CHAPTER - I

-:- PROFILE OF THE REGION -:-

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INTRODUCTION :

The physical environment plays a significant role in determining the development of irrigation. In the present chapter the study of physical bases viz. terrain, drainage, climate, soils, water resources, has been attempted in the context of irrigation. As such, irrigation of a particular region, is the outcome of physico-socio-economic conditions. However, due to some limitations of the present work, the author has discussed salient features of these conditions. The relief divisions are based on the Topo sheets No.47 $\frac{L}{4}$, 47 $\frac{H}{16}$. Wentworth's method is used to analyse the slope of the region and further the slope zones and frequency distribution of slope is attempted. The drainage system, soil types, rainfall and temperature conditions and surface and ground water resources have been discussed in relation to irrigation.

1. THE TERRAIN :

Broadly speaking, relief of an area is one of the primary determinants of the spatial differences in the intensity of agricultural activities. The need for irrigation and drainage is mainly determined by geological, topographical and metereological conditions (Fukuda,1976). The three most significant aspects of terrain are altitude, slope and drainage pattern. The effects of terrain exercieses through altitude, rugged relief and the slope which determines the areas unfit

for irrigation or accessiability for flow or lift irrigation and farm mechanization. Hence, it needs investigation of the physiographic conditions which leads to the possible irrigational and agricultural plans for development (Pawar, 1981). The present chapter highlights the physiography in general and slope in particular as the slope analysis assumes importance in the extent and nature of irrigation.

A) RELIEF :

The Upper Vedganga basin lies between the Bhudargad range in the south and Dudhaganga range in the north. Vedganga river flows between these ranges. The western border of the region is well defined by the watershed of Sahyadri and the northern and southern watershed by Dudhaganga and Bhudargad ranges respectively.

The topography of the region consists of three divisions, viz. hill ranges, foot-hills and narrow erosional plain. Such divisions are made through a close examination of topo sheets, published by the Survey of India. These variations in the land are due to the geological complexity of the region and varied geomorphological evolutions (Deshpande, 1971).

i) Hill Ranges :

This division comprises Bhudargad range in the south and Dudhaganga range in the north. These ranges are the

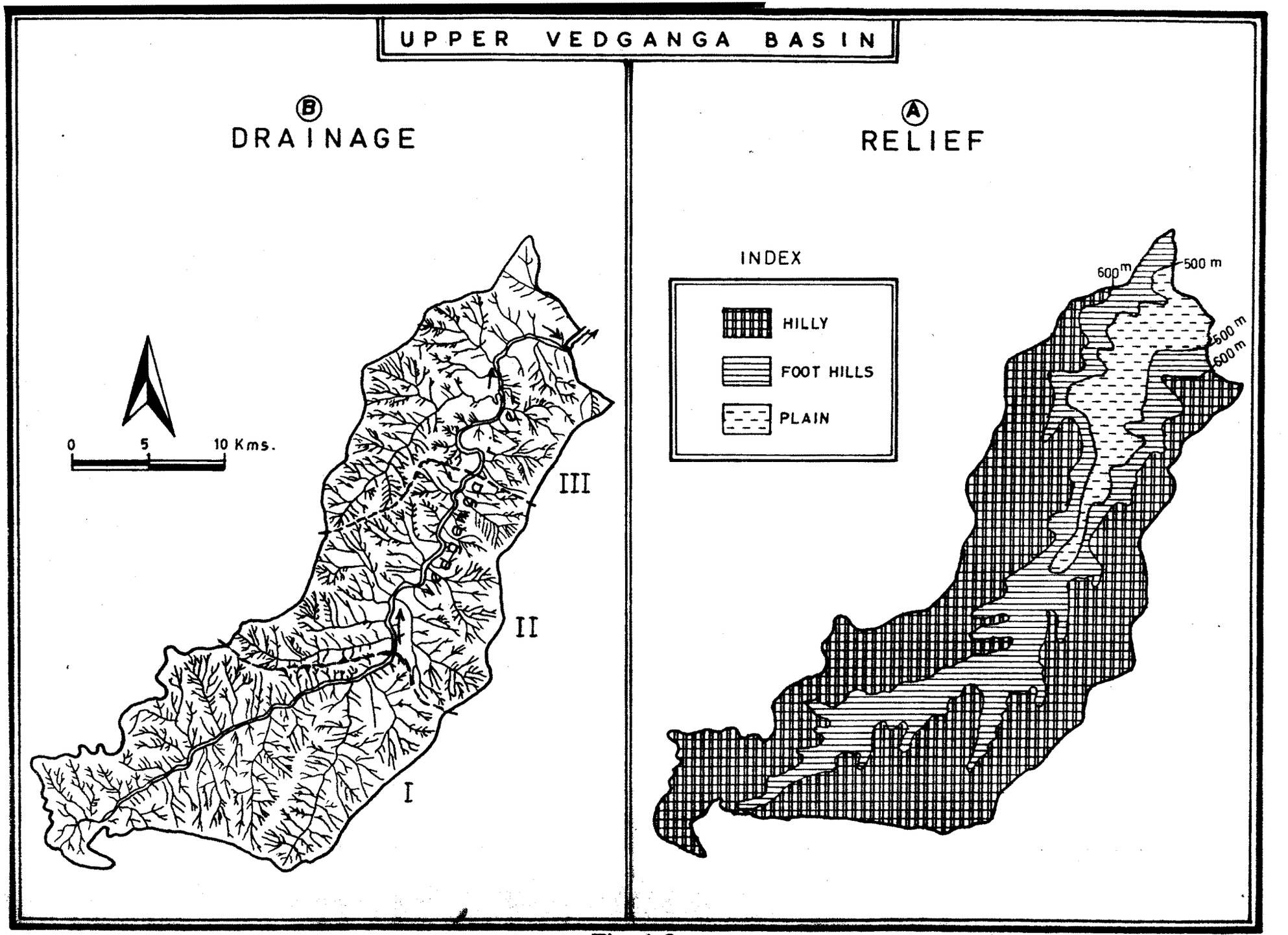

UPPER VEDGANGA BASIN
B
DRAINAGE
0 5 10 Kms.
I
II
III
A
RELIEF
INDEX
HILLY
FOOT HILLS
PLAIN
600 m
500 m
500 m
600 m

Fig. 1·2

eastward extension of Sahyadri and follow the southwest to northeast orientation. It is a part of besaltic plateau of Maharashtra and having the characteristics of lava topography, consisting of flat tops and steep escarpments on the flanks which carry several terraces or steps. The ranges rises to about 250 metres above the valley floors. The summits of the ranges are noted for their remarkably flat table-lands, separated by low saddles. These ranges show intense gully erosion and have a number of sub-branches extended towards the valley. The height of the ranges is less (750 M) in the west as it increases towards east (900 M) and it again decreases further east of the region (Fig.1.2-B).

This division covers an area of 375 sq.km.(68.70%) of the total geographical area. Both ranges form the waterdivide of Vedganga and attribute towards the volume of water in the river. The general nature of the ranges is featured by the occurances of alternate spurs and small valleys - setting the limits to agriculture. The principle character of these ranges is the abruptness of their rise. A large portion of these ranges is covered with the deciduous forests.

ii) Foot-Hill Zone :

This area lies between the river plain and hills, covering about 22 percent of the total area. The altitude ranges from 560 to 600 M presenting undulated topography. It has an average gradient of 10° (Fig.1.3). The general

appearance of this transitional landscape is that of series of spurs extending towards the central plain.

The zone is covered with forests in the west whereas the scrubs and grasslands are dominant in the east. The valleys of the small nalas, meeting Vedganga, show considerable slopes and are carefully terraced, with retaining walls, to produce paddy and rabi crops. On the upland areas, located between the sub-tributary valleys, the terraced cultivation is practised. The zone is associated with a number of springs which have vital role in irrigating the land.

iii) River Plain :

It accounts for 9 percent of the total area of the basin. Vedganga river has formed a narrow plain (below 600 M) which opens towards the east, particularly at Madilge (B) village. This tract, though small in extension, is agriculturally developed. The rolling topography, availability of water in the river course and substantial ground watertable have led to the developments of irrigation. The narrow alluvial tracts along the riverside have proved their suitability for irrigation and subsequently for sugarcane cultivation.

B) SLOPE :

Slopes, defined as an angular inclinations of the terrain between the hill tops to valley bottoms, have close relationship with the development of irrigation facilities.

The slope or inclination of the terrain is the resultant of many factors, such as relative relief, drainage frequency, climate, geology and techtonics operating in the area (Kharkwal,1971). On the levelled land, the water-channels to the fields can be easily made but difficulty arises as the slope increases. Not only this, the slope put limits in the operation of canal and lift irrigation. On the steep sloped fields the water can be provided with the help of lift irrigation schemes inviting very high cost. On the sloped fields, irrigation is bound to decline unless some effective measures like terraces are adopted.

Slope has not only the negative relationship with irrigation but the positive too. Irrigation water can be brought from upslope to downslope and from terrace to terrace by a system of artificial channels. Water from hill streams or springs is diverted by a network of small channels to individual fields. This old tertiary technique is quite popular in this region.

Recently, geographers are more interested in the study of slopes. The analysis of slopes may be objective and arbitrary but it can introduce us with the different regions of average slope (Singh and Dhillon,1984). In view of the significance of the study of slope analysis in relation to irrigation developments it would be worthwhile to highlight the general characteristics of slope features

and their distribution. An attempt is, therefore, made to examine the relationship of slope and irrigation in the study area. Many schemes have been developed in the computation of average slopes from the topographic maps. Wentworth's scheme (1930) has been applied for the analysis of slope in Upper Vedganga basin.

$$\text{Tan } Q = \frac{N \times CI}{3361}$$

Where, N = represents the number of contour crossings per square km area

CI = represents Contour Interval

3361 = is a constant figure

The natural tangent of the values gives the degree of slope.

TABLE 1.1 : Classification of slope

Sr.No.	Degree	Class
i)	$< 3°$	Gently sloping
ii)	$3° - 06°$	Moderate slope
iii)	$6° - 11°$	Fairly steep
iv)	$11° - 18°$	Moderate steep
v)	$18° - 25°$	Steep slope
vi)	$> 25°$	Very steep slope

SOURCE : Compiled by the Author, 1986.

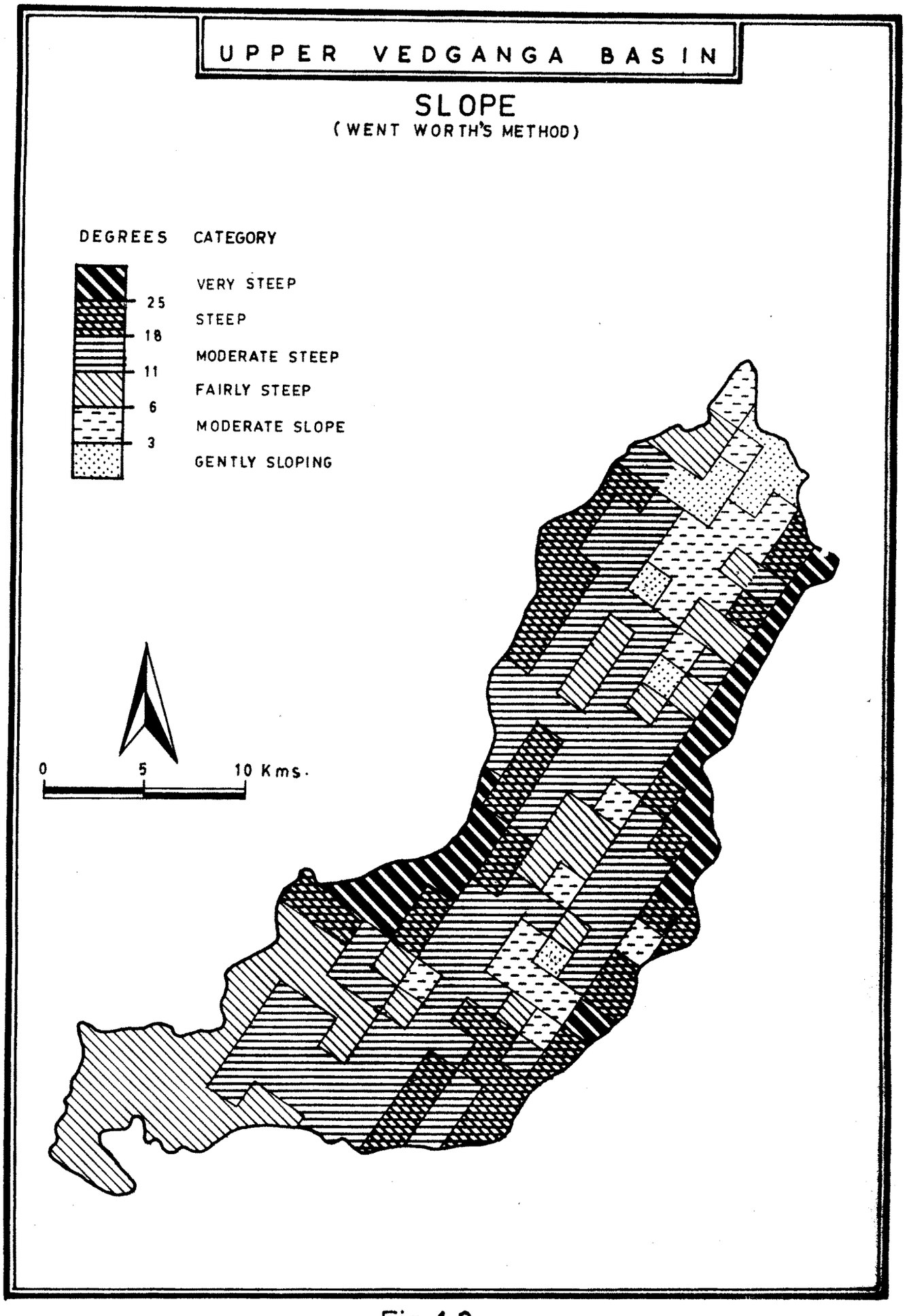

UPPER VEDGANGA BASIN
SLOPE
(WENT WORTH'S METHOD)
DEGREES
CATEGORY
25
18
11
6
3
VERY STEEP
STEEP
MODERATE STEEP
FAIRLY STEEP
MODERATE SLOPE
GENTLY SLOPING
0
5
10 Kms.

Fig. 1·3

The entire Upper Vedganga basin is divided into 190 grids of one square kilometre each and the slope values with the help of above formula are calculated for each grid. The slope values have been classified (Table 1.1) with slight departure from Macgregor's Scheme (Singh and Dhillon, 1984).

Spatial pattern of slope :

The average slope map (Fig.1.3) provides information of slope distribution over the entire study region. In general, the slope values indicates an assymetrical distribution along both sides of the river course.

The highest inclination (39°) of terrain is located near Anturli village. Along the river side, the slope is normal (3° - 5°). The lowest slope values ($<3°$) are observed at the villages Gangapur, Waghapur, Madilge (Br.), Nilpan and parts of Madilge (Kr.), Koor, etc. The patches of gentle slope are located around Gargoti town in the east and Karambali village in the west.

The moderate sloping below 6° is observed in two patches, one being located in the eastern parts of the riverside and another in the middle part of the river valley (Fig.1.3).

The western part records 15° average slope whereas 18° slope covers an extensive area located between river valley and northern and southern ranges. These ranges, however, carry slope values above 20°.

Slope Zones :

While analysing the distribution of slope in the region, the author has observed following slope zones.

i) Level slope zone : ($< 3°$) :

It covers an area of 26 sq.km. (5.26%). It has very low percentage because the basin is in the upper stage of cycle of erosion. This slope covers a large part of the area as the river stream goes forward. This zone consists of the area of villages Gangapur, Waghapur, Madilge (Br.), Nilpan, Gargoti, Karambali and parts of Madilage (Kr.) and Koor. It has below 3° slope. This appears to be suitable area for irrigation development.

ii) Sloping zone (3° to 6°) :

The region ranging between 3° to 6° slope comes under this category which occupies 9.47 percent (46.60 sq.km.) of the total area . It covers parts of Morewadi, Basarewadi, Sarwad, Kalanakwadi, Khanapur, Mhasave, Pacharde, Nandoli, etc. This part also offers favourable opportunities for irrigation.

iii) Foot-hill zone (6° to 11°) :

The area ranging between 6° to 11° slope marks this zone. It consists of 18.42 percent of the total area including the parts of villages such as Koor, Mudhal, Konavade, Sonarwadi, Pushpanagar, Devakewadi, Phanaswadi, Kadgaon, Vengarul, Mamadapur, Tirayade, Nitavade etc. This zone, however, presents difficulties

for the extension of irrigation which have been overcome, in some places, by lift irrigation.

iv) Moderately steep zone (11° to 18°) :

This zone, ranging between 11° to 18° slope, comprises very large portion of the basin. It covers an area of 181.23 sq.km. and lies in between the hill ranges and foot-hill zone. The slope is not suitable for irrigation.

v) Steep slope zone (> 18°) :

The area having above 18° slope lies in this part and is mainly confined to the northern and southern hill ranges, particularly the eastern portion of the range located in south. Both, the moderately steep and steep slope zones, are deprived of irrigation facilities.

Frequency Distribution :

Drainage frequency is the measure of number of stream segments per unit area (Singh and Srivastav,1975). The frequencies of slope category of 190 grid squares is computed and arranged in tabular form (Table 1.2). This table reveals that only 5 percent of the total frequency is represented by gentle slope category. Since the basin is in the first stage of cycle of erosion, it carries moderate and high degree of slope. The categories of gentle and moderately gentle slope account for about 5.26 percent and 9.47 percent frequencies

respectively. The maximum frequencies (36.84%) lie in the category of moderate steep followed by steep (20%), fairly steep (18.42%) and very steep (10%). Thus about 85.26% frequency has been recorded by steep slope in the region. This is, perhaps, due to hilly topography of the region, presenting less prospects for irrigation developments.

TABLE 1.2 : Frequency distribution of slope values.

Slope (degree)	Frequency	Percent of total frequency	Cumulative frequency	Remarks
< 3	10	5.26	5.26	Gentle sloping
3 - 6	18	9.47	14.73	Moderately gentle
6 - 11	35	18.42	33.16	Fairly steep
11 - 18	70	36.84	70.00	Moderate steep
18 - 25	38	20.00	90.00	Steep
25	19	10.00	100.00	Very steep
Total	190	100.00		

SOURCE : Compiled by the Author, 1986.

The relationship of slope in degree and frequency in percentage is represented by the frequency curve (Fig.1.6-D).

It indicates the fact that no slope category is highly dominant. It shows the negative skewness showing thereby that the majority of the area enjoys moderate steep and steep terrain. The frequency curve is skewed to the right, compressing low slope values on the left but expanding high values on the right.

Slope and Irrigation Development :

The foregoing analysis may certainly lead to establish the relationship between slope and irrigation developments in the region. Slope is, however, not the single most factor determining the level of development of irrigation as it is the interaction of a number of factors. But slope still remains as a dominant factor in irrigation developments.

An attempts has been made to correlate this relationship by superimposing the figure 1.3 on figure 2.4-A. With this technique it is observed that in the levelled to moderate sloping land ($\leq$ 6°), the intensity of irrigation is high (16 - 24%). In this zone the villages like Mhasave (30%), Kumbharwadi (43%), Donavde (35%) and Nandoli (41%) records highest intensity of irrigation. It is because the levelled land is very much accessible for providing water to individual fields. The lift irrigation is highly dominant in this zone.

As the slope values increases to 15° away from the river course, the isolines of intensity of irrigation get low

values (8 - 16%). In this region the slope limits the scope of lift irrigation schemes as it costs high and becomes inaccessible. The well irrigation, however, plays an important role in this zone.

In the steep slope zone ($>18°$), there is very poor development of irrigation facilities ($<$ 8%). The zone depends upon the natural sources of water i.e. springs, perennial nalas etc. The lift irrigation is almost impossible and a very little scope is remained for well irrigation in this tract.

In the far west, though the region has average slope of 15°, the irrigation development is nil. In fact is that this region has poor development of land resources (net area sown ranges from 2 to 10%) and high percentage of forested area (above 70%) and overall hilly undulating nature of topography.

Considering the slope, the Irrigation Department of Government of Maharashtra has estimated that the area under command would be available for lifts at a verticle height of 23 metre on both sides of the river Vedganga (Patagaon Medium Irrigation Project Report, 1974). The sources further say that the irrigable land will be 7960 hectares and in fact this would be five times more than the present area under lift irrigation (1,520 hectares).

2. DRAINAGE :

Drainage pattern of an area is closely related to the pattern of irrigation. The perennial drainage affects the intensity of irrigation. The number and length of streams decides the volume of water which further determines the possible developments of irrigation.

The drainage pattern of Upper Vedganga basin is mastered by Vedganga river. The basin is drained by a number of (2104) small streams. The notable big nalas are Mor-Ohol, Abundi etc. There is no much variation in the network of drainage in the region. Vedganga has developed a narrow flood plain along its banks which is locally known as 'Malvi'. These are highly praised for their fertility and are important areas of irrigation, particularly for sugarcane cultivation. The physical setting of the river basin is ideal for constructing K.T.Weirs due to which water is artificially impounded within the river course and such impounded water is lifted to nearby cultivated lands. There are at present 9 K.T.Weirs in operation and another 7 are under construction.

Drainage Frequency:

The study of stream frequency presents proper idea for the development of irrigation as the volume of water is essentially determined by it. An attempt has been made here

to measure the stream frequency of the region. Pofali (1981) has attempted the drainage frequency of Vidarbha region with the help of the following formula :

$$\text{Drainage frequency} = \frac{\text{Total number of streams}}{\text{Total area sq.kms.}}$$

The same formula is employed here to calculate the drainage frequency of the study region. The region is divided into 546 grids of one square kilometer each and the number of streams in each square is computed. The entire region is divided into three arbitrary zones (Fig.1.2-B) and stream frequency is calculated for each zone (Table 1.3).

TABLE 1.3 : Zonal drainage frequency.

Zone	Area in sq.km.	Area in %	Stream frequency	Stream frequency in %	Zonal average frequency
I	228	41.75	876	41.63	3.84
II	156	28.57	586	27.85	3.75
III	162	29.68	642	30.52	3.96
Region	546	100.00	2104	100.00	3.85

SOURCE : Compiled by the Author, 1986.

The average frequency of the region is 3.85. The above table reveals that there is no marked variation in the stream frequency in the region. Generally, the whole basin is almost uniformaly drained.

The number of streams in the entire region is 2104. Fig.1.2-A shows that in the eastern, western and middle portion of the region, the stream frequency is low. The eastern part is comparatively flat and having moderately sloppy land. The middle and western region has less varied topography. The rest of the region shows high drainage frequency. Thus, drainage frequency essentially determines the volume of water which further determines the development of irrigation. The region uder study has good network of drainage. In the western portion of the region the streams are almost perennial which may be useful for irrigation but this region lacks in cultivated area leading to poor development of irrigation. In the middle and eastern portion of the region, though the streams are seasonal, they provide water to rabi crops like vegetables, wheat, etc. The river Vedganga play a significant role in the development of irrigation in the region. It would be worthwhile to develop a chain of K.T.Weirs so as to store the seasonal flow of rainwater which could be utilized for irrigation through proper management.

3. CLIMATE :

The rainfall and temperature are the two important elements of climate which are considered in the present

analysis. The nature of distribution of these elements determines the necessity of irrigation.

i) Temperature :

Being a small region and the absence of meteorological station, the temperature data of any place in the region is not available. Therefore, the data is generated through observations which is further refered to nearby meteorological station i.e. Kolhapur.

TABLE 1.4 : Monthly average temperatures of the region, 1986-87.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Temp. in °C	22	25	27	29	29	24	23	25	23	25	24	22.5

SOURCE : Collected through field work, 1986-87.

It is observed from the table that the January, February, November and December months have recorded low temperatures (below 25°C). May is the hottest month (29.6°C). The temperature during rainy months (Jun to Sept), corresponds with the average of 24.5°C. The annual range of temperature is 7.2°C. The western part of the basin is cooler than the eastern part. The hights are generally cool due to the influence of sea breezes which set in the afternoon (Gazetteer of Kolhapur District).

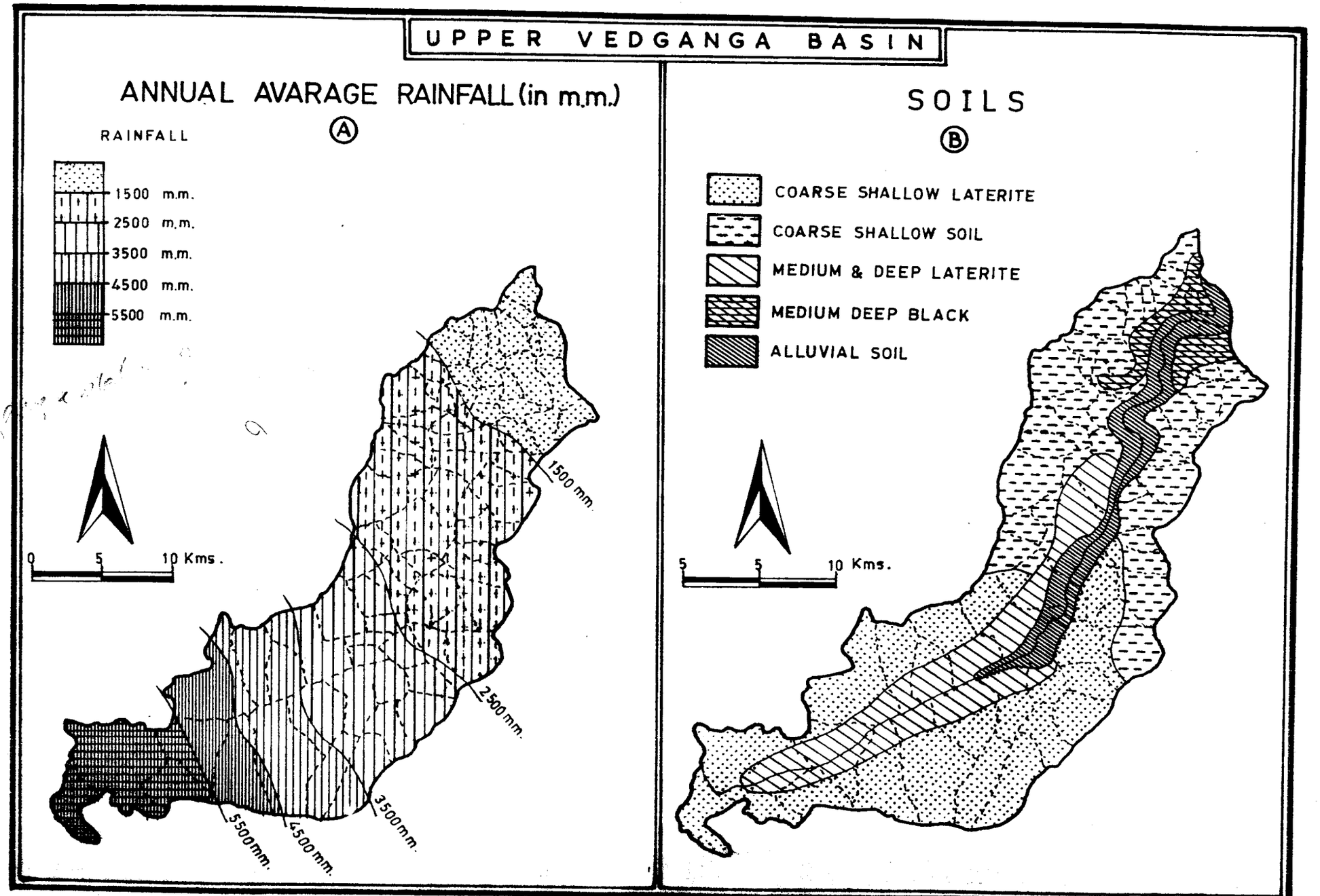

UPPER VEDGANGA BASIN
ANNUAL AVARAGE RAINFALL (in m.m.)
Ⓐ
RAINFALL
1500 m.m.
2500 m.m.
3500 m.m.
4500 m.m.
5500 m.m.
0 5 10 Kms.
1500 mm
2500 mm
3500 mm
4500 mm
5500 mm
SOILS
Ⓑ
COARSE SHALLOW LATERITE
COARSE SHALLOW SOIL
MEDIUM & DEEP LATERITE
MEDIUM DEEP BLACK
ALLUVIAL SOIL
5 5 10 Kms.

Fig.1·4

ii) Rainfall :

The seasonal nature and intensity of rainfall is a very important considerations which determine water regime and consequently the development of irrigation. The average annual rainfall in the region is 3,660 mm.

Spatial Distribution of Rainfall :

The isohytal map (Fig.1.4-A) indicates the rainfall distribution in the region. It is observed that there is large scale variations in the areal distribution of rainfall. The rainfall decreases markedly from west (6000 mm) to east (1500 mm). The region, however has fairly regular rainfall.

Seasonal Distribution of Rainfall :

The necessity of rainfall arises when the distribution of rainfall is unequal in time and space as the crops require timely and adequate water supply. Table 1.6, shows the temporal variation in rainfall in the region which is very remarkable.

In view of the fluctuations occuring in rainfall, the year can convineantly be divided into four seasons :-

i) Rainy season (June to September) :

The rainfall is highly concentrated in this season as it receives about 95 percent of the total rainfall. The rainfall is heavy,mostly assured and very much useful for kharif crops. The intensity of rainfall during this season is important in the contex of water availability for irrigation in the following seasons.

TABLE 1.5 : The annual average rainfall, 1981-85.

Month	Average rainfall in mm	Percentage to total
January	-	-
February	1.5	0.04
March	1.5	0.04
April	9.0	0.25
May	23.0	0.63
June	770.0	21.00
July	1251.0	34.18
August	1178.0	32.18
September	283.0	32.18
October	118.0	3.22
November	30.00	3.22
December	0.5	0.01
TOTAL	3660.0	100.00

SOURCE : Tahsildar Office, Gargoti and compiled by the Author, 1986.

ii) Post-monsoon season (October to November) :

This period is climatically transitional. The southwest monsoon is replaced by north east monsoon which is associated with cyclones. The region receives 4 percent of its total rainfall and it is useful for rabi crops.

iii) Winter season (December to February) :

The region receives almost no rainfall in this period. It is also characterised by the irregular cyclonic rainfall, which is beneficial, though not adequate for rabi crops.

iv) Hot summer season (March to May) :

This season receives a negligible amount of rainfall (0.92%) in this region which is associated with thunderstorms. It is very useful for sugarcane as there is very much scarcity of water for irrigation during this period.

Rainfall and Irrigation :

The spatio-temporal distribution of rainfall in the region is very much varied. There is heavy concentration of rainfall in the rainy season but still the region experiences gaps of drought. The dry months are characterised by an acute shortage of water for crops as they receive a negligible amount of rainfall. This has created the need of irrigation in the region.

4. SOILS :

Soil is the store-house of plant food. It stands as the physical base for any agricultural practice. Soil provide essential material on which agriculture is based and therefore, any comprehensive survey of the geography of agriculture should include a fairly thoroguh treatment of soils (Singh and Dhillon, 1984). The study of soils is essential in the analysis of

irrigation too as irrigation agriculture depends on the control of moisture in soil (Thorn and Peterson,1954).

On the basis of intensive field survey, the soils in the region are classified into five main categories (Fig.1.4-B) as :-

i) Coarse shallow laterite soils :-

The laterite soils of the region are divided into two groups. The coarse shallow laterite soils occupies a large portion of the western part of the region; particularly, the hill ranges. These are light brown in colour, fairly steep and covers the areas of about 23 villages.

ii) Medium and deep laterite :-

These are located along the river course of western part, covering the areas of Patgaon, Mathagaon, Karivade, Shengaon, Nishnap, Kondoshi etc. villages. These are located on moderate steep slope and are dark brown-red in colour.

Both the above soils are not fertile. They are rich in alumina and iron. But, it is observed in the region that they yield satisfactory, if water and fertilizers are provided with required quantity.

iii) Coarse shallow soils :-

These are located in the eastern part of the northern and southern hill ranges, particularly, on the slopes of foot-hills. These are light brown in colour and loamy to sandy in

texture having less depth, poor in nutrient status and thus moderately productive. Generally, groundnut, jowar, nachani are grown on this soil group. These soils occupy the areas of Khedage, Yarandape, Phaye, Hedavade, Tikkewadi, Palshivane, Madur, etc. villages.

TABLE 1.6 : Area percentage under different soil groups 1986.

Sr. No.	Soil groups	Area in percentage
1	Coarse shallow laterite	38
2	Medium and deep laterite	22
3	Coarse shallow	06
4	Medium deep black	24
5	Alluvial	10

SOURCE : Compiled by the Author, 1986.

iv) Medium deep black soils :

This group occupies the lower parts of the basin in the centre. These are loamy to clayey in texture, gentle sloping and are suitable for crops like sugarcane, wheat, jawar, chillies etc. The parts of Adamapur, Vhanagutti, Waghapur, Gangapur, Koor, Darwad, Nilpan etc. falls in this group.

v) Alluvial soils :

These, rich soils, are confined to the narrow flood plain of the river. They are medium brown, gently slopping and suitable for sugarcane, rice crops. They cover the parts of about 24 villages along the river course.

Table 1.6, gives a broad estimation of the areal coverage (percent to total area) of the different soil groups. It shows that a large share (60%) is contributed by laterite (Shallow and Medium deep) soils whereas comparatively rich soils (alluvial and medium black) covers only 16 percent area of the region. The coarse shallow soils covers 24 percent area. It means that the region has big share of infertile soils than the fertile one.

Soils and Irrigation :

The fertility of soil determines the intensity of cropping and agricultural productivity. The fertile soils give very good yields, returns, if water is provided. It is evident from superimposing the Fig.1.4-B on Fig.2.4-A that comparatively rich soil tract along the river course has very high (above 16%) development of irrigation. In the western portion, though the water is adequately available, the intensity of irrigation is low (under 8%) due to infertile soils in association of other unfavourable factors. In the middle part, comprising the area of villages like Madur,

Shengaon etc. the intensity of irrigation is moderate (8 - 16) due to poor laterite soils.

5. WATER RESOURCES :

There is no need to emphasise the importance of water resources in promoting the agricultural development. An uninterupted and assured supply of water to agriculture is of immense importance for augmenting agricultural productivity. An assured and regulated supply of agricultural water from ground and surface resources is the basic essential aspect upon which any future planning of irrigation depends (J.Singh, 1976). The spatio-temporal variations in the yield of ground water and monthly as well as seasonal flow of surface water affect irrigation. Since the spatio-temporal variations are remarkable in the region, the need is to explore the other sources of irrigation.

In the present study an attempt is made to highlight the surface and ground water resources in the region. Ground water is studied in relation to the recharge, with withdrawal and the fluctuations of watertable. For examining the fluctuation of watertable the data are collected for 15 sample villages (Fig.3.1-A) and it is supplemented by the information given by the GSDA (Ground Water Survey and Development Agency, 1979) Government of Maharashtra, Pune. The data pertaining to the recharge, withdrawal and utilization of ground water

is also based on the estimations made by GSDA (1979). The surface water volume is based on the information supplied by Patagaon Medium Irrigation Project, 1974.

(1) Ground water resources :

Ground water, also called as underground water, occurs below the surface of the earth. It occurs in the form of dug wells, springs etc. which further is utilized for different purposes. Various factors like morphological features, drainage pattern, rock type, altitude of the rock, joints patterns and texture as well as structural features such as folds and fractures control the occurance and distribution of ground water (Reddy and Reddy, 1984).

The upper surface of ground water is called watertable which changes according to time and space. There is a very close relationship betwen rainfall and watertable. When rainfall increases, naturally the watertable rises and vice-versa.

A) Watertable during post-monsoon :

All the wells in the region overflows during monsoon season. In post-monsoon period (November) the wells along the river have surface level watertable. This is due to the low lying flood plain and nearness of river course.

The shallow watertable (1 M) is confined to the hilly areas (Fig.1.5-A) which may be related to the prevelence of

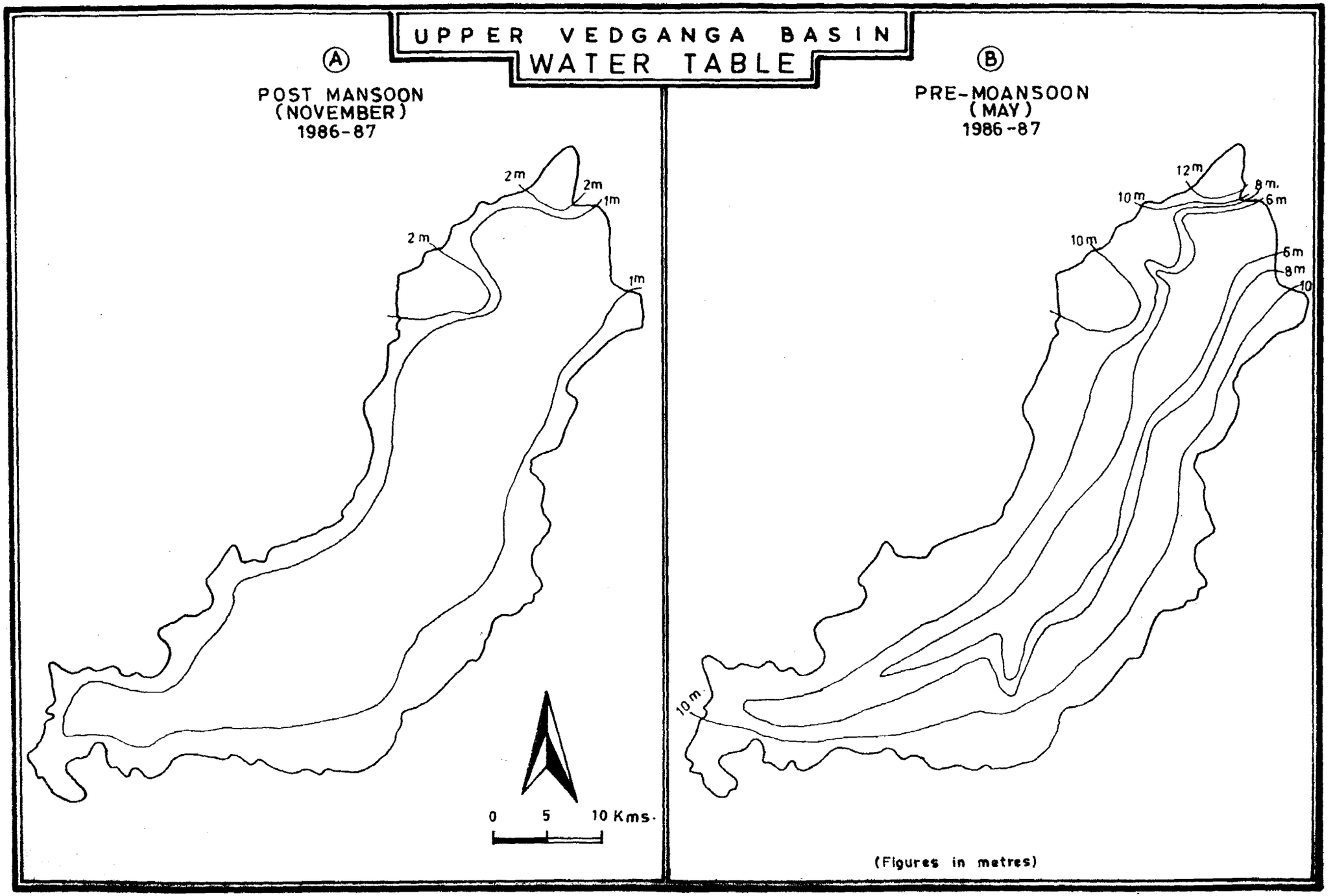

UPPER VEDGANGA BASIN
WATER TABLE
(A)
POST MANSOON
(NOVEMBER)
1986-87
2m
2m
1m
2 m
1m
0 5 10 Kms.
(B)
PRE-MOANSOON
(MAY)
1986-87
12m
8 m.
10 m
6m
10 m
6m
8m
10
10 m.
(Figures in metres)

Fig. 1·5

springs. The high depth of watertable is observed in Miche (Br.) Miche (Kr.) Pandivare, Lotewadi and to the far east in Mudhal, Adamapur villages. It may be due to low rainfall, thin soil cover resulting into low recharge of water.

B) Watertable during pre-monsoon (May) :

As against to the average watertable (1 M) in November, it ranges from 6 to 12 Metres in May (Fig.1.5-B). Watertable upto 6 M is observed in two patches having high intensity of irrigation. It is due to the seepage of irrigated water. The medium watertable is observed in the northern hilly area and in the far west. There is a dense network of perennial springs in the northern hilly tract and the western part of the region possessing the perennial nalas and streams. The high depth is observed in the easternmost villages i.e. Mudhal and Adamapur and the southern hilly tract. In the east, the rainfall is scarce. In the southern hill tract, the hard besalt rock bed do not permit the water to percolate.

C) Fluctuation in watertable :

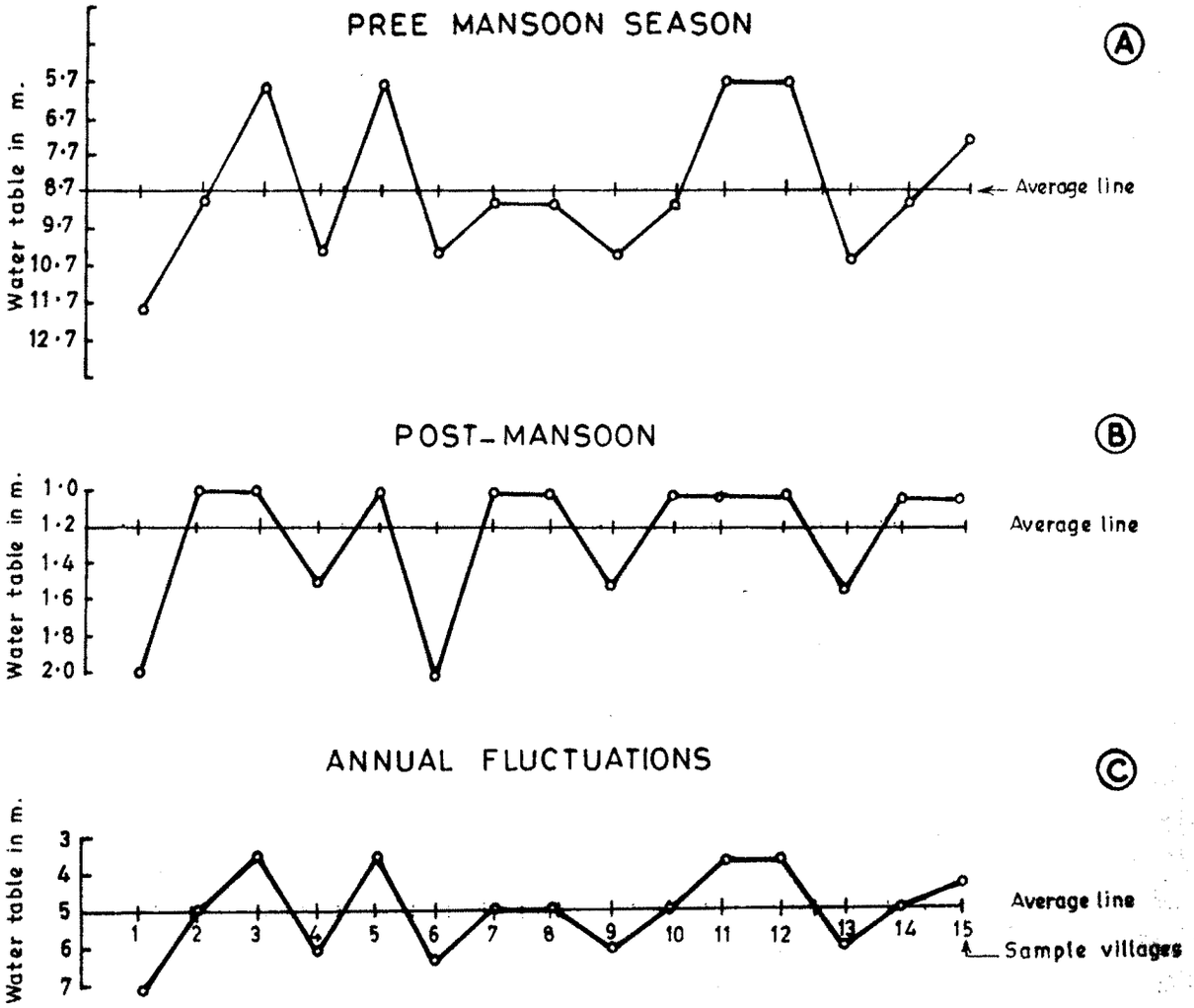
The watertable of any region is conditioned by many factors. The stable and sound watertable determines the intensity, magnitude and overall development of well irrigation. Any fluctuation in it, however, leads to the variations in irrigation intensities.

The fluctuations in watertable in different seasons are notable. The average watertable during pre-monsoon period is 8.7 M which ranges ramarkably from below 3.3 M to above 2.7 M. The watertable during this period is below average in 10 villages and above average in 5 villages (Fig.1.6-A). The highest fluctuation from average is recorded at Mudhal (3.3 M).

The average fluctuation of watertable in post-monsoon (November) is 1.2 M. There is significant rise in watertable during monsoon season in the entire region. Fig.1.6-B, therefore shows that the 10 sample villages have recorded above average watertable with little fluctuation of 0.2 M. Mudhal and Padkhambe villages show highest fluctuation (1.8 M) from the average during post-monsoon.

The annual average watertable in the region is 5 M. Fig.1.6-C reveals that the villages along the southern hill range, have recorded below the annual average watertable fluctuation (1 M) due to the besaltic rock formation. The fluctuation is equal to the regions average in 5 villages which are along the northern hill range and foot-hill zone where the natural springs reduces the intensity of fluctuations in watertable. Due to the presence of K.T.Weirs and high intensity of irrigation, the fluctuation of annual average watertable is above 1.5 M of region's average.

FLUCTUATIONS IN THE LEVEL OF UNDERGROUND WATER 1986



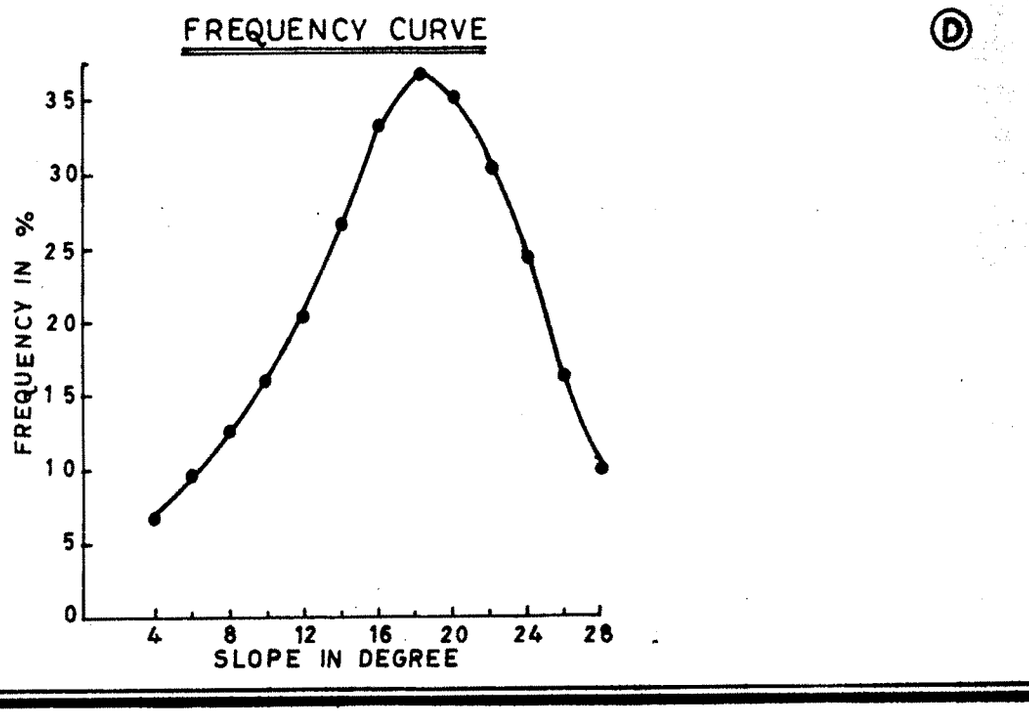


Fig. 1·6

D) Ground water recharge :

Additional water to the zone of saturation in a aquifer is called ground water recharge (Singh, 1979). The western part, being hilly, has low recharge of ground water due to high run-off which results into limited scope for development of well irrigation. The central and eastern parts of the region have high recharge and therefore, create high potentials for the development of well irrigation. The total recharge is highest in the region (48.813 MCM) as compared to the average recharge of other watersheds in Kolhapur district (22.33 MCM).

E) Ground water withdrawal :

The underground water in the region is pumped out by irrigation wells. The total withdrawal in the region is 10.723 MCM which is more than the other watersheds in Kolhapur district (average 8.22 MCM). This withdrawal is more along the river valley, particularly, in the eastern parts wherein the recharge is high and the density of wells is also high (Fig.2.3-B).

F) Utilization of Ground water :

The total recharge of water (48.813 MCM) in the region is quite large as compared to its withdrawal (10.723 MCM - GSDA, 1979). Thus, the annual ground water availability of the region is 37.887 MCM and the present utilization is 22 percent of the total ground water resources. There is also spatial variation in this respect that the southern lower part has

highest utilization (41.64 percent) whereas, southern part has lowest (9.91%). The GSDA sources say that the feasibility of wells in the region is 2648 wells. This number is quite large as compared to the average number of watersheds in Kolhapur district i.e. 940 only. The present number of wells in the region is 660 which means that another 1988 wells can be dug. Another thing is that the watertable should, at least, remain between 3.5 and 5 M. below the natural surface to be able to sustain profitable irrigation agriculture (Singh and Dhillon, 1984). With this view also, the villages in the zone of Akurde, Darwad, Nitavade, Karambali could take much advantage.

(2) Surface water resources :

Surface water in the form of river, streams, springs is also an important source of water in the region. Vedganga is the premior source of surface water with its small tributaries and streams. But these are characterised by the fluctuations of water volume in a year due to their seasonal nature. The water in Vedganga is stored with the help of Kolhapur Type Weirs because of which the river course remains perennial upto February-March. In the western part some nalas are perennial but they contribute very little to the total surface water in the region.

The springs, particularly in the northern portion, are important source of surface water. It is reported that about 15 years ago, the springs had good surface flow throughout the year. Now they flow upto January only. In the southern part, the springs get dried immediately after the monsoon. It may be because of large scale forest cutting on hills and uncertainity of rainfall.

The surface water resources are estimated to 189 MCM in the region. Of which 29.612 MCM annual average utilization is attempted in the region (GSDA, 1979).

SUMMARY :

The water resources i.e. surface water and ground water play an important role in the development of agriculture. Though, the water resources in the region are adequate, they are yet to be utilized. Ground water level changes according to time and space in the region. The watertable is near to the surface during post-monsoon (November) period whereas it deepens during pre-monsoon (May) period. The fluctuations of watertable ranges from 5 to 10.5 M. in the region. The withdrawal of ground water is quite less as compared to its recharge. There therefore, is enormous scope for the development of well irrigation in the region. Surface water in the form of river, streams, springs is yet to be used at its satisfactory level. The water resources of the region could properly be managed and rationally utilized.

6. AGRICULTURAL PROFILE :

Although agricultural landscape is largely controlled by physical factors of an area the socio-economic factors also have an important role to play in promoting agricultural development. Farming is a product, not merely of physical setting but also of man made frames (Singh, 1974). Since irrigation is an artificial way of providing water to crops, it becomes necessary to portray agricultural landscape in the region. The present study deals with some aspects of existing agricultural, social and economic conditions of the study region. A precise and comprehensive analysis of these aspects has been attempted in the succeeding pages.

1) General Landuse Pattern :

Landuse pattern is invariably determined by physico-socio-economic and organizational factors. It represents the use of region's natural resources. It is a dynamic phenomenon as it changes with the introduction of new technology, such as irrigetion and other inputs. Such type of study may help in understanding the regional variations which correspond with the development of irrigation facilities.

The total geographical area of the region is 54661 hect. of which forests cover 38.81 percent area. Due to heavy rainfall and hilly terrain the western part has dense forest land. The eastern part of the region has low proportion of forest area.

The other categories of landuse like area not available for cultivation, cultivable waste, fallow land share only 22% of the total. The second ranking category following forests is net area sown (38.57%). There is also large scale spatial variation in its share in the region as the villages in the valley, in eastern part, have high (above 70) percent of land under this category whereas it is low (below the regions average) in the western and northern and southern tracts of the region.

TABLE 1.7 : General landuse pattern in Upper Vedganga Basin, 1983-85.

Sr. No.	Landuse category	Area in hect.	Percent to total area
1	Forest	21210.00	38.81
2	Area not available for cultivation	1490.00	02.73
3	Cultivable waste	2145.00	03.92
4	Fallow	7111.00	13.02
5	Pastures	1625.00	02.95
6	Net area sown	21080.00	38.57
	Total	54661.00	100.00

SOURCE : Tahsil Office, Gargoti, 1985.

ii) Cropping pattern :

The principle crops grown in the region are rice, nachani, oil seeds, jowar, sugarcane, wheat, pulses. Rice ranks at first position (41.32%). The other crops including vari, sqvar etc. are commercially least important - ranking second (24.56%) in the cropping pattern. The above two crops are followed by nachani (17.32%), sugarcane (6.9%), groundnut (5.76%0 and jowar (4.14%). Rabi crops have also a good share in crop landuse (803 hectares). Table 1.8 shows recent croppigg pattern during 1983-85.

TABLE 1.8 : Cropping pattern in Upper Vedganga Basin 1983-85 (average).

Sr. No.	Crop	Area in hect.	% to net area sown
1	Rice	8,710	41.32
2	Nachani	3,653	17.32
3	Sugarcane	1,455	06.90
4	Groundnut	1,216	05.76
5	Jowar	873	04.14
6	Other crops	5,173	24.56
	Rabi crops	803	
	Gross cropped	21,883	

SOURCE : Tahsil Office - Gargoti, 1985.

Among the irrigated crops, sugarcane, wheat, maize, vegetables are notable. Of these sugarcane dominates the irrigated cropping pattern, covering about 65.60% of the total irrigated area. It is followed by wheat (20.10%) and other crops (12.30%).

iii) Farm Implements :

The use of improved implements is the indicator of developed agriculture. However, the small size holdings, low development of credit facilities, poor economic conditions of the farmers, paucity of technical knowledge are the major obstacles which retard the use of farm implements. Mechanization of agriculture is the essential characteristic of irrigated areas. The region under study has 10,578 wooden and iron ploughs, 655 electric motors, 690 desel engines and 31 tractors.

7. DEMOGRAPHIC ASPECTS :

i) Population :

According to 1981 census the population of Upper Vedganga basin was 94,421 i.e. 3.76 percent of Kolhapur district. The density of population is 173 persons per sq.km. which is unequally distributed in the river valley and in the hilly region of the north and south. Thus the average density of population in the region is less than that of district (312 k^2) and the state of Maharashtra (94 k^2). The significant characteristic feature is that

female population (48,098) exceeds male (46,324). The western region has poor development of resources and hence the male population is migrated to Bombay - Pune industrial area for seeking employment opportunities. Contrasting to this, in the eastern part, comparatively very few people have been migrated out side the region since agricultural resources have provided relatively substantial employment as cultivators, agricultural labourers etc. The region is also characterised by good drinking water supply, cent percent electrification and absence of urban population. The literacy of the region is 38.83 percent in which males are having 27.86 percent and females 10.97 percent literacy. The proportion of literacy is however, low to that of Kolhapur district (44.86) and Maharashtra (45.18).

ii) Cultivators :

No other occupation other than farming has attained any importance in the region. Table 1.9 shows that out of the total workers (37,497) 98.85% are engaged in agriculture of which 79.46% are cultivators. The figures for this category for Kolhapur district and Maharashtra State are 52.63% and 37.73% respectively.

The figures in table indicate that the occupational structure of the study region is traditional where primary occupation i.e. farming is dominant.

TABLE 1.9 : Cultivators and agricultural labourers in the region; district and Maharashtra, 1981.

Worker category	Percentage to total workers		
	Region	Kolhapur Dist.	Maharashtra
Cultivators	79.46	52.63	37.73
Agricultural labourers	19.39	14.96	29.32

SOURCE : Census of India - Maharashtra 1981 and Socio-Economic Review and D.S.A. of Kolhapur Dist., 1981.

iii) Agricultural labourers :

As the family labour force is not sufficient for agricultural operations, particularly at the time of harvest, the farmers, therefore, have to take the help of hired labourers. The obvious fact is that human labour requirement increases with the availability of irrigation facilities. It is observed that the agricultural labourers migrate from the agriculturally backward areas of the west and north and south hill tracts to the rich agriculturally valley areas in the central and east, particularly at the time harvest of rice and sugarcane. The region has 7,272 agricultural labourers (19.39%) comparising 3,237 males and 4,035 females. The Table 1.9 shows that the percentage of agricultural labourers is high as compared to Kolhapur district (14.96%) and low to Maharashtra state (29.32%).

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