ESTIMATION OF SOIL ORGANIC CARBON OF THE AGRICULTURAL SOIL OF SENDHWA CITY IN THE SOUTH EASTERN ZONE OF BARWANI DISTRICT OF MADHYA PRADESH

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***Abstract*- Soil organic carbon (SOC) is the main component of soil organic matter (SOM). As an indicator for soil health, SOC is important for its contributions to food production, mitigation and adaptation to climate change, and the achievement of the Sustainable Development Goals (SDGs).A high SOM content provides nutrients to plants and improves water availability, both of which enhance soil fertility and ultimately improve food productivity. Moreover, SOC improves soil structural stability by promoting aggregate formation which, together with porosity, ensure sufficient aeration and water infiltration to support plant growth. Soil organic matter supplies essential nutrients and has unexcelled capacity to hold water and absorb cations. Soil organic carbon content is one of the key soil properties associated with many soil functions.**
Therefore, this study is designed to estimate the soil organic carbon of the study area which will help to solve the problems low crops productivity, soil erosion, soil pollution and loss of biodiversity of the study area.

Keywords: **Soil Organic Matter, Soil Organic Carbon, Food productivity. Soil erosion.**

Introduction:

Soil carbon is probably the most important component in soils as it affects almost all soil properties.Carbon,as soil organic matter, alters the physical, chemical, and biological properties of soils. Soil organic matter refers to all decomposed, partly decomposed and undecomposed organic materials of plant and animal origin. Soil organic matter is a primary indicator of soil quality. Degradation of soils can occur due to depletion of organic matter (OM), extensive use of chemical fertilizers and pesticides and reduction of biodiversity.(2) Improvements in soil organic matter create a more favorable soil environment, leading to increases in plant growth. Higher soil organic matter levels cause the soil to retain more water that results in better crop yields, reduces soil erosion, increases plant nutrient retention and increases biological diversity. Moreover, improved aggregation of soil particles results in better soil structure, allowing for movement of air and water through the soil, as well as better root growth. Soil organic carbon contributes to the cation exchange capacity of a soil. These cation exchange sites are important for retention of nutrients such as calcium, magnesium and potassium. Soil organic carbon often also provides binding sites for many anthropogenic organochemicals, thus minimizing leaching of hazardous chemicals through the soil profile or making them less bioavailable, which reduces toxicity.

The study area are facing the problems of increasing use of fertilizer and low productivity of crops such as cereal, oilseeds, pulses and soybean are identified. Soil erosion ,barren land , loss of biodiversity, soil pollution and excess application of pesticides, herbicide and chemical fertilizers by farmers may be a threat to the environment especially the soil and water quality in the study area. Therefore this study is designed to estimate the soil organic carbon of the study area which will help to solve the problems of the study area.

Material and Methods:

Location and Climate:

Sendhwa city belongs to the Barwani district in South Western part of Madhya Pradesh. Sendhwa is a small town situated 155 km away from Indore towards Mumbai. Sendhwa is geographically located at 21°41N75° 06E21.68° N75.1°E. It has an average elevation of 409 meters(1341feet). It is also a Tehsil of Barwani district. The city is bordered by Maharashtra state to the south, Gujarat state to the west Dhar district to the north and Khargone district to the east.The climate of the region is divided into four seasons. Winter from December to Februray, summer from March to May, rainy from June to September and autumn for October to November. May is the hottest month in the year and December is the coldest. The peak temperature of the city during day time is 42°C to 45°C in May and low temperature during

night is 6°C to 10°C in December. Humidity during rainy season is about 70%. The average rainfall in the city is about 831 mm.

Collection of samples:
Surface soil samples (0-15 cm) at random were collected from 15 different location in the city during Apr- May 2023 in the help of soil auger. The exact sample location was recorded using a GPS. For representative soil sample collection standard methods, procedure and precautions were adopted.
Sample preparation: Air dry soil sample and sieve to ≤ 2.0 mm size.

Materials:
1) Deionized water/distilled water, it should have an EC < 1.5*10-3 dS m-1m.
2) Potassium Dichromate Standard, 0.167 M (1.0 N).
3) Sulfuric Acid, Concentrated (not less than 96%) , containing 1.25 percent silver sulfate (In case of soils free from chlorides use of Ag_2SO_4 can be avoided). If Cl is present in soil, add Ag_2SO_4 to the acid at the rate of 15 g per liter.
4) Ortho-phosphoric Acid, 85% (If Diphenylamine indicator is used) or chemically pure sodium fluoride.

Indicator (either 1. or 2. or 3. can be chosen):
1) O-Phenanthroline - Ferrous Complex, 0.025 M also available under the name of Ferroin.
2) N-phenylanthranilic acid indicator.
3) Diphenylamine indicator.
Note: It is better to use either O-phenanthroline (Ferroin) or N-phenylanthranilic acid indicators instead of diphenylamine.

Titrant (either 1. or 2. can be chosen):
1) Ferrous Sulphate ($FeSO_4$) solution, 0.5 M: Standardize this reagent daily by titrating it against 10 mL of 0.167 M (1 N) potassium dichromate.
2) Ferrous Ammonium Sulphate, 0.5 M: Standardize this reagent daily by titrating it against 10 mL of 0.167 M potassium dichromate.
Note: The Fe^{2+} in both solutions oxidizes slowly on exposure to air so it must be standardized against the dichromate daily. Prepare a new solution every 30 days.This solution is relatively more stable and convenient to work than that of ferrous sulphate.

Method of determination of soil organic carbon:
Organic carbon content in soil was determined by Walkley and Black's rapid titration method (1934).[3]
5 g of soil sample was taken to which 10 ml potassium dichromate ($K_2Cr_2O_7$) and 20 ml commercial sulphuric acid (H_2SO_4) were mixed. The mixture was kept as such for about ½ an hour. Then 200 ml tap water, 10 ml phosphoric acid(H_3PO_4) and 2 ml diphenylamine indicator was added. The colour of the solution turned into ink blue. Now this solution was titrated against 0.5 N ferrous ammonium sulphate till the solution became green in colour indicating the end point of the titration. The value at end point was noted down from the burette and organic carbon content was estimated by using the formulae.

$$\text{O.C.(\%)} = \frac{X-Y}{2} \times 0.003 \times 100$$

Where X = Blank reading , Y = Titrated value

Health and safety: This procedure involves the use of hazardous chemicals. Refer to laboratory safety guidelines or Material Safety Data Sheet (MSDS) before proceeding.
Personnel safety: Safety glasses, gloves and lab coats must be worn when handling any chemicals.
Chemical hazard:
1) Potassium dichromate: is an inorganic compound that emits toxic chromium fumes upon heating. Potassium dichromate is highly corrosive and is a strong oxidizing agent. This substance is a known human carcinogen and is associated with an increased risk of developing lung cancer.
2) Sulfuric acid: Keep away from naked flames/heat. Measure the concentration in the air regularly. Carry out operations in a fume hood with exhaust/ventilation. Do not discharge the waste into the drain. Never dilute by pouring water into the acid. Always add the acid to the water.
3) Hygiene: Wash hands and clean other exposed areas with mild soap and water after using all chemical reagents.
4) All titrations and handling of chemicals to be undertaken in a fume hood.

S.No.	Location	Latitude and Longitude	Ab-OC%
1.	Gram Merkhedi , Niwali Rd.,Sendhwa ,451666,MP.,India.	Lat.21.691322°Long.75.091958°	0.3638
2.	Gram Pipaldhar, Niwali Rd.,Sendhwa ,451666,MP.,India.	Lat.21.685646°Long.75.073152°	0.2841
3.	Front of Suraj Nagar, Niwali Rd.,Sendhwa ,451666,MP.,India.	Lat.21.682784°Long.75.076104°	0.4611
4.	Front of Agrawal Colony, Niwali Rd.,Sendhwa ,451666,MP.,India.	Lat.21.683744°Long.75.087165°	0.5458
5.	Near Chhote Ghatiya Patiya, Niwali Rd.,Sendhwa ,451666,MP.,India.	Lat.21.681364°Long.75.077811°	0.4235
6.	Ahead of Chhote Ghatiya Patiya, Niwali Rd.,Sendhwa,,451666,MP.,India.	Lat.21.681432°Long.75.077914°	0.5124
7.	Near Swami Vivekananda College, Barwani,Rd.,Sendhwa,451666,MP.,India.	Lat.21.696338°Long.75.88242°	0.4721
8.	Gram Badgaon, Barwani Rd.,Sendhwa ,451666,MP.,India.	Lat.21.700856°Long.75.083233°	0.4323
9.	Gram, Borli,Barwani Rd.,Sendhwa ,451666,MP.,India.	Lat.21.700811°Long.75.083218°	0.4102
10.	Front of Satyam Spinners AB.Rd.,Sendhwa,451666,MP.,India.	Lat.21.705438°Long.75.108519°	0.2881
11.	Near Satyam Spinners AB.Rd.,Sendhwa,451666,MP.,India.	Lat.21.705517°Long.75.108602°	0.2732
12.	Bakee Urf Goi Near Advantage city AB.Rd.,Sendhwa,451666,MP.,India.	Lat.21.719874°Long.75.117312°	0.3106
13.	Mechanic Nagar Near Church AB.Rd.,Sendhwa,451666,MP.,India.	Lat.21.673271°Long.75.085908°	0.4903
14.	Near Chhoti Beejasan Mandir AB. Rd.,Sendhwa ,451666,MP.,India.	Lat.21.663243°Long.75.081412°	0.4350
15.	Gram Segawi Near Sendhwa Bypass AB.Rd.,Sendhwa ,451666,MP.,India.	Lat.21.658764°Long.75.080191°	0.5806
16.	Gram Segawi , AB.Rd.,Sendhwa ,451666,MP.,India.	Lat.21.658925°Long.75.080276°	0.5108

Result:

Available Organic Carbon (Av- OC) status of the soils of Sendhwa City:

The available organic carbon content (Table 1) of the soils of Ralyawan village ranged from 0.27-0.58 %with an average value of 0.42 %. Considering the soil test rating for available - OC (<0.25 as very low, 0.25 -0.50 as low; 0.50 -0.75 as medium and >0.75 as high in the status of organic carbon) the soils of Sendhwa City fall under all the two rating classes of available OC content. In general out of 16 samples, 75% samples were categorized under low OC status, 25% samples under medium OC status. In this way, about 100% soil samples were low to medium in av-OC status. The general statistics calculated from 16 soil samples revealed that the available - OC content ranged from 0.27-0.58% with a mean value of 0.42%.

Appendix -1: Soil samples Analysis Report of Agricultural Soil of different location of Sendhwa City in the South Eastern part of Barwani District Madhya Pradesh:

Available -OC (%)	Number of Samples	% Samples
Very Low (<0.25)	Nil	Nil
Low (0.25-0.50)	12	75
Medium (0.50-0.75)	04	25
High (>0.75)	Nil	Nil

Table 1:Distribution of available -OC status in the soil of Sendhwa City :

Range %	**0.27- 0.58**
Mean %	**0.4218**

Table 2:General statistics of Available Organic Carbon (Av- OC) of the soils of Sendhwa City:

Discussion :

Organic carbon:

Organic carbon content of Sendhwa City soils ranged from 0.27 to 0.58 percent respectively, which in general accumulated in surface layers. The lower contents of organic carbon apparently resulted because of high temperature which induced rapid rate of organic matter oxidation, while the declining trend towards to accumulation of Top residues every year, without substantial downward movement. Low organic carbon in the soil is due to low input of Farm Yard Manure (FYM) and crop residues as well as rapid rate of decomposition due to high temperature. The organic matter degradation and removal taken place at faster rate coupled with low Vegetation cover thereby leaving less changes of accumulation of organic matter the soil. High temperature and good aeration in the soil increased the rate of Oxidation of organic matter resulting reduction of organic carbon content. The high temperature prevailing in the area is responsible for the rapid burning of organic matter, thus resulting in medium organic carbon content of these soils. Similar results were also noted by Sharma et al. (2008)[(1)] in soil of Amritsar district. average value of OC of the soil was found 0.42% in the Sendhwa City.

Conclusion:

In the presence of climate change, land degradation and biodiversity loss, soils have become one of the most vulnerable resources in the world. Soils are a major carbon reservoir containing more carbon than the atmosphere and terrestrial vegetation combined. Soil organic matter is an important property of soil. If the soil is poor in organic matter then it enhances the process of soil erosion .If the soil organic matter is present in soil then this soil is useful for the agricultural practices. Organic matter can be added in the soil in the form of animal manures, compost, etc. The content of organic matter in a soil can maintained the structure of soil. It affects the available water capacity and infiltration rate. It is a source of nitrogen and other essential nutrients for crops that's why it enhances the usefulness of soil for agricultural purposes.

From the study, it can be concluded that, soil organic carbon of Sendhwa City in the South Eastern zone of Barwani District in Madhya Pradesh are low in soil available organic matter content. Deficiency soil organic carbon is important soil fertility constraints indicating it's immediate attention for sustained crop production. The deficient soil organic carbon may be replenished to avoid the crops suffering from their deficiency and for optimum utilization of other nutrients.

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