A study in spacial and frequency distribution of daily rainfall in relation to network of rain recording stations

P. S. HARIHARAN

Regional Meteorological Centre, Bombay

1. Introduction

The forecasting meteorologist gets only the rainfall reports from the synoptic stations for making an assessment of the rainfall distribution in an area in describing the weather situation. A correct assessment of the past weather situation helps considerably, on many occasions, the forecasting of coming weather. In the case of rainfall, the number of recording stations are many times more than the synoptic stations. The question, therefore, as to how far his assessment of rainfall distribution agrees with the distribution as depicted by the more extensive network of recording stations lurks always in the mind of the forecasting meteorologist. This has also a bearing on the forecasting of weather for agriculturists.

In the two previous papers (Hariharan and Rai Sircar 1954, Hariharan 1956) the author has discussed the results of studies of the optimum number of raingauge stations necessary for a proper appraisal of the character of rainfall in selected localities in India. It has been shown therein how the assessment of spacial distribution of rainfall in an area is affected by the density of network of rain recording stations. A method of determining the optimum network for an area was also indicated.

It was considered desirable to examine the question of gradation of the spacial distribution of rainfall *vis-a-vis* the number of reporting and recording stations in the area from a slightly different point of view. In this note, therefore, the spacial distribution of rainfall of a meteorological sub-division as a whole has been studied comparing the gradations of rainfall distribution as reported by synoptic stations only with such gradations based on a more extensive network of raingauge stations for which data are available.

For describing the rainfall distribution in an area, the India Meteorological Department uses the gradations with criteria as indicated in Table 1.

2. Data

The meteorological sub-division selected for the present study is south Hyderabad, a sub-division without much variation in orographical features and with a fairly good network of synoptic stations as well as rain recording stations. There are six observatories. They are—(1) Gulbarga, (2) Raichur, (3) Hyderabad, (4) Hanamkonda, (5) Mahbubnagar and (6) Khammameth. Besides these, there are 23 raingauge stations the distribution of which as well as the observatories are shown in Fig. 1. The data examined refer to days of monsoon season (June—September) for the 3-year period (1941, 1942 and 1943) consisting of 366 days.

The criteria for the grading of rainfall distribution when reduced to the actual number of observatories and rain recording stations which should have rainfall will be as in Table 2.

The rainfall distribution of each of the 366 days of the above mentioned period has been examined and the rainfall in the sub-division was graded as 'widespread',

Fig. 1. South Hyderabad Meteorological sub-divisions

'fairly widespread', 'local' or 'scattered' as the case may be, first taking into account the incidence of rainfall at the six observatory stations only and then by considering the total network of 29 stations including observatories. The 366 occasions have then been reduced to a frequency table under a two way classification.

3. Spacial distribution of rainfall

Table 3 gives a summary of the classification. The last column in the table gives the classification of the 366 days into different kinds of rainfall distribution considering only the rainfall reported by the synoptic stations and using the criteria mentioned in Table 1.

In the main part of the table is shown how these numbers are modified if we consider the total network of rain recording stations in the meteorological sub-division. For example, there have been 14 occasions when rainfall has been judged as 'widespread' considering only the reports from the six synoptic stations. If we consider the network of all rain recording stations, out of 14, only 4 would have shown 'widespread' rainfall, 9 occasions of 'fairly widespread' and one occasion of 'local' rainfall. It is interesting to see that the greater network naturally brings down the gradation of rainfall in the higher classes and has got the effect of modifying the gradation upward when it comes to the lower grades of classification. The class 'scattered' rainfall seems to be least affected by the network.

TABLE 1

Gradation of rainfall distribution	Criteria for grading
Widespread (W)	Rainfall at all stations in the area
Fairly widespread (FW)	Rainfall at atleast two thirds of the stations
Local (L)	Rainfall at 1/3 of the stations or more but less than 2/3
Scattered (SC)	Rainfall at less than 1/3 of the stations
No rain (NR)	No rain at any station

TABLE 2

Gradation of rainfall distribution	No. of stations which should have had rainfall	
	Observa-tories	Raingauge network*
Widespread (W)	6	29
Fairly widespread (FW)	4 or 5	20–28
Local (L)	2 or 3	10–19
Scattered (SC)	1	1–9
No rain (NR)	0	0

*Including observatories

TABLE 3

		Rainfall gradation as per 29 rain recording stations					Total
		W	FW	L	SC	NR	
Rainfall gradation according to six observatories	Widespread	4	9	1			14
	Fairly wide-spread		19	21	1		41
	Local		9	66	44		119
	Scattered			3	76	—	79
	No rain			1	69	43	113
	Total	4	37	92	190	43	366

TABLE 4

		Mean rainfall gradation according to rain recording stations						Total
		A	B	C	D	E	F	
Rainfall gradation according to observatories	A	70	46	18	6	3	1	144
	B	9	50	25	3	1	1	89
	C	2	11	28	15	5	—	61
	D		2	12	15	6	1	36
	E		—	5	8	5	2	20
	f		1	2	3	7	3	16
Total		81	110	90	50	27	8	366

TABLE 5

Rainfall (in inches) recorded at the various raingauge stations in south Hyderabad when the average rainfall of the sub-divisions was 1″ or more

Station	Dates					
	19-6-42	20-6-42	26-8-42	31-8-43	5-9-43	9-9-43
Gulbarga	0·83	0·24	0·73	0·88	0·32	0·10
Tandur	0·85	0·48	0·34	2·25	2·44	0·66
Yadgir	0·80	0·21	0·36	3·35	0·50	0·33
Navandgi	0·45	0·20	4·50	0·85	1·80	1·00
Janawada	1·80	3·00	0·35	4·60	2·03	1·50
Sultan Bazar	1·09	2·22	0·94	2·30	1·16	1·24
Begumpet	1·33	2·28	0·62	1·18	1·50	0·67
Bulkapur	1·05	3·30	0·42	2·61	2·05	2·59
Gandipet	1·48	2·17	0·45	4·76	1·35	1·30
Himayatsagar	1·10	1·78	0·69	2·20	0·70	1·45
Bolaram	1·59	2·23	0·00	0·26	0·04	0·82
Secunderabad	1·19	2·18	0·73	2·07	1·10	0·75
Mahbubnagar	0·59	1·50	1·05	0·33	2·77	0·48
Nagarkarnool	2·08	2·16	1·50	0·44	1·46	0·26
Wanaparthi Road	0·40	0·00	0·90	0·09	2·40	1·80
Nalgonda	2·63	0·40	1·12	0·19	1·80	1·89
Bhongir	0·94	2·33	0·96	1·90	0·22	1·18
Nagaram	1·85	2·77	1·70	0·90	0·60	1·35
Suriapet	0·88	2·33	3·37	0·79	0·13	1·09
Raichur	0·81	1·31	0·26	1·50	1·13	2·18
Lingsugur	1·43	0·56	0·23	0·53	0·24	1·64
Hanamkonda	0·65	1·09	1·02	0·04	0·49	2·28
Khammameth	0·30	2·25	1·03	0·15	1·45	1·27
Mahbubabad	0·44	0·77	1·35	0·00	0·12	1·33
Mulug	0·41	0·61	1·95	0·00	0·65	2·19
Palair	0·16	0·18	1·55	0·00	0·00	0·67
Wyre	0·43	1·48	1·04	0·05	0·50	1·37
Narasampet	0·40	0·94	2·21	0·00	0·64	2·56
Singareni (Collieries)	1·24	0·07	0·57	0·09	0·20	1·25

4. Frequency distribution of mean precipitation for the sub-division

The average amount of rain for the sub-division for each of the 366 days has been determined (1) by taking the data of six observatories only and (2) by considering the data of all the 29 rain recording stations in the sub-division. Then both the series of means were separately reduced to frequency distribution by classifying them according to limits indicated below—

A	< 10 cents
B	10 — 24 ,,
C	25 — 49 ,,
D	50 — 74 ,,
E	75 — 99 ,,
F	1″ or more

The 366 pairs of means have also been reduced to a frequency table under a two way classification. The results are shown in Table 4.

The main features of this table are—

(a) Out of the 191 occasions when the mean rainfall of the sub-division was less than 25 cents according to the full network, the observatories showed the position in the same category on 175 occasions. Out of the 233 occasions when the observatories showed a mean rainfall of less than 25 cents on 58 occasions, i.e., 25 per cent, there was a higher average rainfall according to the full network.

(b) Considering category C, out of 36 occasions when rainfall was in this category according to observatories, only 15 fall in the same category considering the full network.

14 occasions show lower rainfall and 7 more rainfall.

(c) Considering categories D, E and F the fuller network brings down the gradation of rainfall on more occasions than when it increases. Thus observatories show a mean rainfall of 75 to 99 cents on 20 occasions. Out of these, 13 occasions give less rainfall when we consider full network and only 2 occasions when the full network show higher rainfall.

5. Frequency of heavy rain

A rainfall of 2·5″ or more in a day is taken as heavy for the purpose of description in the various weather reports of the India Meteorological Department. In Table 5 are given the figures of rainfall recorded at the various raingauge stations in south Hyderabad on those occasions when the average rainfall of the sub-division, as a whole, has been 1″ or more. It is seen that even on days when the rainfall is fairly widespread, the number of stations reporting heavy rain (2·5″ or more) is very few. Also on some of these occasions, there are stations in the sub-division recording no rainfall at all. Thus the distribution of heavy rain in south Hyderabad during the monsoon season would appear to be only scattered even on days of fairly widespread rain. Heavy rain occurring at a number of places is perhaps extremely rare.

6. Acknowledgement

REFERENCES

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