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CHARACTERISTICS OF SURFACE SOIL AROUND DIGHA COASTAL REGION OF WEST BENGAL

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Abstract: *Soil is an important natural resource and a natural body development by natural forces acting on natural material. A study of soil science includes soil physics deals with the effects of physical laws on the evolution of chemical properties and physical properties of soils. The study of soil would reveal to one that soil aspects are every minute, every seconds, are going on simultaneously and that the resultant changes are consequently taking place always in the soil system.*
In that senses knowledge of coastal soils in respect of their extent, distribution, characteristics and potential is, therefore, extremely important for optimizing the land use and also for better heritage and prosperity. However, little attention has been given to the judicious use of coastal land which is subjected to various land degradation problems. The present paper on coastal soils of Digha, West Bengal is an endeavor towards systematic appraisal of our soil resources in coastal region of West Bengal for optimiz.ing land use on sustainable basis. In this publication attempts have been made to characterize the soil resources in the Digha coastal region of West Bengal.
Keywords: *Natural Resource, Chemical Properties, Physical Properties, Coastal Soil, Landuse, Degradation.*

I. Introduction

Soil is the basic natural resource on which the very existence of mankind depends and, therefore, the optimum utilization of soil needs adequate attention. Generally soil refers to the lose surface of the earth as identified from the original rocks and minerals from which it is derived through weathering processes. Surface soil is the immediate uppermost loose layer of the earth consisting of organic matter and soil organisms suitable for plant growth. It is generally called furrow slice soil layer and fertile soil. The surface soil is, therefore, the seat of greater chemical and biological activities than the sub soil. Tillage operation, addition of manures, fertilizers and soil amendments, and other soil management practices further add to the complexity of activities taking place in surface soil.

In the study region soil comes of interaction of river and tides. Therefore soils of the area generally divided into; alluvial soil, sandy soil and saline soil. Alluvial soil is mainly found to wards in land form the coast. This is very fertile from the coast in nature and therefore different type of crops mainly rice, vegetable are grown. Sandy soil is available on the sand dunes and is generally devoid of organic matter. In the belt of spill basin and along the shore line where tidal water plays a grace role. Saline soil is found in this area a no of salt pan is located.

II. Objectives of the Study

The objectives of the present study may be summarized in the following lines:

1. To make an assessment of the physical environments of the study area with the help of soil characteristics.
2. To study soil profiles in detail, particularly the distribution of soil properties with depth in order to understand the major pedogenic processes operation in the area. This will also helps to understand the genesis of the regional soil.
3. To examine the characteristics of surface soil of the study area to enable us to understand the fertility status of the soil. This will help us in formulating the land capability and land-use planning map.
4. The identification of different taxonomic properties of soil of the study area.

III. Research Methodology and Work Procedure

In order to study the above mentioned objectives, the methodology adopted by the researchers is a rationalistic one comprising of the details outlined as follows:

The researchers at first obtained the basic Arial data from the Survey of India Topographical sheet no. 73 O/10 at a scale of 1:63360. Map published by various governmental organization like Land Record and Revenue, Digha Development Authority, State Fisheries department, Forest department and by individual

researches have also been utilized in collecting information of the study area. These have also been used for preparing the details programmed of present research work, especially the survey plans, the layout of cross-sections and test pits. The chronological depletion of the natural resources have been followed by comprising the old documents with newer ones.

The geomorphological information along with identification of shore-zones, coastal dunes etc. have been copied from survey of India Topographical sheet and through direct field observation. The information regarding natural vegetation, drainage and tidal impact have been collected from intensive field investigation. The methods of Soil Survey have based on the conventional techniques (Soil Survey Staff, 1951, 1960 and 1975). Reconnaissance survey has been made by a series of longitudinal and transverse sections. The field properties of taxonomic classes have been noted and classifications have been carried out following the USDA system (USDA, 1975). During the soil survey, numerous exposures, sections cuttings anger holes and spade cutting have been investigated most carefully. Four soil pedon have been studied in details and tabulated. In addition 18 different soil samples have been analyzed for the identification of various soil properties of the study area. The following analyses have been performed:

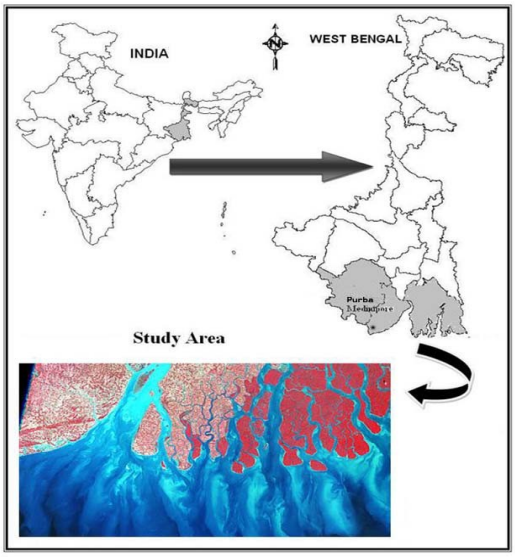
i. Soil textural analysis based on International Pipette Method.
ii. Soil pH by Kuhn's Colorimetric Method.
iii. Soil organic carbon and matter by Walkey and Black's Rapid Titration Method.
iv. Soil colour analysis by Munsell's colour chart.
v. Nitrogen, Phosphorous and Potassium by Kit Box Method.
vi. Physical properties like volume expansion pore spaces, porosity, water holding capacity, specific gravity etc. have been analyzed based on Keen Box Analysis.
vii. Soil structural analysis, Thickness of A horizon, Consistence, Porosity and Permeability have also been analyzed by different soil analysis techniques.

To compile the bibliography as well as the reference work the Library of Digha Development Authority and North Bengal University have been thoroughly consulted. All the data collected from field and various institutional sources have been analyzed, processed and computed in the Pedological laboratory of Department of Geography and Applied Geography, University of North Bengal to predict the exact sequences of events and to provide a workable formula of their control.

About the study area

The study was carried out on the zone of Bay of Bengal specifically from the East Midnapur district of West Bengal, keeping in mind that both marine and inland influences make it a rather complex and unique area of study. It offers a wider variety in soil, topographic variation, drainage and land-use characteristics. Moreover, tidal activity and unique pisci culture activities also added more diversity in the geography of Digha coastal belt. The study area thus appears to be a leaf of 80 sq.km. bounded by the latitude of 21° 30' 36″N to 21°42' N and the longitude of 87°30'E to 87°36'E, falling in the district of East Midnapur, in the south West Bengal. The study area consists of sand, silt and clay covering successively by beach, zone of dunes and inter dune belt of recent formation. However in the Sankarpur area the development of dune feature is less conspicuous. Geologically they are marine region together with some fluvial and aeolian sediment.

Map of the Study Area



IV. Results and Analysis

Analysis of various soil properties, their characteristics and quantitative determination of soil in Digha and its surrounding have been done from 18 different soil samples. Such analysis has been carried out for surface soil only. Among the various soil properties the following are accounted for.

1. Soil mechanical analysis
2. Soil reaction(pH)
3. Organic matter content
4. Nitrogen content
5. Phosphorous content
6. Base Exchange capacity.

Table No.1
Properties of Surface Soil around Digha

Sample no.	Sand (%)	Slit (%)	Clay (%)	pH	Organic matter	Nitrogen content (%)	Phosphorous content (%)	Base exchange ma/gm.
1	83.5	3.0	3.5	6.2	0.05	-	0.05	2.5
2	91.4	2.5	6.1	7.2	0.13	0.01	-	4.9
3	70.5	15.0	14.5	5.2	0.08	0.04	0.01	15.2
4	85.5	9.0	5.2	6.0	0.12	0.01	0.03	2.8
5	95.5	1.5	3.0	5.2	0.05	-	0.04	1.5
6	83.0	35.0	3.0	5.1	0.85	0.07	0.05	14.7
7	59.0	21.5	19.5	5.4	0.90	0.12	0.08	19.20
8	51.0	36.5	12.5	6.0	0.58	0.08	0.12	21.05
9	72.0	19.5	8.5	6.4	0.38	0.31	0.31	13.5
10	15.0	49.1	35.9	5.4	1.35	0.15	0.13	34.2
11	84.0	12.6	3.4	7.0	0.04	-	0.08	1.9
12	20.0	49.5	30.5	5.8	1.29	0.14	0.31	28.9
13	94.5	2.5	3.0	5.4	0.08	0.01	0.02	3.2
14	80.6	21.4	18.1	5.8	0.82	0.07	0.08	17.3
15	40.1	34.5	25.5	6.3	1.31	0.15	0.36	26.5
16	61.5	20.0	18.5	5.7	0.81	0.07	0.03	17.8
17	34.5	30.4	35.1	6.2	0.72	0.08	0.08	19.2
18	38.0	31.5	30.5	6.4	1.02	0.90	0.17	20.3

Source: Field Survey Report, Pedological Laboratory, University of North Bengal, 2013.

1. Soil Mechanical Analysis: The soil mechanical analyses have been based on the analytical results of distribution of sand, slit and clay content of soil. In many soil gravel, stones and bedrock outcrop also effect

texture and influences on land use. It is often possible to identify the soil texture by its feel for example, sand feel gritty to touch. Texture result principally minerals composition of the parent material. To make a mechanical analysis, a sample of soil is broken up. This is usually done by crushing the soil lightly in a wooden mortar. There are several methods of mechanical analysis; here pipette is used for carrying out mechanical analysis of soil.

Soil content in the surface soil of the study area has been depicted in the figure no. 1, it has been found that the percentage of sand content in surface soil of Digha is extremely high. More than 85% sand in soil has been identified along the coastal area of this region, particularly observed in Alankarpur areas. The percentage of sand in surface soil is increasing towards southern part, more than 80%. North western part and northern part of the study area have less sand 40% in its soil surface. The more we go back from Digha coast towards northern part the less percentage of sand content in identified.

It has been noticed that the percentage of clay content in surface soil of Digha coast is extremely low. Because here percentage of sand in soil is so high. More than 30% of clay in soil has been found in few area of Digha. Particularly the highest percentage of clay 30% are found in Alankarpur and northwestern part of Digha. The less amount of clay percentage has been found in coastal areas of Digha and Sankarpur. Here less than 10% of clay content found in surface soil due to heavy occurrence of sand. It has been found that the percentage of sand content in highest along the coastal areas, while the percentage of clay content high in the interior or away from the coast. It also analysis that the percentage of silt in the coastal tract like Digha and Sankarpur coast is 10%. Because here the soil is sandy character in nature. In the north eastern part of the study area the percentage of silt moderate. Here the percentage ranges between 20%-30%, the highest percentage of silt is concentrate in the north western part of the study region. In Alankarpur part of Digha 73% of silt is found. Here the soil is suitable for cultivation.

2. Soil Reaction (pH): Soil reaction is the most important single chemical characteristic influencing many physical and chemical properties of soil. Plant growth and microorganism activity depends upon soil reaction and the factors associated with it. There can be three types of soil reaction, which are acidity, alkalinity and neutrality. Soil reaction is measured by pH (Puissance de Hydrogen) of a suspension of soil in water. It represents concentration or activity of hydrogen ion. pH expresses the relationship between H+ and OH-. In the pH scale, the pH value ranges from 0-14, where pH, 0 represents the highest limit of active acidity and pH 14 the highest degree of alkalinity. Neutral represents pH 7.

Soil acidity is common in regions where precipitation is high enough to leach an appreciable amount of exchangeable bases form the surface layer of the soil. So that the exchange complex is dominated by hydrogen ions on the contrary, alkali soils, occur where there is a comparatively high degree base saturation. By soil pH, is commonly understood the pH of a 1:25 soil water suspension. Soil pH understood is to large extent of merely conventional significance and not absolute values. pH is a scale through which soil reaction may be estimated. The pH value of soil of Digha and its surroundings has been resolved by using Kuhn's colorimetric method. The analytical results have been shown in table no. 1.

It have been identified that the most of the soil of the study area are acidic in nature due to low pH value. In the coastal areas of Digha and Sankarpur the pH value ranges from 5.0-6.0. That means the surface soils of these regions are acidic in nature. Here the soils are acidic because the percentage of sand content is maximum in surface soil. The high pH value zones have been found in the north-western and north-eastern part of the study area. In the central part of this region or a little distance from acidic soils are formed along the Digha coast and neutral of little alkali soils are formed in the inside of the study area.

3. Organic Matter Content: The organic matter of the soil has its origin in the decay of dead plants and animal substances incorporated in various ways in the soil. The decay the soil organic matter is further induced by the soil micro-organism and is called humification and more or less dark-coloured products of this process is called humus. Humus is the world used when referring to organic matter that has undergone extensive decomposition and is resistant to further alteration. Humus is practically in water and one of the most important characteristics properties of human it is Nitrogen content, which usually varies from 3-6%. Humus is characterized by high Base Exchange capacity.

The soil organic matter plays an important role as the store house of plants nutrients. Recent researches on soil and plants have received considerable impetus in connection with the role of organic matter in regulating the growth of plants. But, it must be remembered that all organic matters are not beneficial to higher plants. Under certain conditions several organic components are found in soils that are known to be harmful.

The distribution of soil organic matter in percentage have been described in the above table, it has been found that the percentage of the soil organic matter of Digha and its surrounding is slightly higher in the northern part than the southern part. In the northern part particularly in Alankarpur region the percentage of

organic matter ranges from 1.0%-1.25%. in the central part of Digha, it ranges from 0.5%-1.0%. less than 0.5% of soil organic matter has been identified in the Digha and Sankarpur regions. The percentage of soil organic matter along Digha and Sankarpur beach is nothing or nil, somehow it may be 0.25% where the pure sandy soils are found, the percentage of organic matter is completely nil.

4. Nitrogen Content in the Surface Soil: We live in an ocean on nitrogen, yet the supply of food for human beings and other animals is more limited by nitrogen than any other element. The atmosphere is made up to 79% nitrogen by volume as inert nitrogen gas that resist reacting with other elements to create a form of nitrogen most plants can use. Increasing the soil nitrogen supply for plant consists essentially of increasing the amount of biological fixation or adding fertilizer nitrogen. It is paradoxical that the nutrient absorbed from the soil in greatest quantity by plants is the nutrient most limiting in supply.

Nitrogen content in the surface soil of the study area have been found from the analysis that the percentage of nitrogen in the surface soil of Digha and Sankarpur coast is comparatively low than the percentage of Alankarpur. Due to maximum concentration of sand this coastal region gets only 0.025% of nitrogen, here the growth of plants is relatively low. The nitrogen percentage in surface soil around Digha is high in the interior region than the coastal tract. In the northern-western part and Alankarpur area the percentage of nitrogen varies from 0.10%-0.125%.

5. Phosphorus Content in the Surface Soil: The relation of phosphorus in the soils and plants to animal health and extensive occurrence of phosphorus deficiency in grazing animal are well known. Here, the emphasize will be on development of an understanding of the nature of phosphorus in soils and conditions that control the uptake of phosphorus from soil by plants. The effects of too little or too much phosphorus on plant growth are less striking than those of nitrogen or potassium. It appears to hasten maturity. Phosphorus deficiency is characterized by stunted plants that have about casually affected root and top growth. Many soils produced forage that is deficient in phosphorus in term of the nutritional requirement of animals.

It have been found from the observation that if the percentage of phosphorus in the surface soil of Digha and Sankarpur coast varies from 0.025%-0.05%. This percentage indicates that here the phosphorus content in out surface soil is comparatively low due to high percentage of sand content concentration. On the other hand the percentage of phosphorus in the surface soil is high in north-western part of the study area than the coastal tract. In the interior region like Alankarpur where the percentage of phosphorus varies from 0.075%-0.128%. in this region phosphorus concentration influence the plant growth.

6. Base Exchange Capacity of Surface Soil: One of the most important characteristics properties of soil colloids in their ability to absorb dissolved substances from solution. This is known as Base Exchange. Where an ordinary soil is allowed to react with the solution of natural salt that is Kcl- a portion of K is absorbed of fixed by the soil and approximate equivalent amount of calcium is displaced in solution. The reaction may be expressed as;

Ca-soil + 2 Kcl= K2 soil + CaCl2

Or

H- Soil + Kcl= K Soil +HCl

These and related phenomena are known as the Base Exchange reactions. The total Base Exchange capacity of soil is expressed by multi equivalent of ions per 100 grams of soil. The phenomena of base exchange is of great importance in agriculture and is provided a mechanism by which plant nutrients which would otherwise be readily washed out of soil are retailed for the use of plans. It have been identified that the Base Exchange capacity of Digha is comparatively low. In the coastal tract the Base Exchange capacity varies from 0.5 meq. of per 100 grams of soil. In some areas it ranges between 5.10 meq. per 100 grams of soil. Due to low Base Exchange capacity of soil this region is unsuitable for cultivation or agriculture. Away from the coast the Base Exchange capacity is slightly high. In the northern part of the study area is suitable for agriculture.

V. Conclusion

The knowledge of the chemical, physical and biological behavior of the soil was obtained mainly from the utilitarian point of view for obtaining bigger and better crops. A great emphasis is being placed on the utilization of soil but before they can be utilized properly, they must be recognized system whose nature, properties, characteristics and place in the environment should be understood. Hence a fundamental knowledge of the soil as regard its origin and development, its nature and composition, characteristics, and the part it plays in the nutrition of plants and animals is very essential for the proper understanding and development of the

science of agriculture. The present study reveals that, the proper use of soil is very important for life supporting systems of mankind and socio-economic development of any region.

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