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Physical and Chemical Analysis of Soil Collected from Jaisamand

Bini Das[1] and Bindi[2]

[1,2]Department of Zoology, Rajasthan University

Corresponding author: binidas_ms@yahoo.com

Abstract:

The study was conducted on the physicochemical analysis of soil of Jaisamand lake area. The physical and chemical parameters like pH, EC, moisture content, organic matter, nitrogen, potassium and phosphorous were studied, tabulated and briefly discussed. The soil of Jaisamand is of black cotton type with reddish brown colour. The moisture content of Jaisamand soil is high i.e. 72.41% as compared to normal agricultural field (32.27%). The colour, alkalinity, insufficient amount of phosphorous and organic carbon indicate the starting of soil contamination from agricultural and domestic sewages. The data obtained clearly indicated that the lake is oligotrophic in nature and that the area is good for agriculture of wheat, gram, mustard, zea maize, cotton etc.

Keywords: Physico-chemical analysis, anthropogenic activities, Sewage, Jaisamand

1.0 Introduction:

Alwar is a sub moist climatic district of Rajasthan state. It holds an important place in the agricultural production of the state. Jaisamand lake is one among the important lakes of Alwar, which stores excess water from Siliserh lake during monsoon. Tourism, unscientific agricultural practices and other anthropogenic activities pollute the soil of the south western part of Alwar. Soil is one of the most significant ecological factors, formed from the transformation of surface rock. Soils are natural bodies on which terrestrial plants grow if water, temperature and nutrients are adequate. Man enjoys these plants either for his aesthetic pleasure or to satisfy his material needs. Soil thus form an important substrate for holding the flora as they grow absorbing the nutrients from the soil. According to (Joffee ,1949) soil is a natural body of minerals and organic materials differentiated into horizons. Nature and type of top soil plays an important role in determining the type of vegetations it hold as plants absorb minerals for their normal growth and development. The type of soil is determined by the original parent rock from which the soil is formed by the action of different agents. Soil formation is a constructive as well as a destructive process (pujar et.al., 2012). The predominant destructive process is the physical, chemical and biological degradation of plants and animal structures, which even result in partial loss of some soluble and volatile products, for the formation of organic matter in the soil. However soil microorganisms also have a vital role for maintaining soil fertility as soil is a dynamic medium made up of organic and inorganic matter. (Solanki & Chava , 2010) proved that the nature of the soil is primarily dependant on its continued changes under the effect of physical factors like parent material lime, climate, organic activity etc.

In modern concept, soil quality means the ability of the soil to sustain plant and animal productivity to enhance the quality of air and water for plant and animal health (Doran and Zeiss, 2000; Emnova, 2004). The objectives of the present study were 1) To analyze the nature of the soil samples of Jaisamand lake, Alwar. 2) To investigate the effect of anthropogenic activities in soil quality and crop production. 3) To study the effects of domestic sewage and chemical fertilizers used by famers of the surrounding villages in soil to suggest the suitable restoration and conservation strategies based on the present status of the area.

2. Materials and Methods:

2.1 Study Area:

Alwar district is situated in the north-east of Rajasthan between 27.4° and 28.4°' north Latitudes and 76.7° and 77.13° east Longitude. Its greatest length from south to north is about 137 K.M. and greatest breadth from east to west about 110 K.M. Jaisamand lake is one of the important lake of Alwar district, which is situated in the

geographical depression between two hills of Aravali ranges and two villages (Livari and Balllana). This large artificial lake was constructed by Maharaja Jai Singh in 1910 AD and is situated around 8 km southwest from Alwar city. Soil of this area is black cotton type and suitable for cultivation of many crops like wheat, mustard, gram, zea maize, cotton etc.

2.2 Collection of Samples:

The present study deals with the physico chemical analysis of soil sample from Jaisamand lake collected in the period 2012-2013 from five different sites. The study primarily focused on testing of soil samples collected from five representative sites covering the total area of Jaisamand. The surface contaminated soil material were removed using spade (Gupta, 2007) and for sampling V shaped holes were dug for collecting a uniform 2 cm thick slice of soil up to a depth of 22cm. Samples were collected in a plastic bucket and then thoroughly mixed on a piece of clean cloth and the lumps were broken using wooden pestle and mortar and were air dried (Tandon. 1993). The air dried samples were sieved in 10 mesh diameter, stored in glass bottles and labeled for analysis.

2.3 Estimation of pH and EC:

pH value is a measure of the hydrogen ion activity of the soil water system and expresses the acidity and alkalinity of the soil. It is a very important property of soil as it determines the availability of nutrients, microbial activity and physical condition of soil. pH values were determined using pH meter as described by Jackson (1967). For this, 20 g soil sample was mixed with 40 ml distilled water in 1: 2 ratio. The suspension was stirred intermittently with a glass rod for 30 minutes and left for one hour. The combined electrode was inserted into supernatant and pH was recorded. The electrode was washed with distilled water before each new reading of the soil was taken. Electrical conductivity (EC) expresses ion contents of solution which determine the current carrying capacity thus giving a clear idea of the soluble salts present in the soil. The electrical conductivity of soil samples were determined by immersing Equiptronics digital electrical conductivity bridge in the supernatant solution (prepared in the same as that for pH) to take the reading to record the EC values.

2.4 Soil Moisture:

Soil moisture is the water contained in the soil through rainfall and irrigation. It influences the physical, chemical and biological properties of soil like texture, quality and quantity of organic and inorganic matter and nature and volume of pore size. Moisture content of the soil samples were calculated immediately by oven drying method (Jackson, 1967). 10 g of composite soil sample was kept in hot air oven for 24 hrs at 105°C. Dry weight of the sample was taken till it showed its constant weight.

$$\text{Moisture percentage} = \frac{(W2-W1)}{100} \times 100$$

W1- Weight of Soil before oven drying
W2- Weight of Soil after oven drying

2.5 Estimation of Organic Carbon:

Organic matter is useful in supplying nutrients and water to the plants and also provides good physical conditions to the plants. The quantity of organic carbon in the soil was estimated by using Walkey- black method (Walkey and Black, 1934) as described by (Jackson, 1967). 1g finely ground dry soil sample was passed through 0.5mm sieve without loss and was taken into a 500ml conical flask. To this 10ml of 1N potassium dichromate and 20ml con. H_2SO_4 were added and the contents were shaken for a minute and allowed to set aside for exactly for 30 minutes and then 200ml distilled water, 10ml phosphoric acid and 1ml diphenylamine indicator were added. The solution was titrated against standard ferrous ammonium sulphate till the colour changed from blue violet to green. The blank titration was also carried without soil.

2.6 Estimation of Available Nitrogen:

Nitrogen of soil is mainly present in organic form together with small quantities of ammonium and nitrates. The available nitrogen content of the rhizosphere soil was estimated by alkaline permanganate method. (Subbiah and Asija , 1965). 20 gm of the soil sample was weighed and transferred into 1 lit distillation flask followed by the addition of 10ml of 0.32 % potassium permanganate , 10ml of 2.5% sodium hydroxide, 10ml of distilled water and immediately fitted up in the distillation apparatus. 25ml of 0.02 N sulphuric acid was pipetted into a 250 ml beaker, and one or two drops of methyl red indicator added through the end of the delivery tube dipped in it. The contents of the flask were digested and distilled to collect about 30 ml of the distillate into the known excess of 0.02 N sulphuric acid. The excess of the acid was titrated against 0.02N potassium hydroxide till the pink colour changed into the light yellow. Then from the volume of 0.02N sulphuric acid actually consumed by

ammonia, the percentage of nitrogen present in the given soil sample was calculated.

2.7 Estimation of Available Phosphorous:

In soil available phosphorus is found as orthophosphate in several forms and combinations, but only a small fraction of it may be available to plants. Available phosphorus was estimated by Olsen's method (Olsen, *et al*., 1954). About 5g of soil was weighed and transferred to a 250 ml conical flask and 100 ml of 0.5 M sodium bicarbonate (pH 8.5) was added, followed by one teaspoonful of carbon black, shaken for 30 min. and filtered through Whatman No. 40 filter paper. 10 ml of the filtrate was pipetted out into a 50 ml volumetric flask and a drop of para nitrophenol indicator was added and the pH was adjusted to 3.0 with 4 N Hydrochloric acid. Then 0.25 ml (5 drops) of 0.1 N chlorostannous acid solution was added followed by immediate shaking and the volume was made up. The standard curve was prepared with the same quantity of sodium bicarbonate included. The colour intensity was nearly constant between 4-20 min and was read photometrically after 5 min with a 660 light red filter in Klette summerson calorimeter. The quantity of phosphorus was calculated as Kg per hectare of the soil.

2.8 Estimation of Available Potassium:

Only small fraction of total K is held in exchangeable form (available K), while the rest remains in fixed or non-exchangeable form. The flame photometric method (Jackson, 1958) was employed to estimate available K of samples. 5g of air dried sample was taken in 150ml Erlenmeyer flask and 25 ml of 1 N ammonium acetate was added to the flask. The contents were shaken for 5 minutes on a mechanical shaker and filtered immediately through a dry Whatsman No.1 filter paper. 5ml of filtrate diluted with 25 ml with distilled water. Atomized the above diluted extract to flame photometer to note the reading and the quantity of potassium was calculated as Kg per hectare of the soil.

3.0 Result and Discussion:

Examination of the soil samples show that the values of pH range from 8.25 to 9.00, (tab.1) while ideal pH range from 7.5 to 7.8, which shows that the soil of Jaisamand is slightly alkaline due to excessive evaporation of water in dry areas, which bring salts to the surface. pH can affect the availability of nutrients in the soil (Patil *et al*., 1991) and plant growth is limited in alkaline medium. Sample 4 and 5 showed maximum pH (Fig.1) in soil as the solubility of minerals decreases creating nutrient deficiencies in the soils. EC is used to find out the soluble salt concentration of the soil and when EC values exceed the recommended value, the germination of almost all crops would be seriously affected resulting in much reduced yield. In the present study its value ranges from 0.20mS/cm to 1.08 mS/cm. The soil samples except sample number 5 are severely saline, which may be due to the excessive use of fertilizers for agriculture. Soil moisture content, varying from 40.1 to 72.4, is comparatively high in comparison with surrounding agricultural area. High moisture content indicate the soil is fine structured and have small particles providing more surface area for water absorption and reduce percolation. The organic carbon present in soil range from 0.30% to 0.59%, which is very low from the normal value. The organic soil matter includes plant and animal debris and varies depending on the rate of decomposition. It keeps the soil open to hold air and water and provide energy, nutrients for soil living things. The present study shows that organic carbon increases with soil moisture (Fig. 2) This may be because of increased microbial activity. Similar observations such as the one which suggests that organic matter increases water holding capacity were reported by other scientists also (Darwish (1995). Nitrogen, phosphorous and potassium are the main soil nutrients for normal germination, growth and maturity of plants. The availability of nitrogen depends on the varying degree of soil microbial decomposition (Gairola and Soni, 2010). Nitrogen and potassium content varies from 40-50kg per hectare and 142 to 337kg per hectare respectively indicating its sufficient amount in Jaisamand soil. Potassium was observed to be high during rainy season and low during summer in the investigated period. It may be due to leaching of potassium probably from the agricultural fields. The available phosphorous in Jaisamand soil range from 17.4 to 31.4kg/ha, which is comparatively low. Application of phosphorus is necessary for maintaining a balance between the other plant nutrients and ensuring the normal growth of the crop. Phosphorous act as a limiting or co-limiting factor of ecosystem productivity (Elser et al., 2007; Harpole et al., 2011) and low P availability can constrain N_2 fixation (Wang et al., 2007; Vitousek etal., 2010).

Table 1. Physico chemical properties of soil from Jaisamand area

Sample	pH	EC (mS/cm)	Moisture %	Organic Carbon %	Nitrogen (kg/ha)	Phosphorous (kg/ha)	Potassium (kg/ha)
1	8.75	0.75	40.1	0.38	40	17.4	187
2	8.42	0.56	53.63	0.59	49	31.4	142
3	8.20	0.67	58.12	0.54	51	19.2	257
4	9.00	1.08	72.41	0.47	54	23.1	337
5	8.54	0.20	64.93	0.30	46	27	295

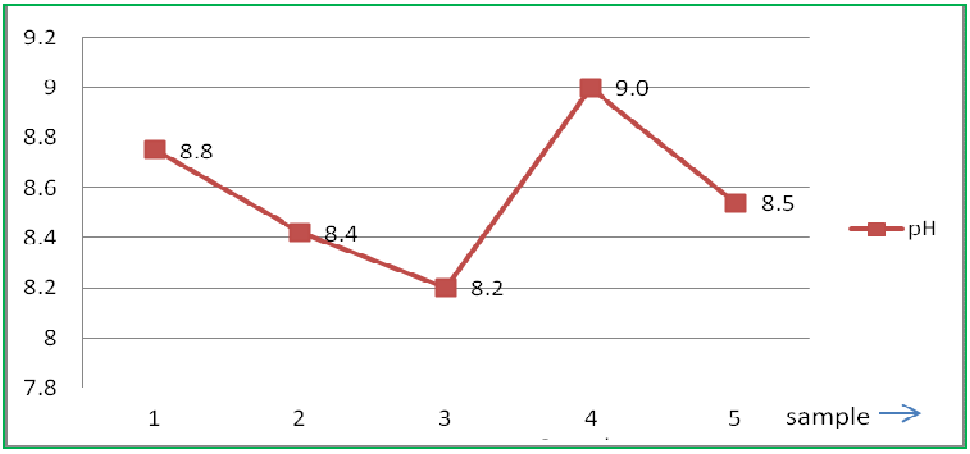

Fig.1: Variation in pH of different soil samples.

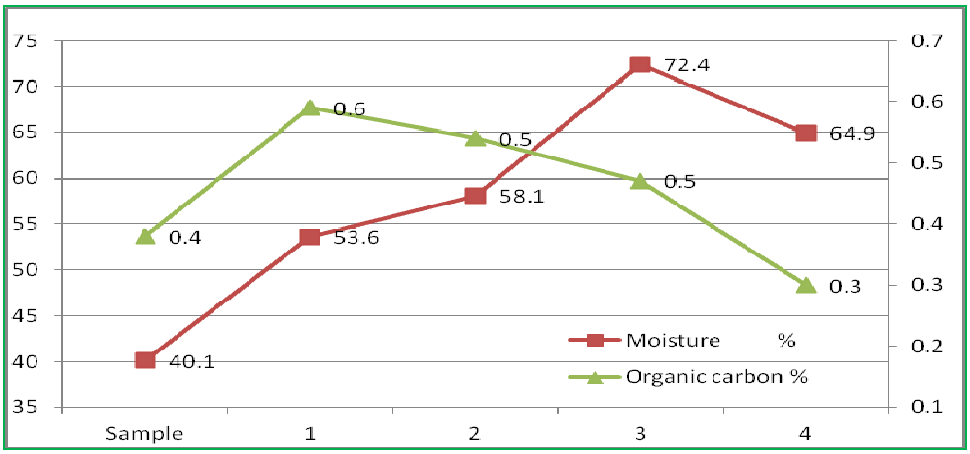

Fig. 2: Comparison of soil organic matter and soil moisture

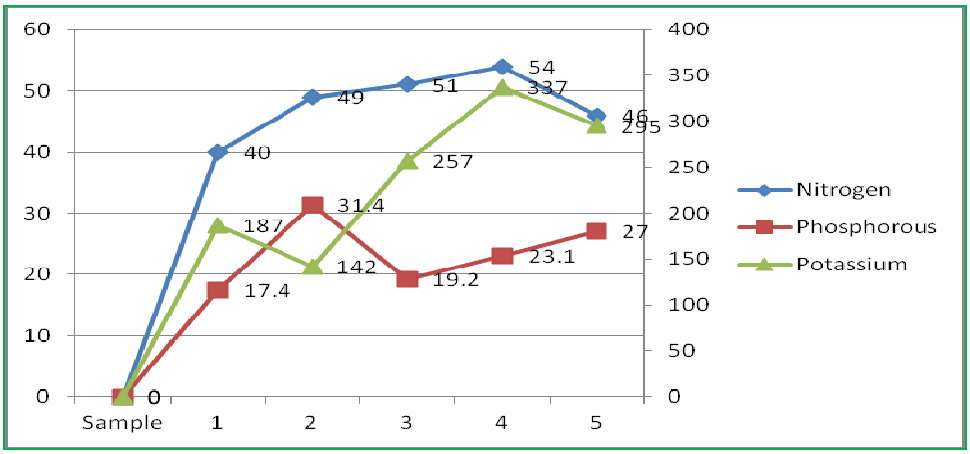

Fig. 3: Comparison of the main soil nutrients

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