CHAPTER I

INTRODUCTION

Soil - a fundamental factor -

The soil is a distinct object in nature. According to pedologists soil is a living body as it has an embryonic state, followed by a period of growth during which it passes from youth to maturity. It is formed by pieces of rocks, minerals and organic matter. It is called as soil material. Ancient scholars have some ideas about soil. They think on soil type while using for perticular crop production. In the 19th century land taxation was the chief source of state revenue. At that time the fertility of the soil, its capacity to yield and its adaptability to various crops had to be evaluated in order to fix a tax rate. This clears that ancient pedologist have also some ideas about soil types, their fertility and productivity. Soil was the main source of income to individual cultivator and for the state also.

Animals and plants require food for their life. Food is as important as water and air. Food for plant is nothing but different elements. These are termed as nutritive elements. Food of plant is one of the material of soil. Therefore soil is a basic resource.

Soil is medium for growth of plants. It is essential to spread the roots deep and wide and fix the plant firm to the ground. It acts as medium for transporting water to the plants and also provides the plant with major requirements of the mineral elements.

Different definitions are given for soil to clear the meaning of this natural object. The commonly accepted definition of soil is that, " it is a mixture of rock and mineral material with organic matter"; some pedologist defines the soil as, " The soil is a medium for plant growth", or " The soil is a mixture of mineral material and organic matter".[1]

Above definitions also make clear the meaning as well as importance of soil inrespect of plant life. It is also clear from above definitions that soil is not a single component but is mixture different organic and inorganic components. The soil is a body formed from rock particals of various sizes, organic matter, chemical elements like nitrogen, phosphorus, pctassium, different salts, sulpher etc. and water and air.

Plant life is in existance due to the soil. And all types of animal lives are depended on the production from plants. That means existance of animal life on the earth is due to the soil. Day by day living beings are increasing in their number and they are creating more and more pressure on soil. Because there are number of limitations on increasing the extend of soil. Therefore to feed human and plant life and also for our progress we have to use it very carefully. The wrong use of it will bring both animal and plant life in great difficulty. Therefore we must have some knowledge about it. It must always be kept in good or fertile condition.

The continued prosperity and well being of people of any nation is dependent upon several factors, one of the most important being the soil and its fertility. Every cultivator desires maximum output per unit of land and it is only possible if the soil is fertile. Potentialities of soil will boost the crop yields and will make farmers rich.

There are so many different aspects of planning for plenty. But it is impossible to give complete account of those aspects. However, the study and proper understanding of the nature and capabilities of the soil is one of the fundamental aspect of agricultural planning, which must not be overlooked by scholars for agricultural planning. Proper understanding of the soil could only be, if a scientific system of determining soil fertility in respect of nitrogen, phosphorus, potassium etc. and knowing the PH and TSS is adopted.

Significance of soil in human economic activities -

In all countries of the world the most fundamental resource of the agricultural industry is the soil. As soil is the medium used to produce food and industrial crops essential for life, soil plays a vital role in assesing the potential base for agricultural production and can be used in plans for agricultural development including the amount of investment need to achieve various levels of soil productivity. Soil is a basic factor of agriculture. It is used even in the most industrilized countries like in England; U.S.A., West-Germany etc. In England 82% of the surface is devoted to farming and very small surface i.e. 18% is used to industrial and residential purposes, for

roads, railways, settlements etc. one reason for the importance of soil in agriculture is the food. Food is a prime necessity of life and it is an agricultural product. Therefore soil must be used for agriculture. Second reason for the importante of soil is that agricultural industry (activity) requires extensive use of land as a factor of production. Soil plays active part in crop production and livestock production. The soil is the only factor whose chemical constituents combine with the seed to produce the plant and its growth is affected by geological constitution of the soil.

From immemorial time the human activities have seen to be confined with soil. Agriculture, animal husbandry and to some extent industrial activities have been depended on the soils. Rich alluvial and black cotton soils have encouraged agricultural activity in different parts of the world. In country like India major industrial activities have depended on the soil through agriculture.

Human civilisation has been started in the fertile soils of rivers like Nile, Taigris, Indus. Those basins have been called as " Cradles of Human civilization".

Soil and Agriculture -

Agriculture is the important activity of man-kind. It is a product of soil and climate. The agriculture provides food to man and raw material to industries. The development in agriculture improves the human life. But the development in agriculture depends on the type of soil. Soils can broadly classified as productive and unproductive

The productive soils have high yielding capacity than the unproductive one. So the region is seen to be agriculturally developed where the soils are productive. e.g. Agricultural development in Gangatic plain of India, Irawaddy Delta of Burma, Indus velley of Pakisthan and Nile river valley in Egypt are due to the deep fertile alluvial soils in those regions. Reverse case is found in lateritic soils on hill slopes and sandy soils of arid and semi arid regions of the world. Therefore, there is close relationship between soil and agriculture. The Konkan is a proper example to show how poor soils are responsible for poor state of agriculture. Soils and cropping pattern have a close relationship. All soils do not give same type of the responce to all crops. Black soils who have more water holding capacity gives good responce to cotton in semi arid region. While alluvial soils gives good responce to wheat in semi arid climate and to rice in humid climate. It clears that there is relationship between soils and cropping pattern.

Soils carries reflection of the physical factors -

Soil is a natural body. It is developed by natural forces acting on natural materials. It is a complex body showing a great many variations in depth, colour, composition and behaviour. Inspite of such diversities, all soils have some things in common. Every soil consist of hard materials called mineral matter, soft and spongy

organic matter, water, air and living organisms. Their proportion may vary, but these major components are present in all the soils.

Soils have primarily developed from different types of rocks. Such rocks may therefore, be called the parent material of soils. They supply the bulk of soil material. Igneous, sedimentary and metamorphic are three principal kinds of rocks. All rocks contain different kinds of minerals. Some of the important minerals are feldspar, quartz, hornblende, mica, pyrites, zeolite, apatite, calcite, gypsum etc. After the rock is weathered these minerals get further disintigrated, decomposed and thus become the source of plant foods. About 90% of the earth's surface is formed from igneous rocks which contain about 60% feldspar, 17% hornblende, 12% quartz, 4% mica and 7% other minerals. They supply all the plant food elements except the most important elements namely nitrogen.

The parent rock is a geological formation. The soil formed from it is primarily the result of the combined action of climatic elements and living organisms on the parent rock over a long period of time. The rocks and minerals exposed at the surface of the earth are constantly being weathered by physical and chemical processes. The physical weathering is called disintigration while the chemical weathering is termed as decomposition. Both are responsible for the soil formation.

Mere weathering of rocks does not produce the soil. The weathered rock material has still to undergo considerable changes until a soil is developed. It is very slow process.

At any specific location of the earth, five factors simultaneously in operation in developing the soil. These are the climate, parent material, relief, plant and animal life, and time. All these are inter-related in soil formation. Any soil property is a function of the collective effect of all these five soil forming factors. Physical properties like texture, structure, colour, drainage, porosity etc. and chemical properties like content of nutritive elements, soil reaction and salts in soil depends on these physical factors, for example certain elements like fe, develops red colour in soil. While clay soils with flat topography causes poor drainage. Therefore in short we can say, soil is reflection of the physical factors.

Climate- It is most dominent factor of soil formation. Climate influences soil formation largely through rainfall and temperature. They have direct as well as indirect effect on soil formation. One of the direct effects of rainfall on soil formation is through its erosive action, mainly producing thin soils on steep slopes and deep soils in valley areas due to the deposition of soil material down hill. Such effect is found on the eastern side of the mountainous terrain of the Sahyadri ranges in western Shirala taluka. The second direct effect of rainfall can be

seen in the shallow accumulation of lime in areas of low rainfall and very less or absence of lime in areas of heavy rainfall. In low rainfall areas like eastern part of study region, very little leaching takes place. These soils, therefore become calcareous and basic in character. They may be alkaline in reaction. In heavy rainfall areas, like western part of Shirala taluka, calcium is more or less completely leached out of the soil profile. Due to intense leaching soils become acidic in character. These soils are also very poor fertile.

Climate also influences soil formation indirectly largely through its action on vegetation. In the semi-arid climate grasses help in the formation of deep, dark, uniform surface soil. In arid climate, the natural vegetation is very sparse and short which does not give adequate protection to the land against erosion.

Parent Material - The kind of soil that develops, partly depends upon the kind of rock. i.e. the soil carries some characters of parent material. The soils developed from granite are usually not very productive. Limestone in the parent rocks develops a dark coloured soil of greater productivity. Sandy soils of low fertility develop from sandstone. Acid igneous rocks and sandstones give rise to course sandy soils. On the other hand the basic igneous rocks and sedimentary rocks normally give rise to fine textured and fertile soils. The amount of nutritive

elements also depends on the quantity of those elements in parent rock.

Relief - Topography determines the extent of runeff and drainage. Runoff is large on steep slopes and less on level plains. Similarly drainage is large on steep slopes and slow from level plains. Soils are thin on steep slopes and deep in low and flat lands. If there is flat topography or depression, then more water enters the soil, and it results in gray colour soil with higher amount of organic matter in the top surface.

Plant and animal life - Vegetation exerts its main influence on soil formation and in tern content of soil through the amount and nature of organic matter it adds to the soil. It controls the soil erosion.

Different kinds of micro-organisms help in decomposition of organic matter.

Time - The time or period required for a soil to develop fully, depends upon many interrelated factors such as climate, nature of parent rock topography etc. Under ideal conditions, recognisable soil profile may develope within few hundred years, but under less favourable circumstances, the time taken to form a soil may be several thousand years. In order to reach maturity, the soil should be stable over a long period of time.

The developmental process and soil conservation are to be complimentary and not at the expense of each other

Soil is one of the most essential factor for the growth and sustenance of plant life and it is a factor of agricultural development. The agricultural development depends on the richness of soil. Ancient cultures have been flourished only in rich alluvial soils of great river valleys like Indus, Nile etc. In country like India, the economic progress of farmers and nation is mostly depended on agriculture.

Though soil is available in plenty, they are not distributed equally in quantity and quality in every part of the world. Their abuse would mean a great loss resulting in poverty. It takes centuries to form one inch layer of soil, but it does not take long time to lose it by erosion. The erosion destroyed the soil completely which in tern, affects agriculture very seriously.

Soil conservation means efficient and scientific management of soil in order to ensure permanent and large production of crops, avoiding all possible drainage of fertility. Soil conservation keeps soil fertile and in productive condition. The fertile and productive soils brings about progress through higher yields of different types of crops by agricultural activity.

If soil is not conserved properly, some natural and human agents like water, winds, deforestation, unscientific grazing and cultivation etc. wash away the soil which is a valuable national asset. There are many

examples which show how once fertile plains and valleys have become deserts or barren lands due to neglect by mankind. Same is the condition is seen in study region around Digraj and Ashta villages; where excess use of water from lift irrigation has made soils highly alkaline and water logged. Some farmers from these villages who were economically rich and satisfaction few years back, are now becomes very poor. Therefore it is clear that the progress it may be individual or national and soil conservation are complementary to each other.

Soil conservation can not be achieved only by individual's efforts. The problem is too big, involving collecting efforts on the part of farmers, technicians and Government. To maintain soil fertility is one of the effort of soil conservation. Soil fertility is one of the important factor responsible for land efficiency. The proper understanding of the term fertility and fertility varriations from farm to farm serves as an effective tool in an economic and judicious use of the agricultural land.

Sangli is such a case -

In some regions due to the wrong use of soil i.e. use of excess of irrigation water, taking the crops without considering nutrient contents of soil and not to think over proper land and climate for proper crop has made some adverse effects on agricultural production. In study area use of excess of irrigation water has made soils saline and alkaline; some soils are at the stage of converting into

saline or alkaline and some are water logged. Such condition is observed along Krishna and Warna rivers. These soils are not useful for agriculture.

All types of crops can not give the same response for perticular nutrient. Some crops required more nitrogen while others require more potassium and phasphorus and less nitrogen. Some crops require acidic soil. Therefore farmer must know chemical constituents and physical properties of the soil. Illiterate farmers like in Sangli district have great need of such information for taking proper crop from proper field. Therefore choice of Sangli district is made to study the soils in this respect, and to come out with some suggestions oriented towards better utilization of soil as an asset, for agricultural development.

Hypothesis -

The study region, eventhough reputed as one of the progressive districts of Maharashtra, is basically agricultural. The industrial landscape of the district is well super-imposed on the agriculture. It is therefore, obvious that the soils of the region, becomes foundation of the economy and the human life thereupon and hold supreme significance. The economic and human development of this region is thus highly dependant upon the status of the soil. This x most important asset, it seems that has not so far been taken care of from the viewpoint of its conservation and development. It is necessary to

undertake a microlevel study of the soils of this district and on the basis of such scientific study, soil management measures like replenishment of nutrients, irrigation, drainage, fertiliser supply and crop potentiality decision, can be taken. This would further lead to optimum and proper utilization of land resources.

Objectives -

The maximum output per unit of land depends on the fertility of soil. The nutritional content of the soil is one of the important factors which determines the fertility of soil and ultimately efficiency of agricultural land. Therefore attempt has been made here to show the nutritional level of soil in Sangli district and fertility of the same in respect of nitrogen, phasphorus, potassium, soil reaction and total soluble salts. Attempt is also made to show condition of soil in respect of physical properties like soil texture, structure, colour, drainage etc.

For more production, today some farmers are though using large quantities of fertilizers, improved seeds, pesticides etc. still they are not able to harvest desired production. Because they provide different fertilizer dosages without examining soil from their fields. They are using different farm practices without considering physical and chemical properties of soils. But now there is great need of it for increasing agricultural production for fastly growing population. Therefore present need of

farmers in respect of increasing agricultural production forced to me to select this topic and help a little to educationally and economically poor farmers.

Methodology -

The present work has been carried out with the help of three main sources i) maps, statistics and available written literature, ii) direct observation of soils and collection of soil samples and iii) actual experiments in the laboratory. The facts observed in the experiments and data collected from the various sources were then analysed mathematically and interpretated fully. Collection of soil samples and analysis of soil samples are two important processes in this study.

Collection of data -

The analysis of one or two soil samples from each taluka or zone of the district, will not be representative of all soils in the district. Because there is great variation in nutrient contents from field to field. This variation may be due to frequency of taking crops without knowing nutrients in the soil, amount of use of fertilizers and climatic conditions of the region. For detailed knowledge of main plant nutrients i.e. N, P, and K and PH and TSS in soil, the analysis of large number of soil samples is essential. Therefore such type of data are collected for selected villages from the laboratory records of Rashtriy Chemical Fertilizer Corporation of India at

Kolhapur and analysed personally in the laboratory of Rashtriy Chemical Fertilizer Corporation of India with kind permission of the chief of laboratory Shri. Deshmukh. To know facts visits are given to the villages like Kasabe - Digraj and Ashta, Nandre, Wategaon and Kasegaon.

The data about physical properties of soil has been collected from the Department of soil survey at Poona. Statastical information about rainfall, area under irrigation landuse etc. is collected from 'Sangli-Miraj, Regional planning Board study Report (1974) and Government of Maharashtra - Sangli district Gazetteer (1969).

Selection of villages and collection of soil samples -

Stratification method has been used ~~(fig.No. 1)~~ to select villages and soil samples. To select villages the study region has been divided in strata on the basis of slope. Because like climate, drainage condition of soil, water holding capacity of soil, amount of water in the soil, salt accumulation or washing of salts from soil, amount of plant nutrients depends on the slope. The strata ~~are~~ have been named as strata No.I, strata No.II, strata No.III and strata No.IV. The selection of sample villages has been made from these strata. As the slope in a strata is nearly same, the sample villages have been selected by Lottery Method ~~(fig.No.2)~~. Number of sample villages selected from each strata has been not kept same. Number of sample village have been selected according to area occupied by that ~~the~~

stratum. The area occupied by stratum No.III is greater than stratum No.II and area occupied by stratum No.II is greater than stratum No.I. The stratum No.IV has occupied least area. Therefore to avoid huge data, eight villages from stratum No.I, 10 villages from stratum No.II, 18 villages from stratum No.III and only 4 villages from stratum No.IV have been selected as sample villages. To indicate location of village instead of names the numbers of those villages have been used ~~as in fig.No.2~~.

Collection of soil samples -

While collecting actual soil samples, the primary information about them like, the name of the farmer, and survey number has been collected by interview method. Specified method has been used to select spots and to take actual soil samples from the field.

The collection of actual soil sample has been made by the process suggested by Tamhane et al (1964). According to this method "the filed has been divided roughly into sampling units leaving the locations of trees and locations of compost fertilizers. Because there is a possibility of more amount of nutrient elements at those places. According to slope in farm separate samples have been collected to a depth of 22 cms from at least 5 to 6 well distributed spots, mixed well and about ½ Kg. of the representative sample has bagged,labelled and brought to the laboratory for chemical analysis. Out of each

sample only 5 to 10 grams of soil has been used for each soil test". [2]

Analysis of soil samples -

Collected soil samples brought to the laboratory first dried, crushed and then used for chemical analysis. The soil samples were examined for pH, total soluble salts, nitrogen, phosphorus and potassium by different methods. pH of soil has been determined by pH meter amount of TSS by conductivity bridge method, amount of nitrogen by Kjeldal's method, amount of phosphorus by citric acid extract method and amount of potash by sodium cobaltinitrate method.

The pH of soil has been obtained in the form of hydrogen ion concantration. The values for TSS and N have been taken in percentage. While the values for P and K have been taken in the form of amount of Kg. per hectare of land.

Collected and experimental values obtained for pH, TSS, N, P and K have been used to find the fertility of soil. For this Azziz method (1961)[3] has been used to calculate Indices for N, P and K. According to this method the highest figures of N, P and K have considered to be equal to index value 100. Separately with this value the index values for other figures of the same have been calculated.

The single nutritive element is not indicator of fertile soil at all times and for all crops. Because

different crops do not give same responce to same nutritive element. Therefore effective index values have been obtained by adding the index values of N, P and K for each soil sample. And to show effective fertility of soil the proporationate Index values have calculated by the same method described above.

Tabulation of data -

The values thus obtained for the pH, TSS, N, P and K and Index, values of each soil sample have been tabulated in different columns of tables and in appendix. These tables are prepared stratumwise. The index values of each soil sample for N, P and K have been tabulated in adjucent columns of each nutritive element. The effective index values and praportionate index values have tabulated in last two columns of table.

Talukawise crop combination with ranking, important crops grown with area under each crop to the gross cropped area and change in cropping pattern in percentage has been shown by different tables in Chapter No.V.

Wherever possible the maps are prepared to show fertility of soil in respect of chemical components and proportionate Index values. Different cartographic, techniques have used to show low medium and high fertility of soil in study region.

Analysis - Tables and maps have been used to

analyse the data. The analysis is made mainly to find the fertility of soil in Sangli district. Whereever possible the soils of district have been grouped in three parts. Those groups have been named as,

I) low (less) fertility

II) Medium fertility &

III) High fertility

While determining soil fertility separate ranges have been used for pH, TSS, N, P, K and index values. Because perticular range of perticular chemical component makes soil fertile.

The limits suggested by Tamhane et al and the ranges suggested by USDA for pH and TSS respectively have used to show low, medium and high fertility of soil in Sangli district. And the ranges suggested by IARI for N, P and K have been used to show low, medium and high fertility in respect of them. All the limits are discussed in Chapter No.IV.

Outline -

The research work can be narrated in short as follows:

The first chapter of research work deals with introductory information about soil. It deals with significance, meaning of soil, role of soil in agricultural activity and human progress etc. The introductory chapter also deals with the different methods which have been used

to achieve the aims.

The chapter second concerns with the geography of the region. It deals with location, extension, area occupied, physiography, climate, drainage, and soil types.

The third chapter deals with important physical properties like soil texture, structure, soil colour and drainage conditions of the soil in study area. The physical properties have been used to show productivity of soil in study area.

The chapter four is concerned with chemical analysis of soil in study area. This is the prime (main) part of the thesis. Soil reaction, total soluble salts, nitrogen, phosphorus and potassium are considered to find the soil fertility of area under study. In short this chapter mainly deals with the fertility of soil in respect of only main plant nutrients.

The fifth chapter deals with landuse and soil in study area. First, attempt has been made to, whether the use of land for agriculture has been made properly according to fertility of soil or not, and later, the attempt has been made to find the fertility of soil has been considered or not while changing the crop.

Conclusions about soil fertility, its distribution and suggestions for keeping the soil in fertile condition have been discussed in last chapter.

R E F E R E N C E S

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