Chapter II

Physical Profile of the Study Region

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Chapter II
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2.1 Introduction:
In the first chapter, meaning of agriculture, agricultural geography, place of agriculture in national economy, its development in India and Maharashtra, choice of the study region, aims and objectives of the present study, data base, methodology, review of literature and chapter scheme these points are discussed. This chapter is mainly related with location and boundaries, historical background of the study region, physiography, geology, drainage system, climate, soil types and natural vegetation of the study region.

2.2 Location and Boundaries:
Beed district is located in the central part of the Marathwada region. Beed district lies between 18°28' and 19°27' north latitudes and 74°54' to 76°57' east longitudes (Map No.1). The east-west stretch of the study region is 268 kilometres and north-south extension of the region is 127 kilometres. But for the projection of Ashti tahsil towards Ahmednagar in the west, the district assumes the shape of trapezum with southern and northern sides running almost parallel. Geographical area of this district as per 1971 census was 11227 square kilometres. Out of which, 10,903 sq.kms. was rural and 324 sq. kms. was urban. During 1981 the area of study region was 11085 square kilometres and its population was 11.86 lakh. It was one of the thinly populated district in the Maharashtra state in 1981.

It is bounded by Aurangabad and Jalna district on the north, Parbhani on the north-east, Parbhani and Latur on the east, Osmanabad and Latur on the south and Ahmednagar on the south-west and north-east. The Godavari forms the boundary of the district from the village of Kuranpimpri to Borkhed throughout the northern Border. The southern boundary mostly concides with the course of the Manjara but makes a considerable number deviations from it, some to the north and others to the south. The southern-boundary similarly follows the course of the Sina with three deviations away from the
river and one only beyond it to include a small stretch to the south of the river in Aurangpur village. Leaving aside the boundaries formed by these rivers the district boundary else where is the result of historic accidents and administrative convenience. Geographical area of this district as per 1991 census is 10615.30 square kilometres and its proportion as compared with Maharashtra state area is about 3.44 percent. Some villages from southern part of Ambejogai were included in Renapur tahsil (Latur district) therefore, the area of the district reduced to some extent. The proportion of the area of the Beed district in Marathwada division is 18.55 percent. Out of the total geographical area 10,680.4 sq. kms. is rural (97.79%) and 324.9 sq. km. (2.21%) is urban. The ratio of rural area and urban area is 98:2. According to 1991 census there were 1280 villages in the Beed district. Out of the total villages 13 villages are uninhabited. The district ranks 11th and second in the state and Marathwada respectively in terms of area as per 1991 census. Similarly the district ranks 24th in the state in terms of population.

At present there are eleven tahsils in Beed district. Wadwani, shirur, Dharur and Parli are newly declared tahsils. Wadwani tahsil is formed by the division of Manjalgaon, Shirur by the division of Patoda, Dharur from Kaji and Parli by the division of Ambejogai tahsil. The time series data of newly formed tahsils is not available, therefore, only old seven tahsils are considered for the study.

2.3 Historical background:

The district has been named after its head-quarter town Bhir. The town by itself is set in a hallow or a 'Beel' into the scrap of the Balaghat plateau trench by Bendsura river, and hence the name Bhir. The word 'Beel' seems to have degenerated into 'Bhir' and subsequently with the passage of time into Beed or Bid. Again the Persian word 'Bhir' implying water may also explain the origin of the name, because the location provides abundance of subterranean water supplies tapped by unfailing wells.

Pre-historic account of the district is not available. In course of time when Aryans came down to south, Kingdoms were founded. These were
ruled by Hindu kings in the ancient period, by Muslim Kings in the mediaeval period and Later by Britishers. Beed District was a part of these kingdoms.

2.4 Territorial Changes:

Kaij taluka, which is a tahsil of the present district also, was abolished to merge with Amba taluka in 1905. The name of Amba taluka was subsequently charged as Mominabad Taluka. Between 1906 and 1948 there were no major changes in the boundaries of the district. In 1950 twenty six inclave villages of Ahmednagar district were transferred to Beed district and in return twenty one villages from Patoda and Ashti tahsils were transferred to Ahmednagar district.

One fourth area of the district was a Jagir. The present Patoda tahsil was mostly Nizam's own estate and was called "Sarf-e-Khas". It was taken over under the Sarf-e-Khas (Merger) Regulation of 1949. With the abolition of all the Jagirs their villages were taken over under direct Government administration in 1949 under the Hyderabad (Abolition of Jagirs) Regulation 1949. Consequent upon the integration of Sarf-e-Khas and Jagirs, boundaries were reconstituted of all the tahsils in the district in the year 1950. A new tahsil Kaij, was recreated with its headquarters at Kaij, Patoda tahsil which was previously under Sarf-e-Khas was converted with a 'Mahal'. Reorganization of states in 1956 resulted in the transfer of the district from Hyderabad state to Bombay state. Since 1st May 1960, it forms a part of Maharashtra state. In 1962, Mominabad tahsil and town was renamed as Ambejogai. New four tahsils are recently formed from the divisions of Kaij, Manjalgaon, Ambejogai and Patoda (3.2).

2.5 Physiography:

Physiography is one of the dominant parameter of physical environment and its impact on patterns and density of agriculture is immense. The study of the influence of environment upon the nature and the distribution of crops and livestock is of prime importance in agricultural geography. Nature with its physical characteristics provides a host of possibilities for
agriculture and agro-based industries in different areas.

The Beed district can be divided into three broad physiographic divisions (map 2.2) viz:

A) The lowland region.
B) The highland region and
C) Low lying undulating region or Sina Basin.

A) The Lowland Region:

The lowland region is found at the northern part of the district. It is a part of the Godavari Valley. The northern lowland Beed has a general elevation from 550 metres in the west to a little under 400 metres in the east, interspread with a number of residual hills of summits over 600 metres. A discontinuous series of such a low residual hills in the south comprise the watershed between the Godavari and the Sindhphana rivers. In the western part there are the Gonoba hill (606.6 metres) and the Chitora hill (618.5 metres) south of Chakalamba. Eastwards they become lower in elevation. Just over 580 metres south of Georai and further east to about 450 metres terminating at Manjlegaon. A more discontinuous southern series of residual hills is found south of the Sindhaphana river, the most remarkable of this being the Narayangad hill comprising a flat topped plateau surface at a level of about 580 metres. This second series is scarcely distinguishable as hills since many of them happen to be interfluent spurs extending northward between the northward trending streams from Balaghat plateau.

B) Highland Beed or Balaghat Plateau:

The northern lowlands rise towards the south by steep scarp to the next division the highland Beed. The dissected scarp of this plateau on the north appears as a series of hills which are often described as the Balaghat ranges. Southwards, this plateau slopes more gently towards the Manjara river except where the crestline has receded south by the back cutting of the northern trending streams down the scarp. The prominent heights on this range in order from west to east are 889 metres near Chincholi or 846 metres near Supe, 791 metres west of Limba Ganesh, 765 metres west of Yevta, 733
metres west of Eda and 697 metres west of Channi near Ambejogai.

The southern boundary scarp of this plateau division of Beed district from Chinchni appex and runs first southwards and then in a southeasterly direction forming the boundary between Ashti and Patoda tahsils of the district.

South of Sautada it becomes the southern boundary of the district and continues to be so as far as south of Pargaon but for a deviation northwards of the district boundary away from the scarp so as to exclude the villages of Kelewadi, Pimpalwadi and Sakat on this plateau from this district. Further eastwards the southern scarp passes to the south of the district into Osmanabad. The creasline of the southern scarp is lower than in the northern counterpart and includes features such as those west of Chinchni with a height of 854 metres, south-west of Jogdand with height of 855.8 metres, west of Dukarwadi with a height of 783 metres and Sautada Peak 792 metres, 4 kilometres south-east of Sautada village.

C) Sina Basin or Low Lying Undulating Region:

The third physical division comprising paractically the whole of Ashti tahsil is the Sina basin draining into that river. This area is found south-west and west of highland Beed. Though of lower elevation this region is interspersed with innumerable low residual hills between the valleys of streams rising from about 600 metres in the south to about 750 metres in the north. These dissected and scattered interfluent uplands sloping generally towards the south are the result of the wasting away of the old plateau by the powerful streams of Sina system.

2.6 Geology:

No systematic geologically work has been carried out in the Beed district. The district is divided into the Balaghat or highland forming the southern and eastern part and the lowlands. A low spur of the western ghats traverses the district from Ahmednagar to Ambejogai. The district is underlain by the Deccan traps of Cretaceous Eocene age. The trap rocks belong to the type called "Plateau Basalt" and are uniform in composition correspond-
ing to that dolerite or basalt with an average specific gravity of 2.99. They are dark grey or dark greenish in colour. The traps have been distinguished into the vesicular and non-vesicular types. The non-vesicular traps are hard, tough, compact and medium to fine grained and break with a conchoidal fracture. The vesicular types are soft and tend to break with more ease. Ashbeds are common.

The Deccan traps by decomposition under tropical conditions give rise to a porous rock, laterite (of Pleistocene age). The laterites form a thin cap over the Deccan traps at many places and at some places rich in iron are which was used by the Primitive Smetters. Beds of gravel and clays of upper Pliocene to Pleistocene age containing fossil bones of extinct Mammalia, overlie the traps in the valleys of the Godavari and some of its tributaries.

The traps more often wither into a rich and fertile black cotton soil which forms vast spreads in different places in the district. Nodules of Kankar are of frequent occurrences in the layer of black cotton soil.

2.7 Drainage:

Drainage texture is expressed as the total length of streams per unit area, while its reciprocal is the distance between two adjacent channels. These are the two important parameters by which one can estimate soil erosion. Surface drainage is the disposal of excess rain water over ground surface through an open drainage system with an adequate outlet. Surface drainage is helpful where (i) soils are deep with low infiltration rates; Where (ii) intensity of rainfall is high, where (iii) terrain is level to nearly-level and where (iv) the water-table is high.

Any bore or well from which the underlying water is extracted either under pressure or through mechanical lifts can be defined as vertical drainage. The success of vertical-drainage depends upon the presence of favourable aquifer and water-table for lifting the groundwater on a sustained basis, and the favourable quality of water that could be re-utilized for irrigation purposes.

Surface water, that is the water on the surface of land, represents the
drainage from the land. A part of the rainfall that is absorbed by the soil also becomes surface water by its discharge when it seeps into rills and runnels. The portion of rain or snow-melt that penetrates deeply becomes the groundwater recharge and it is discharged into the streams slowly. Drainage is a comprehensive expression in Geography. It includes surface as well as underground water flow. It is the result of a combination of numerous factors including climate particularly precipitation, insolation, humidity, cloudiness, wind force and direction, structure and type of rocks, railways, dams and reservoirs also change its nature.

However, drainage is one of the most important component of physical environment. Which affects agriculture directly and indirectly\textsuperscript{12}. Groundwater influent becomes the base flow that maintains the flow of streams in fair weather. When we speak of surface water we mean stream flow regardless of its source\textsuperscript{13}. Therefore, surface water is by far the most important means for providing substantial irrigation which stabilizes and improves agro-economic life in an area that has otherwise plenty of land potential. Because of the uncertainty in the flow of surface water it is probable that any attempt to improve agricultural techniques and landuse planning without combating the problem with the help of shallow and deep water tables is bound to be abortive.

All the streams of the district drain into one of the three principal rivers viz. the Godavari, the Manjara and the Sina which flows along the northern, southern and the south-eastern boundaries of the district. The following are the important rivers of the Beed district (map 2.3).

1. \textit{Godavari}:

Godavari is the important river of Beed district which flows in a winding course with a general trend from north-west to south-east direction through the northern border of Georai and Manjalgaon tahsils. The tributaries of the Godavari in order from west to East of their confluences with that river are the Lendi, the Amrita, the Sindhphana, the Saraswati, the Gunwati and the Wan.
A) Lendi River: The Lendi rises in the low hills to the south-west of Chaklamba village and flows northwards passing by that village on its east and after a further flow of 2 kilometres from the district boundary for a greater part of its course. In its lowermost reach it again flows within the district to join the Godavari.

B) Amrita River: The Amrita rising further east from the same hills flows in a general north-easterly course leaving Umapur 9 kilometre to the north-west of it and flowing by Dhondrai joins the Godavari at Sawleshwar.

C) Sindhphana River: Sindhphana rises in the Chincholi hills at the north-western apex of the Balaghat plateau and flows in a north-easterly course past Amalner. About a kilometre below Chavarwadi it makes a right-angle turn to follow the trend of a small tributary. The Gana in a north-westerly direction flowing by Hingalwadi and resumes again it north-easterly course, the trend of another tributary, the Belpar below the confluence. After the confluence of another tributary, the Kinha, the Sindhphana has a fairly long easterly course up to about Manjalgaon thereafter it flows north-eastward and northwards to join the Godavari at Kshetra Manjrath.

Sindhphana's Tributaries:

The only important tributaries of the Sindhphana on its left bank are the Aad, the Belpar and the Kinha is the western part. In the eastern part the tributaries on the left bank flowing from the north are very small sized streams. The Aad rising on the southern slopes of the Chincholi hills flows by Kotan in a north-easterly direction to join the Sindhphana below Hingalwadi. The Belpar also rises on the north-east slopes of the Chincholi hills to the west of the Aad. After flowing past Hatola, it makes a short Sojourn outside into Ahmednagar district and after re-entering the district flows by Pimpalner to join the Sindhphana at Gomalwadi. The Kinha river rising in the hills to the west of Pangri village, flows in an easterly and north-easterly course sometimes within and some times outside the district and joins the Sindhphana just above Nimgaon. The Kinha has several tributaries such as the Manikarni flowing by manur, and the Nandidara flowing by Ukirda.
There are innumerable right bank tributaries of Sindhphana flowing from the Balaghat slopes, the more important of which in order from west to east are the Uthola flowing by Raimoha, the Utawadi flowing by Khokarmoha and Khalapuri, the Dombri flowing by Rajuri and joining Sindhphana opposite to Sirasmarg, the Bendsura, the Takur rising on the eastern slopes of Pimpalgaon ghat, the Pimpalner river and the Kundlika, of these the Bendsura and the Kundlika are of considerable size and length and require some detailed consideration.

The Bendsura rises near Waghera, 2 kilometres north-west of Limbaganesh and a fairly long course on the northern slopes of the Balaghat plateau, first flowing northwards and after Kadamwadi eastwards to Pali village, receiving a number of tributaries on both banks comprising a fairly large catchment area of 183 square kilometres on the slopes of the plateau. This has been taken advantages for the Bendsura Project. About 8 kms below Pali the river flows through Beed town with a north-northeast course to join the Sindhphana. The head water erosion of this comparatively large sized stream must have been so considerable that the watershed to the south has migrated further south have than at other places.

The Kundlika, called very after by the shortened form Kunda, rises to the north-east of Neknur and flows first in a north-easterly direction and then in an easterly direction upto Nagiheri after which it has a general northerly course to join the Sindhphana a few kilometres up stream of Manjalgaon.

D) Saraswati: After the Sindhphana there are three tributaries of the Godavari of considerable size, the Saraswati, the Gunwati and the Wanganga. The Saraswati and the Gunwati rise very near each other. The Saraswati flows northwards passing by Hingri, Dindur and after Belur turns easterly to join the Godavari.

E) Gunwati: The Gunwati flows in a north-easterly course passing by Hiwara to join the Godavari, a kilometre and a half the Saraswati Sangam.

F) Wan: The wan or the Wanganga as it is often called, has its source to the south of Dharur and has a fairly long deeply incised easterly and south-
easterly course on the Balaghat plateau itself. It makes an abrupt turn northwards to the north-west of Ambejogai cutting through the scarp and then flows in a north-easterly direction towards the Godavari. Flowing through Ambejogai there is a small tributary of this river viz. the Jayanti Nala that meets the river in the opposite direction in the same valley axis.

2. Manjara River:

The Manjara, sometimes called the Wanjara river, rises in the northern edge of the Balaghat Plateau a little above Gaurwadi flows first southwards and then south-eastwards right across the plateau towards the opposite side and makes an abrupt right angular turn to follow the course of a tributary from Sakat. After Pimpalgaon ghat the course becomes zigzag but with a general easterly trend upto near Bhatangli in Osmanabad. Where it is joined by the Rena. Throughout a greater part of its course this river forms the southern boundary of the District. The river flows in a deep bed with high banks which rise some times as much as 9 metres but on an average 5.5 metres above the bed of the river in the district so that the water is not available for irrigation of the banks. Recently Mahasangvi Project has constructed on this river. But for two important exceptions, the Inchana and the Wan, particularly all the streams of the plateau drain into the Manjara. There are two directions in the flow of these rivers, one from north-east to south-east and the other from north to south corresponding to structural lines of weakness. Among these streams are the Chausala, the Limba, the Wagh, the Babhti, the Yelamchi, the Kaij, the Chandan Savargaon, the Hol and the Rena.

a) Limba: The Limba or the Ganesh rises as the name indicates, near Limbaganesh and flows in a south-easterly direction receiving a few tributary streams from the north-flowing due southwards, the last of which is a fairly large sized stream, the Nimgur (Neknur) river. This stream flows only in rainy season.

b) Yelamchi: The Yelamb or Wagh flowing by Yelamb Waghe Babulgaon and Nandur has almost a due southerly course throughout. This is also a seasonal stream.
c) **Babhti**: The Babhti or the Sanvi flowing by Eda. Arangaon and Warapgaon has an easterly course and receives two southerly streams, the first flowing by Sindi and Mhasajog and the other flowing by Yevta and Jaola.

d) **Kaij**: The Kaij stream rising to the south-west of Dharur flows southwards passing by Kaij and joins the Manjara below Sona Sangavi.

e) **Hol**: The Hol stream passing by Hol is having southerly and south-westerly course and joins the Manjara at Deola.

f) **Rena**: The present Rena river, having its source south of Ambajogai, must have once been a much longer and larger, the communication of the upper Wan, as is well testified by the high fertility of the soils of the valley too big for the present river\(^4\).

3. **Mehekri River** :

The Mehekri after having a fairly long course in Ahmednagar district enters the Beed district some 2 kilometres above Nandur. In Beed district it has a long and winding course in a flood plain south-south-eastwards to join the Sina at Sangli. The Mehekri receives very small insignificant streams on its right or west bank but fairly large sized streams on its left or east bank of these latter, the Keli, the Kambli, the Keri and Bokdi are respectively more important streams.

Most of the rivers and streams which are flowing through the Beed district are seasonal. They are having water in rainy season and some times in winter season. Most of the rivers and streams becomes dry in summer season; hence they are not useful for irrigation. Even in rainy and winter season some times few streams have no water in their beds. The wells which comes under the jurisdiction of these streams also becomes dry in summer season. Due to the seasonal nature of the rivers and streams the agricultural sector is greatly affected. Most of the streams are having water only in June, July and August.

2.8 **Climate** :

Some Geographers have argued that climate plays an important part in
the development of nations economy through affecting the energy of land
the stimulus too, man in his various environment. Climate is also reflected
in the habits and requirements of consumers and thus affects the prospect
for consumer goods industries of various types.

In a large measure, climate determines where man may live and thrive,
what crops he may raise? What type of home he may appropriately build?
What sort of clothing he may wear? and what pests and diseases he must
combat. The potential crop-productivity capability of a given area is de-
pendent mainly on the existing climatic and soil conditions. Since climatic
factors exert mainly a regional influence on plant life, the differences in the
behaviour of a crop or a group of crops over extensive areas, as in a given
state or a group of states, may be considered as due primarily to differences
in climatic rather than soil conditions. There always exists a significant
relationship between climate and crops because of the limits imposed on
crop growth by the existing broad natural climatic conditions which in a
way determine the patterns of farm activity and crop production. The obvi-
ous reason is that field crops cannot escape climatic vagaries, drought haz-
ards etc.

The success or failure of the cropping season is determined by the in-
tensity of the climatic factors. The three most important factors of climate
from the stand point of plant response are temperature, water supply and
light (Hildreth et al 1941) and they may be treated as primary determinants
d of crop growth. Plant growth does not depend on limited variables but is
controlled by various elements acting in combination at a time. All these
factors are subject to accelerated fluctuations taking place from time to time,
from season to season and from place to place. Consequently, they deter-
mine the type of crops raised and cause regional differences in crop associa-
tions.

The climate of this district is on the whole dry except in the south-west
monsoon season. The year may be divided into four seasons. The cold sea-
son from December to February is followed by the hot season from March to
May. The period from June to September is the south-west monsoon season while October and November constitute the post-monsoon season.

There are a number of important elements of the climatic conditions. They are as follows.

A) **Temperature**:

Temperature conditions have been far less erratic from year to year than rainfall conditions in each agricultural region. However, great annual ranges may be highly significant in different zones giving rise to two or more cropping seasons. Without suitable temperature conditions, germination of seeds and growth of plants are retarded. Temperature regulates all the chemical and physical processes of plant metabolism. The metabolic processes begin at a certain minimum temperature and increase with rise of temperature until reach a maximum at a temperature called optimum. Further with rise in temperature above the optimum level the metabolic activity is slowed down until it ceases at a temperature called the maximum. Each species has its own minimum and maximum beyond which its life activity ceases (Kochhar 1967)\(^8\).

Each plant needs a certain number of effective heat units for germination, growth, stalking, maturing and ripening. This is called the thermal constant and varies from crop to crop. Temperature above the minimum is, therefore, effective in furthering the growth of a plant towards maturity and ripening. The crucial air temperature is 6\(^\circ\)C (Schimper 1903)\(^9\), at and above which plants grow. It is also known as the crucial limit. In other words, at this air temperature active germination and growth of most of the useful crops begin. Ideal temperature conditions the useful crops begin. Ideal temperature conditions for crop production are between 18.3\(^\circ\)C and 23.9\(^\circ\)C. Low temperature can at best permit only a slow growth of plant.

The only meteorological observatory in the district which is at Beed began functioning recently. The discription of the temperature and other meteorological conditions in the district which follows is based on the records at the meteorological observatories in the neighbouring districts and the
meagre records for Beed. The cold weather commences towards the end of November when temperature begin to fall. December is the coldest month with the mean daily minimum at about 11.5\(^{\circ}\)C and mean maximum at about 28.5\(^{\circ}\)C.

In cold season the district is sometimes affected by cold waves in association with the passage eastwards of western disturbances accross north India. On such occasions the minimum temperatures may drop about 3\(^{\circ}\)C or 4\(^{\circ}\)C in the study region.

**Table 2.1 : Mean Daily Maximum and Minimum Temperature in \(^{\circ}\)C at Beed Cetnre.**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Month</th>
<th>Mean daily maximum temperature in (^{\circ})C</th>
<th>Mean daily minimum temperature in (^{\circ})C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>January</td>
<td>28.7</td>
<td>14.3</td>
</tr>
<tr>
<td>2.</td>
<td>February</td>
<td>30.0</td>
<td>14.0</td>
</tr>
<tr>
<td>3.</td>
<td>March</td>
<td>36.7</td>
<td>19.0</td>
</tr>
<tr>
<td>4.</td>
<td>April</td>
<td>36.7</td>
<td>22.0</td>
</tr>
<tr>
<td>5.</td>
<td>May</td>
<td>40.4</td>
<td>24.8</td>
</tr>
<tr>
<td>6.</td>
<td>June</td>
<td>32.8</td>
<td>23.8</td>
</tr>
<tr>
<td>7.</td>
<td>July</td>
<td>29.1</td>
<td>22.8</td>
</tr>
<tr>
<td>8.</td>
<td>August</td>
<td>29.6</td>
<td>22.4</td>
</tr>
<tr>
<td>9.</td>
<td>September</td>
<td>30.6</td>
<td>21.3</td>
</tr>
<tr>
<td>10.</td>
<td>October</td>
<td>32.0</td>
<td>20.2</td>
</tr>
<tr>
<td>11.</td>
<td>November</td>
<td>28.5</td>
<td>16.5</td>
</tr>
<tr>
<td>12.</td>
<td>December</td>
<td>28.5</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>Annual</td>
<td>31.97</td>
<td>19.38</td>
</tr>
</tbody>
</table>

Source : *Socio-Economic Abstract of Beed District. 1996-97*

Although on an average the temperature in January and February are slightly higher than in December, the rapid rise in temperature starts only by about begining of March. May is the hottest month with the mean daily maximum temperature may be as high as 46\(^{\circ}\)C with the advance of the south-west monsoon into the district by about the second weak of June the temperature falls appreciably and weather is pleasant throughout the south-west
monsoon season. By about the first week of October the monsoon with draws and the day temperature increase slightly and a secondary maximum is reached in October up to 32°C (table 2.1). Thereafter the temperature begin to decrease gradually.

B) Rainfall:

It is dominant single weather element influencing the intensity and location of farming systems and the farmer’s choice of enterprises. It also becomes a climatic hazard to farming when it is characterised with scantiness, concentration, intensity, variability and unreliability. Variations in rainfall characteristics affect agriculture as a whole, and therefore, there is need to investigate them in detail. They become more subtle when crops are affected by moisture conditions at sowing, germination, shooting, stalking and heading and at maturing, harvesting and threshing. Moisture is needed a basic in all crop-producing areas. It is all the more important in the minimal regions, where average or normal rainfall is generally necessary for successful crop production. In such areas the system of crop production must be correlated more or less to the moisture factor (Klages 1958)\textsuperscript{20}. Thus it may be said that rainfall is the most important climatic factor as it determines the potential of any region in terms of crops to be produced, farming systems to be adopted, the nature and sequence of farming operations to be followed, and the targets to be achieved in agricultural productivity\textsuperscript{21}.

The quantum of rainfall and the number of rainy days may be quite sufficient to meet the annual requirement of successful crop production, provided they are so naturally spread that rain is received at the time it is required.

The district has seven rain-guage stations. While the rainfall records at Beed extend to about 27 years, those at the other six stations are also available for a period of 27 years.

The average annual rainfall for the district is 750mm. The rainfall in the district increases from the west to the east varying from 590mm at Ashti near the western border to 685mm, at Ashti near the western border to 685 mm.at
Ambejogai near the eastern border about 80 percent of the annual rainfall is received in the south-west monsoon period. September is the rainiest month. The variation in the annual rainfall from year to year is fairly large (map 2.4).

Table 2.2: Mean Annual Rainfall and Co-efficient of Rainfall Variability in Beed District (1970-1997).

<table>
<thead>
<tr>
<th>Name of the tahsils</th>
<th>Mean Annual Rainfall in m.m.</th>
<th>Co-efficient of Rainfall Variability in%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beed</td>
<td>685.64</td>
<td>40.50</td>
</tr>
<tr>
<td>Georai</td>
<td>647.64</td>
<td>43.27</td>
</tr>
<tr>
<td>Kaj</td>
<td>644.68</td>
<td>38.95</td>
</tr>
<tr>
<td>Ambejogai</td>
<td>785.12</td>
<td>29.50</td>
</tr>
<tr>
<td>Patoda</td>
<td>658.88</td>
<td>36.14</td>
</tr>
<tr>
<td>Ashti</td>
<td>590.00</td>
<td>36.55</td>
</tr>
<tr>
<td>Manjalgao</td>
<td>736.24</td>
<td>33.28</td>
</tr>
<tr>
<td>Beed district</td>
<td>678.31</td>
<td>37.03</td>
</tr>
</tbody>
</table>

Source: Computed by the Author.

The district could be divided on the basis of the rainfall returns for a series of years into three zones as given below.

1. The Eastern Zone which comprises Ambejogai, Kaj parts of Manjalgao and Beed tahsils. This zone gets more or less assured rainfall.

2. The Central Zone which comprises part of Beed, western part of Manjalgao and east Georai tahsils receives moderate rainfall.

3. The Western Zone which comprises western part of Georai, west part of Beed, Ashti and Patoda tahsils receives irregular and uncertain rains. The co-efficient of rainfall variability is calculated by the following formula.

\[
\text{Co-efficient of rainfall variability} = \frac{S}{X} \times 100
\]

Where \( S \) = The standard deviation of rainfall.
\( X \) = The mean of rainfall during 27 years.

It will be seen from table 2.2 that the variability of rainfall in the dis-
BEED DISTRICT

MEAN ANNUAL RAINFALL

1970-1997

INDEX

- ABOVE 700 MM
- 600 MM - 700 MM
- BELOW 600 MM

MAP NO. 2:4
BEED DISTRICT

CO-EFFICIENT OF RAINFALL VARIABILITY

1970-1997

INDEX

- ABOVE 40%
- 30% - 40%
- BELOW 30%

MAP NO. 2-5
trict ranges between 29.5% to 43.27% in Ambejogai and Georai tahsils respectively. Below 30% rainfall variability was found in Ambejogai tahsil where as 30% to 40% rainfall variability was observed in Kaij, Patoda, Ashti and Manjalgaon tahsils during the period of 1970-1997. Above 40% rainfall variability was recorded in Beed and Georai tahsils during the period of investigation (map 2.5).

The south-west monsoon during June to September influences the agronomy of the district to a very great extent. It also affects the agricultural operations culturable particles and system of crop rotation. The rainfall during the north-east monsoon i.e. October to November, though scanty, is very helpful for the rabi crops and also augments water in the wells and tanks. Some showers in the first quarter of the year have also beneficial affects on the growth of rabi crops and summer crops.

C) Humidity:

Humidity is one of the prominent elements of weather from the farmer’s point of view and play a significant role in changing agroclimatic conditions from place to place. Humidity, in fact, is the state of atmosphere with respect to the gaseous form of $\text{H}_2\text{O}$ i.e. the water vapour it contains. It is commonly expressed in terms of grams per cubic feet, grams per cubic metre or in any other unit of weight per unit of volume. It is necessarily an active factor in the precipitation that any area is likely to receive. In a particular area where air humidity is low, the precipitation will naturally be light unless moisture quantities are influxed. It is a noteworthy fact that the amount of water vapour in the air is highly variable depending on the existing temperature and also on the nature of its source, which may be ocean, desert, grassland, forest, ice, snow etc.

Of many possible beneficial influences of high atmospheric humidity on plant growth, two are most significant, namely: First many plant can absorb moisture directly from an undersaturated air of high humidity. Second, humidity affects the photosynthesis in the leaves of plants. Most plants grow well in conditions of high atmospheric humidity, because very often
saturated air completely stops transpiration. High humidity at night is considered most beneficial to plants. Breazeale and McGeorge (1953)\textsuperscript{22} have proved that maize and tomato plants grown under conditions of high humidity not only gained more weight but developed better root systems. During the dry summer, crops often exhibit a distinctly different growth response to showers that are accompanied by low humidity (Chang 1968)\textsuperscript{23}. The relative humidities of the study region are high during south-west monsoon season. After September the humidities decrease gradually and in the cold and summer seasons the air is dry, particularly in the afternoons when relative humidity may be less than 30 percent.

\textbf{D) Cloudiness :}

Skies are heavily clouded to overcast in the south-west monsoon season. There is a rapid decrease of cloudiness in the post-monsoon months in the study region. In the rest of the year the skies are generally clear or lightly clouded.

\textbf{E) Winds :}

Winds are moderate in strength in the latter half of summer and the south-west monsoon period and light in the rest of the year. During the south-west monsoon season winds blow predominantly from directions between south-west to north-east. In the post-monsoon and winter months winds are from directions between east and north. From about the beginning of summer winds from directions between south-west and north-west appear and these predominantly by May and continue till the onset of the monsoon.

\textbf{F) Special weather phenomena :}

Thunder showers occur in the summer and monsoon months, their frequency being higher in June and September. Dust raising winds are common in the summer afternoons.

\textbf{2.9 Soils :}

Soils constitute the physical basis of an agricultural enterprises and play a very important role in the agricultural economy of a region. Differences in soil texture, drainage and fertility are of major importance in ex-
plaining contrasts in agriculture.

Unlike climate, soils should not be regarded as part of the natural endowment of an area. In fact, it is agriculture that modifies soils, excepting certain virgin soils which can retain their original characteristics. On the whole, soils constitute the physical base for any agricultural enterprise. Farming is a business and soil is part of the farmer's stock in trades. Good soils are good to the extent that man makes judicious use of them. Our standard of living which predominantly depends on agriculture is often determined by a combination of the physical, chemical and biological characteristics of the soils and crops and livestock raised on them.

Crop growth is determined to a considerable extent by the amount of nutrients in the soils. The main factor that has influenced the development of soils in Beed district is the undulating and hilly topography. The soils of varying are to be found throughout the district. Deep black soils covers about 12.76% portion of the Beed district, while medium black soils covers 65%, coarse and shallow soils covers 22.74% portion of the district. The soils in the district can be classified into four main categories on the basis of depth and structure namely (map 2.6):

a) Shallow soils with depth below 7"
b) Moderate deep soils between 7" to 9"
c) Medium deep soils between 9" to 27"
d) Deep soils between 27" to 45"

a) Shallow Soils:

The shallow soils of Beed district have dark brown to dark yellowish brown colour, single grain to blacky structure and sandy loam to loamy texture. They are found in some parts of Georai, Kaij and Ashti tahsils. The Ph value of the soil is from 8.3 to 8.5 with total soluble salts of 0.2 to 0.3%. The calcium carbonate is as much as 20% in Georai tahsil's soil, whereas it is 5% in Ashti tahsil's soil. The shallow soils are Murum Mixed Soils which are suitable for growing crops like bajara, math, chavali etc. The exchangeable calcium varies from 43 to 46 m.e. percent, Magnesium 5 m.e. percent and
INDEX:

- DEEP SOILS (27" TO 45")
- MEDIUM DEEP SOILS (9" TO 27")
- MODERATE DEEP SOILS (7" TO 9")
- SHALLOW SOILS (BELOW 7")

MAP NO. 2.6
sodium and potassium together about 1 m.e. percent\(^26\). The organic matter varies from 43 to 46 m.e. percent.

**b) Moderately Deep Soils:**

The moderately deep soils are found in hilly and undulating areas of Georai, Naigaon (Patoda) and Ashti and have varying colours, structure and texture. The colour of the soil is dark brown, dark reddish brown or dark grey brown. The structure varies from single grain to blacky while texture varies from sand loam to clay. The Ph value varies from 7.5 to 8.5 and total soluable salts from 0.2 to 0.4 percent. The calcium carbonate varies from 2 to 20 percent and Organic matter from 0.92 to 2.37%. The base exchange capacity of the soils is high with exchangeable calcium from 21 to 62 m.e. percent, magnesium from 5 to 15 m.e. percent and sodium and potassium together from 1 to 2 m.e. percent.

Like shallow soils, these soils are also of inferior quality due to the lack of nutritious contents in them. Nitrogen is found only in dark reddish brown soils that too in very small quantity of about 0.14%. The phosphate contents are between 10 and 18 Mgm percent. Potash is found up to 28 Mgm percent. Generally speaking those soils respond to all kinds of fertilizers.

**c) Medium Deep Soils:**

The medium deep soil is found in every tahsils particularly on the banks of various streams. It has dark brown or black colour and is granular or blacky in structure and sandy loam to clayey in texture. The Ph value of this soil varies from 8.2 to 8.7 and total soluable salts from 0.2 to 0.3 percent. The contents of calcium carbonate and those of organic matter vary widely from 3 to 20 percent and from 0.48 to 2.16% respectively. The base exchange capacity of the soil is fairly high with calcium from 22 to 24 m.e. percent, magnesium from 11 to 25 m.e. percent and sodium and potassium together from 1 to 2 m.e. percent\(^27\). The nutritious elements in the soil also vary considerably. Thus in dark grey, light brown grey and greyish brown soil there is more of nitrogen and potash than other elements. This type of soil responds favourable to the nitrogenous and phosphatic fertilizers.
d) Deep Soils:

These soils are found in Georai, Ambejogai and Manjalgaon tahsils. Particularly these soils are found in the river valley of Manjara, Sina, Bendsura, Godavari, Chausala, Rena, Kaij and Saraswati etc. Their colour changes from dark brown to black and so also the texture changes from clay loam to clayey. The Ph value of these soils vary from 8.5 to 8.9% and total soluble salts from 0.4 to 2 percent. The high Ph value and total soluble salts show that soils have developed the saline and alkaline conditions which are pronounced in the yellowish brown and black soils. The base exchange capacity is a little high with calcium varying from 22 to 24 m.e. percent, Magnesium from 13 to 29 m.e. percent and sodium and potassium together from 2 to 15 m.e. percent.

The plant nutritious contents in the soil are low with nitrogen 0.04 percent, phosphate between 9 and 15 Mgm percent and potash between 31 and 41 Mgm percent. This soil responds to nitrogen and phosphatic fertilizers.

Most of the Kaij tahsil is having barad type of soil. In some part underground watertable is very high, hence these types soils are only useful for bajara, mung etc. Balaghat ranges are also having barad soil on its two sides. These soils are covered with short trees and grasses. Human life of hilly region is very hard and difficult.

2.10 Natural Vegetation:

Vegetation of some sort of the other, is the natural covering of the land surface of the earth. Even the so called deserts have their vegetation, though it may be scanty and incospicious. Natural vegetation is important from the view point of rainfall distribution and the fertility of the soil. It also check the soil erosion to the greater extent. It also keeps the environmental balance. It is also important to protect the wild animals. Forest products supports to the forest based industries. Forest also provides raw material for agricultural implements.

The Beed district has limited area under forest. Dry deciduous forest are found in the entire study region out of the total area below 20% forest
area was found in Pimpalwadi, Imampur, Kolwadi, Karzani villages of Beed tahsil where as 20% to 45% geographical area was observed under forest in Kakadhari, Palwan, Patoda villages of Beed tahsil during 1992-97.

Forest area is found in Dhumeagaon, Golegaon, Bhat Antarwali, Chaklamba, Rasulabad, Paulachiwadi, Kumbhe Jalgaon, Deopimpri, Thakur Adgaon, Marfala, Bhend B.K., Ardhamalsak, Pimpala, Kaudgaon, Taratgavhan, Anandwadi, Tintarvani and Singarwadi villages of Georoi tahsil. There is uneven distribution of forest in the above mentioned villages. Out of the total geographical area 4% to 20% area was under forest in the above mentioned villages of Georai tahsil. Very little area below 4% was found under forest in Madalmoni, Rui, Sultanpur, Sinegaon, Ankota, Loladgaon, Siras Marg, Malegaon, Wahegaon Amla, Shahajanpur Chakla villages of Georai tahsil during 1992-97. Only nine villages are having forest cover in Manjalaon tahsil. Above 81% area as under forest in Lonwat village in Manjalaon tahsil. About 3% to 12% area was under forest in Sands Chincholi, Nagadgaon, Longaon, Devla Khurd, Umri B.K., Telgaon B.K., Bavi, Upali village of Manjalaon tahsil during 1992-97.

Forest area is found in Aranwadi, Saundana, Lamananda, Dharur, Rajegaon and Devla B.K, villages of Kaij tahsil where as it is found in Ambalwadi, Patharwadi, Fradpur, Dharmapur, Dighol Deshmuk, Katkarwadi, Khodwa Savargaon, Ghatnandur, Chanai and Tawalgaon villages of Ambejogai tahsil.

Out of the total geographical area below 10% area was found under forest in Tembhurni, Warni, Nirgudi, Pangri, Bendsura, Paroan Ghamra, Manzarighat, Pachegaon, Panchangri, Domri Villages of Patoda tahsil while 10% to 25% area was found under forest in Loni, Shirur, Arvi, Pimpdgaon, Sawargaon ghat, Supa, Rakshasbhuwan, Dahiwadi, Tagrdgaon villages of Patoda tahsil during 1992-97. Villages like Gazipur, Kamaleshwar, Shirapur, Taratgavhan and Arvi were having above 90% geographical area under forest during 1992-97.

About 5% to 25% geographical area was found under forest in Ashta,
Waluj, Pargaon, Khadkat, Matawali, Brahmagaoon, Keruni, Bidsangvi, Bavi, Dongargaon, Ambhora, suleman Deola, Dadegaon, Kapsi, Dhamangaon and Devali villages of Ashfi tahsil during 1992-97. Villagewise information was obtained from the forest office of the Beed district by the Author. Dry deciduous forest are found in the entire study region. Within this type, local variations are met with, due to variations in the nature of the soil, topography, past-treatment and accessibility. Although the altitudinal variations are very limited, they play an important part in influencing the character of vegetation. Better stocked patches occur in cooler and protected depressions on the northern and eastern slopes. The forests of the Beed district can be classified into the following three groups.

A) Scrub forest.
B) Tree forest.
C) Grasses.

A) Scrub Forests :

Owing to the pressure of the increasing population and the ever-increasing demand for land for tilage, the forest areas have receded to distant hilly tracts with poor and shallow soil with the result that the forests are of very poor and open type. In addition to this other biotic influences such as heavy illicit cuttings, uncontrolled grazing and trees in the past have been responsible for further retrogression of the forests. Actually majority of the forest blocks in this district carry shrub by growth of Bharatti (Gymnosporia Montama), Dhawai, Dhal, Ghela, Ghanero, Karonda, Madar rui, Nirgudi, Parijatak, Tarwad, Tarota, Chindh and thick grass due to which most of these blocks have been declared as remanas or Kurans and are sold either on cutting or grazing terms.

B) Tree Forest :

These types of forest occurs only in cool sheltered pockets having northern and eastern aspects. These forests are of mixed-miscellaneous type and consist mostly of Salai, Moina, Temru, Kandol, Khair, Bahawa, Palas, Bhilwa, Tokhandi, Ghat-bor, Apta, Bhutkes with scattered Dhavala, Awala and Chandan at some places.
C) Grasses:

The main grasses found in the various forest blocks of the district are Boni, Kusali, Panoya, Rosha, Sheda, Kunda, Gondal, Chirka and Marvel.

Every tahsil has forest cover but the proportion of cover varies from one tahsil to another tahsil.

Table No. 2.3: Tahsilwise Changes in Forest Area in Beed District.

<table>
<thead>
<tr>
<th>Tahsil</th>
<th>1970-75</th>
<th>1992-97</th>
<th>Volume of change in%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area under forest in hectare</td>
<td>% to the geographical area</td>
<td>Area under forest in hectare</td>
</tr>
<tr>
<td>Beed</td>
<td>4908</td>
<td>3.23</td>
<td>4400</td>
</tr>
<tr>
<td>Georai</td>
<td>1378</td>
<td>0.89</td>
<td>1200</td>
</tr>
<tr>
<td>Kaij</td>
<td>4350</td>
<td>2.33</td>
<td>3900</td>
</tr>
<tr>
<td>Ambejogai</td>
<td>4361</td>
<td>2.36</td>
<td>4400</td>
</tr>
<tr>
<td>Patoda</td>
<td>5111</td>
<td>3.91</td>
<td>5100</td>
</tr>
<tr>
<td>Ashti</td>
<td>3670</td>
<td>2.49</td>
<td>2700</td>
</tr>
<tr>
<td>Manjalgaon</td>
<td>773</td>
<td>0.48</td>
<td>625</td>
</tr>
<tr>
<td>Beed Dist.</td>
<td>24551</td>
<td>2.20</td>
<td>22325</td>
</tr>
</tbody>
</table>


A review of changes in forest area in Beed district during the period 1970-75 and 1992-97 is briefly presented in table 2.3. The quinquennial average area under forest and their relative share of each tahsil in total geographical area has been deployed for the study of forest distribution. The volume of change in percent is also calculated.

Table 2.3 indicates that out of the total geographical area 2.20% area was under forest during 1970-75 in Beed district. It was decreased upto 2.11% during 1992-97. It is clear that there is only light negative change (0.06%) from 1970-75 to 1992-97. The area under forest varies from tahsil to tahsil. Out of the total geographical area below 1% area was recorded under forest in Manjalgaon and Georai tahsils where as 1% to 2% geographi-
BEEED DISTRICT

AREA UNDER FOREST

1992-1997

INDEX:

- ABOVE 2%
- 1% - 2%
- BELOW 1%

MAP NO. 2.7
cal area was observed under forest in Ashti tahsil during 1992-97. Above 2% geographical area was experienced under forest in Beed, Kaij, Ambejogai and Patoda tahsils during the period of 1992-97 (map 2.7).

About 0.02% positive change in forest area was recorded in Ambejogai tahsil during the period of investigation.

Below 1% negative change in forest area was experienced in Beed, Georai, Kaij, Ashti and Manjalgaon tahsils and above 1% negative change was found in Patoda tahsil from 1970-75 to 1992-97. Due to increase in population the area under forest decreased to some extent in above mentioned tahsils.

A major portion of the forest produce of this district is consumed locally. There is a great demand for Teak timber and firewood, but as the forest of this district are very poor it cannot meet the local demand and hence, most of the timber and firewood is imported from Nizamabad, Adilabad and Nirmal districts of Andhra Pradesh.

The main minor forest produce which is utilized in the district consists of fodder and grasses, Tendu leaves for bidi manufacture, Chandan, Charoli and gums. There is a fair local demand for fodder grasses. Some quantity is also thatching. At some places Rosha-grass occurs in extensive patches but this is at present extracted for thatching and making screens. Shindi leaves are also used for thatching and making brooms. Tendu is another important marketable forest produce which is extracted on a large scale for the manufacture of bidis. Exploitable strong trees of Chandan are at present not available anywhere in significant numbers, however, local dealers are extracting Chandan from dead and dry trees found in the fields of the villages. In addition to the above Mahu toli, Charoli, Biba Karanj seed and gums are extracted locally for various uses.

2.11 Summary:

i) Agricultural activities are highly concentrated along the river bank of Godavari, Manjara, Wan, Bendsura, Sina, Sarswati, Rena, Mehkari, Kaij, Limba etc. Gonoba, Chitora and Narayangad hilly areas are not suitable for
agriculture due to rigid topography. Balaghat range area is also not suitable for agriculture.

ii) Godavari and Manjara rivers have changed agricultural structure to the greater extent in the study region. Most of the rivers and streams which are flowing through the Beed district are seasonal. They become dry in the winter and summer seasons hence, agriculture is affected.

iii) The variability of rainfall ranges between 29.5% to 43.27% in Ambejogai and Georai tahsils respectively. All the tahsils are having high rainfall variability, therefore, there is no guaranty of crops in the district. Agriculture is purely depends upon monsoon rainfall.

iv) Deep black soils covers about 12.76% portion of the study region, where as medium black soils covers 65% area, coarse and shallow soils covers 22.74% portion of the district. It means that study region has great soil potentials for the agricultural development. Therefore, it is essential to increase irrigation facilities in the district.

v) During 1992-97 about 2.0% geographical area was found under forest. It varies from tahsil to tahsil in the study region. Below 2% geographical area was recorded under forest in Manjalgaon, Georai and Ashti tahsils during 1992-97. Where as above 2% geographical area was found under forest in the rest of the villages. According to the rule of nature atleast 33% area should be under forest to maintain natural balance. Therefore, it is essential to increase area under forest through social forestry scheme in the study region.

--- References ---

5. Gazetteer of India, Maharashtra State, Beed District 1969. p-1.

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