

THE CLIMATE OF MADRAS AND ENVIRONS

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The city of Madras is situated at Lat. 13°N and its climate should naturally have the characteristic of the north tropical zone in the belt of North East trade-winds. These winds are developed fully over the oceans and oceanic islands but their course is modified in summer by the existing large areas of lands which get heated more than the neighbouring oceans. India, extending in latitude from 8° to 30°N , presents a variety of climate in its different parts but the one constant factor which influences the climate of the whole country is the semi-annual reversal of its wind-system which causes the monsoon winds.

The causes determining the monsoon currents are many and complex but the chief cause is the difference in temperature in winter and summer months between southern Asia on the one hand and the Indian Ocean and the China seas on the other. During the summer, the north of Africa and southern Asia are much hotter than the Indian ocean which is again hotter than South Africa and Australia. As the heated air of southern Asia expands and rises, colder air from the south flows in to supply its place. In other words a general movement of the atmosphere of the Indian Ocean sets in towards the north, thus giving a southerly direction to the winds, but as the air comes from those parts of the globe which revolve faster to those which revolve more slowly, an easterly direction is communicated to the wind and a combination of these two directions results in the southwest monsoon which prevails in summer. In winter, central Asia, and the China seas are colder than southern Asia, which again is colder than the Indian Ocean and a reversal of the wind system is set in from North East to Southwest. The movement of the low pressure areas of the

equatorial belt towards northwest India in summer and to the South Indian Ocean in winter aids to strengthen the velocity of the South West and North-east currents.

The great benefits of the monsoon winds to India are recognised only when they are considered in relation to the rainfall of the country. The great velocity of the winds and their periodical changes of direction and the oscillatory movement of the low pressure area across the country are responsible for the proper distribution of rainfall in space and time. The influence of the direction of the monsoon winds on the distribution of rainfall in South India becomes apparent when we consider the seasons of rainfall in the two coasts of the Madras Presidency. The Malabar coast has its rainy season during the south-west monsoon period in summer, the winds carrying moisture from the South Indian Ocean and the Arabian sea. In its passage across the peninsula the southwest monsoon current loses most of its moisture with the result that the east coast has practically no rainfall during the south-west monsoon. The Coramandal coast, about the middle of which lies Madras, has its rainy season during the months of October and November, *viz.*, retreating south-west monsoon period when there is a conflict between the waning south-westerly current and the advancing north-east monsoon winds. The two coasts of the peninsula thus have their rainy seasons reversed, the dry season of the one corresponding to the wet season of the other. In April, the North-east monsoon changes to the South-west and in October the South-west to the North-east. These times depending upon the course of the sun, vary with latitude and are called the breaking up of monsoons and are generally accompanied by variable wind intervals of calms and furious storms. The period of transition between the North-east monsoon and the South-west is longer than that of the opposite change and is known as the hot season.

Madras has its hot or dry season from the middle of December to the middle of June. The average rainfall in January and February is about an inch. March has the scantiest rainfall during the year. In April and May there are

occasional thunderstorms accompanied with heavy showers. Severe cyclonic storms are not unknown during these months. Whether the storms cross the coast or not, they cause heavy rain during their travel. The average rainfall of the dry season is about 6 inches, more than half of which is contributed by thunderstorms. Compared with other stations on the east coast Madras may be said to have a dry atmosphere. The highest mean percentage of humidity is 79 in November the wettest month of the year and the lowest 62 in June, the month recording the highest mean maximum temperature. The dry season is characterised by falling humidity and rising temperature. In the mornings of January and February the horizontal visibility is low, due to thin mist. The direction of wind changes from North North-east in December through East to South-west in June, giving rise to climatic changes. The inhabitant of Madras or the visitor finds that December and January are the best months, the nights being cool with dry winds blowing from the north and the day temperatures not excessive. In the latter part of January and early February the grass minimum thermometer indicates temperatures below dew-point on several days and thick dew is deposited on grass. The general direction of wind changes to East in February and the temperature also increases. The wind being feeble during the month, does not give the same soothing effect to the body against the high day temperatures as the sea breeze of the later months. The strength of wind increases steadily from March to June and its general direction changes to southerly shore winds in April and May. As their name suggests the shore winds blow parallel to the coast and are damp and relaxing. The sea breeze in the months of April and May gives great relief during the day and the nights are agreeable on account of the land breeze which is cooled by radiation. The onset of the sea breeze is often noted by a sharp stray shower lasting for a minute or two. The time at which the sea breeze sets in, varies from day to day. Hot land winds begin to blow from June, the stronger the monsoon on the west coast the hotter and stronger is the southwest land wind, which is warmed up by the hot surface of the land. The percentage of humidity

increases from July onwards and the moist atmosphere combined with the high temperature creates a great deal of discomfort to the body, by preventing evaporation of perspiration and consequent cooling. Climatic conditions get steadily worse during August and September with the winds becoming more and more feeble.

With the advance of the dry season and steady increase of temperature the moist winds blowing from the seas get warmed up by the hot land surface and rise higher and higher. The normal upper winds of the season are cold and dry and blow in a direction opposite to that of the southwest surface winds. When these cold dry winds overrun the warm moist winds, conditions become favourable for the occurrence of thunderstorms. In Madras thunderstorms occur rarely in January and February, occasionally in March, and with greater frequency in April, May and June. The usual time of their occurrence is between 2 P.M. and 3 P.M. in the afternoons. They are associated with a sudden drop of temperature and sharp showers for short intervals. The amount of fall in temperature varies with the temperature of the air at the time when the thunderstorm occurs—the higher the air temperature the greater the fall. In June and July a few dust-storms occur, raising a lot of dust and polluting the air. Dust haze is common in the evenings of June and July.

Temperature and its variations constitute an important element of the climate of a place. During the first part of the year, January to June, the increase of temperature by solar action is greater than the loss by radiation and other actions and hence the temperature rises steadily with the increasing elevation of the sun. During the latter part of the year, the balance is the other way and the temperature steadily decreases from July to December. A reference to table A shows that the dry bulb temperature increases up to May and then decreases. The highest maximum temperature is recorded in June. The dry minimum records its lowest in January and it is highest in May. An analysis of the maximum temperatures in shade of Madras reveals that they are two periods of

ten days each of high temperatures with an interval of low temperatures between. This interval varies from a week to two. One period of high temperatures occurs in June and the other in July. During some years there is a long period of high temperatures lasting for three to four weeks after which the temperature goes down. In summer, a few cases of heat strokes are reported. The causes of heat strokes have been investigated and they are supposed to happen when the sweating mechanism of the body fails. It usually occurs in an atmosphere where the vapour tension is high, the air is calm and the evaporation of perspiration becomes inadequate to cool the body.

The diurnal range of temperature is smaller in Madras than in many stations in the interior of the peninsula and varies from 13.8° in November to 19.1° in February. The annual range of temperature falls round about 50° . The largest range of temperature observed so far (the highest maximum observed—the lowest minimum observed) is 55.5° .

Bright sunshine as a climatic factor affects considerably the vegetation of a place. It also has an effect on its public health. Sunshine not only affects the growth of crops but also promotes evaporation of moisture from the soil, vegetation, and the surfaces of water tanks and reservoirs. The disastrous effects of draughts are aggravated by the bright sunshine. Madras records on an average 2400 hours of bright sunshine in a year out of a total of 4400 hours. The difference between the two figures given is accounted for by the amount of clouded-sky during the hours of the day. The highest number of hours of bright sunshine is recorded in March and the lowest in July. The greatest amount of cloudiness occurs in July and the lowest in March. The month during which the greatest precipitation is recorded has cloudiness only, amounting to a little over fifty per cent.

The winds change their direction to NE and NE by N in October and November respectively and the temperature falls relatively below that of the previous months. As mentioned in the introductory paragraphs, during these months there is a

conflict between the waning South-west monsoon winds and the advancing Northeast monsoon winds. A series of depressions originate in the Bay as a result of which copious rainfall occurs in the eastern half of the peninsula. The conditions are again favourable for the occurrence of thunderstorms, the maximum frequency of which for the year happens to be in October. The winds up to a level of 2 kms blow from the Bay of Bengal and are moisture laden. Above 2 kms level, the upper winds of the season that blow into the peninsula come from the land and are consequently dry. The north-east winds blowing from the Bay bring more moisture than the south-west winds of the pre-monsoon period and the rainfall associated with the thunderstorms of this period is heavier. The occurrence of the thunderstorms of this period also happen to be in the afternoons between 15 hours and 16 hours. Due to the rainfall, the weather is agreeable and in case the rains are postponed or fail, the atmosphere becomes oppressive.

Rainfall is the most important element in the climatological study of a region. The rainfall of Madras in the dry season is scanty as already mentioned. In January there are occasional showers, due to the revival of north-east monsoon conditions in the south of the Bay. These showers are popularly known as "Pongal showers." February and March get only occasional scattered showers. The rains of April, May and June are mainly due to thunderstorms or the cyclonic storms of the Bay. The summer monsoon does not give much rain to the east coast as the moist winds exhaust most of the moisture by giving heavy precipitation on the west coast. Madras however records 16 inches of rain from June to September mostly due to the depressions of the Arabian sea. The period, October to December gives nearly 30 inches or three-fifths of the annual average. Heavy falls of rain occasionally occur during cyclonic storms of this period. During one such storm there was a fall of 17 inches in 24 hours. The number of rainy days recording more than 10 cents of rain is about 90 in a year and they are well distributed during the latter half of the year. The variability of rainfall is between 20 and 25 per cent. A study of

rainfall statistics for a long period does not reveal any tendency for an increase or decrease of the annual average.

In the neighbourhood of Madras dry tracts of sand have been planted with casuarina which is very valuable for firewood. These plantations not only improve the aspect of the country by clothing the sands with luxuriant green verdure but also seem to have a beneficial effect on the climate and cultivation of the neighbouring areas. Though Madras has a fairly long dry season, the vegetation seems to thrive well, absorbing moisture from the atmosphere. The grass and shrubs get a little moisture from heavy dew falls in January and February. The large number of hours of bright sunshine seems to act beneficially in evaporating water from the sea and providing moisture required by vegetation.

Almost every year Madras experiences the effects of cyclones and storms when low lying parts of the city are flooded and the poorer classes are rendered homeless. Great damage is done to life and property in the coastal districts when the storms cross the coast. A description of the characteristics of storms may not be out of place. Any violent wind accompanied with rain may be termed as storm. Those that are lasting and belong to a destructive type are known as cyclones are cyclonic storms. In these storms oval or circular in shape, the air moves in converging spirals in a left handed direction against the hands of a clock. Winds become fiercer and fiercer as the centre is approached and reach hurricane force near it. In the innermost central zone the wind suddenly falls off to a calm or light air and the barometric pressure marks an inch or more below normal. Generally cyclones die away soon after they reach land but before they die they cause great deal of havoc through torrential rain and terrific winds in the coastal districts.

The Coramandal coast is affected by a storm either in the months of May and June or October and November. Though no month except February is free from the occurrence of storms

the frequency is greatest in the months mentioned. The pre-monsoon storms differ markedly from those of the later periods both in their place of origin in the Bay and their direction of movement. They form in the southern half of the Bay and move in a north-westerly direction and cross the Coramandal coast or may turn their direction northwards and cross the Bengal coast. At times they attain great violence and cause terrific winds and heavy rainfall on the coast. The storms in this period generally move more slowly than those of the later period.

The post-monsoon storms form in any part of the Bay and travel in a westerly, north-westerly or northerly direction. Occasionally they move in a north-easterly direction and cross the Burma coast. These storms generally cross the Circars coast or Orissa coast. A few storms cross Coramandal coast near Madras. The rainfall associated with the cyclones of this period is very heavy. The rains begin on the coast even when the storm centre is 200 to 300 miles away. The heavy rainfall area extends more to the right of the direction in which the storm is travelling rather than to the left. After the storm crosses the coast the heavy rainfall areas proceed along two tracks one along the coast in a northerly direction and the other in a northwesterly direction across the peninsula. A few storms after crossing the coast travel across the peninsula and renew their vigour after they reach the Arabian sea. The case of a storm originating in the Arabian sea and entering the Bay after crossing the peninsula is almost unknown.

Twenty two storms travelled towards the east coast of the peninsula between the years 1893 and 1922, one occurred in May, one in July, one in September, six in October, 9 in November and 4 in December. From the above figures it is concluded that the frequency of occurrence is greatest in November. Of these twenty-two storms, six crossed the coast to the north of Madras and seven to the south. It may be safely said that nearly fifty per cent. of the storms that originate in the Bay and travel towards east coast and cross near Madras. A

pre-monsoon period storm which caused great havoc and took terrible toll of life on the east coast occurred in the year 1877.

The habits of the people, their clothing, food, housing, and health are conditioned by the climate of the place. These aspects have not been touched upon in this article. The meteorological means as an aid to the study of the climate of a place has been considered briefly. The upper air climatology which is gaining increasing importance with the progress of aviation has also not been dealt with.

In conclusion I express my indebtedness to the India Meteorological Department, the publications of which I have used in the preparation of this article.