CHAPTER - II

PHYSICAL PROPERTIES OF SOILS

2.1 INTRODUCTION :

The study of physical characteristics of soils is essential to determine land capability. Land capability classification is based on the appraisal of these components. An attempt has been made in this chapter to map and examine the spatial aspects of the inherent characteristics. Here soil refers to upper layer of land surface which may be ploughed. It has been defined as the surface film or loose materials of earth's surface. The physical characteristics of soil need careful study because soil is a natural medium for the plant growth and gives mechanical support to plant (Vaidya and Sahastrabudhe, 1979). According to physical chemists, soils have three phases i.e. solid, liquid and gaseous. The solid phase consisting of enumerable minerals and organic substances (Kanwar, 1970).

The quality of land can be assessed by physical characteristics of soil which consists of soil texture, slope, soil depth, soil drainage, soil erosion, soil gravelness, soil colour and soil moisture. The properties of each component were identified by keen observation in the field and maps were prepared to show regional distribution of land capability zones in the study region. The region was divided into stratas and six villages were selected from each strata by adopting random sampling. The details of each characteristic of soils, in each selected villages, were observed and marked on the base maps.

The interpolation techniques was employed and map for each individual component was prepared. For the assessment of each characteristics in the field, different techniques were used.

2.2 SOIL TEXTURE :

Soil texture refers to the fineness of soil particle. Obviously, the size of soil particles determines the texture. This has been assessed with the help of textural diagram (Fig.1.3-A) evolved by Indian Council of Agricultural Research, New Delhi, 1984, and coarse textural method (Singh,1984). In fact, soil consists of combination sand, silt and clay. Thus, proportion of clay, silt and sand particles in relation to each other is called the texture of siol (Lorentz,C. Pearsons,1966).

TABLE 2.1 : Textural classification system.

Sr. No.	Name	Size range in mm	Symbol
1	Clay	Less than 0.002	C
2	Silt	0.002 - 0.02	S
3	Fine sand	0.02 - 0.20	F S
4	Coarse sand	0.20 - 2.00	CS
5	Gravel	More than 2.0 - 20	G

SOURCE : The nature and properties of soil, Buckman and Brady (1967).

The large amount of sand in soil is called coarse soil. If silt is present in large quantities it is called as silt loam or loam. Large amount of clay in soils makes it sticky and it is termed as clay or clay loam (Raychaudhuri,S.P.,1966).

TABLE 2.2 : Area under different categories of texture in 1989 of Khatav taluka.

Sr. No.	Category	Area in hect.	Area in percentage
1	Clay	16,480.30	12.10
2	Clay loam	26,967.30	19.80
3	Sandy clay	22,473.10	16.50
4	Sandy loam	28,466.00	20.90
5	Sandy clay loam	14,482.70	10.60
6	Sandy	26,468.30	19.40
7	Area under dams	998.80	00.70
	Total	136,337.00	100.00

SOURCE : Compiled by the author, 1989.

Six classes of texture are identified (Fig.2.1-A) as clay, clay loam, sandy clay, sandy loam, sandy clay loam and sandy. The zone of clay textural soil is confined to the banks of the Yerala river in the central parts covering 12.1 percent (16,480.30 hect.)

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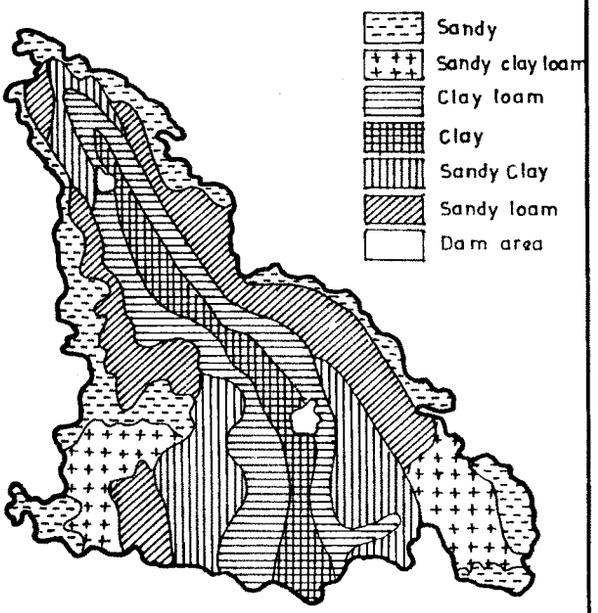
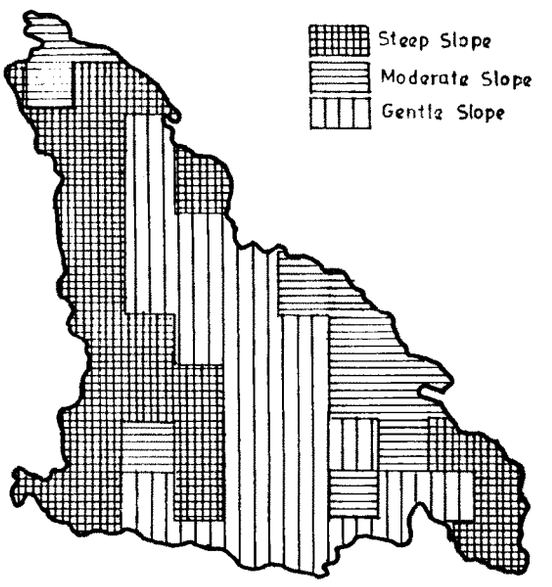
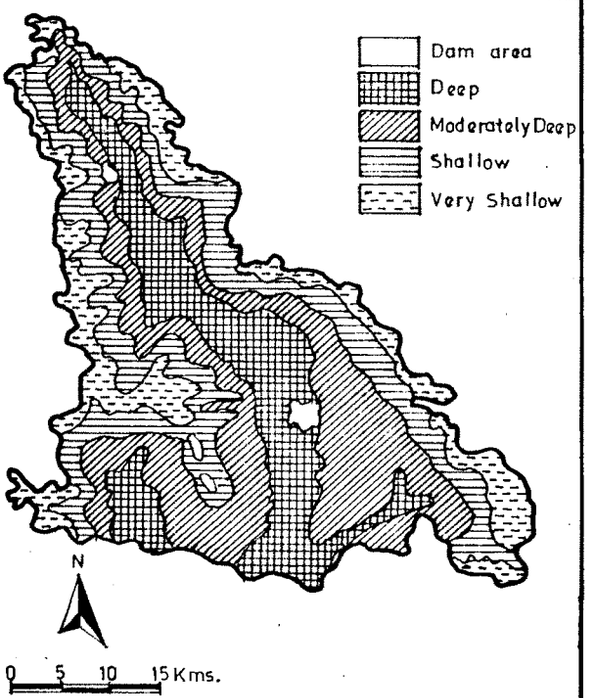
(A) SOIL TEXTURE



(B) AVERAGE SLOPE (WENTWORTH'S METHOD)



(C) SOIL DEPTH



(D) SOIL DRAINAGE

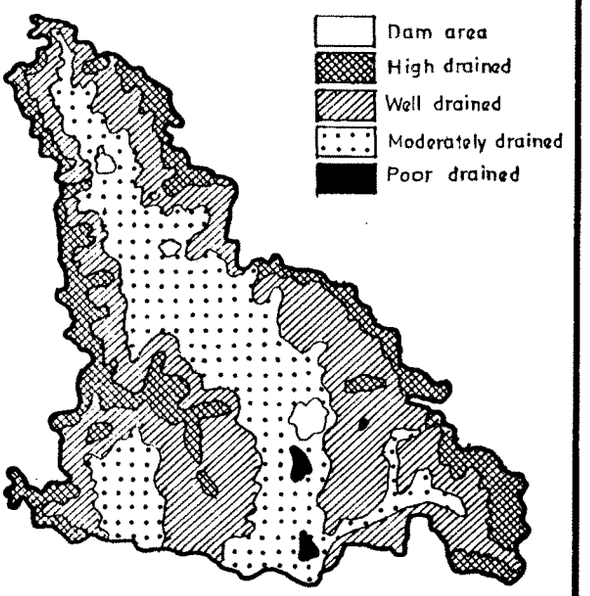


FIG. 2.1

areas of Ner, Pusegaon, Khatgun, Khatav, Vakeshwar, Vaduj, Nadhaval, Ambavde, Nimsod and Chitali villages. The second zone of clay-loam soils occupies about 19.8 percent (26,967.8 hect.) area. Whereas the proportion of sandy clay textural class is 16.5 percent (22,473.1 hect.). This class covers the areas of villages like Vanzoli, Shirasavadi, Shenvadi, Chorade, Mol, Diskal, Lalgun, Mayani, Anphal and Vikhale etc. (Fig.2.1-A). Sandy loam soils have covered about 20.9 percent (28,466.0 hect.) land of the taluka in the villages of Vadgaon, Aundh, Varud, Bhosare, Jakhangaon, Visapur, Vardhangad, Rajapur, Budh, Vetane, Dharpudi, Daruj, Pedgaon, Katar-Khatav and Khatval (Fig.2.1-A). Sandy clay loam textural class is observed in the south-western and south-eastern part of the region (Fig.2.1-A) covering about 10.6 percent (14,482.7 hect.) of total land of the taluka. The sandy soils (19.4 percent) are found mostly along the eastern and western borders which are hilly and rugged in nature (Fig. 2.1-A). The absolute areas and proportions in percentages are shown in Table 2.2.

2.3 SLOPE :

Gradient and length of slope affects the rates of runoff and soil removal and indirectly the amount of moisture to be absorbed by the soil. This certainly influences the landuse capability. The percentage of slope determines the erosion susceptibility of the soil depending on it's nature and helps in placing land in suitable capability classess (Mohmad Noor, 1980).

The average slope has been determined by employing Wentworth's method of slope analysis (Monkhouse Willkinson, 1970). The following formula is considered to determine the slope.

$$\text{Average Slope} = \frac{\text{Average number of contour crossing per sq. km} \times \text{Contour interval}}{3361 \text{ (Constant)}}$$

Thus, three categories of slope are identified as steep, moderate and gentle.

TABLE 2.3 : Area under different categories of slope in Khatav taluka 1989.

Sr. No.	Category	Area in hect.	Area in percentage
1	Steep	59,306.6	43.50
2	Moderate	26,585.7	19.50
3	Gentle	50,444.7	37.00
	Total	136,337.0	100.0

SOURCE : Compiled by the author, 1989.

Gentle slope has occupied about 37.0 percent area located in areas of Maradwak, Morale, Chitali, Vakeshwar, Khatav, Vaduj, Ambavade and Nadhawal village. Moderately sloping land ranges

between 10 to 15 percent acquiring the 19.5 percent (26,585.7 hect.). Steep sloping area is examined in the eastern and western boundaries of taluka (Fig.2.1-B). The areal extention of steep slope land is about 43.5 percent (Table 2.3).

2.4 SOIL DEPTH :

The effective depth of soil is determined by the thickness of soil layers readily penetrated by plant roots. Soil depth has been identified by observing soil profiles along the river and stream banks.

TABLE 2.4 : Area under different categories of soil depth in Khatav taluka 1989.

Sr. No.	Category	Depth (cm)	Area in hect.	Area in percentage
1	Deep	Above - 45	27,966.6	20.5
2	Moderate deep	22.5 - 45.0	44,446.8	32.5
3	Shallow	7.5 - 22.5	32,461.2	23.8
4	Very shallow	Below - 7.5	30,463.6	22.4
5	Area under dams	-	998.8	0.7
	Total		136,337.0	100.0

SOURCE : Compiled by the Author, 1989.

Based on the field studies two broad zones i.e. deep and shallow are identified. They are further sub-divided as per the variation in depth (Fig.2.1-C). The belt of deep soils is found in the central part which is parallel to Yerala river course covering about 20.5 percent (27,966.6 hect.) area with soil depth above 45 cms. This type of land is observed in the areas of Diskal, Ner, Pusegaon, Khatgun, Khatav, Vaduj, Vakeshwar, Ambavade, and Chitali villages. The moderate deep soils ranging from 22.5 to 45 cms have covered 32.6 percent (44,446.8 hect.) land of the total. The stream banks in the villages of Mhasurne, Chorade, Nimsod, Bhandewadi, Kumthe, Gopuj, Dhondewadi, Maradwak, Morale, Kaledhon, Vikhale, Palasgaon and Khatval have shown occurances of such soils (Fig.2.1-C). About 23.8 percent (32,461.2 hect.) land has been covered by shallow soils in different parts of the taluka. And about 22.4 percent land has been occupied by very shallow soils (Fig.2.1-C). Usually the depth is less than 7.5 cms. These soils are generally kept fallow owing to their infertility. The western and eastern hilly region, along the border, are covered by these soils.

2.5 SOIL DRAINAGE :

The nature of watertable in the soil may be caused by excessive rainfall, seepage, injudicious irrigation or low permeability of surface layers (I.C.A.R.,1970). When the infilteration is not rapid enough, the rain or irrigation water will flow over the soil surface and cause the waterlogging.

If the flow of soil water attains rapid velocity it will carry the top fertile soil with it and will result in erosion (Vaidya and Sahastrabudhe, 1979). The fertile top soil surface will be protected from erosion and waterlogging if the soil drainage is poor.

TABLE 2.5 : Area under different categories of soil drainage in Khatav taluka, 1989.

Sr. No.	Category	Area in hect.	Area in percentage
1	High drained	33,959.3	24.9
2	Well drained	48,442.2	35.5
3	Moderately drained	32,437.3	38.5
4	Poor drained	499.4	0.4
5	Area under dams	998.8	0.7
	Total	136,337.0	100.0

SOURCE : Compiled by the author, 1989.

The spot surveys of sample villages have enabled to divide the region into four categories based on soil drainage as high drained, well drained, moderately drained and poor drained (Fig.2.1-D). About 0.4 percent area of the taluka is having very gentle slope which has poor drainage of soils in the villages of Maradwak

and Morale. The soils are moderately drained in the central parts of Yerala basin covering 38.5 percent (52,437.30 hect.) area parallel to the above zone. Well drained soils have covered 35.5 percent (48,442.2 hect.) area. They are located on the foot hill zone of the region. The high drained lands records 24.9 percent (33,959.3 hect.) and are observed along the eastern and western hilly parts with steep slope (Fig.2.1-D).

2.6 SOIL EROSION :

The erosion is the wearing away of top soil. It is caused by flowing water and wind or any other external agent. Erosion is the loss of soil by water and wind (Raychaudhuri, 1969). Soil erosion can be estimated with the help of drainage texture which expressed as the total length of streams per sq. km. This would be an indix to soil erosion. The entire region was divided into grids of which each grid would measure one sq. km area (i.e. 1 x 1 cm) and values pertaining to drainage texture were computed for each grid and were plotted on corresponding grid. The critical value of drainage texture per sq.km which may cause soil erosion by water is 0.90 and above per sq.km of area (Singh, 1976). The lower values denotes safe areas in terms of erosion. In view of this, the categories like excessive (above 0.90), moderate (0.60 to 0.90) and low (below 0.60) erosion are determined and the map was prepared accordingly (Fig.2.2-E). Thus, different zones of soil erosion are ascertained in the study region.

TABLE 2.6 : Area under different categories of soil erosion in Khatav taluka, 1989.

Sr. No.	Category	Area in hect.	Area in percentage
1	Excessive erosion	39,128.7	28.7
2	Moderate erosion	65,578.1	48.1
3	Less erosion	31,630.2	23.2
	Total	136,337.0	100.0

SOURCE : Compiled by the author, 1989.

The zone having excessive erosion (above 0.90 sq.km) is observed along the western border comprising the areas of Kurle, Kalambi, Trimali and Nandoshi and eastern border village as Kaledhon, Pachwad, Nidhal and Rajapur villages covering about 28.7 percent (39,128.7 hect.) area of the total (Fig.2.2-E). The areas with moderate erosion (0.60 to 0.90) is confined to extreme northern and south-eastern border areas of the region. This zone occupies about 48.1 percent (65,578.1 hect.). The threshold areas or safe areas (below 0.60) are found in the central parts. This zone occupies Yerala river Valley with narrow flood plains (Fig.2.2-E).

2.7 SOIL GRAVELNESS :

When the size of sand or stone particles excesses to 2.0 mm is called soil gravelness. The presence of gravels affects

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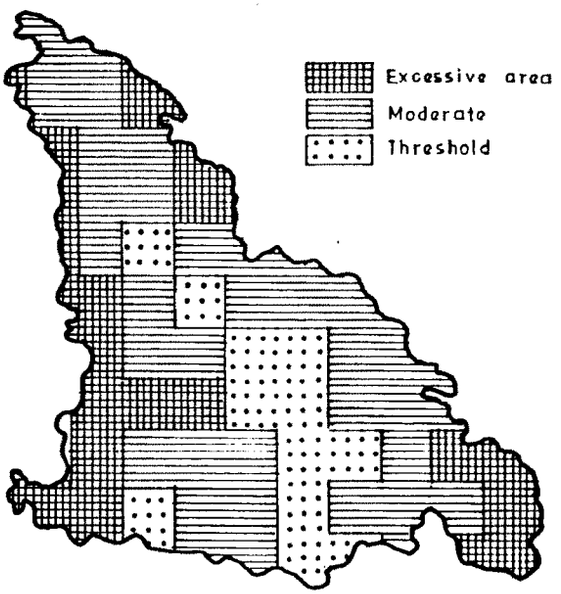
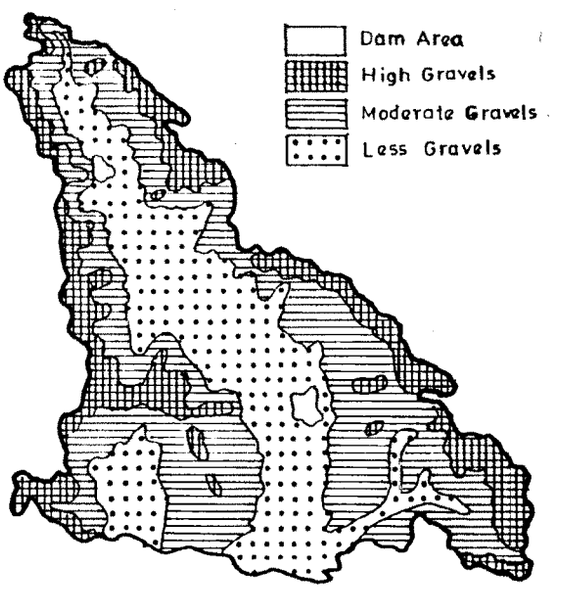
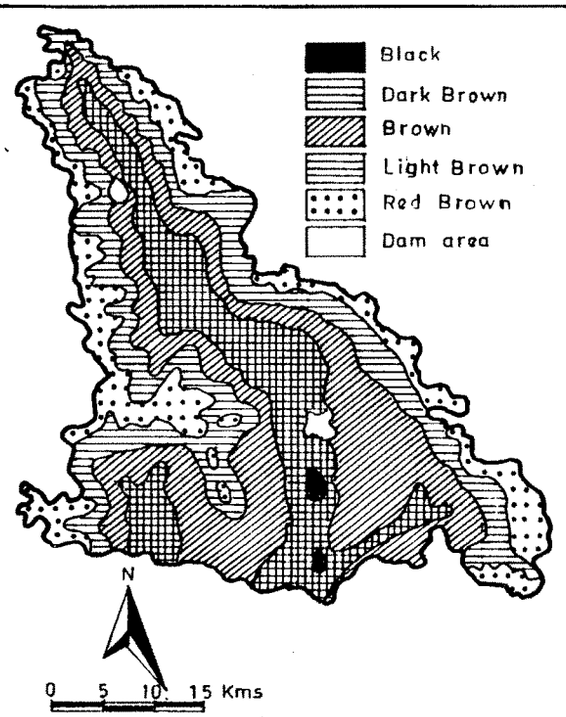
(E) EROSION PRONENESS



(F) GRAVELS



(G) SOIL COLOUR



(H) SOIL MOISTURE

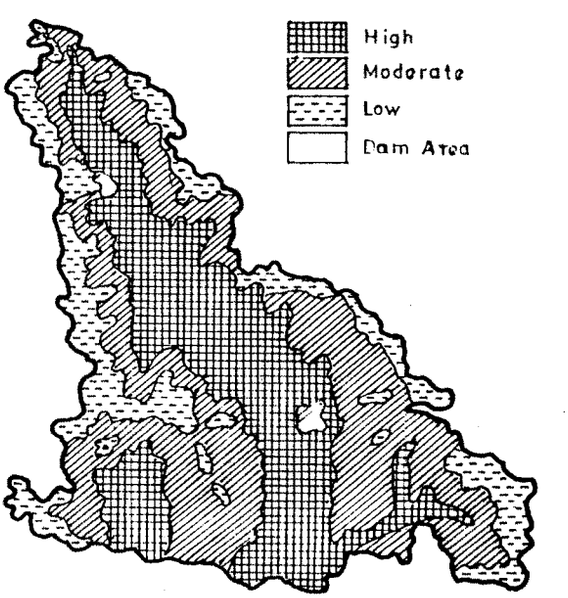


FIG. 2.2

the fertility of soil and so the capability. The soil gravelness is assessed by the amount and size of gravels which is based on keen observation.

TABLE 2.7 : Area under different categories of soil gravels in Khatav taluka, 1989.

Sr. No.	Category	Area in hect.	Area in percentage
1	High gravels	33,959.3	24.9
2	Moderate gravels	48,442.2	35.5
3	Less gravels	52,936.7	38.9
4	Area under dams	998.8	0.7
	Total	136,337.0	100.0

SOURCE : Compiled by the Author, 1989.

Fig.2.2-F exhibits the distributional pattern of soil gravelness. Three categories have been identified as high, moderate and less presence of gravels in the soil. The central belt with gentle slope and deep soils shows less presence of gravels. This acquires about 38.9 percent (529,367 hect.) area and agriculturally productive attaining significant capability. The zone of moderate gravelness is parallel to the above zone (Fig.2.2-F) which occupies about 35.5 percent (48,442.2 hect.) area. The extreme eastern and western border belts are characterised by the presence of high gravels covering about 24.9

percent (33,959.3 hect.) area. This may be attributed to hilly and rugged nature of topography.

2.8 SOIL COLOUR :

The colour of soil may be attributed to many variables which can be ascertained by a careful observation in the field. Different shades of soil colour can be assigned to the presence of parent materials, organic matters and certain minerals. The colour of soil is mostly due to the iron and manganese components and the organic matter in soil (Narayana and Shah,1966). The colour of the top soil is an indication of soil drainage. A well and moderately drained soil has generally uniform brown colour when moist. But in some cases there may be various shades of red or yellow (Raychaudhuri,1966).

TABLE 2.8 : Area under different categories of soil colours in Khatav taluka, 1989.

Sr. No.	Category	Area in hect.	Area in percentage
1	Dark brown	27,467.2	20.2
2	Brown	44,446.9	32.6
3	Light brown	32,461.2	23.8
4	Red brown	30,463.6	22.3
5	Black	499.4	0.4
6	Area under dams	998.8	0.7
	Total	136,337.0	100.0

SOURCE : Compiled by the Author, 1989.

In the study region, soil colour categories as black, dark brown, brown, light brown and red brown are observed (Fig.2.2-G). Dark brown soil occurs along the banks of Yerala river comprising the areas of Diskal, Ner, Pusegaon, Katgun, Khatav, Vakeshwar, Vaduj, Ambavade and Chitali villages covering about 20.2 percent (27,467.2 hect.) area. The major portion of Khatav taluka is covered by brown soil and its proportion is 32.6 percent (44,446.9 hect.) to the total area. Light brown soils are found in the western and eastern foot hill region occupying 23.8 percent (32,461 hect.) area. Red brown colour is confined to western and eastern margins located at higher altitude (above 800 metres). It has covered about 22.3 percent area showing deficiency in different elements. The patches of black soils are found in the areas of Maradwak and Morale village (Fig.2.2-G).

2.9 SOIL MOISTURE :

The available soil moisture has been assessed by using 'Core Roll Molding Method'.

TABLE 2.9 : Area under different categories of soil moisture in Khatav taluka, 1989.

Sr. No.	Category	Area in hect.	Area in percentage
1	High moisture	52,936.7	38.9
2	Moderate moisture	48,442.2	35.5
3	Less moisture	33,959.3	24.9
4	Area under dams	998.8	0.7
	Total	136,337.0	100.0

SOURCE : Compiled by the Author, 1989.

High moisture content of soils is observed along the banks of Yerala river comprising the areas of Diskal, Nar, Pusegaon, Khatgun, Khatav, Vakeshwar, Vaduj, Ambavade, and Chitali villages. This zone covers about 38.9 percent area. This may be attributed to the gentle slope and greater depth of soils. Moderate proportion of soil moisture is observed in the villages of Mayani, Kaledhon, Mandve, Tadavale, Hingne, Pedgaon, Vadgaon, Chorade and Pusesavali (Fig.2.2-H). This zone occupies 35.5 percent (48,442.2 hect.) area. The low moisture soil content is found in hilly region of the west and east. The topography is characterised by the presence of steep slope, less depth, high drainage, intensive erosion and sandy texture. All these have lead for poor capability of land.

2.10 SUMMARY :

The physical characteristics of soil such as soil texture, slope, depth, erosion, drainage, gravelness, colour and moisture are used as bases for land capability classification. There is uneven distribution of these variables which leads for regional imbalances in land capability. Soil texture varies spatially. Clay loam, sandy clay, sandy loam, sandy and clay textural soils are found in the study region. The slope is moderately steep in taluka. Soil depth is determined by the thickness of soil layers. Shallow soil cover (below 7.5 cm) is located along the western and eastern borders of the study

area whereas central parts have attained significant depth (above 45 cms). The intensity of erosion is also spatially varying in the region. High soil drainage is confined to hilly parts. The hilly region proper and foot hill zones have shown the occurance of more gravelness. Generally all over taluka brown red soils observed. Moisture content of soil has decreased from river sides to the hilly region in the west and east. Moreover, the inherent characteristics of soils are unevenly distributed.

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