

551.578.42 : 551.481.1 (548.1)

SEASONAL DISTRIBUTION OF RAINFALL OVER LAKES AROUND MADRAS CITY*

Madras being one of the major cities, fourth largest city in India and also headquarters of the State of Tamilnadu, the study of rainfall over and around the city is quite important especially for the water management studies.

The city of Madras gets its normal water supplies from the lakes and reservoirs located generally in the west to northwest of the city about 40 to 50 km in the Chengleput district of Tamilnadu. The principal reservoirs and lakes that feed the city of Madras are Poondi, Tambarambakkam, Korattur, Cholavaram, Chembarambakkam, Vallur Anicut, Kesavaram and Red Hills. In the present study a detailed rainfall analysis for all the seasons is carried out over the lakes and reservoirs surrounding Madras city.

Rainfall data for a period of 30 years (1946-1975) is taken for all the raingauge stations mentioned above. The rainfall data is divided into four seasons, viz., (i) winter season (January and February), (ii) hot weather or pre-monsoon season (March to May), (iii) southwest monsoon season (June to September) and (iv) post-monsoon season (October to December). The post-monsoon season is also locally referred to as northeast monsoon rainy season in Tamilnadu. The mean is calculated for all the different seasons and is taken to be the normal since 30 years period is sufficient enough to arrive at a normal. The mean of the annual rainfall is also worked out and the annual normal rainfall pattern is also analysed and presented in this study.

2. *Synoptic features* — The weather situations which normally give rise to rainfall over Madras and neighbourhood are :

(i) The sea level trough running north-south across the Peninsula. This feature is quite common in the hot weather season (viz., March to May). The east to west oscillation of this trough may give rise to rainfall over Madras city and neighbourhood especially when the trough line runs quite close to north Tamilnadu coast off southwest Bay. However, the sea level trough must also be seen extending upto the lower tropospheric level at least upto 0.9 km above sea level to cause significant rainfall. This feature is also noticed in southwest monsoon season during break or weak condition.

(ii) Low pressure waves in the easterlies or trough of low pressure or well marked low pressure areas which lie close to north Tamilnadu coast. Such synoptic situations occur in both southwest monsoon and northeast monsoon seasons.

(iii) Depressions or cyclonic storm which cross or come near enough to Madras to influence rainfall over that area. Such systems are quite common in northeast monsoon season, (i.e., October to December) and also occur occasionally in pre-monsoon season.

TABLE 1

Normal rainfall (cm) and coefficient of variation (Cv) over principal reservoirs around Madras city

Station		Seasons				Annual
		Winter	Hot weather	SW monsoon	Post monsoon	
Red Hills	N	2.1	6.9	35.7	59.7	104.4
	Cv	180	149	34	45	30.0
Cholavaram	N	2.5	7.4	44.3	71.1	125.3
	Cv	167	121	41	51	22.4
Tamarapakkam	N	2.3	5.4	40.1	61.7	109.5
	Cv	155	124	33	52	32.5
Poondi	N	2.1	6.3	56.1	58.2	122.7
	Cv	133	61	32	45	26.5
Kesavaram	N	1.6	7.8	46.4	44.8	100.7
	Cv	148	87	36	56	30.7
Korattur	N	2.0	5.4	40.0	51.0	97.5
	Cv	208	110	30	52	30.3
Chembarambakkam	N	2.3	7.2	42.4	59.8	111.8
	Cv	163	118	30	49	29.6
Vallur Anicut	N	2.7	7.6	39.0	66.9	116.2
	Cv	171	150	33	47	31.4

N=Normal

(iv) Other minor synoptic features such as upper air circulations and troughs or asymptotes of convergence in lower levels over the concerned area in north Tamilnadu. These are more common in post-monsoon season.

3. *Analysis of seasonal and annual rainfall pattern* — The general pattern of the seasonal distribution of normal rainfall indicates that as is characteristic of Chengleput district, the normal rainfall is the least during winter season, viz., January and February and is generally of the order of less than 2 cm in this season over the lake areas. However, along the narrow coastal strip the rainfall is of the order of 6 cm.

During the hot weather season, the rainfall over the lake areas is of the order of 5 to 7 cm. During the southwest monsoon season there is a steep increase in the rainfall and is of the order of 40 to 45 cm. Also the rainfall pattern during this season indicates a general increase in spatial distribution of rainfall as we go westwards from the coast. With the onset of the southwest monsoon over the country, the rainfall over this area increases from June onwards and then declines sharply in December, the rainiest month being November.

The normal rainfall in the post-monsoon season is of the order of 60 to 70 cm over the lakes and reservoirs, whereas it is of the order of 80 cm over the city area situated along the coastal strip. Unlike the

*The paper was presented in the Seminar on "Hydrological investigation during the last 25 year in India" held at Andhra University Waltair, 23-24 May 1982.

southwest monsoon season, the spatial distribution of northeast monsoon rainfall indicates maximum rainfall near the coastal strip and this decreases as we go inland as this is the season of maximum cyclonic activity where cyclones, depressions and well marked low pressure areas from the Bay of Bengal move from east to west and weaken rapidly inland due to friction as well as cut off in moisture supply.

From Fig. 1 it is seen that the area under question normally receives annual rainfall of the order of 100 to 120 cm. The major contribution to this total is the northeast monsoon which accounts for about 55 to 60% of the annual rainfall. The contribution from the southwest monsoon season is also significant being of the order of 35 to 40%. The winter and pre-monsoon rainfall together contribute even less than 5%. In fact January and February are the months with practically no rainfall.

4. *Natural variability of rainfall* — To find out how the actual rainfall is scattered from the mean, the coefficient of variation a measure of natural variability, is worked out for all the four seasons, and for the year as a whole. Fig. 2 depicts the rainfall variability for the year as a whole. Table 1 gives the normal as well as coefficient of variation for the principal reservoirs.

The lake area has an annual coefficient of variability of the order of 30% indicating that the scatter of actual annual rainfall from the normal is moderate and the year to year rainfall distribution is a moderately steady one.

Coming to the seasonal variability of rainfall, it is seen that the variability in any season is greater than that of the annual. It is lowest in southwest monsoon season and is of the order of 35 to 40% and highest in the winter season being of the order of 150 to 200%.

In case of northeast monsoon rainfall, the variability is of the order of 50% which is quite significant. The rainfall in the northeast monsoon season, as mentioned earlier occurs in association with cyclonic activity such as depressions and storms and is usually interspersed with spells of heavy rainfall and dry periods. As the number of cyclonic storms and depressions can vary considerably from year to year, the consequent rainfall also shows a high variability. On the other hand the rainfall in southwest monsoon season occurs in association with weaker system which occur more frequently and hence are likely to be not significantly different from year to year. This accounts for the lower variability in southwest monsoon rainfall than that of post-monsoon season. Though the natural variability in winter as well as in hot weather season is as high as the order of more than 150% it is not quite significant as the normal rainfall during these period itself is negligible. Therefore natural variability in these seasons is not of great concern when compared to the principal rainy seasons.

These factors indicate that there is some amount of compensation by rainfall in one season to that of another season in the same year, so that the annual rainfall tends to be more steady than the seasonal rainfall.

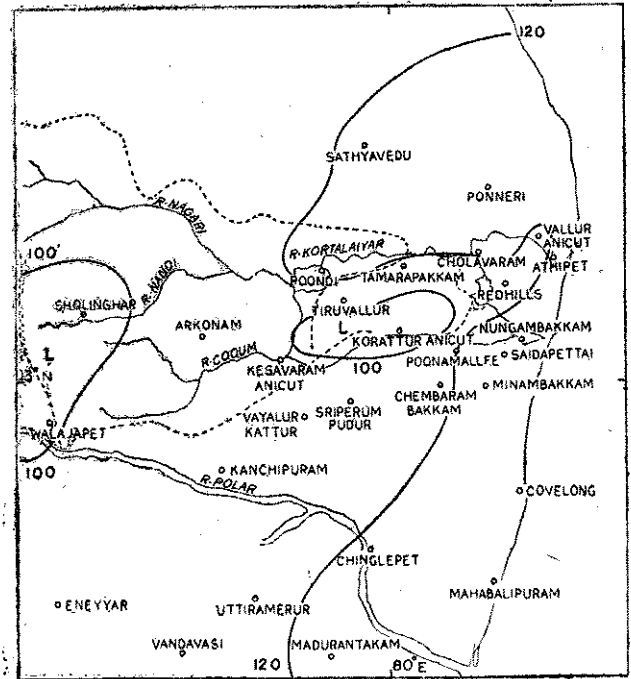


Fig. 1. Normal annual rainfall (cm) distribution

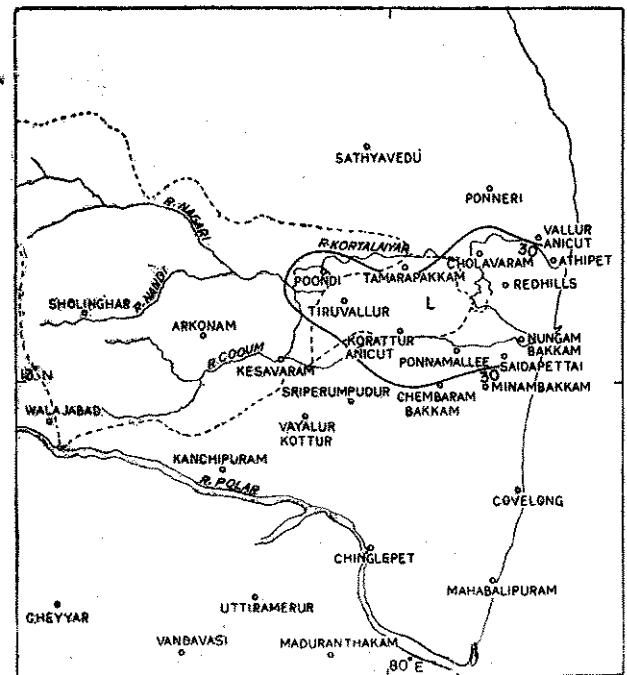


Fig. 2. Coefficient of annual variation

5. *Highest ever recorded rainfall over the lake areas* — Exceptionally heavy falls occurred on 25 November 1976 when the rainfall at some places were of the order as high as 50 cm. Poluvakkam, a station in the catchment area recorded an unusual rainfall of the order of 57 cm on that day. Most of the lakes and reservoirs recorded an average rainfall of the order of 40 cm on that day. That day's rainfall alone had contributed nearly the entire seasonal normal value for that particular year. Fig. 3 gives the isohyetal pat-

tern of rainfall of that day when such an unusual rainfall occurred. An extreme value analysis by Jayanthi *et al.* (1978) shows that such cases are only freak and are extremely rare phenomena and have a return period greater than 500 years.

From the above study it is seen that though the northeast monsoon rainfall over the lakes and reservoirs is the principal rainy season (about 60% of the annual rainfall), as the variability during season is quite high (of the order of 50 %) this rainfall is not a highly dependable source for Madras city water supply. In fact though southwest monsoon attributes to about 40% of total annual rainfall, considering the less variability during this season (of the order of 35 to 40%), this rainfall is much more dependable and it appears desirable that ways and means to preserve, store and plan the water management of this rainfall instead of waiting for northeast monsoon season, should be exploited.

6. *Acknowledgement* — The authors are very much thankful to Dr. N.S. Bhaskara Rao, Regional Director, Regional Meteorological Centre, Madras for his helpful suggestions. They also wish to thank S/Shri N.R. Subramaniam, J. Alexander and V. Ramaswamy for helping in computational work and in preparing the diagrams. The typing of the manuscript is done by Miss R. Saradha which is also acknowledged with thanks.

References

Jayanthi, N., Srinivasan, T.R., 1978, *Vayu Manda*, 8, 3 & 4.

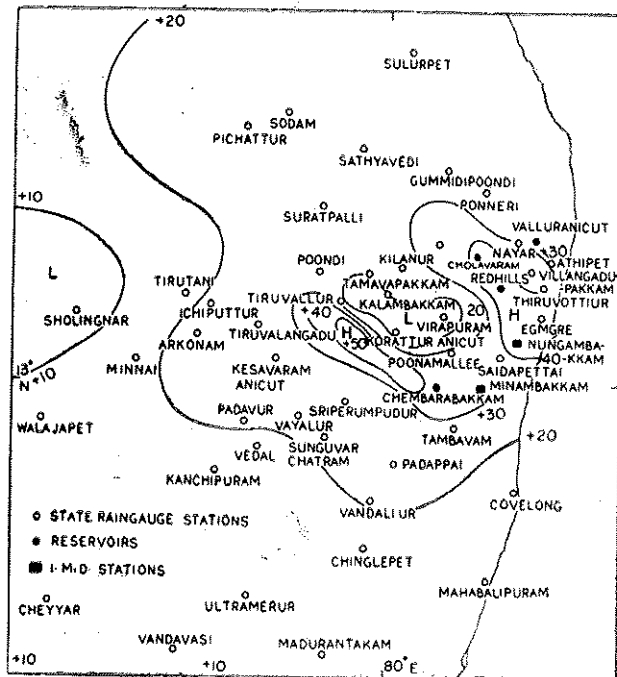


Fig. 3. Rainfall (cm) of 25 November 1976 over Madras and neighbourhood

N. JAYANTHI
A. THULASI DAS

Meteorological Centre, Madras
23 May 1982