

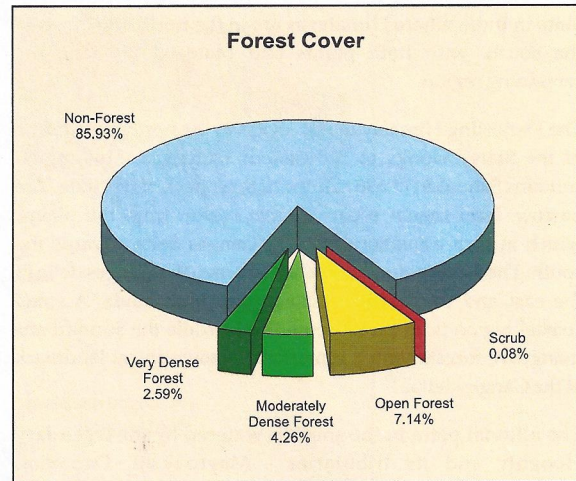
29. WEST BENGAL

29.1 Location and General description

With Bangladesh, which lies on its eastern border, the State forms the ethno-linguistic region of Bengal. To its north lie States of Assam and Sikkim and the country Bhutan, and to its southwest, State of Orissa. To the west it borders States of Jharkhand and Bihar, and to the northwest, Nepal. An agriculture-dependent State, it occupies only 2.7% of the India's land area, though it supports over 7.8% of Indian population, and is the most densely populated State in India. West Bengal has a geographical area of 88,752 km². It lies between 21°20' & 27°32' N latitude and 85° 50' & 89° 52' E longitude.

29.2 Forest cover

The total forest cover of West Bengal is 12,413 km² which is 13.99% of the geographic area. Very dense forest accounts for 2,302 km², moderately dense forest 3,777 km² and open forest 6,334 km², whereas, scrub is 68 km² (Fig. 29.1). The recorded forest area in the State is 11,879 km², which is 13.38% of the geographical area. (Source : SFR 2005; Forest Type mapping project was started in the year 2005, therefore, forest cover map of 2005 has been used in this exercise).



29.3 Soil

The soil pattern in the State ranges from acidic in the entire north to Gangetic alluvial in the central districts; Lateritic red soil to coastal saline soil in the southern delta region.

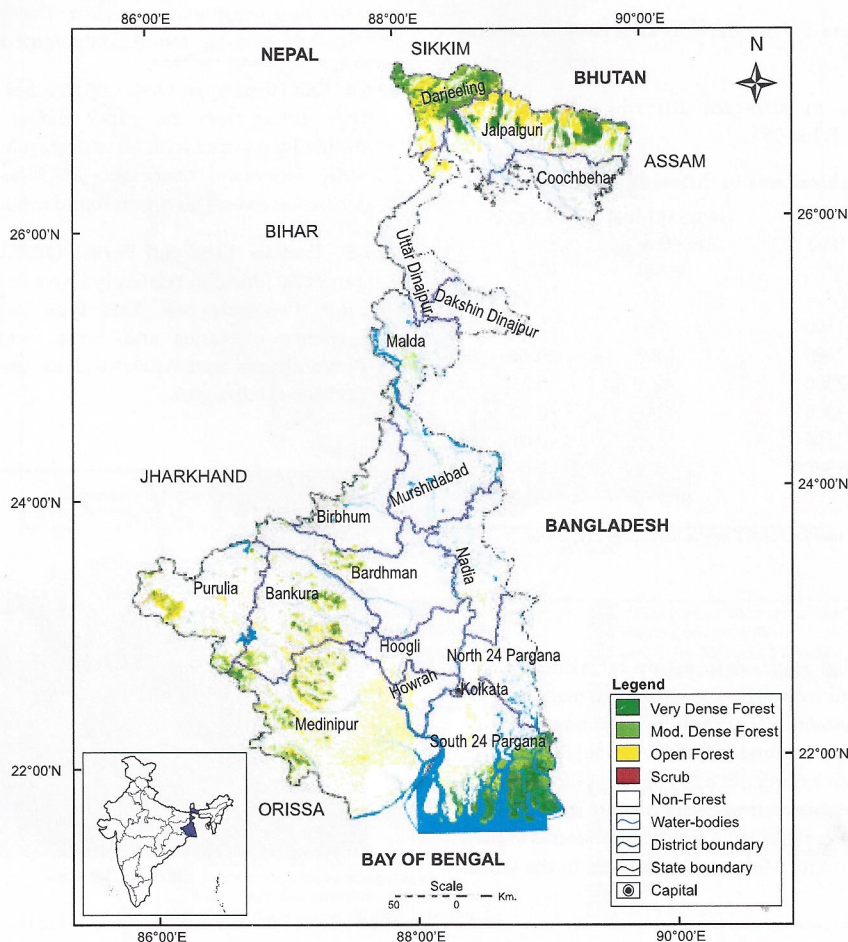


Fig. 29.1 Forest Cover Map of West Bengal

29.4 Topography

West Bengal has a diverse topography, consisting of high peaks of Himalaya in the northern extremes to coastal regions down south, with regions such as plateau and Ganges delta intervening in between. West Bengal is the only State in India where Himalayas are in the north and Sea is at the south, with both plains and plateaus covering the remaining region.

The Darjeeling Himalayan hill region in the northern extreme of the State belongs to the eastern Himalaya. This region contains Sandakfu (3,636 m) - the highest peak of the State. The narrow Terai region separates this region from the plains, which in turn transitions into the Ganges delta towards the south. The Rarh region intervenes between the Ganges delta in the east and the western plateau and high lands. A small coastal region is on the extreme south, while the Sunderbans mangrove forests form a remarkable geographical landmark at the Ganges delta.

The alluvial plain in the south is watered by the legendary Hooghly and its tributaries - Mayurakshi, Damodar, Kangsabati and Rupnarayan. The Himalayan north, comprising the districts of Darjeeling, Jalpaiguri and Cooch Behar are watered by the swift flowing rivers Teesta, Torsa, Jaldhaka and Ranggit. Variations in altitude result in great variety in the nature and climate of West Bengal. From the northern highlands at the feet of the Himalayas to the tropical forests of Sunderbans, West Bengal is a land of myriad beauties, each region different from the other.

The Ganges delta and the Sunderbans area have numerous rivers and creeks.

Geographical area in different altitude zones in the State are shown in Table 29a.

Table 29a Geographical area in different altitude zones.

S.No.	Altitude (metres)	Geographical Area (km ²)	% age
1	0-500	86,584	97.56
2	500-1000	836	0.94
3	1000-1500	563	0.63
4	1500-2000	423	0.48
5	2000-2500	200	0.23
6	2500-3000	106	0.12
7	3000-3500	39	0.04
8	above 3500	1	0.00
	Total	88,752	100

based on SRTM, 90m interval (GLCF www.landcover.org, 2006)

29.5 Climate

The climate of West Bengal varies from tropical in the southern portions to humid subtropical in the north. The main seasons are summer, rainy season, a short autumn, and winter. While the summer in the delta region is noted for excessive humidity, the western highlands experience a dry summer like northern India, with the highest day temperature ranging from 38°C to 45°C. In early summer brief squalls and thunderstorms known as *Kalbaisakhi* often occur. Monsoon brings rain to the whole

State from June to September. West Bengal receives the Bay of Bengal branch of the Indian Ocean monsoon that moves in a northwest direction. Winter (December-January) is mild over the plains with average minimum temperatures of 15°C. A cold and dry northern wind blows in the winter, substantially lowering the humidity level. However, the Darjeeling Himalayan Hill region experiences a harsh winter, with occasional snowfall at places.

29.6 Forest Types

The forest types found in West Bengal are shown in Fig. 29.2 and described as follows:

29.6.1 Sub-Himalayan Secondary Wet Mixed Forest (2B/2S3): This type exists in Jalpaiguri district where Sal comprises about 5 to 10% of the forest. *Machilus gamblei* is the dominating species and other associates are *Litsea polyantha*, *Dillenia pentagyna*, *Macaranga* spp and *Syzigium jambolonum* etc.

29.6.2 East Himalayan Sal Forest (3C/C1a(i)) : It is present on the lower slopes of Mahananda WLS in Darjeeling district but as the elevation increases more of miscellaneous and some exposed area is found on the higher slopes and summits of the hills.

29.6.3 East Himalayan Upper Bhabar Sal (3C/C1b(i)) : This type is characterized by the presence of dense *Microstegium ciliatum*. Sal is of high quality. Other associates are *Schima wallichii*, *Lagerstroemia parviflora*, *Terminalia tomentosa* etc. This type is usually found in Jalpaiguri district.

29.6.4 East Himalayan Lower Bhabar Sal (3C/C1b(ii)) : This type differs from the upper bhabar subtype in being decidedly damper with *Microstegium* less in evidence and with *Terminalia tomentosa*, *Machilus* spp and more *Meliaceae* trees. This type is found in Jalpaiguri district.

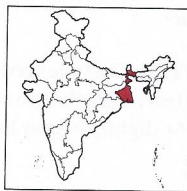
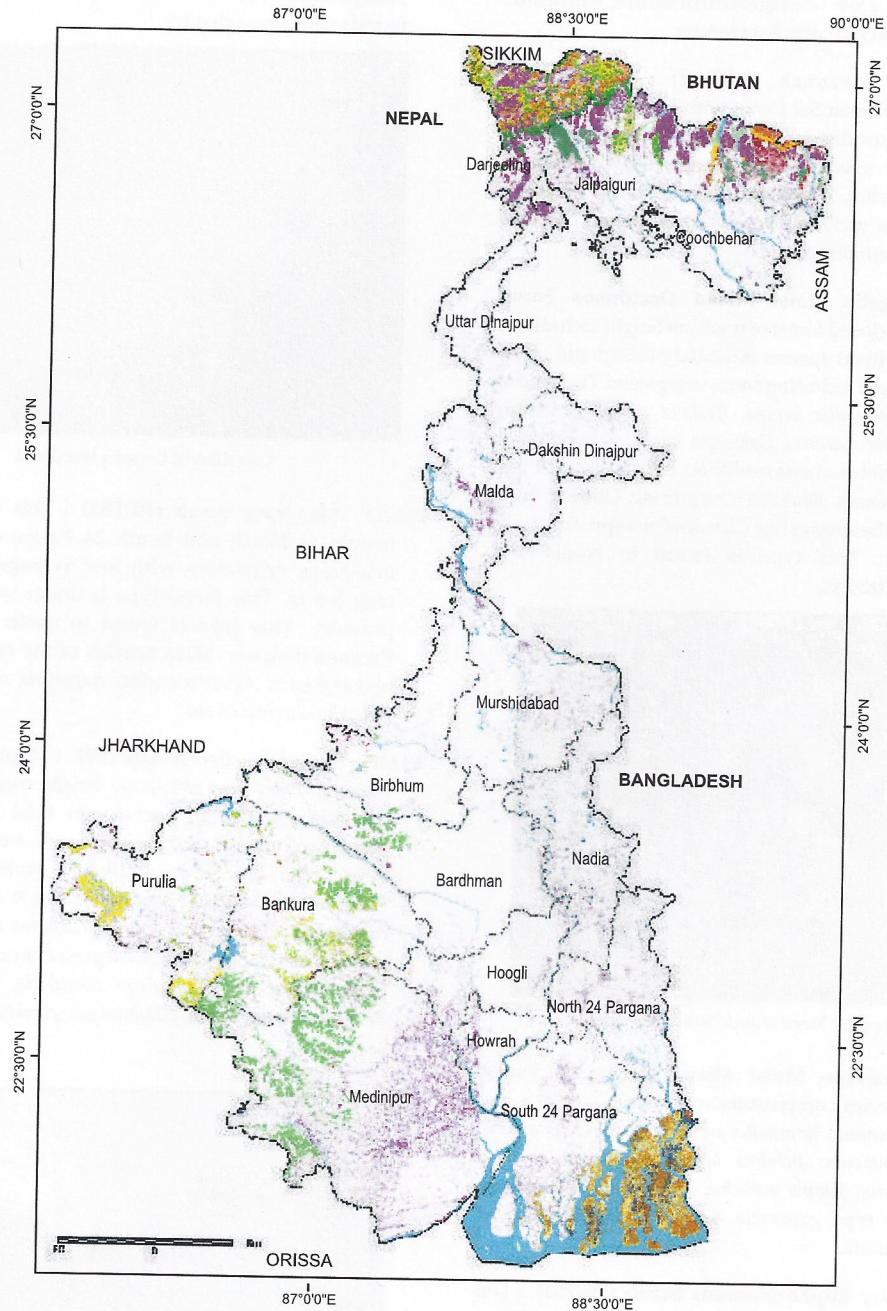
29.6.5 Eastern Tarai Sal Forest (3C/C1c) : This type is generally found in relatively lower heights compared to other two subtypes. This type is characterized by presence of canes and ferns, which is found in Baikunthapur and Apalchand RF under Baikunthapur division of Jalpaiguri.



Eastern Tarai Sal



FOREST TYPE MAP
(As per Champion & Seth's Classification-1968)
WEST BENGAL



Legend

2B/2S3 Sub Himalayan Secondary Wet Mixed Forest	4D/SS2 <i>Barringtonia</i> Swamp Forest
3C/C1a(i) East Himalayan Sal Forest	4D/2S2 Eastern Wet Alluvial Grassland
3C/C1b(i) East Himalayan Upper Bhabar Sal Forest	5B/C1c Dry Peninsular Sal Forest
3C/C1b(ii) East Himalayan Lower Bhabar Sal Forest	5B/C2 Northern Dry Mixed Deciduous Forest
3C/C1c Eastern Tarai Sal Forest	5/DS1 Dry Deciduous Scrub
3C/C2a(iiii) Eastern Heavy Alluvium Plain Sal Forest	5/E5 <i>Butea</i> Forest
3C/DS1 Moist Sal Savannah	5/IS2 Khair-Sissu Forest
3C/C3a West Gangetic Moist Mixed Deciduous Forest	8B/C1 East Himalayan Subtropical Wet Hill Forest
3C/C3b East Himalayan Moist Mixed Deciduous Forest	11B/C1a Lauraceous Forest
3C/2S2 Secondary Euphorbiaceous Scrub	11B/C1b Buk Oak Forest
3/TS1 Low Alluvial Savanna Woodland	11B/C1c High Level Oak Forest
4B/TS1 Mangrove Scrub	12/C3a East Himalayan Mixed Coniferous Forest
4B/TS2 Mangrove Forest	14/C2 East Himalayan Sub-alpine Birch/Fir Forest
4B/TS3 Salt Water Mixed Forest	Plantation/TOF
4B/TS4 Brackish Water Mixed Forest	Water
4B/E1 Palm Swamp Forest	Non Forest
4C/FS2 Submontane Hill-valley Swamp Forest	

Fig. 29.2

29.6.6 Eastern Heavy Alluvium Plain Sal (3C/C2d(iii)) :

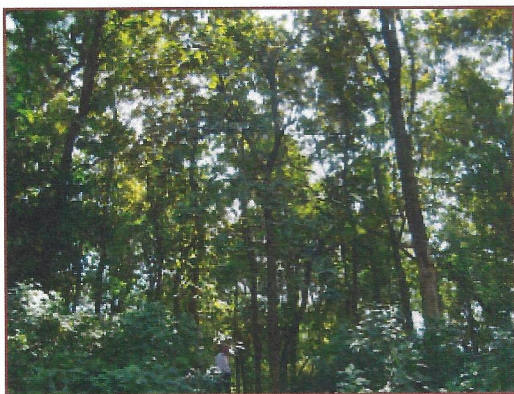
Generally this type occurs on yellow clayey alluvium of Malda, Uttar Dinajpur and Dakshin Dinajpur districts. Sal is dominant with a low undergrowth of shrubs, with a little or no grass. Usually small poles are seen.

29.6.7 Moist Sal Savannah (3C/DS1) :

This type is characterized by open Sal forest with heavy grass and is found in Jalpaiguri district. The Sal occurs in groups with other fire hardy species such as *Lagerstroemia parviflora*, *Lannea coromandelica*, *Wrightia tomentosa*, *Embllica officinalis*, etc. The grasses include *Themeda arundinacea*, *Imperata*, *Cymbopogon*, *Erianthus* spp etc.

29.6.8 West Gangetic Moist Mixed Deciduous Forest (3C/C3a) :

It is a closed forest of medium height including a number of dominant species intimately mixed and many second storey trees including some evergreens. The species present are *Terminalia arjuna*, *Tectona grandis*, *Albizia procera*, *Syzgium cuminii*, *Dalbergia sissoo*, *Lagerstroemia* spp, *Pongamia glabra*, *Adina cordifolia*, *Zizyphus* spp, *Acacia catechu*, *Cassia siamea*, *Bauhinia variegata* etc. Undergrowth is present with the species like *Clerodendrum* spp, *Glycosmis pentaphylla* etc. This type is found in Nadia and Murshidabad districts.



West Gangetic Moist Mixed Deciduous Forest

29.6.9 East Himalayan Moist Mixed Deciduous Forest (3C/C3b) :

Species composition comprises *Duabanga* spp, *Terminalia tomentosa*, *Terminalia myriocarpa*, *Sterculia villosa*, *Chloroxylon indicum*, *Bombax* spp, *Arundinaria maling*, *Alstonia scholaris*, *Schima wallichii*, *Albizia* spp, *Macaranga* spp etc. This type generally occurs in Darjeeling and Jalpaiguri districts.

29.6.10 Secondary Euphorbiaceous Scrub (3C/2S2) :

The type has usually come into existence in old village clearings in Sal forests but is difficult to distinguish from tracts where the fire hardy species are slowly invading the mixed deciduous type. Dominant species comprise dense crop of *Macaranga denticulata* succeeding treeless heavy savannah grass. This type is found in Jalpaiguri district.

29.6.11 Low Alluvial Savanna Woodland (3/1S1) :

The type is met with on the more stable riverain flats which tend to be flooded during the rainy season but which dry out during the rest of the year. Scattered trees of the early series of the

normal succession are found with very dense tall grass growth in which *Themeda* spp, *Erianthus* spp and *Saccharum* spp are characteristic genera. There are also patches of fire hardy shrubs such as *Zizyphus mauritiana*. This type is found in Jalpaiguri district.



Low Alluvial Savanna Woodland

29.6.12 Mangrove Scrub (4B/TS1) : This type of forest, mainly in North and South 24 Pargana districts has mangrove vegetation with low average height, often only 3-6 m. This forest type is under sustained biotic pressure. This type is found in north and south 24 Pargana districts. Main species of the type are *Ceriops roxburghiana*, *Avicennia alba*, *Aegialitis rotundifolia* and *Acanthus ilicifolius* etc.

29.6.13 Mangrove Forest (4B/TS2) : Typically a closed evergreen forest of moderate height composed of trees specially adapted to survive on tidal mud which is permanently wet with salt water and submerged during every tide. Stilt roots are very typical (notably in *Rhizophora*), so also are leathery leaves & vivipary. It does not develop on the sandy banks at the sea face. This type is seen in North and South 24 Pargana districts. Main species of this type are *Rhizophora candelaria*, *Kandelia candel*, *Bruguiera conjugates* and *Xylocarpus granatum* etc.



Mangrove Forest

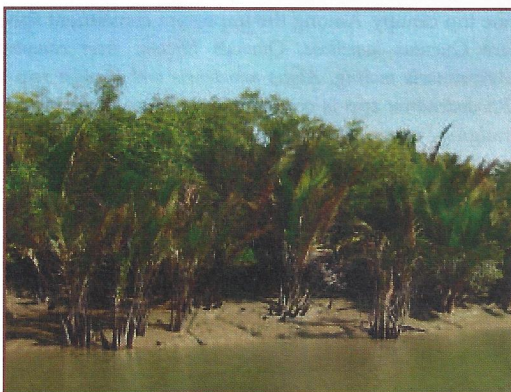
29.6.14 Salt Water Mixed Forest (4B/TS3) : The type occurs in North and South 24 Pargana districts where the ground is flooded by tidal brackish water. At slightly higher levels,



Salt Water Mixed Forest

the flooding is less frequent and the salt concentrates with resultant poor forest, typically scattered *Heritiera* spp minor, Mangrove forests with the *Rhizophora* spp occurs in close proximity along the edges of the rivers throughout. Others species found in this type are *Excoecaria agallocha*, *Xylocarpus molluccensis*, *Bruguiera conjugata* and *Amoora cucullata* etc. Stilt roots are infrequent but pneumatophores are typical.

29.6.15 Brackish Water Mixed Forest (4B/TS4) : It is a close forest over 3.3 m high (*Bruguiera* spp & *Heritiera* spp) but is poorly represented in the western part of Sundarbans especially in North and South 24 Pargana districts. Stilt roots are rarely met with but pneumatophores are usual. This type occupies the levels which are flooded for some portion of each day, the water never being very salty & during the rainy season either quite fresh or only slightly brackish. It is best developed on the ground lying between the drier banks of the larger streams & the central depressions. Main species found in this type are *Xylocarpus molluccensis*, *Heritiera minor*, *Bruguiera conjugata*, *Excoecaria agallocha* and *Acanthus ilicifolius* etc.



Brackish Water Mixed Forest

29.6.16 Palm Swamp Forest (4B/TS/E1) : This type comprises a dense low growth of tufted palms up to 6 m high. It is found on the drier areas within the salt-water mangrove scrub or forest. The only species of this type is *Phoenix paludosa*. This type is generally found in the mangroves of North and South 24 Pargana districts.



Palm Swamp Forest

29.6.17 Submontane Hill-valley Swamp Forest (4C/FS2) : Species composition comprises a dense growth of *Calamus* and *Ficus* spp and *Alpinia* spp forms the undergrowth. The trees are low crowned and branchy. This type is generally found in Coochbehar district.

29.6.18 Barringtonia Swamp Forest (4D/SS2) : The type normally consists of dense evergreen trees of medium height (often pure crops) with or without thick undergrowth. Climbers are few though *Calamus* spp may be abundant. Other species are *Barringtonia acutangula*, *Salix* spp, *Pongamia* spp, *Lagerstroemia flosreginae* etc. This type is found in Malda, Uttar Dinajpur and Dakshin Dinajpur districts.



Barringtonia Swamp Forest

29.6.19 Eastern Wet Alluvial Grassland (4D/2S2) : These are treeless grasslands occurring in cut-off meanders of the main rivers and similar low alluvial sites mainly in Jalpaiguri districts. Main species are *Acacia catechu*, *Bombax ceiba*, *Dalbergia sissoo*, *Oroxylum indicum*, *Embllica officinalis*, *Bauhinia* spp, *Dillenia* spp etc.

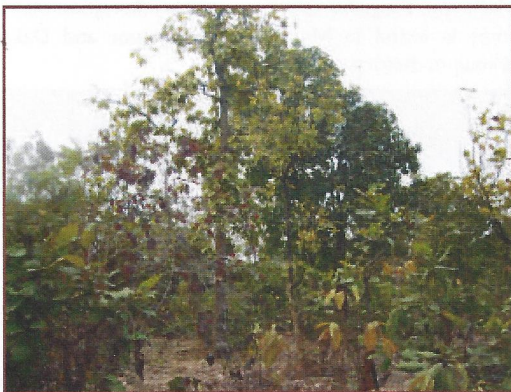
29.6.20 Dry Peninsular Sal Forest (5B/C1c) : The best Sal forests are confined to the southern part of the State especially in Purulia, Bankura, Medinapur, Bardhaman, Birbhum and Murshidabad districts where it occurs either pure or in mixture with *Terminalia tomentosa*, *Terminalia bellerica*, *Pterocarpus marsupium*, *Anogeissus latifolia*, *Lagerstroemia parviflora*, *Madhuca latifolia*, *Diospyros melanoxylon*, *Buchanania lanzan*, *Ougeinia dalbergioides* etc. Under storey consists of *Combretum*

decandrum, *Flacourtia cataphracta*, *Randia dumetorum*, *Zizyphus* species, *Gardenia gummifera*, *Holarrhena* spp, *Lantana* spp, *Eupatorium odoratum* etc.



Dry Peninsular Sal Forest

29.6.21. Northern Dry Mixed Deciduous Forest (5B/C2) : The rocky & rugged steep slopes in the southwestern part of the State mainly in Purulia and Bankura districts, are mostly devoid of vegetation with some trees of miscellaneous species viz *Acacia latifolia*, *Lagerstroemia parviflora*, *Diospyros melanoxylon*, *Schleichera trijuga*, *Boswellia serrata*, *Cochlospermum gossypium* etc. Sal also exists in such forests but less in percentage.



Northern Dry Mixed Deciduous Forest

29.6.22 Dry Deciduous Scrub (5/DS1): *Terminalia arjuna*, *Zizyphus* spp, *Aristida hystrix*, *Butea monosperma*, *Cassia siamea* are the dominant species. This type occurs in Purulia, Bankura, Medinapur, Bardhaman and Birbhum districts.

29.6.23 Butea Forest (5/E5) : On the lower drier slopes, plain & undulating land of Purulia district, there are numerous trees of *Butea monosperma*, *Cochlospermum gossypium* that seems to cover the hillocks.

29.6.24 Khair-Sissu Forest (5/1S2) : *Acacia catechu*, *Dalbergia sissoo* are the dominant species. Other associates are *Cassia tora*, *Holoptelia integrifolia*, *Erianthus munja*, *Grewia*, *Tamarix*, etc. This type is found in Jaipalguri district.

29.6.25 East Himalayan Sub-tropical Wet Hill Forest (8B/C1): Species like *Elaeocarpus lanceaefolius*, *Machilus odoratissima*, *Semingtonia populnea*, *Engelhardtia spicata*, *Castanopsis* spp,



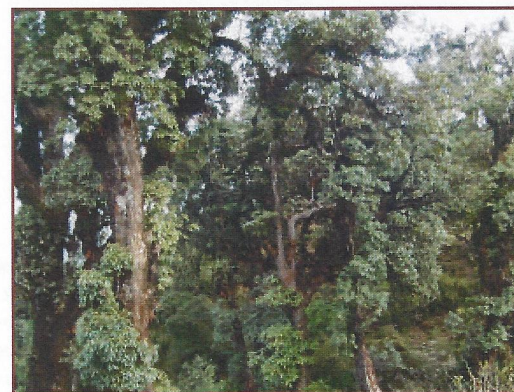
East Himalayan Sub-tropical Wet Hill Forest

Macaranga spp, *Acer* spp, *Michelia carkaratae*, *Nyssa japonica*, *Rubus* spp, fern and climbers like *Ardisia macrocarpa*, *Pathenocissus himalayana*, etc are found. The shrubby growth of the *Maesa indica* species occurs abundantly. This type is generally found in Darjeeling and Jalpaiguri districts.

29.6.26 Lauraceous Forest (11B/C1a) : The composition of crops varies with the increase in the altitude and variation, in aspect & rainfall, together with biotic & edaphic factors. Main species comprise *Quercus pachyphylla*, *Quercus lamellose*, *Quercus lineata* etc with other associating species like *Rhododendron* spp, *Acer campbellii*, *Arundinaria maling*, *Alnus nepalensis* and *Evoidia* spp. This type is found in Darjeeling district.

29.6.27 Buk Oak Forest (11B/C1b) : Found in Darjeeling district, the crop composition comprises *Quercus pachyphylla*, *Alnus nepalensis*, *Bucklandia* spp, *Castanopsis* spp, *Quercus* spp, *Symploco* spp, *Acer* spp, *Elaeocarpus* spp, etc with undergrowth like *Rubus* spp, fern, *Polygonum*, *Berberies*, *Azaractum conizoid*, *Eupatorium* spp etc.

29.6.28 High Level Oak Forest (11B/C1c) : In the zone between 2100 to 2400 m in Darjeeling district, Oaks occupy the top canopy. Among the important constituent species are *Quercus lamellose*, *Quercus lineata*, *Acer campbellii*, *Arundinaria maling*, *Alnus nepalensis* and *Evoidia* spp etc. *Rhododendron* spp is comparatively more at an elevation ranging from 2400-2800m associating more with the species like *Viburnum erubescens*.



High Level Oak Forest

29.6.29 East Himalayan Mixed Coniferous Forest (12/C3a) :
 This type is present at an elevation ranging from 2300-3000m above the sea level in Darjeeling district with the dominant species like *Tsuga dumosa*, *Rhododendron* spp, *Abies densa*, *Arundinaria malinga* etc.

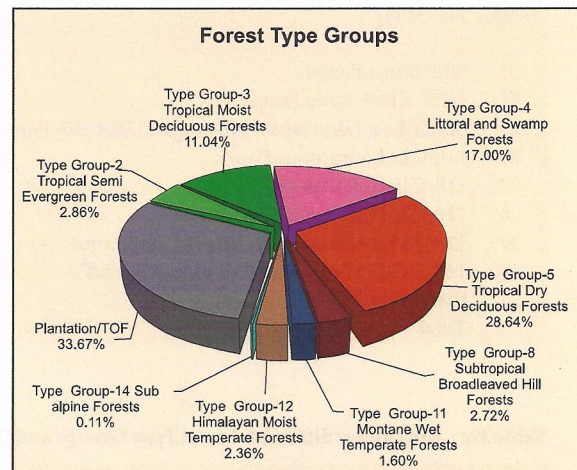
29.6.30 East Himalayan Sub-alpine Birch/Fir Forest (14/C2) :
Tsuga dumosa, *Rhododendron* spp, *Abies densa* are found in moderate quantity with its associates e.g. Birch (*Betula utilis*). In Darjeeling district, at some places the area is blank or covered with evergreen forest sometime so dense for light difficult to penetrate. The undergrowth is sparse & mostly consists of *Berberies aristae*, *Rosa sericea*, *Cotoneaster* spp etc.



East Himalayan Mixed Coniferous Forest

29.7 Area under different Forest Types

The area statistics of the forest types found in West Bengal are shown in Table 29b.



The Table shows that Dry Peninsular Sal Forest type covers about 21.88% of the total forest cover in West Bengal. Mangroves cover around 9% of the total forest cover. Other forest types occur in scattered patches.

Total 30 forest types have been identified in West Bengal State. Broadly, these forest types belong to eight type groups of the classification given by Champion & Seth. Type Group-5 Tropical Dry Deciduous forests dominate the whole forested area with about 29% of forest cover. Type Group-4 Littoral & Swamp forests cover about 17%, Type Group-3 Tropical Moist Deciduous occupy around 11% and rest of the type groups occupy less than 5% of forest cover.

Area under different Forest Type Groups and canopy density classes have been shown in Table 29c.

Table 29b: Area under different forest types

S.No.	Forest Type	Area	(area in Km ²) % of Total Forest Cover
1	2B/2S3 Sub Himalayan Secondary Wet Mixed Forest	357.50	2.86
2	3C/C1ai East Himalayan Sal	323.67	2.59
3	3C/C1bi East Himalayan Upper Bhabar Sal	151.95	1.22
4	3C/C1bii East Himalayan Lower Bhabar Sal	126.22	1.01
5	3C/C1c Eastern Tarai Sal	326.32	2.61
6	3C/C2diii Eastern Heavy Alluvium Plain Sal	5.08	0.04
7	3C/DS1 Moist Sal Savannah	12.33	0.10
8	3C/C3a West Gangetic Moist Mixed Deciduous Forest	10.98	0.09
9	3C/C3b East Himalayan Moist Mixed Deciduous Forest	378.87	3.05
10	3C/2S2 Secondary Euphorbiaceous Scrub	6.33	0.05
11	3/1S1 Low Alluvial Savanna Woodland	34.44	0.28
12	4B/TS1 Mangrove Scrub	123.12	0.99
13	4B/TS2 Mangrove Forest	1,025.33	8.22
14	4B/TS3 Salt Water Mixed Forest	487.72	3.91
15	4B/TS4 Brackish Water Mixed Forest	313.62	2.51
16	4B/E1 Palm Swamp Forest	151.61	1.21
17	4C/FS2 Submontane Hill-valley Swamp Forest	3.26	0.03
18	4D/SS2 Barringtonia Swamp Forest	10.83	0.09
19	4D/2S2 Eastern Wet Alluvial Grassland	4.59	0.04
20	5B/C1c Dry Peninsular Sal Forest	2,732.05	21.88
21	5B/C2 Northern Dry Mixed Deciduous Forest	429.41	3.44
22	5/DS1 Dry Deciduous Scrub	84.38	0.68

S.No.	Forest type	Area	% of Total (area in km ²) Forest Cover
23	5/E5 Butea Forest	109.97	0.88
24	5/1S2 Khair-Sissu Forest	219.89	1.76
25	8B/C1 East Himalayan Sub-tropical Wet Hill Forest	339.41	2.72
26	11B/C1a Lauraceous Forest	123.39	0.99
27	11B/C1b Buk Oak Forest	56.58	0.45
28	11B/C1c High Level Oak	20.34	0.16
29	12/C3a East Himalayan Mixed Coniferous	295.36	2.36
30	14/C2 East Himalayan Sub-alpine Birch/Fir	14.21	0.11
31	Plantation/TOF	4,202.24	33.67
	Total	12,481.00	100.00

Table 29c: Area under different Forest Type Groups and Canopy Density Classes (area in km²)

S.No.	Forest Type Group	Very Dense Forest	Mod. Dense Forest	Open Forest	Scrub	Total
1	Group-2 Tropical Semi-Evergreen Forests	200.37	104.76	52.27	0.10	357.50
2	Group-3 Tropical Moist Deciduous Forests	525.73	620.88	223.22	6.36	1,376.19
3	Group-4 Littoral & Swamp Forests	886.97	905.45	322.99	4.67	2,120.08
4	Group-5 Tropical Dry Deciduous Forests	400.04	1,208.82	1,910.32	56.52	3,575.70
5	Group-8 Subtropical Broadleaved Hill Forests	81.76	185.11	72.54	0.00	339.41
6	Group-11 Montane Wet Temperate Forests	79.16	103.52	17.63	0.00	200.31
7	Group-12 Himalayan Moist Temperate Forests	71.92	134.94	88.50	0.00	295.36
8	Group-14 Sub-alpine Forests	2.40	10.36	1.45	0.00	14.21
9	Plantation/TOF	53.65	503.16	3,645.08	0.35	4,202.24
	Total	2,302.00	3,777.00	6,334.00	68.00	12,481.00