CHAPTER - I

PHYSICAL FACTORS AND HORTICULTURAL SET UP

INTRODUCTION :

A careful study of the Geo-physical status as well as horticultural set up of West Bengal have been discussed in this chapter which are essential to analyze the great scope for growing horticultural crops of high field potentialities. Stretching from the icy caps of Himalayas in the North to the rolling Ocean in the South; from the undulating tracts of the West to the low riverine flats in the east, West Bengal is the only State of India to be the owner of a great variety of landscape, climate, soil and obviously agriculture.

1.1 RELIEF :

The State of West Bengal is extended from the hills on the north and the coastal low lands in the south and has varied in topographic and terrain characters on the basis of these variations, the State is divided into three well marked physiographic regions (Fig. 1.1).

1.1.1. Hills in the North

The Himalayan range of the North covers the Darjiling district (excluding Siliguri Sub-division) and a very small narrow tract on the extreme northern border line of Jalpaiguri district. These mountains attain a maximum height of 3,630 mt. (Sandakphu) above mean sea level. Two of the high transverse ranges of the Great Himalaya - the Singalila and Dongkya converge here throwing spurs and ridges. Landforms are heavily dissected by swift flowing rivers and

deep dense forests. Four major peaks of the Singalila range are Sandakphu (3,630 m.), Phalut (3,596 m.) Sabargam (3,543 m.) and Tanghe (3,063 m.). Between the Balasan river valley and Tista river valley lie Senchal (2,614 m.) and Tiger Hill (2,573 m.) on the Senchal Mahaldhiram Ridge. The portion of Sinchula range lying in Jalpaiguri district reels in long even ridges with an average height of 1,600 mt. The sculpturing actions of ice, rain and wind in the Himalaya have built up topography of diverse character and of varied composition. Owing to the situation of the northern extreme part of the State in the form of high mountains, this part is -called "The crown of West Bengal. (Bhattacharya 1985).

1.1.2. The Plateau Tracts

The plateau tracts which are a continuation of the Chotanagpur Plateau cover the districts of Puruliya, and the Western part of Birbhum, Barddhaman, Bankura and Medinipur. Quite a large part of the western tract are covered by the Archeans, that form the eastern part of the Peninsular Shield. The ancient crystalline rocks cover most of the table land. (Hunday, et.al., 1967). The 100 m. contour line is taken roughly as the eastern limit of the plateau merging in Rarh Plain. The pene plain is dotted with rounded steep-sided hills known as "monadnocks", formed through the processes of weathering, denudation and erosion in operation throughout the ages. These small hills are locally known as 'Dungri' or 'Tila'. The rugged terrain of the Puruliya is known as 'Barabhum'. Of the hillocks the highest peak is the Gargaburu of Ayodhya Hill (677 m.).

1.1.3. The Plains

The flat alluvial plains of West Bengal can be classified into two on the basis of their origins and characters. They are located at different places in the State.

1.1.3.(a) Tarai Plain

The undulating land south of the Himalayan range covering the southern part of Darjiling and Jalpaiguri districts comprise the Tarai Plain. Unconsolidated rock materials, coarser alluvium constitute this piedment plain with gentle slope towards the south, the eastern part of the Tista valley is known as 'Duar' (derived from the word 'door'). Tarai plain are classified as : (i) The Western Duar and Siliguri Duar ; (ii) Central or Jalpaiguri Duar; and (3) Eastern or Alipurduar. Originally forested and marshy areas of Tarai is now deforested and well drained to convert agricultural field.

1.1.3.(b) Northern Plain

Kochbihar, Uttar and Dakshin Dinajpur and Malda districts constitute the northern plain. Vigorous river action created by Mahananda river and its tributaries and distributaries have made the region as flood plain (Jana, 1996). The region, located left bank of the Mahananda is known as 'Barendrabhumi' or 'Barind' which is the part of the Old Ganga delta, made up of old alluvium or 'Bhabar' soil. Eastern portion of Mahananda is made up with new alluvium or 'Khadar' soil. Region, on the left bank of the river Kalindi is known as 'Tal'. This is very low flood plain with many 'bills' or marshy lands. The right bank of the Kalindi river is very fertile with new alluvium and is known as 'Diara'.

1.1.3.(c) Rarh Plain

Western part of the Murshidabad district (on the right bank of the river Bhagirathi), Birbhum district, Barddhaman district (excluding the western high lands and Ganga delta), Bankura district (except western high land) Medinipur district (excluding the western highland, sandy coastal plain

and the Ganga delta) constitute the region of red earth or 'Rangamati'. A mixture of laterite and old alluvium with coarse sand gravel, pebble, etc. are found at places. On the basis of variations in surface configuration Rarh plain may be classified into : (i) Murshidabad Rarh, (ii) Birbhum - Barddhaman Rarh (Ajay - Damodar Interfluve), (iii) Bankura Rarh (Damodar - Dwarkeshwar Kangsabati Doab) and (iv) Medinipur Rarh.

1.1.3.(d) Ganga Delta

Ganga delta extends southwards from the right bank of the Ganga to the shores of the Bay of Bengal comprising the districts of Nadia, Uttar and Dakshin 24 Parganas, Haora, Hugli, eastern part of Murshidabad, parts of Barddhaman and Medinipur. Ganga delta is formed by the fluvial action and silts brought down by the Bhagirathi - Hugli river and its tributaries. Bills, swamps, marshes, leevees and deltas are the remarkable components of this physical landscapes. The micro order diversities within the apparently homogeneous physical entity of the Ganga delta can be classified into the following divisions like ; (1) Moriband delta plain, comprising eastern Murshidabad and the entire Nadia district, which, once criss-crossed by numerous rivers but now chocked and transformed into numerous bills and natural canals locally known as 'Bagri'; (2) Mature delta plain, comprising Barddhaman, Haora, Hugli and Medinipur plains which are formed by the choked rivers lying particularly to the west of the Bhagirathi-Hugli. The delta plain of Calcutta and Uttar 24-Parganas are now resembles mature delta plain; (3) Active delta plain is found in the Dakshin 24-Parganas district which is the land of marshes, leevees saline-water lakes and the tidal forests, the famous Sundarban (named after the Sundari tree). Sundarban is marked with swampy lands seperated by estuaries of Bhagirathi-Hugli and interlaced with a network of tidal creeks. Important tidal

rivers are Bartala, Saptamukhi, Jamira, Matla Gosaba, Hariabhanga etc.

1.1.4 Sandy Coastal Plain

The sandy coastal plain of West Bengal stretches from the western part of the mouth of the Hugli river almost upto the mouth of the Subarnarekha river in the west in Medinipur district which is almost 15 km. wide. South-westerly winds, carrying sands of marine origin form low dunes. Only Rasulpur river flows through the coastal plain. Among two parallel dunes in the coast of Medinipur district, Contai dune is old and permanent while the Digha dune is newer one. (Chatterjee, et. al., 1970).

1.1.5 Flood Plains

Drainage or disposal of rain water, along with other waste waters or the draining rivers is very much important for growing crops. Removal of surplus water is essential because it creates problems in plant growth (as the available moisture for potential root zone is disturbed), yield and harvesting operations. Flood plains of West Bengal are divided into three on the basis of their locations. (Bagchi, K. 1942)

1.1.5(a) Flood plains of North Bengal

Heavy rainfall in the mountaineous and sub-mountain areas of North Bengal creates frequent floods. The region experiences severity of flood problem owing to surface run-off as due to steep slope (5 to 15 mt/km.). The turbulent Tista and other rivers of the North Bengal districts are responsible for submergence of the agricultural fields. Frequent and sudden change of coarse of the rivers also causes floods.

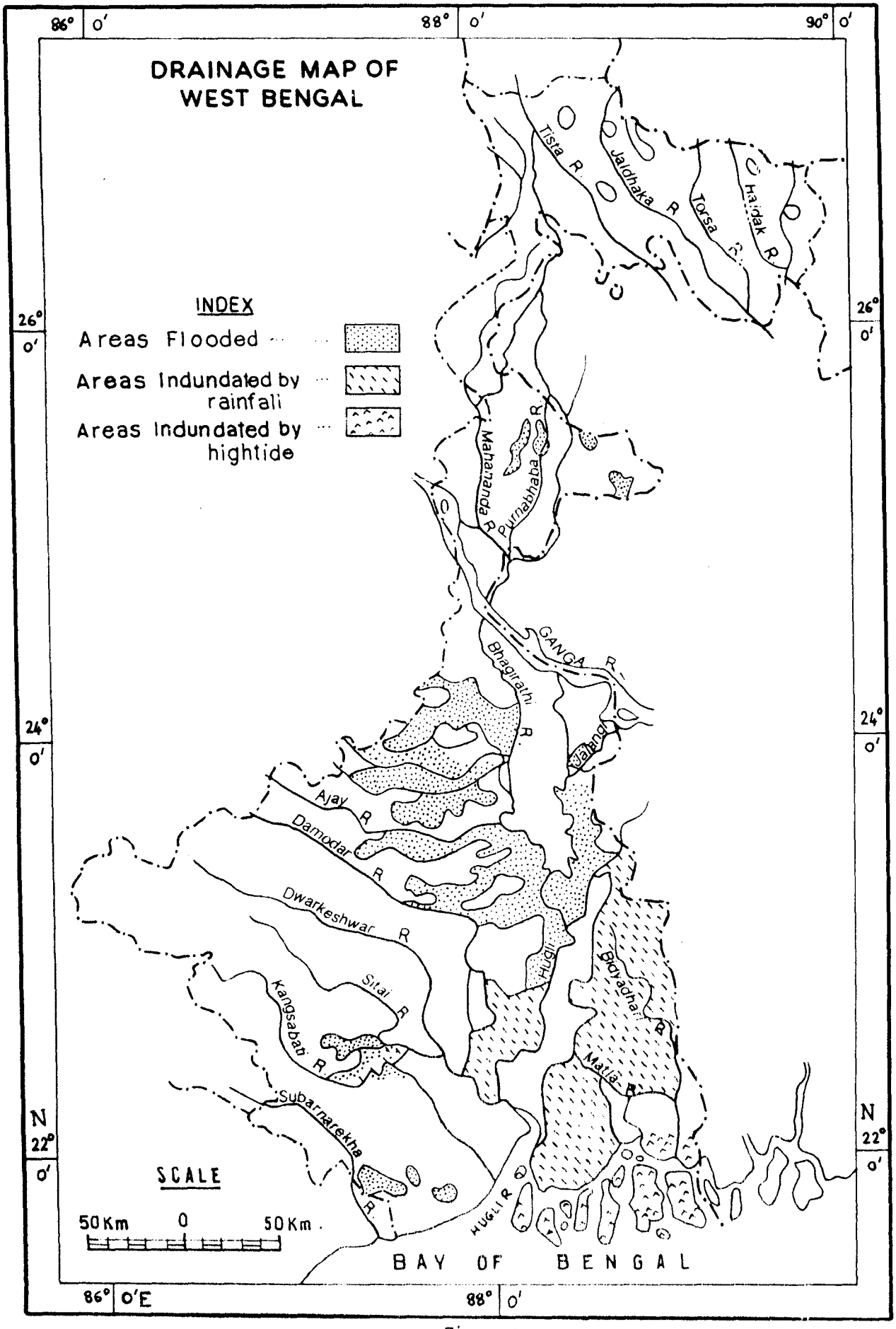

DRAINAGE MAP OF WEST BENGAL
INDEX
Areas Flooded
Areas Indundated by rainfall
Areas Indundated by hightide
Tista R.
Jaldhaka R.
Torsa R.
Haldak R.
Mahanada R.
Purnabhaba R.
GANGA R.
Bhagirathi R.
Jalangi
Ajay R.
Damodar R.
Dwarkeshwar R.
Sitai R.
Kangsabati R.
Subarnarekha R.
Hugli R.
Bidyadhari R.
Matla R.
HUGLI R.
BAY OF BENGAL
SCALE
50 Km 0 50 Km
86° 0'
88° 0'
90° 0'
26° 0'
24° 0'
N 22° 0'
86° 0'E
88° 0'

Fig. 1.2

1.1.5(b) Central Plain

Central Plain or the Bhagirathi-Hugli Basin with the rivers Mayurakshi, Dwarakswar, Ajoy covers an area of 5,957 km.^{2} of flood plain. Heavy rainfall in the late monsoon period increases upland discharge which synchronises with high tide levels of Hugli and Rupnarayan rivers resulting severe flood situation. Floods in low lying depressions of the Damodar - Hugli interfluve, affect the agriculture very much.

1.1.5(c) Deltaic Area

During wet season, rivers like Bhagirathi, Jalangi, Churni become swollen and overflown the banks inundating low lying areas. Further south, the monsoon run off and the high tides coincides, resulting congestion of the drainage channels of the Sundarbans.

1.2. DRAINAGE :

The State has numerous srivers which are originated either from the mountains on the north or the plateau on the west. These rivers have played important role in formation of flood plains, alluvial plains and coastal plains. They are either snowfed or rainfed. (Fig. 1.2)

1.2.1. Snowfed Rivers

The snowfed rivers of the Himalayas include the Ganga, The Tista and some of their tributaries, Rangit being the main one. The Tista, on debouching into the plains south of Darjeeling at sevoke, flows in a mighty stream towards the south-east upto Brahmaputra in Bangladesh. Among other rivers, rising in the Himalayas are the Jaldhaka, the

Torsha, the Sankosh, the Balason and the Raidak. These rivers, carrying the bulk of the monsoon waters of the huge catchment area of the Himalaya assume an uncontrollable fury during the monsoon season. (Ghosh, 1976) The Mahananda forms the boundary between Bihar and West Bengal for some distance. The Ganga touches West Bengal at the south-western boundary of the Malda district. The Ganga throws a number of spill channels like the Bhagirathi, Bhairab and Jalangi along its right bank through the district of Murshidabad. The Bhagirathi, the lifeline of West Bengal with its network of tributaries and distributaries serves the natural drainage and irrigation in the State.

1.2.2. Rainfed Rivers

The rainfed rivers like Damodar, Ajoy, Mayurakshi, Kangsabati etc. which originated either from the low hills of Chotonagpur plateau or the Santhal Parganas drain into Bhagirathi-Hugli. The rivers rising from the Santhal Parganas include Dwarka, Brahmani, Mayurakshi, Kula and Kana. These rivers are torrential in nautre and are active only during the rainy season. Rivers rising out from Chotonagpur plateau are Ajoy, Damodar, Rupnarayan and Kangsabati. The Ajoy flows along the border of Birbhum and Barddhaman districts and joins with Bhagirathi in the Murshidabad district. The mighty Damodar flows through the districts of Barddhaman, Hugli and Haora before it joins with Hugli (the lower course of Bhagirathi river). The Dwarakeshwar rises in Chotanagpur and enters in the district of Bankura and meets with Silabati near Ghatal in Medinipur and their combined flow is known as the Rupnarayan. The Kangsabati rises in the Chotonagpur plateau in Bihar and flows through Bankura and Medinipur. It joins with Keleghai and ended its journey, as Haldi, to the Hugli river.

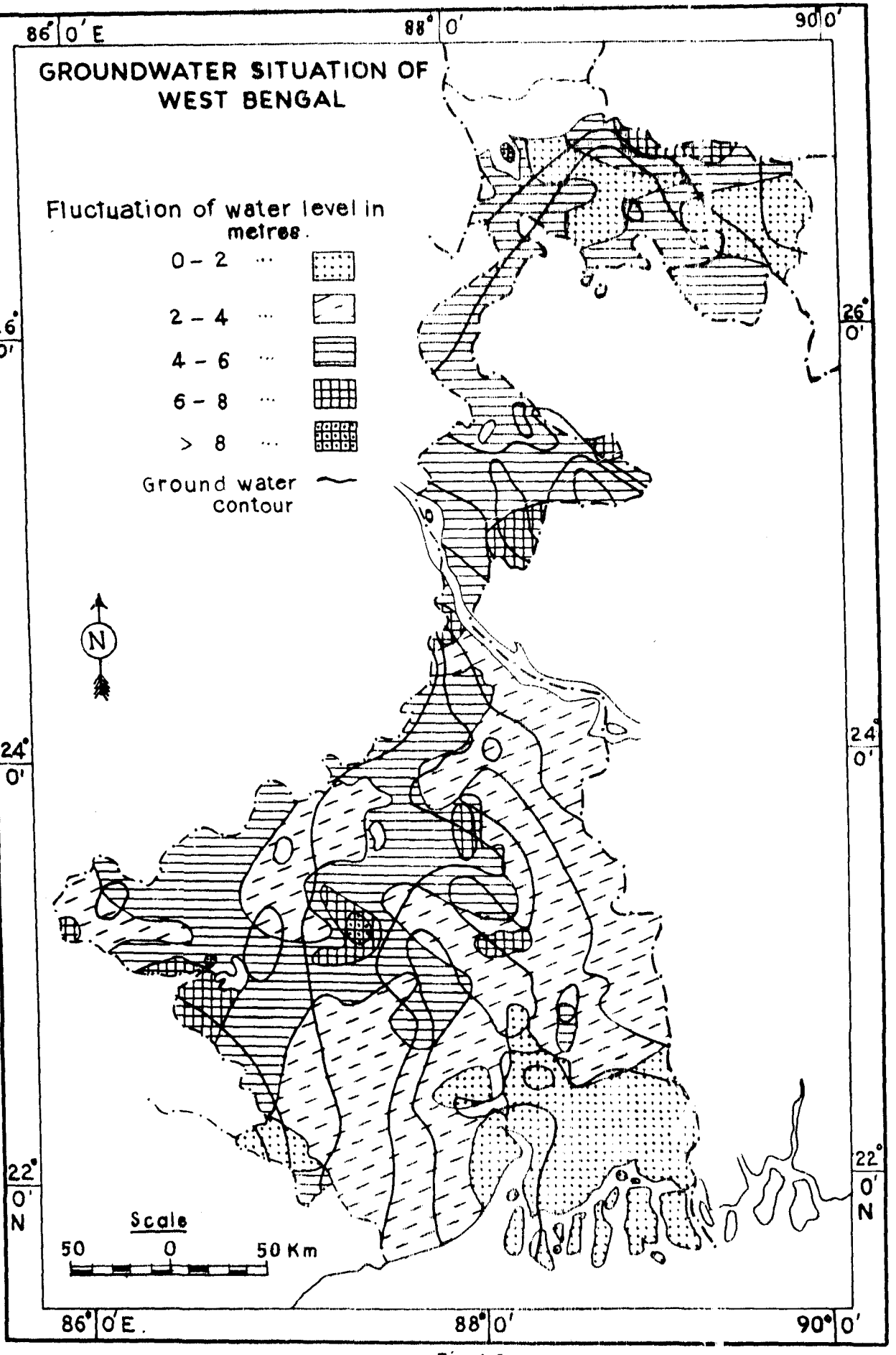

GROUNDWATER SITUATION OF WEST BENGAL
Fluctuation of water level in metres.
0 – 2 ...
2 – 4 ...
4 – 6 ...
6 – 8 ...
> 8 ...
Ground water contour
N
Scale
50 0 50 Km
86° 0' E
88° 0'
90° 0'
26° 0'
24° 0'
22° 0' N

Fig. 1.3

1.2.3. Tidal Rivers

Important tidals rivers are Piali, Bidyadhari and Matla. The southern-most part of the State, consisting of 24-parganas district, forms the tidal basin, washed alternatively by the seaward flow of the Bhagirathi-Hugli and the rivers flow of the tide from the sea. The other main channels in the tidal basin are Manganga or Baratola, the Saptamukhi, the Thakuran, the Matla, the Gosaba and the Raimangal which skirts the boundary between West Bengal and Bangladesh in the extreme south (Fig. 1.2).

1.2.4. Ground Water Depth

In Summer, the water table depth from the surface increases from east to west in South Bengal and from South to North in North Bengal. Situation of the depth of water level as shown in the map (Fig. 1.3) allows two periods, namely, (i) pre-monsoon and (ii) Post-monsoon conditions. From the average seasonal fluctuation of water level over a decade (1976-86) it has been possible to demarcate five different zones, e.g., 0-2m, 2-4m, 4-6m, 6-8m and more than 8 metres below ground level (bgl).

In major part of the State, average fluctuation of 1-3 metre was recorded in the districts of Medinipur, Barddhaman, Hugli, Haora, uttar 24-Parganas, nadia, Murshidabad, Malda, Uttar and Dakshin Dinajpur and parts of Darjiling district. A depth of 4-6 metre are found in the western part of the State i.e., in Murshidabad, Birbhum, Barddhaman, parts of Puruliya, Bankura and Medinipur districts. Depth of 6-8m have been recorded in small pockets of West of the Bhagirathi river, mainly in Puruliya and Bankura districts. Small patches of Bankura district have also recorded the fluctuation of more than 8 metre. A great magnitude of

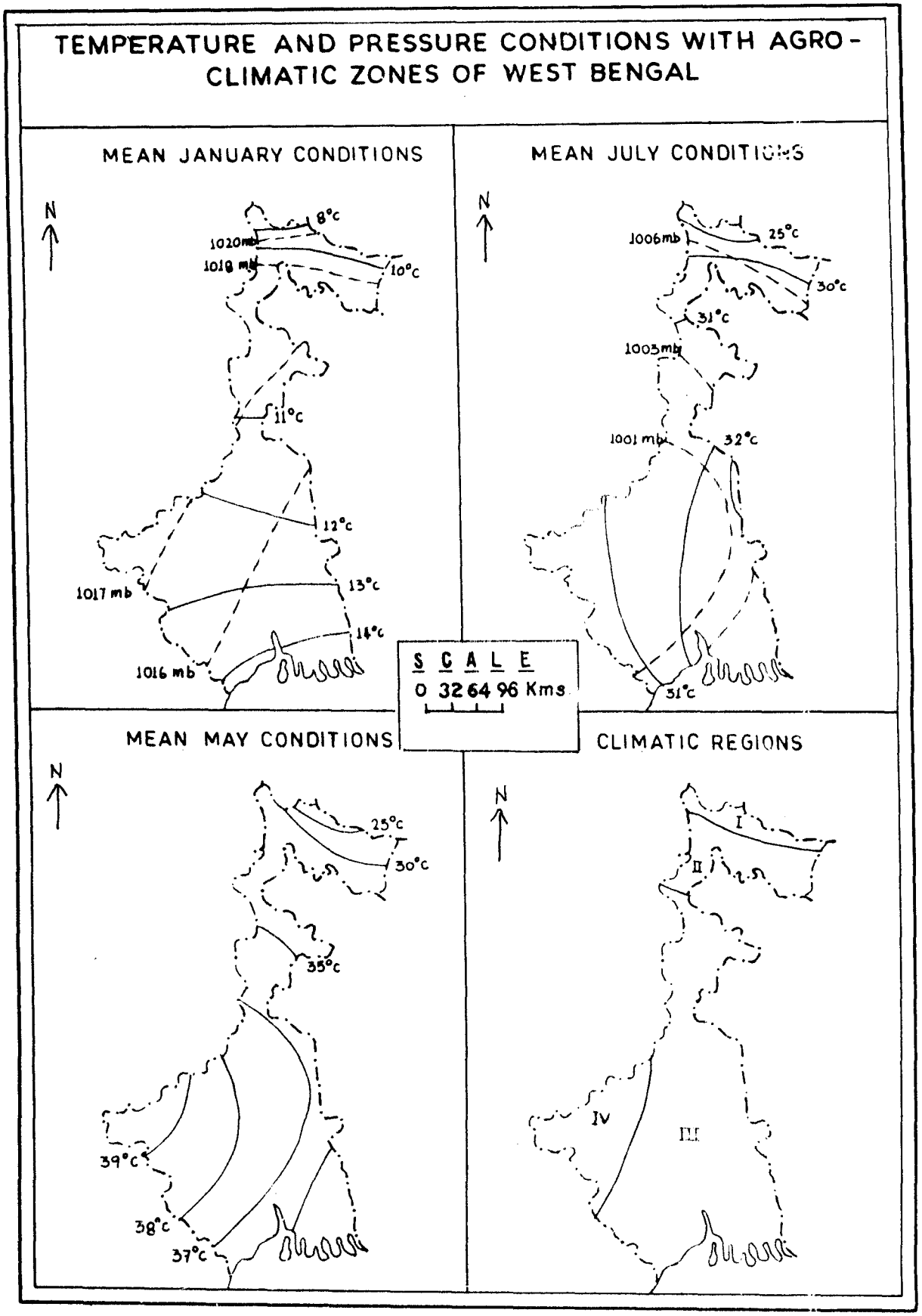

TEMPERATURE AND PRESSURE CONDITIONS WITH AGRO-CLIMATIC ZONES OF WEST BENGAL
MEAN JANUARY CONDITIONS
N
8°c
1020mb
1018 mb
10°c
11°c
12°c
1017 mb
13°c
14°c
1016 mb
MEAN JULY CONDITIONS
N
1006mb
25°c
30°c
31°c
1003mb
1001 mb
32°c
31°c
SCALE
0 32 64 96 Kms
MEAN MAY CONDITIONS
N
25°c
30°c
35°c
39°c
38°c
37°c
CLIMATIC REGIONS
N
I
II
IV
III

Fig. 1.4

fluctuation occurs in the hard rock terrain of Puruliya, Bankura, Medinipur, Birbhum and the 'Barind' tract of Malda, Uttar Dinajpur as well as the piedmont (Bhabar) zones of Himalayan foot hills in Jalpaiguri and Darjiling districts (Govt. of India, 1990).

1.3. CLIMATE

1.3.1. Temperature

The average maximum temperature in the plains is attained in April and the highest maximum is recorded in May June. Summer temperature in the State varies from 37°C to 43°C. The proximity of the sea has a moderating effect on the temperature conditions in the southern part of the State. During the month of January, West Bengal experiences the lowest temperature throughout the State. The average minimum temperature is not falling below 12°C except in the northern hilly region (lowest recorded 4.8°C) the winter is attained by a cold and day northern wind, substantially lowering the humidity level. (Fig. 1.4)

1.3.2. Pressure

Winter surface pressure conditions, dominated by anti-cyclones, increase latitudinally. Winter depressions originate in mid latitudes (north western India and Upper Ganga Plain). Summer surface conditions show the dominance of the low pressure over north-western India and a semi-permanent low pressure over adjacent Chotanagpur. Over the rest of Bengal, there is a broad easterly current which concentrates into a jet stream with the core in the mean positions along 15°N latitude. This current is subject to perturbations and wave like secondary wind maximum which are occassionally found over Calcutta. These perturbations are of

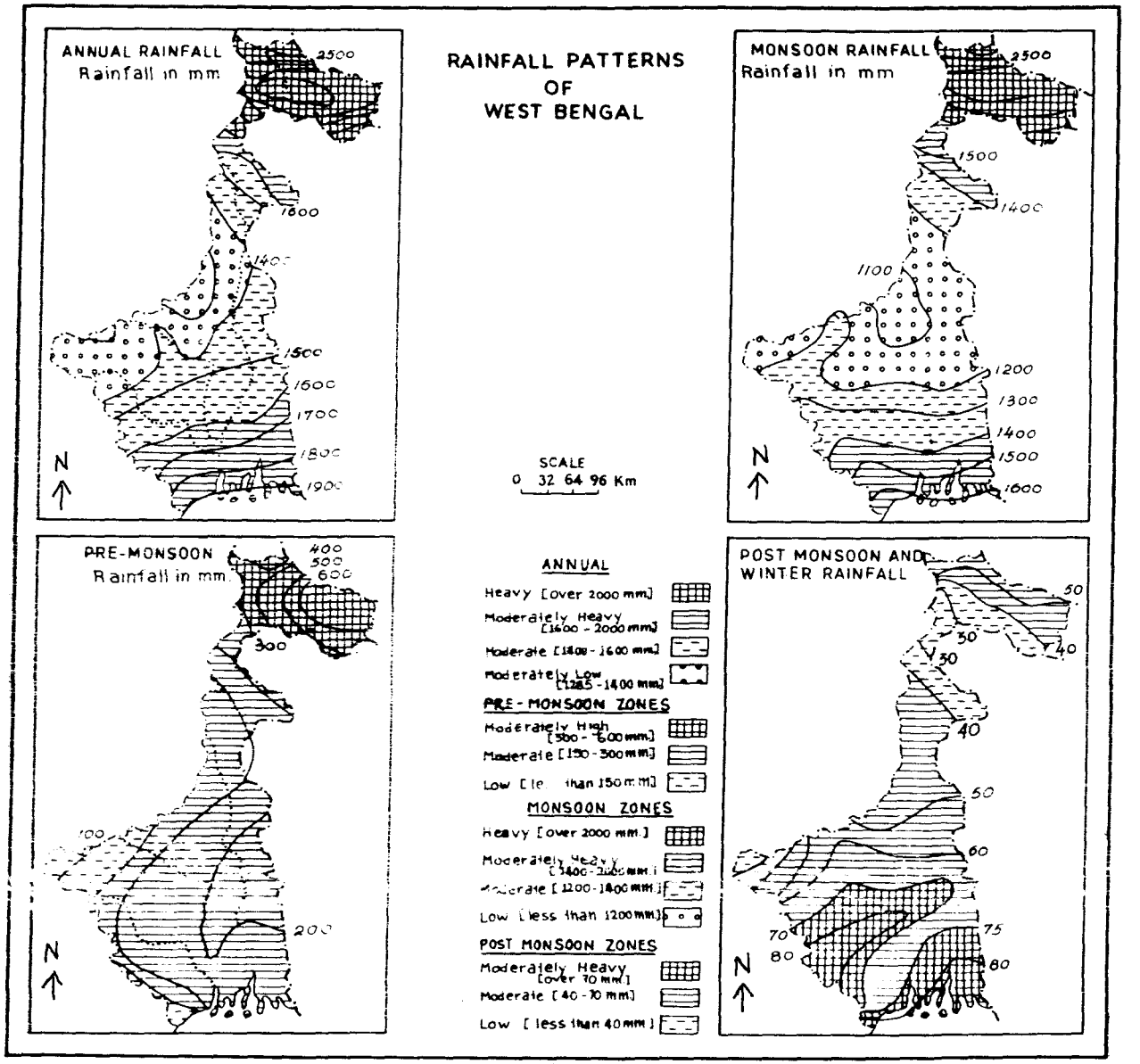

RAINFALL PATTERNS
OF
WEST BENGAL
ANNUAL RAINFALL
Rainfall in mm
2500
1800
1400
1500
1600
1700
1800
1900
N
MONSOON RAINFALL
Rainfall in mm
2500
1500
1400
1100
1200
1300
1400
1500
1600
N
PRE-MONSOON
Rainfall in mm
400
500
600
300
100
200
N
POST MONSOON AND
WINTER RAINFALL
50
50
40
50
40
60
70
75
80
80
N
SCALE
0 32 64 96 Km
ANNUAL
Heavy [over 2000 mm]
Moderately Heavy [1600 - 2000 mm]
Moderate [1400 - 1600 mm]
Moderately Low [1285 - 1400 mm]
PRE-MONSOON ZONES
Moderately High [300 - 600 mm]
Moderate [150 - 300 mm]
Low [le... than 150 mm]
MONSOON ZONES
Heavy [over 2000 mm]
Moderately Heavy [1400 - 2000 mm]
Moderate [1200 - 1400 mm]
Low [less than 1200 mm]
POST MONSOON ZONES
Moderately Heavy [over 70 mm]
Moderate [40 - 70 mm]
Low [less than 40 mm]

Fig. 1.5

utmost importance in the genesis of the climate of West Bengal. (Chatterjee, 1988). Fig. 1.4 shows the temperature and pressure conditions as well as the Agro-climatic regions of West Bengal.

1.3.3. Rainfall

Figure 1.5 shows the rainfall pattern of western part of West Bengal which delineates the State into different climatic zones. On the basis of normal monthly rainfall of the 21 Meteorological Stations in West Bengal, seasonal rainfall is evaluated. (Govt. of West Bengal, 1985). The monthly rainfall data are grouped into three seasons, namely; (i) pre-monsoon (March to May); (ii) Monsoon (June to October) and (iii) post-monsoon or winter (November to February) keeping tally with the principal cropping seasons of West Bengal namely, pre-kharif, kharif and rabi crops. Rainfall data is given in the Appendix-I.

Variability is a characteristic feature of the monsoon of West Bengal. High temperature often causes troughs of low pressure and develops into cyclonic storms especially in the months of April - May and in early Autumn. These are known as "Kal-Baisakhi" or "Nor-Westers". The summer storms are quite destructive. During the Nor'wester months, moist air from the Bay of Bengal having a high degree of latent instability present at lower levels (1524) m.). The synoptic situation is a result of the increasing heat of the plains, which develops low level convergences, thereby, attracting moist southerly sea air.

1.3.4 Agro-climatic Zone of West Bengal

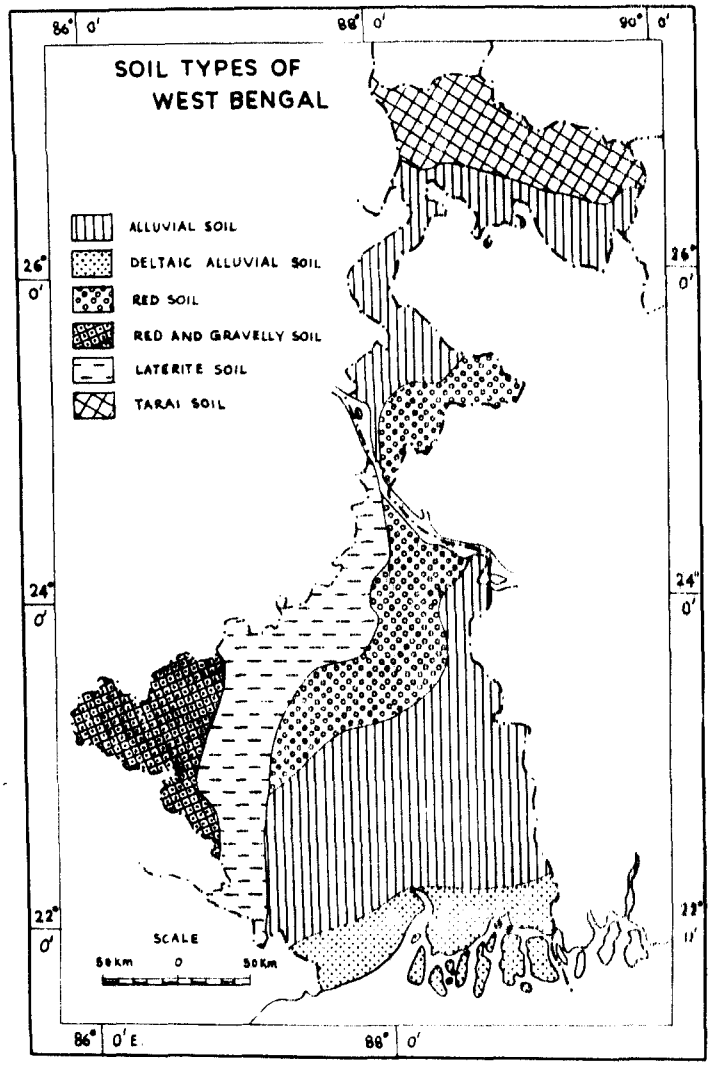
West Bengal is divided into five district AGro-climatic zones on the basis of temperature, rainfall, & pressure. These are shown in Table 1.1.

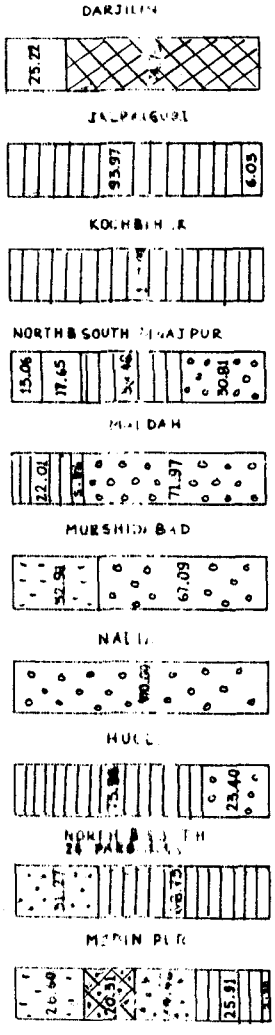
Table-1.1

Agro-climatic zones of West Bengal

Sl. No.	Geographical Regions	Weather Factors	WEATHER Characteristics		
			Summer season March-May	Rainy season June-Oct.	Winter season Nov. - Feb.
1.	Northern Hilly Region	R.F.(mm.)	398.5	2637.5	68.5
		Tem.Max.°C	17.5°	19.5	12.0
		Min.°C	10.5°	14.3	4.8
		Relative Humidity %	74.0	88.0	77.0
2.	North Bengal Plains	R.F.(mm.)°C	372.6	2134.0	42.6
		Tem.Max.°C	32 .3	31.3	26.0
		Min.°C	20.5	24.5	12.0
		Relative Humidity %	60.0	81.0	70.0
3.	Central Plain	R.F.(mm.)	233.8	1206.0	67.8
		Tem.Max.°C	35.0	32.2	27.4
		Min.°C	23.4	25.6	15.6
		R.H.%	58.0	80.0	65.0
4.	Coastal Plain	R.F.(mm.)	195.0	1475.0	82.8
		Temp.Max°C	34.0	32.0	28.2
		Min.°C	24.8	26.0	16.0
		R.H. %	72.0	82.0	68.0
5.	Western Undulating Land	R.F.(mm.)	137.0	1224.0	66.0
		Temp.Max.°C	37.0	32.0	27.2
		Min.°C	23.7	25.0	14.8
		R.H. (%)	44%	78.0	55.0

Source: Department of Agriculture, Govt. of West Bengal.


SOIL TYPES OF
WEST BENGAL
ALLUVIAL SOIL
DELTAIC ALLUVIAL SOIL
RED SOIL
RED AND GRAVELLY SOIL
LATERITE SOIL
TARAI SOIL
SCALE
50km 0 50km
86° 0' E
88° 0'
90° 0'
26° 0'
24° 0'
22° 0'


DARJILING
25.22
JALPAIGURI
93.97
6.03
KOCHBIHAR
NORTH & SOUTH DINAJPUR
15.06
17.65
30.81
MALDAH
22.01
71.97
MURSHIDABAD
32.91
67.09
NADIA
HOOGHLY
23.40
NORTH & SOUTH 24 PARGANAS
MEDINIPUR
26.69
20.93
25.91

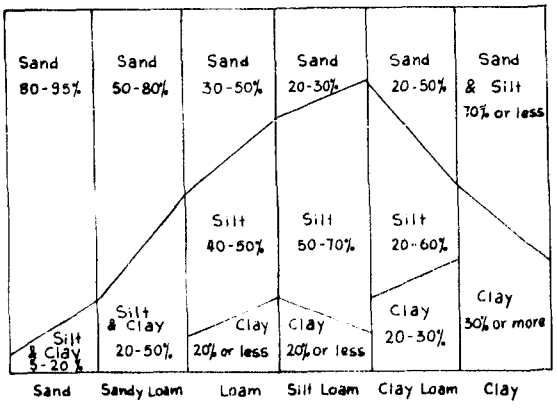

Sand
80-95%
Sand
50-80%
Sand
30-50%
Sand
20-30%
Sand
20-50%
Sand
& Silt
70% or less
Silt
40-50%
Silt
50-70%
Silt
20-60%
Silt
& Clay
5-20%
Silt
& Clay
20-50%
Clay
20% or less
Clay
20% or less
Clay
20-30%
Clay
30% or more
Sand
Sandy Loam
Loam
Silt Loam
Clay Loam
Clay

Fig. 1.6

1.4. SOILS

The variations in the climatic behaviour with the prevailing variable, vegetation provides enough causative factors for the formation of differentn types of soils. The six main types of soils of West Bengal are grouped as follows (Table 1.2) and these are shown in Fig. 1.6.

Table-1.2

Types of Soils in West Bengal

Sl.No.	Types of Soils	Total area in '000 ha	Main locations/areas
1.	Brown Hill/Forest Soil (Palehumulls)	194	Hilly areas of North in Darjiling district.
2.	Terai Soils or Tista Alluvium (Haplaquolls)	648	Jalpaiguri, Koch Bihar Uttar and Dakshin Dinajpur.
3.	Red and yellow soils/ Laterite (Haplustults)	1085	Parts of Birbhum, Bankura and Puruliya, parts of Barddhaman and Medinipur.
4.	Grilly and Gravelly soil	1,313	Parts of Birbhum, Bankura and Puruliya.
5.	Alluvial soil		Malda, Murshidabad, Nadia, Haora, Hugli, Uttar and Dakshin 24 Parganas.
	a) Gangetic Alluvium (Haplaquents)	1,597	
	b) Bindhya Alluvium	1,292	Birbhum, Bankura, Puruliya, Medinipur (east) parts of Barddhaman and Hugli.
6.	Deltaic Alluvium	1,142	24-Parganas and Medinipur.

Source: Directorate of Agriculture, Govt. of West Bengal (Soil Conservation Section)

1.4.1. Brown Hill Forest Soil

Brown Hill Forest Soils occupy comparatively small area in the hilly uplands of Darjiling district. The uplands of north Duars have ferrogenous clay soil highly suitable for cultivation of tea.

1.4.2. Terai Soil

Terai Soils or Tista alluvium soils have been derived from the mountains of the Himalaya. The deposits are mostly sandy, raw humus type, and deep black to grey black in colour. The soils are acidic, poor in bases but rich in plant nutrients. They occupy a major part of Jalpaiguri, Kochbihar, Uttar and Dakshin Dinajpur districts.

1.4.3. Red and Yellow Soils

Red and Yellow Soils (laterites) cover about major parts of the districts of Birbhum, Bankura, Puruliya, parts of Barddhaman and Medinipur. Large tracts of wastelands are without vegetation cover and are exposed to laterite rocks. Rivulets are remained dry throughout the year except in wet season, when the soils become subject to severe erosion. The soils are acidic, very poor in organic matter, nitrogen (N), phosphorus (P) and calcium (Ca) contents. They are poorly aggregated and possess low water-holding capacity.

1.4.4. Grilly or Gravelly Soils

Grilly or gravelly soils are also known as colluvial soils. They occur in Puruliya, western parts of Birbhum and Bankura districts. The soils are derived from the hills of the Chotonagpur Plateau. They contain large amount of coarse sands and gravels. The soils are acidic in nature and are poor in plant nutrients.

1.4.5. Alluvial Soils

Alluvial soils may be grouped into : (a) Gangetic alluvium ; and (b) Vindhya alluvium, families depending on the parent materials. Each of these families is divided into a number of associations, depending on their mode of formations and morphology indicating similar profile characteristics (Roy Chowdhuri, 1963).

1.4.5(a) Ganga Alluvium

Ganga Alluviaum covers the districts of Malda, Murshidabad, Nadia, Haora and 24-Parganas. Soils of the uplands are older alluvium with well developed soil profile, moderately clayey with lime concretions. Soils of the low and flat lands are less mature, calcareous and greyish in colour due to presence of sands.

1.4.5(b) Vindhya Alluvium

Vindhya alluvium soils are brought down by the rivers originated in the Chotanagpur plateau. They occur in the districts of Birbhum, Bankura, Puruliya, parts of Medinipur and Barddhaman. Upland soils are mature with evidence of leaching of clay, sesqui-oxides, alkaline earth and metal salts accumulation in the lower horizons. Flat land soils are less mature with irregular stratification with occasional bonds of sand. pH is neutral and poor in plant nutrients.

1.4.5(c) Deltaic Alluvium or Coastal Soil

Deltaic Alluvium or coastal Soils have been formed from deposits brought by the tidal currents. They cover the districts of Dakshin 24-Parganas and Medinipur. The parent deposits are either rich in calcium (Ca) or magnesium (Mg) or consists of half decomposed organic matter. According to the

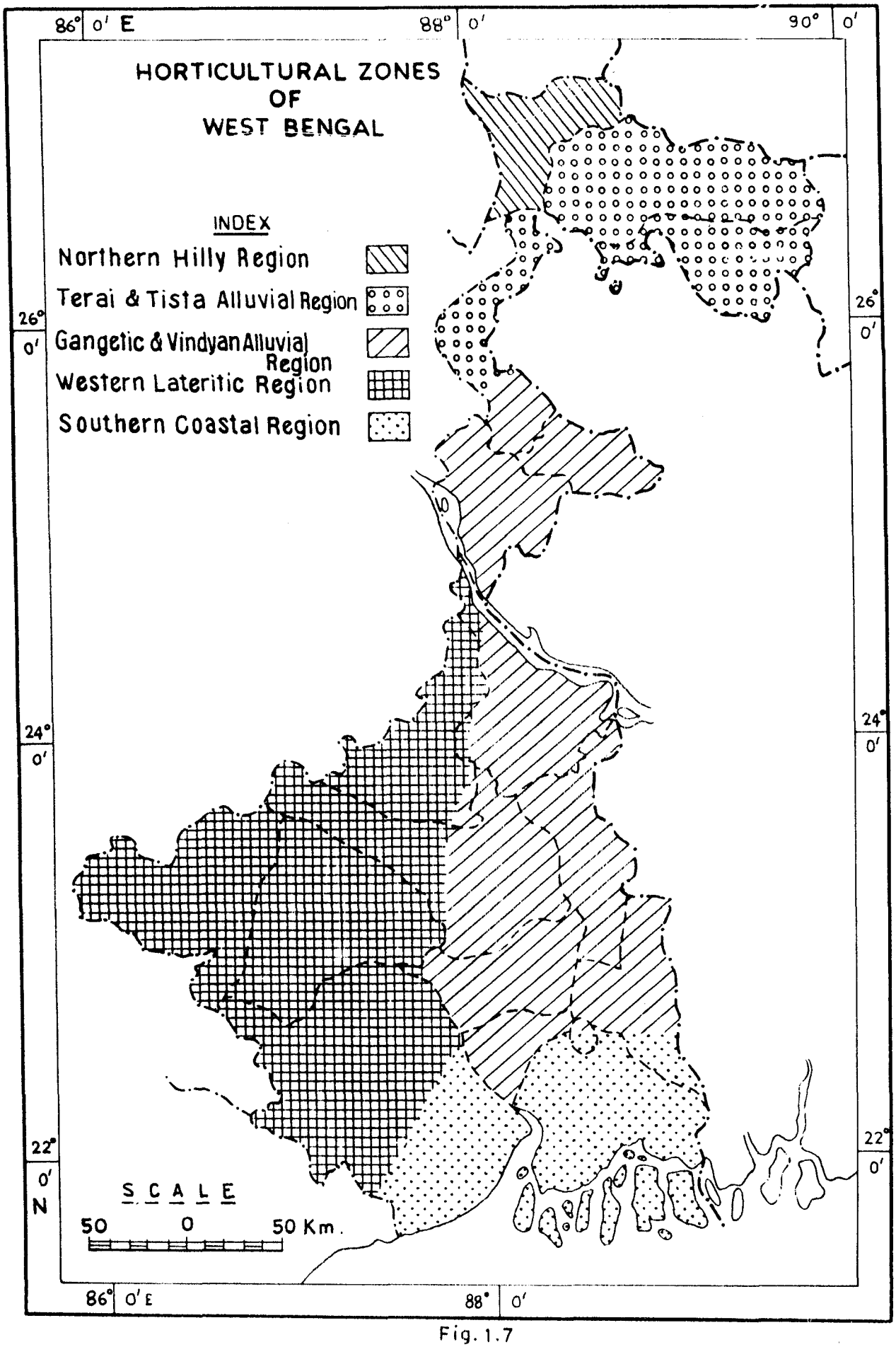

HORTICULTURAL ZONES
OF
WEST BENGAL
INDEX
Northern Hilly Region
Terai & Tista Alluvial Region
Gangetic & Vindyan Alluvial Region
Western Lateritic Region
Southern Coastal Region
86° 0' E
88° 0'
90° 0'
26° 0'
24° 0'
22° 0'
N
SCALE
50 0 50 Km.

Fig. 1.7

chemical composition, the coastal soils are classified as saline and alkaline soils (Banerjee, B. 1964 ; Lahiri, R. 1956). Areas of broad classes/associations of soils in different districts of West Bengal is given in the Appendix-II.

1.5. HORTICULTURAL ZONES :

Summerizing all these geophysical background of the State of West Bengal, five horticultural zones are identified (Fig. 1.7).

1.5.1. Northern Hilly Region

Northern Hilly Regions of West Bengal comprises three sub-divisions, namely Sadar, Kalimpong and Kurseong of Darjiling district. Altitude ranges upto 4000 metre above sea level. Climate is cold and humid. Average annual rainfall is between 2,200 mm. and 4,000 mm. About 80% of which is received in 120 days within monsoon. Average maximum temperature is 20°C in May and minimum temperature is 3°C in January. The sky is mostly foggy and cloudy. Snowfall is also occured in certain years. Soil condition is acidic. The brown forest soil of the area contains medium to high levels of organic matter, nitrogen (N), phosphorous (P) and potassium (K).

Predominant horticultural crops grown in this area are good quality mandarine orange, tea, vegetables, flowers, flower-seed and orchids.

1.5.2. Terai Region

Siliguri sub-division of Darjiling district and parts of Jalpaiguri and Kochbihar districts cover this region. High rainfall around 3,000 mm associated with high temperature ranging between 30°C and 32°C and a minimum of 12°C are the climatic conditions found in this region. Soil is leached, light, acidic with low organic carbon. Good drainage offers scope for cultivating horticultural crops in this region. Pine-apple is extensively grown here (6.5 thousand ha.). Giant Kew and Queen, the two most important varieties are grown here.

1.5.3. Alluvial Regions of Central and South Bengal

The vast plain areas of 16 lakh ha in Uttar & Dakshin Dinajpur, Malda, Nadia, Murshidabad, 24-Parganas, Haora, Hugli, and Barddhaman districts cover this region. Rainfall ranges from 1,500 to 2,000 mm. Atmospheric temperature is within 30°C - 38°C during March to September and between 10°C and 26°C during the remaining period. Bright sunshine is received for 8.5 to 9.5 hours during day in dry season and between 4.5 and 5.5 hours during day in cloudy monsoon months. Deep Gangetic alluvium with high calcium content enriches the soils. Soils are neutral in reaction. Texture varies from sandy loam to loam with good depth, having low carbon and nitrogen, but medium to high percentage of phosphorus and potash. This region is the most important agricultural region of the State. All important food crops along with vegetables are luxuriously grown here. Among the horticultural crops mango occupies an area of roughly 56,000 ha followed by banana, papaya, guava, litchi and jackfruit.

1.5.4 Western Lateritic Tract

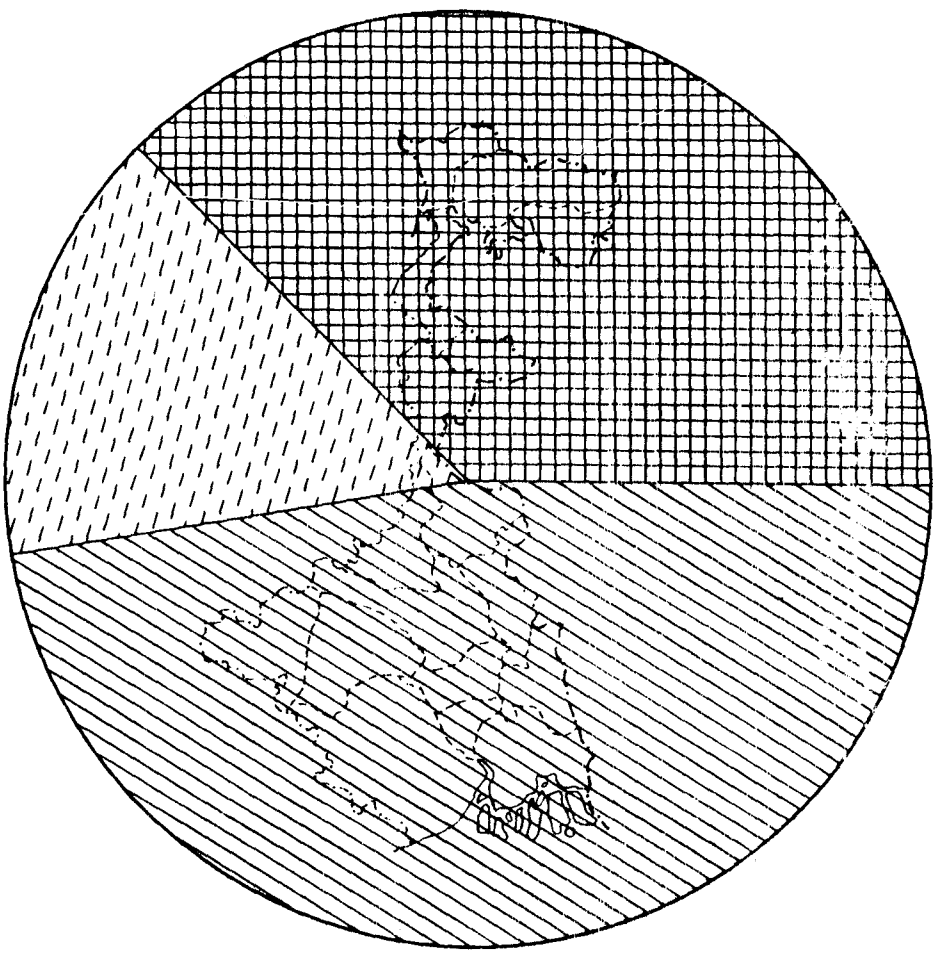
The lateritic tract of the State comprises the vast areas of Bankura, Puruliya, Birbhum, Medinipur and Barddhaman districts along the western boundary of the State. The area is subjected to soil erosion by numerous streams flowing from Chotanagpur Plateau in the west to the river Hugli in the east.

Types of soils are lateritic, colluvial, gravelly, slightly acidic, low in organic carbon, nitrogen, phosphorus and clacium. Water holding capacity of the soil is very low. Climate is comparatively very high and receives an average of 1,000 to 1,300 mm. of precipitation during monsoon months (mid June to mid October). Occassionally, the tracts suffer from severe drought conditions. Average maximum temperature in April is 37°C and minimum is 10°C to 15°C. Dry hot winds in summer dessicate spring blossoms and young fruits. The region is particularly useful for growing winter vegetables, especially cauliflower and fruits like Musambi, guava, custard apple, ber, pomegranate etc. Due to dry heat in summer and long hours of bright sunshine, the fruits develop taste and are sweeter than those grown in humid areas. Due to non-availability of ground water, fruit crops cannot be grown in wider scale.

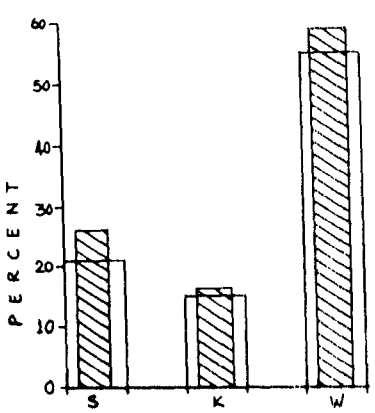
1.5.5. Southern Coastal Region

The region follows the sea coast of Medinipur and Dakshin 24-Parganas. Rainfall ranges between 1,500 and 2,000 mm annually. Average maximum temperature is 37°C and minimum is 15°C in Winter. The soil is generally saline or alkaline with high quantity of exchangeable calcium (Ca), Nitrogen (N) and Phosphorus (P). The region is important for growing

PERCENTAGE AREA OF HORTICULTURAL CROPS IN WEST BENGAL



VEGETABLES FLOWERS FRUITS



Graph Showing Percentage Of Area And Production Of Vegetables In Summer, Rain (Kharijf) And Winter Or Rabi Seasons.

INDEX

AREA

PRODUTION

SUMMER S

KHARIFF K

WINTER W

Fig. 1.8

cashew nut, water melon, sapota and chilli. Diagram (Fig. 1.8) shows the percentage area of horticultural crops in West Bengal and the diagram (inset) shows the percentage of area and production of vegetables in Summer, Rain or Kharif and Winter or Rabi season. District-wise distribution of fruits, flowers and vegetables has been estimated from the diagram (Fig. 1.9). The areas calculated as per data (Appendix no. III) available.

1.6. CLIMATIC FACTORS REQUIRED FOR HORTICULTURE

A combination of favourable climate and soil governs the success of horticulture. Climate as related to fruit culture are heat, light, atmospheric humidity, rainfall, wind, hail-storm, etc. The importance of all these factors in the study of horticulture can be realised from the following discussions.

1.6.1 Heat

The bio-chemical reactions within the crop plant depends wholly on heat in the form of different temperature ranges. During night, water absorption by plants is relatively high whereas the rate of transpiration is low resuslting turgour pressure for high elongation of new cell. Hence, alternating diurnal temperature guides two important activities for the crop plant : (a) making of abundant quantity of initial food and (b) related substances during the day and making of new cells during the night. On the basis of optimum temperature range, horticultural plants are classified as follows :

i) Crops which produce their highest yield at a low temperature range.

ii) Crops which produce their highest yield at a moderately high temperature range.

iii) Crops which produce their highest yield at a high temperature range.

The table 1.3 shows heat and temperature requirements of different horticultural crops.

Table-1.3

Temperature Range of different Horticultural Crops

Temperature range	Fruit crops	Vegetable Crops	Flower & Ornamental crops
A. Crops requiring low temp. Range (7° - 13°).	Apple, Pear, Plum, Cherry, Grapes Strawberry, Blue-Berry, Raspberry etc.	Asparagus, Spinach, Lettuce, Cabbage, Root crops, Pea, Potato.	Aster, Carnation Geranium, Petunia Snapdragon, Verbena Cineraria etc.
B. Crops requiring moderately High Temperature Range (13° - 18°C)	Apricot, Grape Blackberry etc.	Tomato, Capsicum Pepper, Beans etc.	African violet, Azelea, Begonia, Lily, Orchids Poinsettia, Rose etc.
C. Crops Requiring High temp. Range (18°C - 24°C)	Banana, Papaya, Citrus, Date, Olive, Brazil nut, Cashew-nut, Coffee.	Sweet Potato, Yams, cucurbits etc.	Croton, Gloxinia etc.

1.6.2. Light

Productivity depends very much on the total amount of light which plant receives in varying degree with seasons as well as distance from equator (the sun). From the Table 1.4, light intensity of some horticultural crops can be observed.

Table-1.4

Light condition required for Horticultural

	Shade only, no direct sun. 150 - 300 m.	Shade and direct sun for short time daily 300 - 900m.	Direct sun mostly 900-2400 m.	Slight shade and direct sun tolerent 600 - 2400m.
1.	Fruit Crops		Banana, Citrus, Coconut, Date, Fig, Olive, Papaya, Pine-apple.	Apple Pear peach etc.
2.	Vegetables		Capsicum, Cucurbit, Egg plant, Sweet Potato etc.	Cabbage, Potato.
3.	Flower & ornamentals.	African violet, Begenia, ferns etc.	Calla-dium, Gloxi-	Carvation chry-santhemun, gladiolous, lantana, lily, rose etc.	Gardenia, Magnolia, Berberies etc.

1.6.3. Humidity

Apart from light and heat, atmospheric humidity has played very important role in horticulture. Generally, heavy rainfall is unfavourable for fruits grown in the plains as it causes water logging conditions which affects adversely the blossoms and fruits while extremely low rainfall necessitates artificial watering (irrigation) and became expensive. High atmospheric humidity also affects adversely in colour and keeping quality as well as promotes fungus and bacterial growth of the horticultural products (Slatyer, R.O.1967).

1.6.4. Wind

Strong wind and cyclone damage the fruit trees and crops by breaking limbs and shadding flowers and fruits. In such cases, wind break belts and selection of protected sites became helpful.

1.6.5. Hailstorm

Hailstorm is another limiting factor in the cultivation of horticultural crops. Next to climate, soil condition is the most valuable factor of such practice. Porous, aerated and deep soil, preferably deep having uniform texture with perfect drainage condition, is always favourable for such crops. For most of the fruit trees, soils having pH value between 6 and 8 is most suitable. Extreme conditions of the top and sub-soil, that is, very heavy (clayey) and very light (highly sandy), soils with 'Kankar' layers or salt pans are avoided.

DISTRICTWISE DISTRIBUTION OF HORTICULTURAL AREA% IN WEST BENGAL

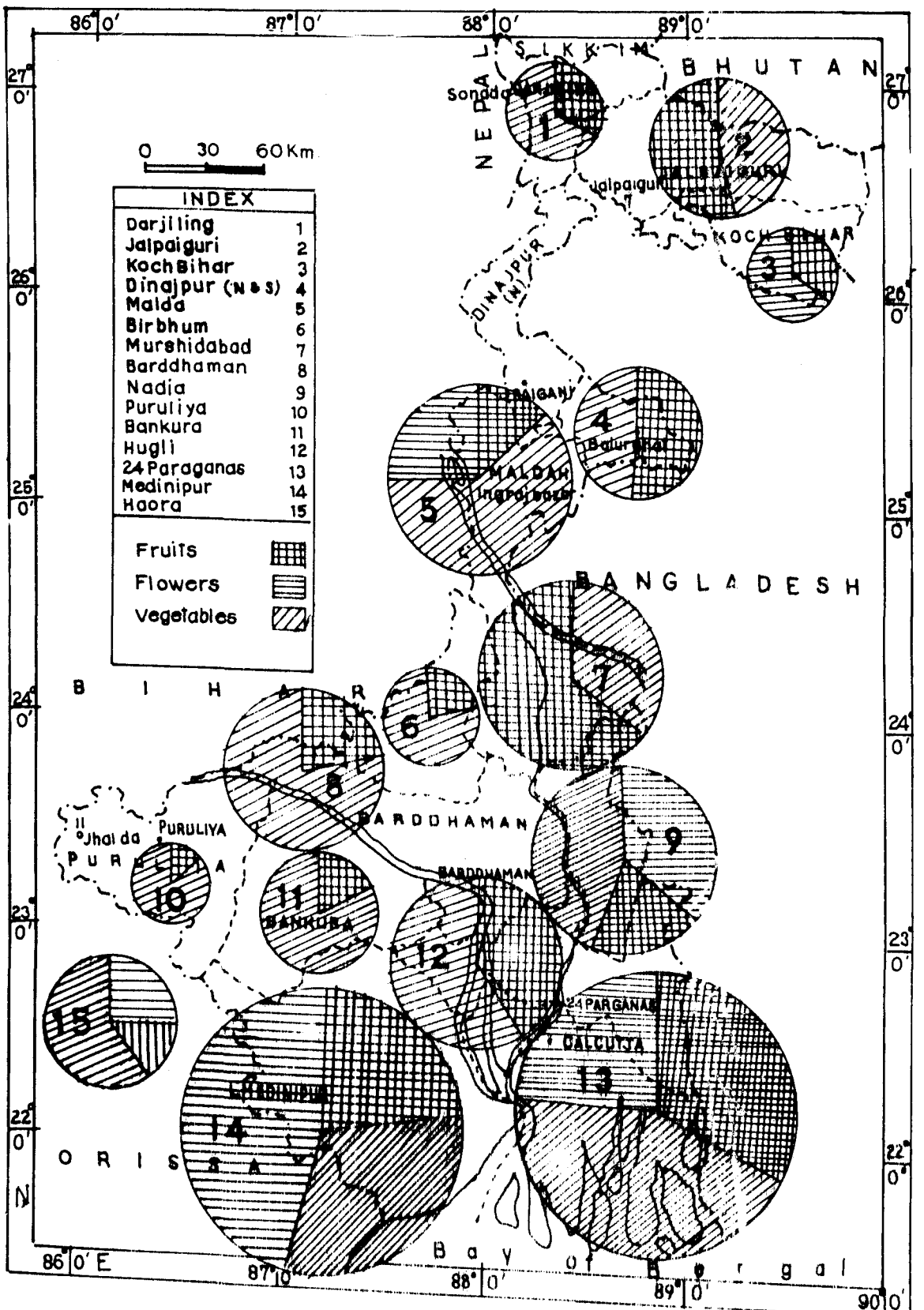


Fig. 1·9

1.7. ORCHARD PLAN :

Careful planning is taken to establish an orchard as it is a long term investments. It is safe to start a new orchard in a well established fruit region so that possible assistance or co-operation is available in purchasing nursery plants, new equipments as well as a ready market and cold storage facilities. (Fig. 1.9c)

1.7.1. Lay out :

Four systems are followed in laying out orchards. These are : (Plate 1-4)

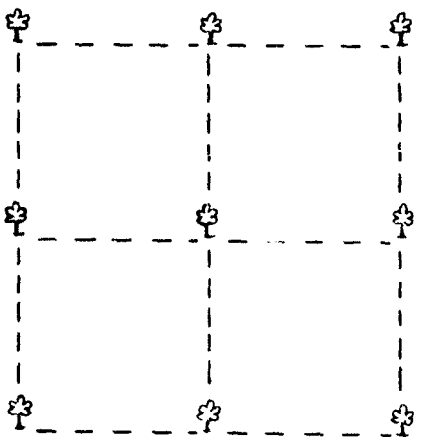
(a) In square system : Trees are planted on each corner of the square so that intercropping cultivation is possible in two directions.

(b) Hexagonal : In this system, trees are planted in each corner of an equilateral triangle forming a hexagon with a seventh tree in the centre. This system is only possible where the land is fertile with good water supply and hence is costly too. Ordinary growers avoid this system as interculture is not possible.

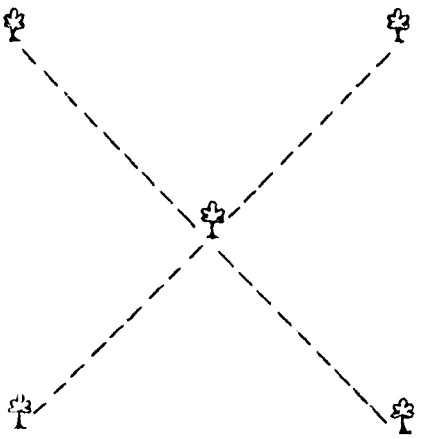
(c) Quinceonx or Diagonal System : Planting a central tree in a square system, diagonal method is followed. The central tree is a filler tree which can be kept for another period.

(d) Contour System: In the Hills with high slopes, trees are planted along a uniform slope and at a right angles to the slopes so that loss of top soil due to erosion is avoided. (Paulas, D. 1975)

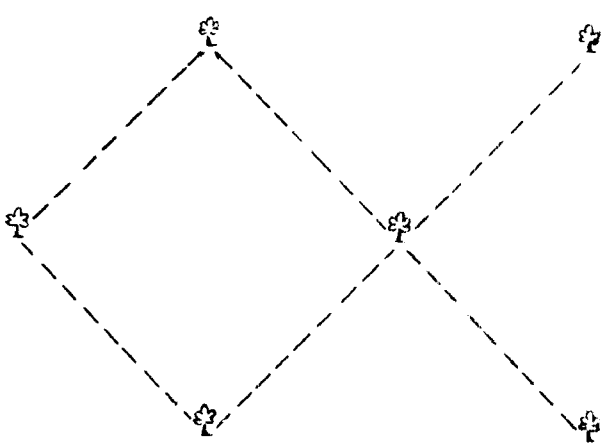
LAY-OUT OF THE ORCHARDS



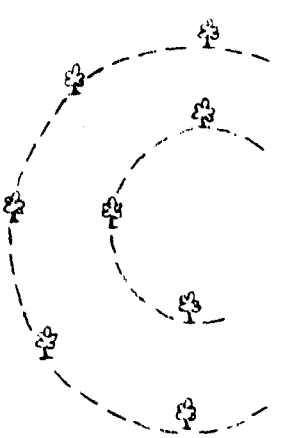
SQUARE SYSTEM



DIAGONAL or QUINCUNX SYSTEM



HEXAGONAL SYSTEM



CONTOUR SYSTEM

Fig. 1.10

1.7.2. Plant Selection

In purchasing of nursery plants two factors are considered,

(i) Age and grade of trees, i.e. healthy, vigorous nursery plants of one or two years perform excellent quality and a good yield.

(ii) Source of supply should be approved by the Government Department of Agriculture.

1.7.3. Propagation

Monsoon season is the best period of planting evergreen fruit trees like Mango, Guava and citrus fruits. A pit about 1 mt. cube or of derived dimensions are filled with tank silts and the surface soil is mixed with farm yard manure to give a good start for the new plants. Nursery plants with their heavily branched sides are kept towards the prevailing wind to prevent damage by strong winds. The best protection is a combination of wire fence and ledge.

To achieve excellent quality and a good yield, nursury plants are propagated by (1) sexual and (2) Asexual or vegetative methods.

(1) By sexual method plants are raised from matured seeds and are called seedlings. Trees grown out of seedlings are long lived and bear more heavily. Seedlings are cheaper and easy to raise.

(2) By asexual method plants are propagated vegetatively from leaf, steemed or roots. They possess all the characteristics of the parent plants. Products are uniform in growth, yielding capacity and quality. They bear earlier than seedling trees. Vegetative propagation or graftage is

is useful in removing the wounded or diseased part of the trees. Trees bear in two to three years without replanting. The table 1.5 shows the methods usually applied for the horticultural products.

Table- 1.5

Methods of Propagation

Types of Propagation	Fruit crops	Vegetables	Flower and Ornamentals.
1. By Seed	Coconut	Asperagus, Cabbage, Celery, Onion Spinach, Tomato, Vine crops.	Aster, Calendula, Marygold, pansy, Salva, Sweet Rea, Forege-me-not.
2. By Vegetative Propagation.	Baua, Pine apple, Rose Berry, Strawberry.	Potato, Sweet-Potato, Rheeburb Arsichoke.	Carnation, Chrysanthemiem, gerenivm, poinsettia, Iris, Peony flox etc.
3. By both Seed & Vegetative Prapagation.	Apple, Reach, citrius		Dogwood Cherry Juniper.

1.7.4. Cultural Practice

1.7.4(a) Sod Culture

Sod culture in the orchard is very important so that the trees and plants remain in healthy condition.

1.7.4(b) Mulching

Mulching or covering soil by hay, straw or cut grass is very common to prevent evaporation of soil moisture.

1.7.4(c) Manuring

Fruit trees remove larger amount of soil nutrients than any other crops and hence manuring programme is very important. Orchards are manured both by organic and inorganic compounds. Farmyard manure is the most common organic manure which is prepared properly containing about 1.5% nitrogen, 0.9% phosphoric acid and 3% Potash. Oil Cake is a rich source of nitrogen. Deficiency of inorganic compounds like, Nitrogen (N), Phosphorus (P), Potassium (K), Lime (CaO), Sulphur and Magnesium, is met with artificial fertilizers. For commercial orcharding, proper manuring is done during the actiive growing and blossoming period. If inter or cover crops are raised, organic manure is applied during inactive or dormont period. Fertilizers can be forked into the surface soil or ploughed under with little irrigation.

1.7.4(d) Inter-cropping

Inter crops, cover crops and green manure crops are grown to reduce soil erosion as well as supplier of plant nutrients to the soil. Inter crops are also raised for

additional income. They are usually vegetables, pulses or short duration fruit crops, cover crops in sloping terrain conserving the soil. Selection of inter crops depends on the location of orchard. When the orchard is near to towns and cities or other urban agglomerations, vegetables like raddish, cabbage, cauliflower, carrots and tomatoes can be grown profitably where as orchards distantly located can be good for growing potato, onion, chilli etc. which can be transported long distance.

1.7.5. Training & Pruning

Training and pruning of the orchard trees promote light and allow other cultural operations like spraying, harvesting etc. easier. Most deciduous and evergreen woodly trees are trained to a single stem with a low head. Trees are pruned annually in two ways.

(i) When undesirable branches are removed without leaving any stems, the operation is called "thinning".

(ii) By other method, terminal portions of other branches are removed keeping the basal portions intact.

1.7.6 Plant Regulators

The aid of synthetic regulator of growth has been used in control of flower, pre-harvest fruit crop, thinning of blossoms, fruit ripening and weed control.

The table 1.6 shows the chemical used for different purposes.

Table-1.6

Chemical used for different purposes

Sl. No.	Purpose of Use	Chemical used
1.	Propagation	Indolebutyric Acid (IBA) Napthalene-acetic Acid (NAA) 2.4 Dichlorophenoxy-acetic Acid.
2.	Control of flowering.	NAA
3.	Pre-harvest Fruit drop.	Trichlorophenoxyprophonic Acid.
4.	ossom thinning	3 - Chloroisopropyl N - Pheriyl Carbonate.
5.	Fruit ripening	4,5 Trichloropherioxyacetic Acid.
6.	Weed control	2,4 D (Dichloropherio-xyacetic acid)

Source: Singh, Krishnamurthi etc. 1983.

CONCLUSION :

Analysing the Geo-physical status of West Bengal, it is revealed that there is a high potentialities for growing horticultural crops. West Bengal, possibly the single State of India, to be the owner of a great variety of landscape. The State is divided into three well marked physiographic regions with topography of diverse character by the sculpturing actions of ice, snowfed rivers, heavy rainfall and cold wind actions. Good quality Mandarine orange, season flowers and flower seeds, orchids and ornamental plants are the products of this region. Alluvial regions of central and lower Bengal is the vast plain areas covering the districts of N & S Dinajpur, Malda, Nadia, Murshidabad, 24-Parganas, Haora, Hugli and parts of Barddhaman district. All well balanced climatic condition along with the rich fertile soils of the Ganga basin have made the region a grannary of West Bengal. All important food crops along with horticultural crops are luxuriently grown in this region. Among the horticultural crops, Mango, banana, Pine - apple, Guava, Litchi, Sapota, Jack fruit, various seasonal flowers and a wide range of vegetables are grown in this region. Western lateritic tract of the State comprise the vast areas of Bankura, Puruliya, Birbhum, Medinipur and parts of Barddhaman farming the western boundary of the State. The plateau tract is subjected to erosion and soils are poor in plant nutrients. Climate is high and precipitation occurs only in the monsoon months. The area suffers from severe drought and ground water position threatens to agriculture. The region is useful for winter vegetables, specially cauliflower and fruits like Mosambi, Guava, Custard apple, Ber, Pomegranate citrus fruits etc. Detail climatic factors required for horticulture are also discussed in this chapter. Temperature range of different horticultural crops light condition for fruits, flowers and vegetables have been analysed in detail.

Apart from climatic conditions orchard plan, plant selection, propagation has been lighted. Cultural practices is very much an important issue in horticulture which include manuring, training and pruning of the trees. Plant regulators for inducing better quality fruits and flowers and prevention of disease and pests are very much important in orchard hygene. Mechanical, chemical and biological controls of disease are discussed in detail.

Keeping in view, the analysis of the horticulture as a special branch of agriculture, the conditions and suitability of fruit cultivation have been discussed in the next chapter. Because among the horticultural crops, fruits share the largest area and important in the State of West Bengal.