

## AVERAGE RAINFALL OF COIMBATORE DISTRICT

V. B. BHANU MURTHY and R. KULANDAIVELU

Wide variations are seen in the occurrence of rainfall and distribution in Coimbatore district. As such arithmetic mean may not represent the average rainfall, so Thiessen-weighted average and Isohyetal average of rainfall were worked out. The arithmetic mean (826.70 mm) was the lowest and the Thiessen weighted average value was increased by about 100 mm. The isohyetal average showed a very high value (1348.05 mm). These variations were due to the non-uniformity in the distribution of rain gauges and also because of steep precipitation gradients. Isohyetal mean which seems to be more representative, should be utilised for hydrological analysis such as surface water, recharge of ground water etc.

The rainfall of any particular area is estimated based on the data collected from rain gauges. The distribution of rain gauges in a district is mostly a random process and do not take into account any criteria. The rainfall pattern also differs widely. Because of the wide variations in the occurrence of rain and also in the distribution of rain gauges, it is not easy to arrive at the average rainfall for a district or a state. The easiest and the common practice of expressing average rainfall is by computing the arithmetic mean. If there are steep precipitation gradients and non-uniform patterns of rain gauges, then the arithmetic mean may not give the correct picture. The Coimbatore district gets the benefit of both S.W and N.E. monsoons and wide variations occur in the rainfall patterns. In view of these variations, the rainfall data of the district was considered for computing Thiessen-weighted average and Isohyetal average in addition to arithmetic mean.

## MATERIALS AND METHODS

In the present Coimbatore district, data are recorded at 16 raingauge stations. The rainfall data for 20 years (1955-56 to 1974-75) for all these stations were considered to study the variations in the occurrence of rain and also in the computation of average rainfall by various means. The rainfall data for these 20 years are presented in Table 1, and the location of the raingauges are shown in Fig. 1. Anamalai, a station located in the hills records highest rainfall. The district consists of hills on the West and South West sides. Stations like Coimbatore, Peelamedu, Suler, Nattakalpalayam and Krishnapuram recorded lower rainfall while Pollachi, Avanashi, Mettupalayam, Annur recorded moderately higher rainfall. Apart from these variations in rainfall, the distribution pattern of rain gauges is also not uniform.

Hence, Thiessen-weighted average and Isohyetal average were wor-

\* Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore-641 003.

Table 1: Year-wise rainfall for all the rain

| Station         | Year | 55—<br>56 | 56—<br>57 | 57—<br>58 | 58—<br>59 | 59—<br>60 | 60—<br>61 | 61—<br>62 | 62—<br>63 | 63—<br>64 |
|-----------------|------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Coimbatore      |      | 264       | 390       | 918       | 318       | 570       | 679       | 673       | 674       | 534       |
| TNAU            |      | 307       | 715       | 920       | 495       | 1014      | 700       | 770       | 715       | 411       |
| Peelamedu       |      | 184       | 670       | 923       | 254       | 645       | 728       | 384       | 548       | 548       |
| P.N. Palayam    |      | 693       | 893       | 1209      | 473       | 702       | 619       | 777       | 758       | 607       |
| Avanashi        |      | 596       | 699       | 888       | 464       | 781       | 613       | 819       | 726       | 627       |
| Annur           |      | 490       | 1992      | 970       | 622       | 841       | 651       | 544       | 706       | 353       |
| Mettupalayam    |      | 615       | 984       | 1176      | 707       | 976       | 1032      | 943       | 1019      | 461       |
| Falladam        |      | 350       | 649       | 533       | 481       | 521       | 450       | 816       | 437       | 482       |
| Tiruppu         |      | 539       | 686       | 733       | 531       | 598       | 677       | 584       | 607       | 565       |
| Sulur           |      | 297       | 525       | 705       | 442       | 370       | 358       | 563       | 364       | 416       |
| Pollachi        |      | 695       | 951       | 1054      | 728       | 1335      | 1165      | 1163      | 1009      | 732       |
| Anamalai        |      | 3460      | 4822      | 3363      | 464       | 5484      | 3719      | 5711      | 3960      | 3152      |
| Nattakalpalayam |      | NA        | NA        | NA        | 471       | 471       | 331       | 468       | 532       | 260       |
| Udumalpet       |      | 494       | 797       | 670       | 406       | 778       | 537       | 609       | 648       | 433       |
| Krishnapuram    |      | NA        | NA        | NA        | NA        | 644       | 457       | 438       | 376       | 339       |
| Amaravathinagar |      | 574       | 616       | 1025      | 411       | 710       | 846       | 740       | 612       | 452       |
| Mean            |      | 684       | 1098      | 1078      | 484       | 1021      | 854       | 1000      | 856       | 649       |

ked out as per the procedure given below.

*Thiessen-weighted average:* A weighing factor is involved that is proportional to the fraction of the total area represented by each gauge. For this, the neighbouring gauges on the map were joined and perpendicular bisectors were drawn with a set of drawing compasses for each line. The bisectors meet to form a polygon around each gauge. The area of each polygon was measured with leaf area meter and expressed as a decimal fraction of the total area. The rainfall at each gauge was multiplied by its appropriate fraction and the products of each gauge

were added to form the Thiessen-weighted average for the whole district.

*Isohyetal average:*

Isohyetal average was obtained by contouring precipitation values. The area between two adjacent contours was then measured with leaf area meter and expressed as a decimal fraction of the total area. The average precipitation for the area between two isohyets is the mean of the isohyetal values and this mean was weighted by the fractional area between the contours. The area weighted precipitation values were then summed to obtain the isohyetal average precipitation for the district. To be more realistic in completing the

gauge stations in the Coimbatore district (mm)

| 64—<br>65 | 65—<br>66 | 66—<br>67 | 67—<br>68 | 68—<br>69 | 69—<br>70 | 70—<br>71 | 71—<br>72 | 72—<br>73 | 73—<br>74 | 74—<br>75 | Mean   |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--------|
| 827       | 544       | 646       | 423       | 333       | 660       | 339       | 567       | 794       | 515       | 362       | 551.4  |
| 830       | 486       | 714       | 421       | 352       | 725       | 395       | 760       | 1034      | 666       | 462       | 644.7  |
| 782       | 436       | 681       | 443       | 283       | 595       | 451       | 655       | 921       | 461       | 377       | 543.4  |
| 1050      | 641       | 910       | NA        | NA        | NA        | NA        | NA        | NA        | NA        | NA        | 778.5  |
| 1093      | 738       | 949       | 469       | 373       | 633       | 636       | 913       | 1099      | 580       | 535       | 714.1  |
| 540       | 592       | 844       | 506       | 418       | 798       | 623       | 750       | 893       | 440       | 590       | 708.2  |
| 1022      | 460       | 1111      | 369       | 623       | 1269      | 494       | 909       | 678       | 462       | 635       | 807.3  |
| 869       | 461       | 706       | 413       | 349       | 517       | 506       | 709       | 648       | 302       | 414       | 530.6  |
| 766       | 367       | 731       | 469       | 422       | 514       | 610       | 734       | 836       | 594       | 456       | 601.0  |
| 627       | NA        | NA        | 190       | 149       | 773       | 484       | 551       | 777       | 529       | 699       | 481.1  |
| 922       | 643       | 872       | 675       | 654       | 809       | 712       | 1138      | 773       | 679       | 756       | 873.2  |
| 4660      | 2578      | 3277      | 3049      | 4136      | 3667      | 3937      | 4143      | 2532      | 3618      | 3770      | 3677.8 |
| 350       | 493       | 497       | 266       | 210       | 413       | 583       | 667       | 436       | 265       | 723       | 413.8  |
| 685       | 440       | 603       | 391       | 560       | 540       | 790       | 787       | 498       | 608       | 426       | 585.3  |
| 433       | 717       | 510       | 322       | 327       | 446       | 574       | 944       | 420       | 511       | 261       | 482.5  |
| 723       | 589       | 1050      | 626       | 332       | 525       | 592       | 1084      | 544       | 458       | 432       | 652.1  |
| 1012      | 679       | 940       | 602       | 634       | 856       | 785       | 1021      | 872       | 712       | 693       |        |

NA = Not available

isohyets, the data from the adjacent stations viz., Sathyamangalam, Kangayam and Dharapuram were utilised.

Thiessen-weighted average was worked out for all the years. The arithmetic mean of each station was utilised for the missing data. Using the arithmetic mean values for all the stations the isohyetal mean for 20 years was determined.

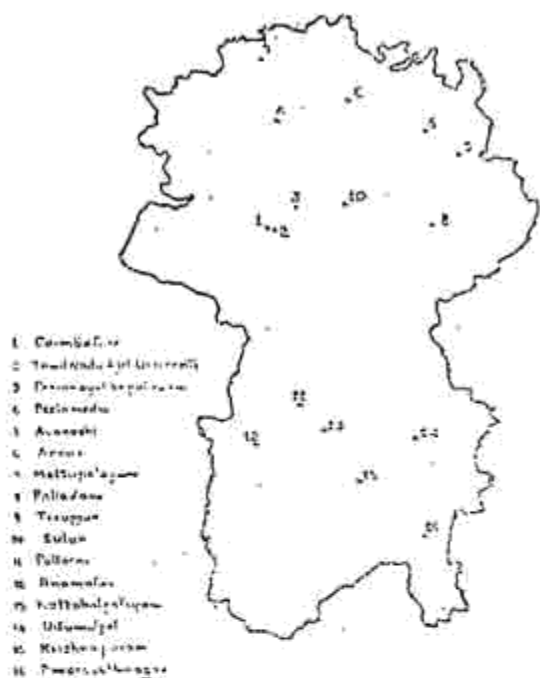
## RESULTS AND DISCUSSION

Fig 2 shows the polygons for Thiessen-weighted average and the fractional area is indicated within the polygon. The year-wise Thiessen-weighted average and arithmetic mean

are presented in Table 2. The 20 years average according to Thiessen-weighted polygons was 910.88 mm whereas the arithmetic mean was worked out to be 826.70 mm. These values when subjected to  $\chi^2$ -test were found to be significantly different from each other.

The variation in the Thiessen weighted average can be attributed to the non-uniformity in the fractional area occupied by each rain gauge. As there are 16 rain gauges in all, each rain gauge is expected to occupy a mean fractional area of 0.062. But the fractional area occupied by the Coimbatore station is as

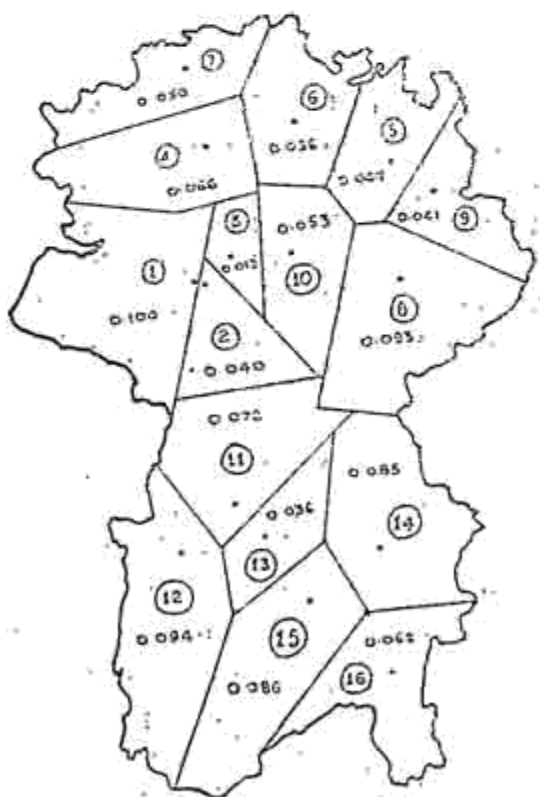
COIMBATORE DISTRICT  
Fig. 1. Location of rain gauges



COIMBATORE DISTRICT  
Fig. 3. Isohyetal map



COIMBATORE DISTRICT  
Fig. 2. Thiessen-weighted polygons



high as 0.100, whereas the Peelamedu, station occupied the lowest fractional area (0.019). The standard deviation (SD) for the fractional areas of polygons was worked out to be  $\pm 0.024$ , and the above values lie outside the limits. The non uniformity in the fractional areas had caused the average rainfall to differ from arithmetic mean. From Fig.1 it can be very well stated that the central part of the Coimbatore district goes without any rain gauge.

The isohyetal map (Fig 3) shows the variations in the occurrence of rainfall and the isohyetal average using 20 years mean data (Table 3) was worked out to be 1348.05 mm as against the arithmetic mean of 826.70 mm. The hilly area where the average rainfall is more than 3500 mm and yet considered as 3500 mm

Table 2: Year-wise arithmetic mean and Thiessen-weighted average of rainfall

| Year    | Arithmetic mean (mm) | Thiessen-weighted average (mm) |
|---------|----------------------|--------------------------------|
| 1955-56 | 684.23               | 755.68                         |
| 1956-57 | 1098.49              | 1133.13                        |
| 1957-58 | 1077.96              | 1067.02                        |
| 1958-59 | 484.53               | 484.13                         |
| 1959-60 | 1021.22              | 1173.49                        |
| 1960-61 | 853.81               | 944.94                         |
| 1961-62 | 1000.19              | 1175.23                        |
| 1962-63 | 856.20               | 955.96                         |
| 1963-64 | 648.67               | 735.51                         |
| 1964-65 | 1012.52              | 1137.46                        |
| 1965-66 | 679.11               | 740.76                         |
| 1966-67 | 940.01               | 983.58                         |
| 1967-68 | 602.18               | 700.04                         |
| 1968-69 | 634.75               | 773.62                         |
| 1969-70 | 856.34               | 938.30                         |
| 1970-71 | 785.14               | 894.82                         |
| 1971-72 | 1020.72              | 1117.16                        |
| 1972-73 | 872.16               | 892.44                         |
| 1973-74 | 712.47               | 816.24                         |
| 1974-75 | 693.27               | 798.01                         |
| Mean    | 826.70               | 910.88                         |

$\chi^2$  - test value = 198.93\*\* Table value at 19 d. f at 0.05 level = 30.14 at 0.01 level = 36.19

alone, occupied a very high fractional area (0.243) of the district. Hence the isohyetal average was enormously high. The district map as drawn by Sivanappan and Aiyasamy (1978) was considered to earmark the hilly area.

The differences in the Thiessen-weighted average and isohyetal mean were again due to the fractional areas. About 0.243 fraction of the total area is constituted by hills

whereas the rain gauge station at Anamalai located in hills represented 0.094 fraction of the total area. Rest of the hilly area got represented by the rain gauges of Coimbatore, Ferianaickenpalayam, Mettupalayam, Krishnapuram and Amaravathinagar stations, which in fact do not represent the rainfall of the hills. As such, the Thiessen-weighted average was lower than the isohyetal mean.

Table 3: Isohyetal average for Coimbatore District

| Isohyetal range<br>(mm) | Average rainfall<br>between isohyets<br>(mm) | Proportion of the area<br>between the isohyets. | Average rainfall (weig-<br>hted by fractional) area |
|-------------------------|--|---|---|
| > 3500                  | 3500   | 0.243   | 850.50  |
| 3000-3500               | 875  | 0.006   | 5.25  |
| 850-800                 | 825  | 0.044   | 36.30   |
| 800-750                 | 775  | 0.100   | 77.50   |
| 750-700                 | 725  | 0.139   | 100.77  |
| 700-650                 | 575  | 0.092   | 62.10   |
| 650-600                 | 650  | 0.021   | 13.65   |
| 600-550                 | 625  | 0.128   | 80.60   |
| 550-500                 | 575  | 0.105   | 60.38   |
| 500-450                 | 550  | 0.040   | 22.00   |
| 450-400                 | 525  | 0.034   | 17.85   |
| 400-350                 | 475  | 0.027   | 12.82   |
| 350-300                 | 425  | 0.021   | 8.93  |
| (< 300)                 |  |   |   |
|                         |  | Total   | 1348.05   |

Under these conditions, arithmetic mean gives a wrong picture, when the entire district is taken as an unit, isohyetal average seems to be more appropriate. Rainfall data is often utilised for various purposes. For the studies related to cropping patterns and cropping systems which are mostly regionally oriented, the arithmetic mean for a particular region can serve the purpose. When rainfall data are used in the estimation of surface water, ground water, recharge of ground water and allied hydrological analysis, it is better to utilise the isohyetal mean, otherwise erroneous conclusions would be drawn if the average rainfall is not correctly chosen.

## REFERENCES

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