551.585 (548.3)

CLIMATIC CLASSIFICATION OF KERALA

Delineating the various climatic profiles with a view to find out the agricultural potential of a region is an important aspect of planning for agricultural development. Koppen (1936), Thornwaite (1948) and Hargreaves (1982) suggested various apriori criteria for the classification of climates. All these methods depend on the choice of an appropriate number of distinguishing traits, usually seasonal rainfall and are often guided by the applications envisaged. A more rational approach to the problem is to identify the major climatic profile of the region on the basis of a few objective indicators and group the micro-climates of the reporting stations into a limited number of homogeneous groups through the technique of statistical clustering. Gadgil and Joshi (1980) used principal component analysis of monthly rainfall data for determining the underlying profile in grouping micro-climates of several reporting stations in India. From the agriculturists point of view, the moisture availability index (MAI) proposed by Hargreaves (1975) is a more dependable criterion in identifying ISO climatic zones than seasonal rainfall. An attempt has been made to delineate the various moisture availability regions of Kerala through the derivation of principal components of monthly moisture availability indices of different reporting stations in Kerala. According to Subramanyam *et al.* (1965) Kerala comes under monsoon climate. Subramanyam and Murthy (1982) opined that the climates of Kerala could be grouped broadly into 2 classes, *viz.*, tropical monsoon and tropical savanna type. According to them a small portion of Kozhikode and Kannur districts, more than 50% of Kottayam and Alleppey districts, and the entire Thiruvananthapuram and Quilon districts come under tropical savanna and the rest of the State under tropical monsoon.

2. *Data and method of study* — Data on monthly rainfall amounts were gathered from 77 reporting stations of Kerala for the period 1901-1980. The maximum assured rainfall received at 75% probability level was calculated from each station at each month. For this the monthly rainfall records for each station were arranged in descending order and each record was assigned with a rank number m corresponding to its position in the array. Every rank order was assigned a probability level F_a (m) as given by $F_a(m) = 100\ m/(n+1)$, where, n=number of records. The rank number which has a probability level 0.75 was calculated. The rainfall record corresponding to this rank order is known as dependable rainfall (PD). Moisture availability index (MAI) was defined by Hargreaves (1975) as MAI=PD/PET, where, PET is the potential evapotranspiration. PET was calculated by the Thornthwaite's method.

In most of the reporting stations the MAI values during January and February were all zeros and hence these months were excluded from the final analysis.

Let X_{ij} denote the MAI at the ith station (i=1,2,..,77) in the jth (j=1, 2, ..., 10) month. Principal component analysis consists in selecting a set of linear combinations is given by :

$$Y_m = \sum_{j=1}^{10} a_{mj}\, x_j'$$

where, Y_m=The mth principal component

(m=1, 2,................10).

a_{mj} = The coefficient of the jth variable (month) for the mth component,

x_j' = Standardised values of the MAI for the jth month.

The coefficients a_{mj}'s are known as eigen vectors with eigen value λ_m. In this study the components which yielded eigen values greater than unity alone were retained (Rao 1954). The per cent variability contributed by the jth components is $\lambda_j/_n$. The component scores of the selected components were determined for each station. The spatial zonification for each component was done on the basis of the relative distance of the station from the centre of gravity (mean). Scores were thus grouped into 3 classes on each component, *viz.*, below A, A to B and above B (A: $\bar{X}-\sigma$, B : $\bar{X}+\sigma$, $\bar{X}$ = Mean, σ = S D).

3. *Results and discussion* — The eigen values and the eigen vectors representing the first three components are given in Table 1. It could be seen that the three components together have contributed as much as 71 per cent of variations in the distribution of MAI at the different centres. The index scores corresponding to each reporting station based on the 3 components were determined. The mean score for each component was found to be zero. The standard deviation of the scores

TABLE 1

Eigen values and eigen vectors of the first 3 principal components

S. No.	Eigen vectors 1	2	3
1	0.2136	0.2808	0.4436
2	0.3928	0.3326	0.0658
3	0.0136	−0.0335	0.5268
4	0.3721	0.3457	−0.9556
5	−0.2249	0.4634	−0.2564
6	−0.4203	0.2342	−0.1969
7	−0.4033	0.3111	−0.1561
8	0.1892	0.5139	0.0297
9	−0.3251	0.2420	0.3910
10	−0.3606	0.0257	0.4795
Eigen value	3.9668	2.5596	1.5814
% variation explained	39.7	25.6	15 8

on the three components were 1.979, 1.596 and 1.594 respectively. The reporting stations were then grouped into 9 clusters, taking into account the distance of each station from the three axes of co-ordinates. The names of stations included in each cluster together with their component scores are given in Table 2.

The reporting station included under each cluster exhibited a high degree of similarity among themselves with regard to the rainfall pattern and moisture availability. This information is helpful in labelling the different clusters. The reporting stations included under cluster 3 clearly indicates the most humid (wet) regime of Kerala with abnormally high monsoon precipitation. Stations included in cluster 4 may be labelled as those belonging to the 'perhumid' zone of Kerala characterised by high annual rainfall and mositure

TABLE 2(a)

List of reporting stations in cluster 1 and the component scores P_1, P_2 and P_3

Station	P_1	P_2	P_3	Station	P_1	P_2	P_3
Karunagappalli	1.98	−0.92	−0.39	Thrissur	−1.31	−0.48	0.02
Kottarakkara	1.98	−0.36	0.17	Chowghat	−1.33	−0.38	0.23
Aryankavu	1.88	0.03	−0.94	Thriprayar	−1.29	−0.39	0.24
Adoor	1.47	−0.23	−0.33	Ottappalam	−1.34	−1.17	0.25
Ambalapuzha	1.71	0.01	−0.96	Cherpulacherry	−1.26	−1.24	0.96
Changannur	1.79	0.70	−0.66	Mannarghat	−1.62	−0.85	0.27
Harippadu	1.67	0.02	−0.94	Parli	−1.34	−1.17	0.69
Mavelikkara	1.84	0.64	−1.30	Perinthalamanna	−1.61	−1.17	0.48
Kayamkulam	1.77	−0.68	−0.69	Ponnani	−1.15	−0.71	0.39
Ettumannoor	1.97	0.14	−1.33	Thirurangadi	−1.09	−0.92	0.29
Kottayam	1.74	0.49	0.64	Nilambur	−1.16	−1.23	0.29
Chenganachery	1.85	0.47	−1.05	Calicut	−1.62	−0.53	0.01
Vandannedu	1.43	1.23	−1.16	Quilondi	−1.35	−0.6	0.30
Malayattur	−1.57	0.61	1.36	Badakara	−1.51	−0.36	−0.54
Parur	−0.73	−0.92	0.24	Thalasseri	−1.24	−0.53	−0.38
Perumbavoor	−1.78	0.18	0.83	Kannur	−1.32	−0.46	0.24
Ernakulam	−1.08	−0.23	0.87	Payyannur	−1.73	0.01	−0.74
Alwaye	−1.55	−0.34	0.48	Hosdrug	−1.76	0.17	−0.76
Crangannore	−0.96	−0.34	0.23	Kasaragod	−1.79	0.26	−0.75
Mukundapuram	−1.08	−0.71	0.02	Thiruvalla	−1.67	−0.03	−1.13
Thalappalli	−1.24	−1.12	0.22	Manjeri	−1.45	−0.91	0.39
Ollukkara	−0.93	−1.18	0.01				

TABLE 2 (b)

List of reporting stations in clusters 2-9 and the component scores P_1, P_2 and P_3

Cluster No.	Station	P_1	P_2	P_3
2	Arukkutty	1.77	0.37	−2.28
	Shertallai	1.64	−0.20	−1.66
	Alleppey	1.47	−0.13	−1.66
	Velur	−0.95	0.22	3.22
	Kumuli	−0.81	−1.47	7.86
3	Vytheri	−5.54	4.08	−0.77
	Kuttiyadi	−3.46	1.41	0.06
	Peerumadu	−5.26	5.38	0.40
4	Karikode	−2.56	−1.11	1.58
	Irikkur	−2.30	0.25	−0.24
	Thaliparamba	−1.93	−0.02	−0.39
	Muvattupuzha	−2.15	0.24	0.35
5	Munnar	0.87	5.36	5.02
	Devikulam	1.48	3.77	3.42
6	Pattanamthitta	2.66	1.58	0.36
	Ponmudi	2.23	3.80	−1.42
	Konni	3.10	2.03	0.47
	Kanjirappalli	3.31	3.53	0.64
	Palai	2.48	2.29	−0.13
7	Varkala	2.02	−1.31	−0.22
	Attingal	2.08	−1.44	−0.41
	Nedumangadu	2.29	−0.51	0.87
	Thiruvanthapuram	2.00	−1.47	0.39
	Punalur	1.97	−0.36	−0.63
	Quilon	2.29	−0.85	−0.93
	Nilamel	2.90	−0.40	−0.74
	Vaikom	2.29	0.31	−0.99
	Paravur	2.08	−1.44	−0.64
8	Chinnar	1.42	−1.33	0.76
	Marayur	0.80	−1.48	1.03
	Alathur	−1.20	−1.07	0.67
	Palghat	−1.19	−1.17	0.62
	Chittoor	−0.24	−2.32	0.50
9	Santhanpara	−2.54	−1.01	4.46

availability. The uplands of Pathanamthitta, Thiruvananthapuram and Kottayam districts are included in another cluster (cluster 6) having some degree of similarity with the 'perhumid' region. Cluster 7 indicates the semi-dry tract of Kerala comprising of the major parts of Thiruvananthapuram and Quilon districts and the Vaikom area in Ernakulam district. Cluster 8 may be labelled as the 'dry tract' consisting mainly parts of Udumpanchola taluk in Idukki district and Chittoor, Alathur and Palghat taluks in the Palghat district. Reporting stations belonging to cluster 1 are characterised by the normal monsoon climate of Kerala and can be labelled as the 'humid' tract of Kerala. Santhanpara constitutes the sole reporting station included in cluster 9.

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