Chapter 16 The Tropical Monsoon and Tropical Marine Climates

Distribution

We have learnt in Chapter 13 that some parts of the world experience seasonal winds like land and sea breezes but on a much larger scale. These are the tropical monsoon lands with on-shore wet monsoons in the summer and off-shore dry monsoons in the winter. They are best developed in the Indian sub-continent, Burma, Thailand, Laos, Cambodia, parts of Vietnam and south China and northern Australia. Outside this zone, the climate is modified by the influence of the on-shore Trade Winds all the year round, and has a more evenly distributed rainfall. Such a climate, better termed the Tropical Marine Climate, is experienced in Central America, West Indies, north-eastern Australia, the Philippines, parts of East Africa, Madagascar, the Guinea Coast and eastern Brazil (Fig.124).

Climatic Conditions in Tropical Monsoon Lands

The basic cause of monsoon climates is the difference in the rate of heating and cooling of land and sea. In the summer, when the sun is overhead at the Tropic of Cancer, the great land masses of the northern hemisphere are heated. Central Asia, backed by the lofty Himalayan ranges, is more than 15°F. hotter than its normal temperature and a region of intense low pressure is set up. The seas, which warm up much slower, remain comparatively cool. At the same time, the southern hemisphere experiences winter, and a region of high pressure is set up in the continental interior of Australia. Winds blow outwards as the South-East Monsoon, to Java, and after crossing the equator are drawn towards the continental low pressure area reaching the Indian sub-continent as the South-West Monsoon, as shown in Fig. 125(a).

In the winter, conditions are reversed. The sun is overhead at the Tropic of Capricorn, central Asia is extremely cold, resulting in rapid cooling of the land. A region of high pressure is created with outblowing winds—the North-East Monsoon. On crossing the equator, the winds are attracted to the low pressure centre in Australia and arrive in northern Australia as the North-West Monsoon

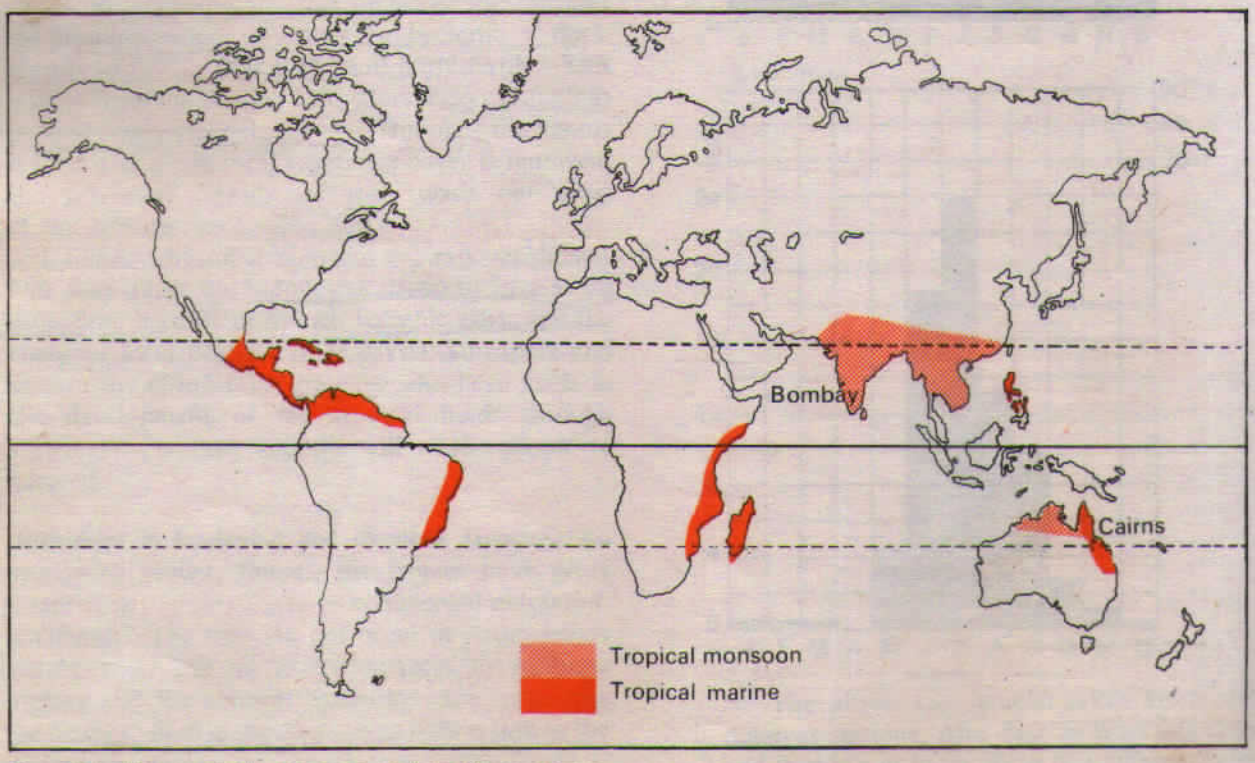


Fig. 124 The tropical monsoon and marine regions

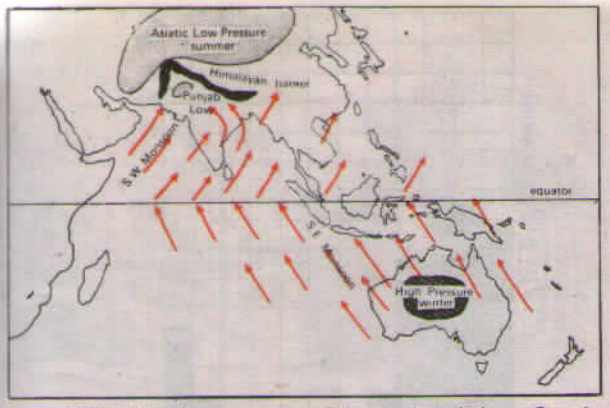
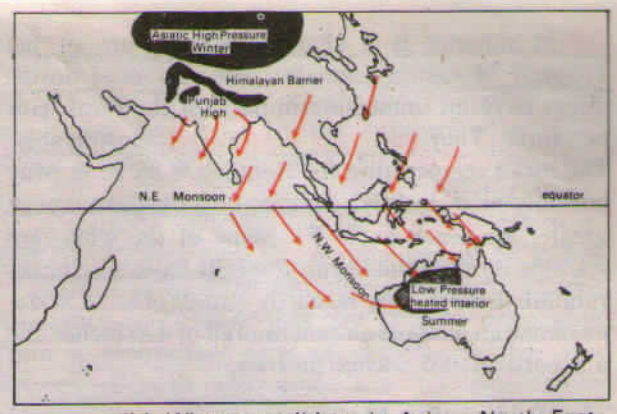


Fig. 125 (a) Summer conditions in Asia—South West Monsoon in Indo-Pakistan is on-shore in the rainy season (July)



(b) Winter conditions in Asia—North-East Monsoon in Indo-Pakistan is off-shore in the cool, dry season (January)

(Fig. 125 (b)). In other parts of the world which experience a tropical monsoon climate a similar seasonal reversal of wind directions occurs.

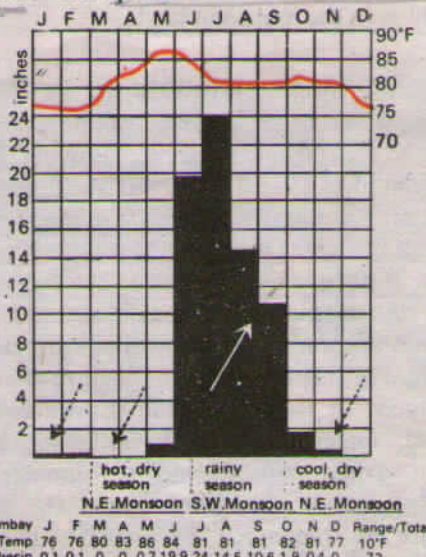
The Seasons of Tropical Monsoon Climate

In regions like the Indian sub-continent which have a true Tropical Monsoon Climate, *three* distinct seasons are distinguishable, as illustrated in Fig. 126 (a).

1. The cool, dry season (October to February). Temperatures are low 76°F. in Bombay and only 50°F. in Punjab, with heavy sinking air. Frosts may occur at night in the colder north. The centre of high pressure is over the Punjab. Outblowing dry winds, the North-East Monsoon, bring little or no rain to the Indian sub-continent. However, a small amount of rain falls in Punjab from cyclonic sources and this is vital for the survival of winter cereals. Where the North-East Monsoon blows over the Bay of Bengal it acquires moisture and thus brings rain to the south-eastern tip of the peninsula at this time of the year. For instance, in Madras 50 inches of rain falls during October and November, accounting for half its annual rainfall.

2. The hot dry season (March to mid-June). As can be seen from Fig. 126(a), the temperature rises sharply with the sun's northward shift to the Tropic of Cancer. Bombay has a mean May temperature of 86°F. which is considered moderate, for many parts of India are even hotter. The heat is so great that schools and colleges are closed. The stifling heat and the low relative humidity make outdoor life almost unbearable. Day temperatures of 95°F. are usual in central India and the mean temperature in Sind may be as high as 110°F. Coastal districts are a little relieved by sea breezes. There is practically no rain anywhere. By May, the temperature is so high that an intense low pressure zone is set up in north-west India. *Duststorms* are frequent, followed by long awaited rainstorms that 'break' by the middle of June. The transitional period between 'no rain' and 'plenty of rain' is over.

3. The rainy season (mid-June to September). With the 'burst' of the South-West Monsoon in mid-June, *torrential downpours* sweep across the country to the delight of everybody. Almost all the rain for the year falls within this rainy season. For example in Bombay 19·9 inches are recorded in June, 24 inches in July, 14·5 inches in August and a further 10·6 inches in September. As much as 95 per cent of the annual rainfall is concentrated within four months. This pattern of concentrated heavy rain-



Bombay	J	F	M	A	M	J	J	A	S	O	N	D	Range/Total
Temp	76	76	80	83	86	84	81	81	81	82	81	77	10°F
Precip	0·1	0·1	0	0	0·7	19·9	24	14·5	10·6	1·9	0·4	0	72

Fig. 126 (a) Tropical Monsoon Climate
Place: Bombay, India (18° 55'N., 73°E.)
Altitude: 37 feet
Annual precipitation: 72 inches
Annual temperature range: 10°F. (86°–76°F.)

fall in summer is a characteristic feature of the Tropical Monsoon Climate. The torrential downpours have an immediate impact on the local temperature. They lower the temperature considerably. The mean temperature for Bombay is 86°F. in May but only 81°F. in July. In the north the drop is even greater, as much as 13°F. Some of the windward stations on the Himalayan foothills have very heavy rainfall, though this is partly orographic. *Cherrapunji* has an average annual rainfall of 425 inches and a record of 905 inches in 1861.

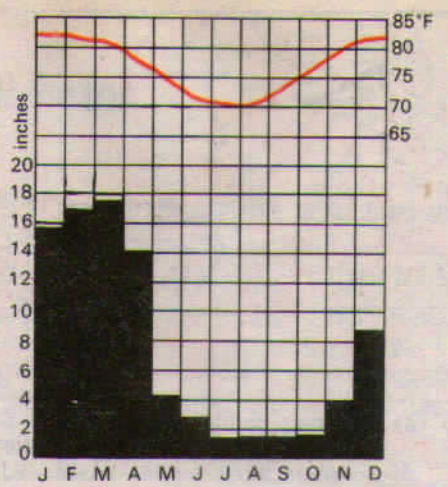
The Retreating Monsoon

The amount and frequency of rain decreases towards the end of the rainy season. It retreats gradually southwards after mid-September until it leaves the continent altogether. The Punjab plains which receive the south-west monsoon earliest are the first to see the withdrawal of the monsoon. The skies are clear again and the cool, dry season returns in October, with the outblowing North-East Monsoon.

The role of monsoons in India is vital in its economy. A late monsoon or one that ends far too early will condemn large stretches of agricultural land to drought. There will be widespread famine from crop failure and thousands will perish. When there is too much water from the rainy monsoons, severe floods occur, destroying both crops and lives and disrupting communications. In no part of the world has the climate affected Man's way of life so profoundly as in the monsoon lands.

The Tropical Marine Climate

This type of climate is experienced along the eastern coasts of tropical lands, receiving steady rainfall from the Trade Winds all the time. The rainfall is both orographic where the moist trades meet upland masses as in eastern Brazil, and convectional due to intense heating during the day and in summer. Its tendency is towards a summer maximum as in monsoon lands, but without any distinct dry period. Fig. 126 (b) shows the rhythm of climate as experienced in Cairns, on the eastern coast of Queensland, under the constant influence of the South-East Trade Winds, and in summer also affected by the tropical monsoons. Its wettest months are in January (15·8 inches), February (16·4), March (17·7) and April (12·1), which is summer in the southern hemisphere. Approximately 70 per cent of the annual rainfall is concentrated in the four summer months. There is no month



Cairns	J	F	M	A	M	J	J	A	S	O	N	D	Range/Total
Temp	82	81	80	77	74	71	70	70	73	76	79	81	12°F
Precip	15.8	16.4	17.7	12.1	4.3	2.8	1.6	1.7	1.7	1.8	4.0	8.6	88

Fig. 126 (b) Tropical marine Climate
Place: Cairns, Australia (17°S., 145°, 42'E.)
Altitude: coastal lowland
Annual precipitation: 88 inches
Annual temperature range: 12°F. (82°–70°F.)

without any rainfall. The range of temperature is typical of the tropical latitudes with a maximum of 82°F. in January and a minimum of 70°F. in July—a range of 12°F. for the year. Due to the steady influence of the trades, the Tropical Marine Climate is more favourable for habitation, but it is prone to severe tropical cyclones, hurricanes or typhoons, as mentioned in Chapter 13.

Tropical Monsoon Forests

The natural vegetation of tropical monsoon lands depends on the *amount of the summer rainfall*. Trees are normally deciduous, because of the marked dry period, during which they shed their leaves to withstand the drought. Where the rainfall is heavy, e.g. in southern Burma, peninsular India, northern Australia and coastal regions with a tropical marine climate, the resultant vegetation is forest. The forests are more open and less luxuriant than the equatorial jungle and there are far fewer species. Most of the forests yield valuable timber, and are prized for their durable hardwood. Amongst these teak is the best known. Burma alone accounts for as much as three-quarters of the world's production. It is such a durable timber that it is extensively used for ship building, furniture and other constructional purposes. Other kinds of timber include sal, acacia and some varieties of eucalyptus in northern Australia. Together with the forests are bamboo thickets, which often grow to great heights (Fig. 127).

With a decrease in rainfall in summer, the forests thin out into thorny scrubland or savanna with

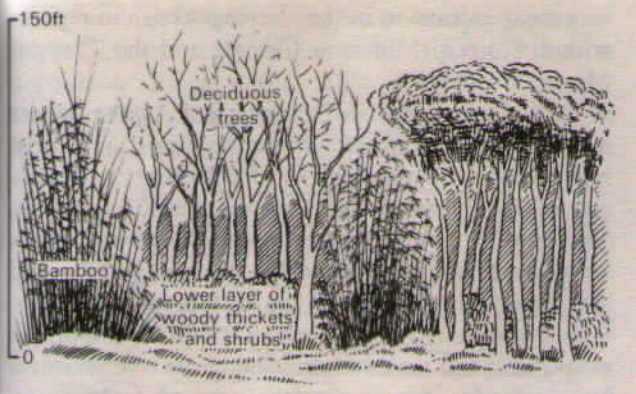


Fig. 127 Main features of a monsoon forest

scattered trees and tall grass. In parts of the Indian sub-continent, rainfall is so deficient that semi-desert conditions are found. Monsoonal vegetation is thus most varied, ranging from forests to thickets, and from savanna to scrubland.

Agricultural Development in the Monsoon Lands

Much of the monsoon forest has been cleared for agriculture to support the very dense population. The cultural landscape throughout the length and breadth of the monsoon lands deeply reflects the intensity of Man's quest for subsistence. Wherever possible, crops are grown. The plains are ploughed, and the hills are terraced to provide farmland. Farms are small and the people are forever 'land hungry'. In their quest for land, they have removed the natural vegetation, sometimes wantonly, resulting in acute soil erosion. This is particularly serious in the Indian sub-continent which has a very high density of population with a rapid rate of growth. But in the plains the same piece of land may have been tilled for generations with little or no replenishment, and yet able to yield fairly reasonable returns.

Tropical agriculture dependent on natural rainfall and a large labour force, reaches its greatest magnitude in the monsoon lands. The soil provides the basis for the livelihood of millions. Farming is not only the dominant occupation of the greater part of the people, but also forms the mainstay of the economy of the Indian sub-continent, China, South-East Asia, eastern Brazil and the West Indies. The following types of agriculture are recognisable.

1. **Wet padi cultivation.** Rice is the most important staple crop and is grown in tropical lowlands wherever the rain exceeds 70 inches. It is perhaps the most characteristic crop of the monsoon lands and its total acreage far exceeds that of any other crop. In fact, very few areas outside the influence of the monsoons ever take to the cultivation of padi. There are two main varieties, the wet padi, which is mainly grown on lowlands in flooded fields or in terraced uplands, and the dry padi grown in regions of lower rainfall. A minimum of 50 inches of rainfall is required during the growing season. Droughts and floods that are almost inseparable from a monsoonal type of climate can be very detrimental to its cultivation. Irrigation water from rivers, canals, dams or wells is extensively used in the major rice producing countries. Other food crops like maize, millet, sorghum, wheat, gram and beans are of subsidiary importance. They are cultivated in the drier or cooler areas where rice cannot be grown.

2. **Lowland cash crops.** A wide range of lowland tropical cash crops are cultivated for the export market, after local needs have been met. The most important crop in this category is cane sugar. As much as two-thirds of world's sugar production comes from tropical countries. Sugar is either grown on plantations or on small holdings wherever rainfall and sunshine are abundant. Some of the major producers include India, Java, Formosa, Cuba, Jamaica, Trinidad and Barbados. Jute is confined

Harvesting sugar-cane in Queensland, Australia *Australian News and Information Bureau*

almost entirely to the Ganges - Brahmaputra delta, in India and Bangladesh. It has long been a leading hard fibre for the manufacture of sacks (gunny). Manila hemp (abaca) is a product of the Philippines, particularly of Mindanao. It is used to make high quality rope. Other crops include indigo, still cultivated in India and Java; cotton, a major export of the Indian sub-continent and bananas, coconuts and spices.

3. Highland plantation crops. The colonization of tropical lands by Europeans gave rise to a new form of cultivated landscape in the cooler monsoonal highlands. This is the cultivation of certain tree crops in tropical plantations. Thousands of acres of tropical upland forests were cleared to make way for *plantation agriculture* in which tea and coffee are the most important crops. These were luxuries in Europe in the eighteenth century and the products of the plantations were originally meant only for export to the mother countries where there was a great craze for the beverages. Later, the local people also got into the habit of drinking them and they fast became necessities. Both the beverages became so popular in and out of the tropics that there was great expansion in their acreages both in regions with a Tropical Monsoon Climate and the Tropical Marine Climate.

Coffee originated in Ethiopia and Arabia, where it is still grown, but *Brazil* now accounts for almost half the world's production of coffee. It is mainly grown on the eastern slopes of the Brazilian plateau. The crop is also cultivated on the highland slopes between 2,000 feet and 4,500 feet in the Central American states, India and eastern Java.

Tea originated in China and is still an important crop there, but as it requires moderate temperatures (about 60°F.), heavy rainfall (over 60 inches) and well drained highland slopes it thrives well in the tropical monsoon zone, but preferably at a higher altitude. The best regions are thus the Himalayan foothills of India and Bangladesh, the central highlands of Sri Lanka and western Java, from all of which it is exported. In China tea is grown mostly for local consumption.

4. Lumbering. Wherever there are tropical forests which still have not been felled to make way for the plough, *lumbering* is undertaken in the more accessible areas. This is particularly important in conti-

Tea picking in a plantation in Sri Lanka *Camera Press*

nental South-East Asia. Of the tropical deciduous trees, teak, of which Burma is the leading producer, is perhaps the most sought after. It is valuable on account of its great durability, strength, immunity to shrinkage, fungus attack and insects. It is grown in hilly districts up to 3,000 feet in altitude with a moderate rainfall. Under government supervision, teak trees which are cut have to be replaced. This is the only way to ensure the steady supply of the timber which is the second greatest money-earner for Burma after rice. In northern Burma, in the region of the Chindwin River, there are large teak plantations. It takes as long as 100 years for a teak tree to mature into commercial timber. Green teak logs are so heavy that they will not float readily on water. It is therefore necessary to 'poison' the tree several years before actual felling, so that it is dry and light enough to be floated down the Chindwin and the Irrawaddy to reach the saw mills at Rangoon. The individual logs are tied in rafts and guided downstream by crews of men and tugboats. It takes something like 18 months for a log of teak to reach Rangoon to be sawn into planks for export.

5. Shifting Cultivation. This most primitive form of farming is widely practised. Instead of rotating the crops in the same field to preserve fertility, the tribesmen move to a new clearing when their first field is exhausted. The clearing, or field, in the midst of the jungle is usually made by fire, which destroys practically everything in its way. After planting, little attention is paid to the field either in weeding or manuring. The crops are left entirely to the care of nature. The farmers use simple hoes and sticks for ploughing and seeding. Draught animals are unknown and labour is exclusively manual. Their needs are so basic that every farmer produces much the same range of crops as his neighbours. Maize or corn, dry padi, yams, tapioca, sweet potatoes and some beans are the most common crops. Farming is entirely for subsistence, i.e. everything is consumed by the farmer's family, it is not traded or sold.

As tropical soils are mainly latosolic, rapidly leached and easily exhausted, the first crop may be bountiful but the subsequent harvests deteriorate. A few years later, the field has to be abandoned and a new patch cleared elsewhere. This system of a short period of cultivation alternating with long periods of fallowing is probably the best way of using land in many parts of the tropics where manuring is unknown.

Shifting cultivation is so widely practised amongst indigenous peoples that different local names are used in different countries. For example, *ladang* in Malaysia, *taungya* in Burma, *tamrai* in Thailand, *caingin* in the Philippines, *humah* in Java, *chena* in Sri Lanka and *milpa* in Africa and Central America.

QUESTIONS AND EXERCISES

1. The climate of India is characterized by three distinct seasons. Explain why this is so.

2. With the aid of diagrams or sketch maps, explain any *three* of the following statements.
   (a) The east coasts of continents within the tropics have much heavier rainfall than the interiors or the west coasts.
   (b) The Tropical Monsoon Climate is, in fact, land and sea breezes on a continental scale.
   (c) Near the equatorial latitudes, the period of maximum rainfall is closely related to the movements of the overhead sun.
   (d) There is a marked difference in temperature between the east and west coasts of countries in latitudes 20° to 35°N.

3. In which parts of the monsoon lands has the natural vegetation been removed by men? Describe and explain the uses made of the cleared lands.

4. Name the types of climate which have
   (a) rain mainly in winter
   (b) rain only in summer
   (c) rain throughout the year
      i. Describe the characteristic climatic features of any *two* of the types you have named.
      ii. For any *one* of them account for its rainfall distribution.

5. Contrast the essential characteristics of plantation agriculture and shifting cultivation.