Organic carbon (mg/l)	8.66±1.03	8.99±0.02	8±0
Calcium (mg/l)	55.2±9.33	96±4	40±0
Magnesium (mg/l)	97.2±0	55.8±2.59	97.2±0
Nitrate (mg/l)	4.38±0.01	2.31±0.02	1.49±0.02

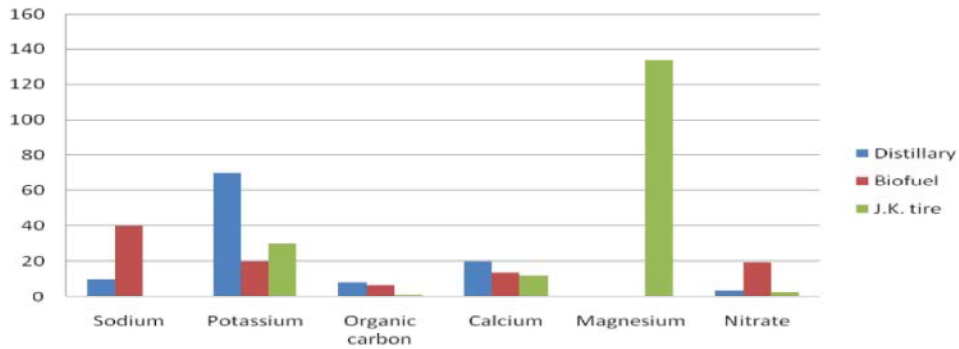

Fig. 6: Fertilizer value of Industrial soil at differents sties

Table 9: Physico-chemical properties of Barren soil at different sites

Parameters	Site 1	Site 2	Site 3
Soil texture	Sand	Sand	Loamy sand
Soil moisture %	67.53±0.94	62.73±1.04	61.57±0.41
pH	10.2±0	10.2±0	9.9±0
EC dS/cm (in soil suspension 1:5)	0.3±0	0.6±0	0.6±0
Alkalinity (mg/l)	102±2	104±1.96	102±2
Acidity(mg/l)	30±0	30±0	30±0
HCO_3^- and CO_3^- (mg/l)	0.366±0	0.305±0	0.305±0
Chloride(mg/l)	177.5±0	53.25±0	177.5±0
Sulphate (mg/l)	0.32±0.01	0.33±0.01	0.29±0.01

Table 10: Fertilizer value of Barren soil at different sites

Parameters	Site 1	Site 2	Site 3
Sodium (mg/l)	20±0	0	10±0
Potassium (mg/l)	120±0	70±0	120±0
Organic carbon (mg/l)	8.33±0.06	8±0	8.66±1.03
Calcium (mg/l)	87.2±11.6	40±0	56±4
Magnesium (mg/l)	126.3±0	124.2±0	126.3±0
Nitrate (mg/l)	1.49±0.02	4.38±0.01	1.49±0.02

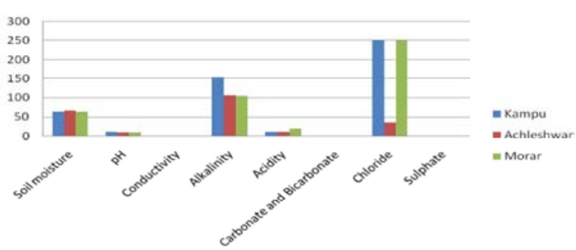

Fig. 7: Physico-chemical properties of market soils at different sites

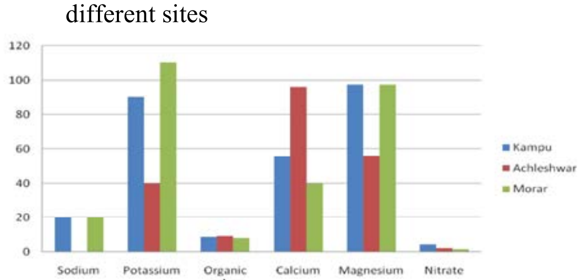

Fig. 8: Fertilizer value of Market soil at differents sties

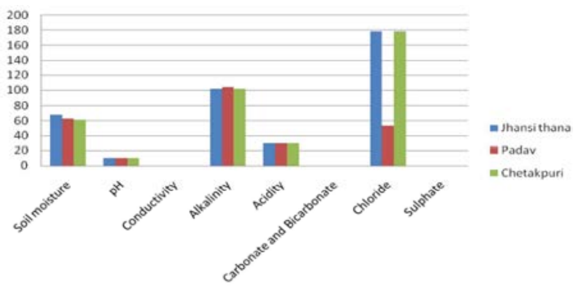

Fig. 9: Physico-chemical properties of Barren soils at different sites

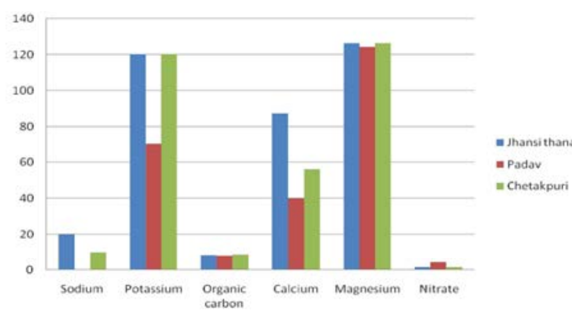

Fig. 10: Fertilizer value Barren of soil at differents sties

respectively. During the present investigation the sodium (mg/l) content ranged between 10±0 to 20±0 in the soil samples of Barren land.

DISCUSSION

The soil of Gwalior is Loamy sand and Silt loam and the texture of agriculture, Industrial, highway and market sites was silt loam, clay loam, sandy loam and sandy respectively, presumably related to the parent materials. However, at agriculture site, there were two different soil textures (i.e. clay loam and silt loam). It may have originated from the parent material i.e. sandstone and color of the soil become redder with depth. However, the soil at industrial area was black to brown which is attributed to the type of activity carried out at these industries. This phenomenon was probably also due to the difference in weathering process of parental materials of sedimentary rocks and unconsolidated or alluvial sediments. The soil at Gwalior was situated on a plain area covered by endemic plants. During the soil sampling, soil fauna activity was observed at agricultural soil and industrial soil. There was no evidence of soil fauna activity at the Highway site. The organic layer at these sites could be attributed to the supply of raw materials and the different types of fauna present. The evidence of soil fauna activity could be seen under a thick litter above the ground of the plantation site [8]. No soil fauna activity at the site was probably due to the constant flow of vehicles, day and night on the roads of highway.

Macronutrient tends to be less available in soil with low pH, while the micronutrient tends to be less available with high pH. The pH of all the soil samples was between 9.5 and 10.2; hence all soils were slightly alkaline in nature. Higher pH at depth suggested that the acidification process tended to be higher in the surface horizon than the subsoil. According to Kadir *et al*, [9], the higher acidity in the surface soil was associated with hydrolysis of Al, which was released under strongly leaching conditions and which subsequently lower pH, causing toxicity.

Electrical conductivity of all the soil samples was between 0 to 0.6 /ums. Soil with 35 and 65% overall fertility are considered to be good for plant growth. All the soils under the study were found to be fairly fertile. It was observed that cultivated soils like Rice, maize, gram and sugarcane were quite fertile, while uncultivated soils Highway, Industrial and barren soils less fertile.

Alkalinity of soil was found in the soil sample shows that presence of H^+ ions OH^- ions and CO_3 ions. The alkalinity was found in the agriculture soil sample ranged between 50 to 114 mg/l. Previous study suggested that the higher amount of alkalinity is harmful for the proper growth of cultivable species.

Acidity of soil sample shows that HCO_3 present in the soil sample. If the amount of acidity will increase in the soil it is very harmful for the human beings, plant and other aquatic organisms. The higher amount of acidity range was found in the Highway soil 100 – 150 mg/l (Table 5). This may be attributed to the point and non point source of pollution due to vehicles and other associated activities along the highway.

Carbonate and Bicarbonate found in the soil sample and the amount of this element in the soil sample shows that presence of CO_3 and HCO_3 ions. The higher amount of carbonate and bicarbonate present in the Market soil and low amount of carbonate and bicarbonate present in Highway soil.

Chloride was not found in the ratio of 2:1 of Loamy sand soil and was almost absent in the soils of agriculture at site I but in the industrial soil chloride was present in sufficient amount above 355 mg/l indicating that the soils were highly weathered. Therefore, further weathering of the soil associated with high rainfall would lead to the soil leaching and acidity, which subsequently increased the retention of aluminum. This consequently leads to the formation of soil with low nutrient capacity and the availability to the plants would be restricted. This is due to alteration of primary minerals as the weathering process starts.

Organic matter in the soil associates partly with minerals; this renders SOM less susceptible to biodegradation than when it is free. Therefore, in the ecosystem with frequent soil disturbance, accelerated turnover rates of macro-aggregates limit the physical stabilization of labile SOM compounds. The extractable phosphorous concentration of agriculture land at site I, II, III and IV was relatively higher than other sites might be attributed to external phosphorous supply. Site 1 of agriculture soil exhibit adequate micro- nutrient availability, while the other sites tended to be deficient with most micro-nutrient Na, K and Ca, attributed to its pH and non-amendments of these micro nutrients as fertilizer.

Organic carbon content of all the cultivated soil samples was found to be high in Agriculture land (Table 2) except the chloride found is very high in Highway soil (Table 3). In Barren land soil samples also the organic carbon was found very low. Garden soil have also very high organic carbon (Table 2 and site 4) respectively. The agriculture soil shows significantly varied organic carbon, total nitrogen, extractable phosphorous, pH and conductivity between sites. The site 1 of agriculture soil relatively high organic carbon and high nitrate was present at site 1 of highway soil, respectively. Despite difference in land use and management practice, the higher organic carbon and nitrogen in site 1 might be ascribed to less intensive cultivation and higher organic residues return through litter fall and root exudates of plants and shade trees. By contrast, low organic carbon (OC), nitrogen concentration is most likely attributed to the reduced amount of organic material being returned to the soil system and high rate of oxidation of SOM due to more intensive cultivation by heavy machinery. Similarly, studies indicated that intensive cultivation decrease soil carbon contributed to terrestrial net fluxes of carbon to the atmosphere and decreased net primary productivity.

Accumulation of thick litter of about 3 cm above the ground was observed in the field during the soil sampling at industrial area (J.K. Tire). Litter, a potential source of organic carbon for the soils, mainly consisted of undecomposed leaves, which were not found at the other planting site. However, this does not necessary means that the other planting sites were effective in producing litter. A study by Fisher, 1995 stated that degraded land could be improved by planting fast growing tree species such as *Acacia mangium* that grew rapidly and returned large amount of organic carbon 3 years after establishment in tropical rain forests.

Sodium of all the soil samples was found within the normal ranged of (10 – 40 mg/l) except for one sample of garden soil with slightly beyond the limit (12%). Sodium is essential for plant growth and work as a nutrient for the plant. In the Agriculture soil like Gram, Wheat and Mustered amount of sodium is present 0.

Potassium is absorbed by the plant in larger amounts than any other mineral element except nitrogen and in some cases, calcium. It helps in the building of protein, photosynthesis, fruit quality and reduction of diseases. Available potassium of cultivated soils and barren land soils was between medium to high and some cases it is found in medium, whereas in the garden soils it was medium.

Sulfur is very important part of the proteins needed to sustain life in all biological organisms, sources of sulfur in soils. The range of sulfur in the agriculture soil is 0.21 to 102 mg/l. the highest amount of sulfur found in the vegetable soil and low amount sulfur found in the industrial soil.

The different sites displayed measured variation among the selected physico-chemical properties. A high amount of calcium found in the agriculture soil specific the site-2 when the adding of limiting material in the soil. Calcium deficiency symptoms can be rather vague in soils of Gwalior since the situation often is accompanied by low soil pH. The wheat plant may get deformity in no of ways due to the deficiency in the calcium. The first definite symptoms in wheat plant are a necrotic spotting about the middle of the leaf in the new growth which gradually expands and collapses midway before unrolling. Extremely base soils are induced an entirely new set of symptom often from different toxicity and deficiency as it is evident from many fruits and vegetable that demonstrated symptoms such as Black heart in celery and broccoli tip burn in lettuce and cabbage white heart or hollow heart in cucurbits, blossom end not in tomatoes and peppers and pops in peanuts. The relatively low value of silt loam and clay loam content of the soil at the industrial site were probably due to the weathering process, reflected by low silt loam to clay loam ratio, which are the characteristics of humid soils [10]. Calcium is an essential part of plant cell wall structure, provides for normal transport and retention of other elements as well as strength to the plant. It is also counteract the effect alkali salt and organic acids within a plant. Calcium content in all the soils was medium to very low, ranging from 8.8 – 96 kg/Ha. Comparatively, agriculture soils were medium in calcium content ranged between 40 – 88 kg/Ha. Tree fruit with how calcium will exhibit increase storage problem such as bitter-pit in apples, cork spot in apples and pears cracking in cherries and often degradation of the fruit while in storage deficiency in all crops also impair root growth and lead to additional symptoms such as a secondary effect. Most of the problem caused by excess soil calcium is the result of secondary effect of high soil pH.

For the formation of cell wall calcium is essential in the wheat plants as calcium pectate forms part of the middle layer of the cell-wall. The middle lamina regulates the entry of only that nutrient which is not toxic to the plants. The root tip of wheat calcium is very essential for the merismatic activity or formation of new tissues. Beside the direct nutrient value calcium when applied to acid soil increase the availability of other nutrients like phosphorous, nitrogen and molybdenum. Excess of calcium in the calcareous soils depress the uptake of potassium and magnesium.

Magnesium is the part of chlorophyll in all green plants and essential for the photosynthesis. It also helps active many plant enzymes needed for growth. The entire soil sample showed magnesium with the normal ranged required (85 – 126 mg/l) except for two samples each in all the four types of soils that were below the required level (Below 7%).

Nitrate is present in the soil sample is important for the development of the plant and it is very essential nutrient for the crop production. During the present investigation the Nitrate content ranged between 4.58 to 34.1in the soil samples of agriculture field and low amount of nitrate present in the Barren and Industrial soil.

Phosphorous is the essential part for process of the photosynthesis. It is evolved in the formation of all oils, sugar, Starch, transformation of solar energy into chemical energy, proper plant maturation, withstanding stress, rapid growth, blooming and root growth. Available phosphate in the cultivated land was medium to low. In the Barren land soil also, it ranged from medium to low. In the garden soils the available phosphorous was slightly better than the other two types of soil. It was between medium high to medium.

Rate of depletion within N, P and K nutrients, there was highly significant and in difference was observed in those locations. The mean comparison revealed that; the depletion rate of N weighed against P and K, was higher than P and K. This variation happened due to the amount of N, P and K withdrawn from soil by harvesting or due to intense human activities in these areas. The quantity of N, P and K added to soil (through fertilizer, wet deposition, biological fixation and other inputs) differ and their susceptibility to remove through leached and erosion.

In general, it was observed that the agricultural soil samples were more fertile as compared to other sites selected in the present investigation. This is due to the addition o synthetic fertilizers and rotation of crops and due to the addition of litter that may either originate from the crops grown in the fields and may come with the help of different agencies like wind and runoff into the agricultural fields. However, the industrial soil samples that were analyzed in this study showed a fertility values that were moderate to average when compared with industrial and barren soil samples. This is due to the fact that in industrial areas different activities add nutrients and different other substances that may either decrease or increase the value of nutrients in the soil. The soil samples were collected from the adjacent areas of distillery, Global Biofuels and JK Tires and the type of products they are manufacturing may not have added any chemical or pollutant that may have decreased a fertility value of the soil. The presence high plantation cover (*Mangifera indica, Prunus mume, Dalbergia sissoo, Azadirachta indica, Ocimum sanctum, Hibiscus rosa-sinensis*) around these industries might have added the nutrients in the soil and the pollutants may have been absorbed by these plants by a process of phyto-remediation. However, this study has not analyzed the heavy metals that may be present in these areas. Similarly, in case of National highways soil samples the fertility value of the soils was very less and is attributed to less plantation, high traffic flow and influence of human activities. The barren area showed negative response to fertility values due to the absence of tree cover.

The development process and industrialization that has taken place over the decades is playing an important role in minimizing the fertility values of soils in Gwalior. This may decrease the crop productivity in Madhya Pradesh. Provisions must be made to plant trees in barren land in and around Gwalior that may not only add fertility to the soil but may add beauty to the city as well. Further, soil testing should be done regularly to know the fertility value of the agriculture soils. There must be a proper demarcation of agriculture and industrial belts in the Gwalior which has currently zero existence. It was found that most of the industries and developmental projects are engulfing the agricultural land in Gwalior that is a threat for the sustainable development of the agriculture and cause of concern among the farming community. Strict provision must be made while issuing non objection certificate for the developmental projects in Gwalior. It was observed that some of the socioeconomic and political issues are marring this process which must be abolished.

CONCLUSIONS

- It was observed that the fertility of agriculture soil in Gwalior is low (30-35%).
- The application of synthetic pesticides and fertilizers is very high in Gwalior that has also decreased the fertility of soil.
- The crops are grown for the fodder of cattle that drain out the soil from nutrients.
- The industrial effluent directly passes into the agriculture soil is also the cause of concern.
- Industrial area in general is much polluted and less planted.
- Distillery industry is situated at the center of village Rairu that may not only affect the adjacent agriculture soil but also affects the health of people.
- Waste from industrial area is thrown directly into the agriculture soil that depletes the soil from its original nutrients.
- Industries and developmental projects are engulfing the agricultural soil in Gwalior that is a threat for the sustainable development of the agriculture and cause of concern among the farming community.

REFERENCES

1. Osman, K.T., 2013. Soils: principles, properties and management. Springer Science+ Business media, Dordrecht, The Netherlands, pp: 271.
2. Foth, H.D. and B.G. Ellis. 1997. Soil Fertility, 2nd Ed. Lewis CRC Press LLC. USA. pp: 290.
3. Mesfin Abebe, 1998. Nature and management of Ethiopian soils. Alemaya University of Agriculture, Ethiopia. pp: 272.
4. Gupta, P.K., 2005. Methods in Environmental Analysis: Water, Soil and Air. Published by Agrobios (India), Jodhpur. pp: 1-127.
5. Bashour, I., I. Sayegh and A.H. 2007. Methods of analysis for soils of arid and semi-arid regions. FAO Viale delle Terme di Caracalla, 00153 Rome, Italy.
6. Tandon, H.L.S., 1993. Methods of analysis of soil, plants, water and fertilizers. Publ. FDCO. pp: 144.
7. Walkley, A. and C.A. Black, 1934. An examination of different methods for determining soil organic matter and proposed modifications of the chromic acid titration method. Soil Science. 37: 29-38.
8. Fisher, R.F., 1995. Amelioration of degraded rain forest soils by plantation of native trees. Soil Sci. Soc. Am. J., 59: 544-549.
9. Kadir, S., I. Ishizuka, K. Sakurai, S. Tanaka, S. Kubota, M. Hirota and S.J. Priatna, 2001. Characterization of ultisols under different wildfire in South Sumatra, Indonesia, I. Physico-chemical properties. Tropics, 10: 565-580.
10. Kauffman, S., W. Sombroek and S. Mantel, 1998. Soils of Rainforests Characterization and Major Constraints of Dominant Forest Soils in the Humid Tropics. In: Soils of Tropical Forest Ecosystems, Schulte, A. and D. Ruhiyat (Eds.). Springer-Verlag, Berlin, pp: 9-20.