CHAPTER NO. III

PHYSICAL ANALYSIS

INTRODUCTION

Soil texture, structure, soil colour, porosity of soil, permeability of soil, temperature of soil are the physical properties of the soil. The study of these properties is of great importance in determining the fertility of soil and ultimately productivity of soil. Because soil aeration, movement of water, availability of water and nutrients, chemical composition of soil aggregates, colloidal properties of soil or cation exchange capacity of soil depends on physical properties of soil. Therefore attempt has been made to study ~~s~~ fertility of soil in respect of physical properties of the soil in study area.

The seperation of the sand, silt, and clay particle size groups of the mineral component of the soil is known as mechanical analysis of the soil.[1] The machanical analysis is not made personally in this study. The data about sand, silt, clay, i.e. textural class, soil colour, structure and drainage is collected from the department of soil survey at Pune to show the soil condition of Sangli district.

Texture -

"The fabric of the mineral component of the ~~of the~~ soil resulting from the relative proporation of the three particle size fractions- sands, silt and clay -

is known as soil texture"[2]. In general the texture of soils is spoken of as light or heavy. Gravels, sand, silt and clay are also termed as'soil separates' or 'soil-fractions'. The soil texture depends on the soil separates. Gravel and sand fractions of the soil consists of loose friable particles. They increase the size of pore spaces between soil particles and facilitates movement of air and water in the soil. They have very low moisture retentive capacity. The sand and gravel fractions are a poor sources of nutrients because they are largely made up of silica. These fractions can not absorb and retain the nutrients. Therefore if percentage of gravel and sand is higher the soils become infertile.

Silt fractions play important role in physical and some chemical properties of the soil. They create larger exposed surface area than sandy soil. They absorb considerable quantities of water. Even though this fraction absorbs large amount of water they do not swell and they do not adhere to each other. Silt soil contains sufficient quantities of plant nutrients, both organic and inorganic. So these soils are very fertile in respect of texture. But there is possibility to turn silty soils to saline or alkali soils by application of excess water.

Clay is the smallest fraction (below .002 mm. diameter) of soil which exibit plasticity and smoothness when wet and hard when dry. They take very active part in physico chemical reactions of the soil. Clay also has

fine pores; poor drainage and poor aeration. They have high water holding capacity. The clay act as store house for water and nutrients.

The clay fraction absorbs, Ca, Mg. K, NH_4 Mn, Cu, Zn and many other cations. They joined with absobed bases and forms phasphates, sulphates and other complex inorganic and organic anions.

T A B L E NO. 3.1

Soil texture of different soils from various places.

S. No.	Village	Survey No.	Depth in cms.	Mechanical Analysis				Textural class
				Coarse sand	Fine sand	Silt	clay	
1	Tujarpur	122	0-25	4.3	19.25	16.00	48.25	Clay
2	Ashta	1717	0-30	6.80	11.38	12.05	60.25	,,
3	Kokrud	334/5	0-25	4.20	20.40	53.10	25.15	Silt
4	Manjarde	1786	0-30	5.02	12.80	16.34	58.55	Clay
5	Yedeni-pani	NA	0-25	0.80	7.75	18.00	58.00	,,
6	Gotkhindi	655	0-20	2.60	12.00	19.50	50.50	,,
7	Walwa	336	0-25	3.31	7.05	16.10	59.10	,,
8	Kameri	1798	0-30	5.80	9.94	14.90	61.00	,,
9	Shegaon	387	0-25	7.48	6.17	12.50	54.50	,,

Source:- Department of soil survey at Pune.

When wet, clay has a tendancy to swell. Adhesion and cohesion are properties of clay which are important

in structure formation.

Some soils are fine, while other are sandy or coarse. It is so because of the fact that relative percentages of sand, silt and clay differ from soil to soil. The relative percentages of soil separates in a given soil are refered to as soil texture. Texture of soil for a given horizon is almost a permanent character, because it remains unchanged over a long period of time. The relative percentages of soil separates of average samples are almost infinite in possible combinations. Same is the case found in the study area.

Findings -

The data collected in respect of mechanical analysis of soil for sangli district is presented in table No. 3.1. The data in the table shows clay texture of solid soil in the sangli district. The clay percentage is high which ranges from 48.25 to 61.10% except soils from western hilly part of district. Therefore most of soils have high water holding capacity. Soils are poorly drained. This nature of the soil has developed water logging condition at low lying areas and the flat areas where the soils are provided with perennial irrigation water from the lift irrigation projects on Krishna and Warana rivers. Most of the salts are dissolved in water. In fact water is the chief transporting agent for salts. In any semi-arid area, the process of evaporation brings about

SANGLI DISTRICT

TEXTURE OF THE SOIL

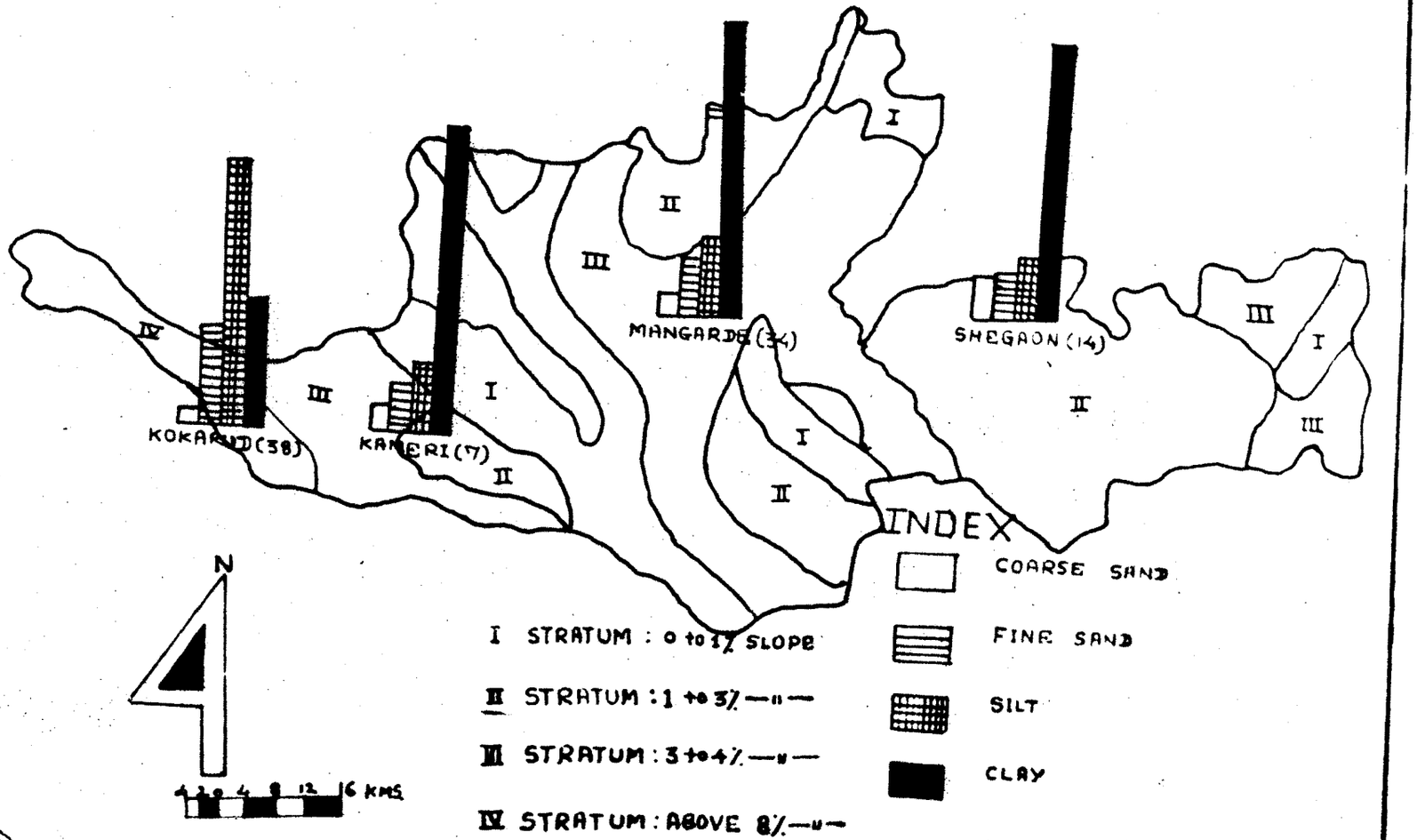

Fig. No 8

movement of salts along the water on the surface or in subsoil by capillary action. The water evaporates leaving salts on the surface or in subsoil or in root zone of soil. Accumulation of salts on the surface or in subsoil gives rise to locatization of salines in the soil. This textural class has developed saline and alkali soils along the banks of krishna and warana rivers by above mentioned process.

The table No. 3.1 shows that the soils in Ashta, Walwa, Kameri, and Yedenipani villages which are situated near the bank of krishna river and in the eastern flat part of district have high clay content. The clay content ranges from 54.5 to 61%. It is due to absence of washing of clay particles along with rain water. The sand and silt content is less in all above mentioned villages.

The soils from Tujarpur and Gotkhindi villages have 48.25 to 50.50% of clay content. While the soils from village Kokrud which is situated in the western hilly part of the district have lowest clay content. It is due to washing of a clay particles by heavy rainfall in rainy season and sloping topography. The more slope has also helped to decrease clay content of soil in these villages.

The percentage of silt content is highest i.e. 53.1% in the soils of Kokrud village. The coarse sand percentage is lowest i.e. 0.08 % in the soils of Yedinipani village.

The table No. 3.1 shows that the amount of coarse and fine sand is less in all parts. Though it has helped to some extent to drain water from silty and clay soils. The amount of coarse sand ranges from 0.80 to 7.48% while fine sand ranges from 7.05 to 20.40% all over the district. In short most of soils in villages located in the eastern flat part of the district are clay in texture while in the western hilly part has silty soils.

Soil Structure -

The soil fractions not found in separate form, but they are found to be arranged in definite form. "Arrangement of these soil particles on certain defined patterns is called soil structure"[3]. Generally, except sands the other fractions are grouped into compound particles by Cohesion and other such forces. "The aggregation of the textural units of the soil mass into variously shaped and sized soil particles forms the units consisting soil structure"[4]. Only heavy soils could scarcely support plant life. The fine grains would clog up the pores. That means if structureless heavy soils could not be a medium for plant growth. It is found that soil grains less than 0.002 mm in diameter, when packed as individual particles, do not provide sufficient pore space for root hairs to penetrate and to function, even it stops the movement of bacteria also.

The aggregates of soil fractions have given different structures to soil particles. They are known by various names, like crumb, granular platy, prismatic, and columnar. All these structural shapas and forms may be classified into three fundamental types. One is known as cube-like, second is prism like while third is known as plate like.

A favourable soil structure provides pore space which facilitates the movement of water and air through the soil. Rainwater striking the soil moves through the large pores between the structural aggregates; simultaneously, the aggregates take up water by capillary action. In this way water and air supply is closely related to structure for crop production. Many times low yields of crop may be due to poor aeration of the soil, caused by poor structure. Structureless soil creates waterlogged condition which results in increased runoff and hence erosion or surface swamping.

Conditions for soil structure -

For structure formation following conditions are required.

1) Sufficient clay must be present in the soil to bind the grains of silt and sand. 8 to 10% of clay in a soil is generally considered the lowest limit for structure formation.

2) Clay must not contain absorbed Na, which

tends to keep the clay in a dispersed condition. Whenever Na is added into the clay-fraction as by the excessive use of $NaNO_3$ or by the use of irrigation water containing salts of Na, it destroyes the soil structure.

3) Organic matter must be present in soil which coats the structural units and protects the original structure of soil.

In short structure of soil is also important factor which influences directly and indirectly on productivity of soil.

The study region -

The information about soil structure has been collected and tabulated in table No.3.2. The table No.3.2 shows that most of soil's samples from sangli district have angular blocky structure on the surface. All talukas except Shirala have flat topography, where soil structure is angular blocky to sub angular blocky. The soils from Shirala taluka have granular structure. That means the soil structure is favourable for crop growth. But at some patches in district excess of Na and decrease in organic matter is changing the soil structure.

Drainage :-

Drainage is the dispersal of excess of irrigation water or rainfall or sub soil water, to prevent injury to crops. Because restricted drainage is a factor that usually contributes to the salinization of soils and may involve the presence of a high ground water table. The

water in the root zone of crops decays the roots of crops or plants and ultimately causes death of plant. The drainage of salt bearing waters away from the higher lands may raise the ground water level to the soil surface on the lower lands. It may cause temporary flooding or may form permanent salt lakes. Under such conditions upward movement of saline ground water and evaporation of surface water results in the formation of saline soils.

T A B L E NO. 3.2

Morphological features of soil from Sangli District.

Sr. No.	Village	Survey No.	Soil colour	Structure	Drainage
1	Tujarpur	122	Dark Greyish brown	Angular blocky sub-angular blockey.	Imperfe-catly drained.
2	Ashta	1717	,,	,,	,,
3	Ashta	1786	,,	Angular blockey to sub-angular blockey with slicken side.	Poorly drained
4	Yedenipanyt	113	very dark greyish brown	Angular sub angular blocky.	,,
5	Gotkhindi	655	Dark grey brown	,,	very poorly drained
6	Walwa	336	Greyish brown to dark brown	,,	Poorly drained
7	Kameri	387	,,	,,	,,
8	Walwa	353	Dark greyish brown to dark brown.	,,	,,
9	Pethond	68/7	Red clay	granular	well drained
10	Kokrud	334/5	,,	,,	,,

Sources: Department of soil survey, Pune.

Low permeability of the soil causes poor drainage by impeding the downward movement of water. Low permeability may be the result of an unfavourable soil texture and structure. Extensive seepage occurs from water flowing in canals, distributaries, channels and waste in drains. All of these add to subsoil water. It is calculated that in canals of north India average water loss through seepage is 17% from main canals and branches, 8% from distributaries and 20% from gullies or field channals. Extensive seepage occurs in sangli district but difference is that instead of canals the seepage is through the disbributaries of large and small lift irrigation schemes. The net result is that there is a rise of ground water level.

In study area it is actually observed that the problem of rise of water table is acute in krishna and lower warna basin where, their is perennial water supply from the lift irrigation projects on krishna and warna rivers. Along with both sides of road from sangli to Kolhapur and near the bridge on krishna river at sangli, ground water level is near the surface and at some places on the surface. Same is the case along the railway line near Nandre village and also in Ashta Digraj area.

The table No. 3.2 shows that the soils possess poor and very poor as well as imperfect drainage capacity except soils from strata number IV. The soils from the

strata number IV which are confined to the shirala taluka are well drained due to greater slope. Therefore there is no possibility to turn normal soils to saline or alkali soils. But there is fear that there is possibility to turn the same soils into acidic in future.

The topography of most of study area is flat and some what bowl type. The natural water coarses in river basins are completely silted. The soils are very deep with heavy clay texture. Under these conditions the seepage water received from the irrigated area could not be drained out freely and consequently resulting into rise of water table in such areas. Therefore poorly drained soils need to use water properly otherwise fertile soils will be converted into saline-alkali in future.

Soil Colour -

Soil colour serves as an indicator of geological and pedological effect on the soil. It gives idea about organic matter content, the degree of leaching, the accumulation of salts at certain depths and the state of oxidation and reduction to which soil has been exposed during its formation and development.

Soil colour may be inherited from the parental material. Some times soil colour may be due to soil forming processes. The variations in the soil colour are due to organic substances, iron compounds, silica, lime and other inorganic compounds.

The organic substances impart black or dark greyish black colour to the soils like in flat region. Iron compounds are responsible for brown, red and yellow colour of soils like in shirala taluka. Iron oxides in combination with organic substances imparts brown colour which is most common soil colour. Silica, lime and some other inorganic compounds give light white and grey tinges to the soil.

Soil colour influences greatly the soil temperature. The dark coloured soils absorbs heat more readily than light coloured soils. The black cotton absorb 86% of the total solar rediations falling on the soil surface as against 40% by the grey alluvial soil. Soil colour is used as an important criterion for description and classification of soil. Many soils are named after their prominent colours such as black cotton soil, yellow soil, red soil, brown soil etc.

The soils of sangli district are grouped into four groups according to the colour. Those are as shown in fig. No. 7 and as described below:

I) Lateritic soils :- Occur on upghat in the extreme western part of the district i.e. in shirala taluka; which receives heavy rainfall. These soils are slightly acidic and usually leach soluble salts and calcium carbonates. The leaching of soluble salts is due to heavy rainfall and more runoff from steep slopes. The soils are poor in fertility.

II) Reddish-Brown soils:- These types of soils are found on the slopes of shirala sub-region. These soils are also found in the eastern part of tasgaon sub-region. The depth of soil varies from 23 to 45 cms. These soils are residual and developed from parent material of trap rock. These are usually structureless, reddish-brown in colour and sandy loam in texture.

III) Yellowish to Reddish-Brown And Dark Brown soils

These types of soils are found in the area from Mandur to Natoli and Girijawada in Shirala sub-region; for eastern and nothern part of sangli-miraj sub-region. The soil here are very shallow. Area north of Kundal in Kirloskarwadi sub-region has yellowish brown to dark brwon soils with depths varying from 45 to 90 cms. In eastern part of Tasgaon sub-region has yellowish to reddish brown soils with depth ranging from 45 to 90 cms. These soils are loamy sands to sandy clay in texture and are usually structureless. Soil reaction in them is high. The content of soluble salts and calcium carbonate are moderate. The soils in general have moderate nitrogen content and are poor in phosphate and potash content.

IV) Medium to Deep black soils- These soils are found in krishna and warana villeys of Islampur and Ashta sub-region, sangli-miraj sub-region, the area in between krishna and yerala rivers of kirloskarawadi sub-region, in two kilometers wide belts along yerala river and Kapur nalla and in approximately one kilo-meter wide belts along yerala and Nandini rivers. Most of deep black soils are alluvial in origin and granular in texture.

R E F E R E N C E S

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2. Jacob, S. Jaffe : A B C of Soils pp 9

3. Shukla and Chandel : Plant Ecology and Soil Science Chanda & Co Ltd. New-Delhi pp 238

4. Jacob S Joffe : A B C of soils pp 118