Journal of Agrometeorology 9(2) : 209 - 215 (Dec. 2007)

Rainfall analysis and crop planning for the Nilgiris

K.MANORAMA, G.RAVICHANDRAN and T.A.JOSEPH
Central Potato Research Station, Muthorai, The Nilgiris - 643004

ABSTRACT

Thirty years of time series data on rainfall was analysed for Nilgiris using coefficient of variation, and probability to have an appropriate crop planning for the region. Through this analysis the crop period could be identified and it was found that two crops are possible every year under rainfed conditions with judicial planning for the same.

Key words : Rainfall, coefficient of variation, probability, crop planning

The Nilgiris district which forms a part of Tamilnadu state differes greatly from the other parts of the state with regard to agro-climatic conditions, economy, population, land use and history (Azariah, 1986). The district consists of four blocks, Ootacamund, Kotagiri, Coonoor and Gudalur. The entire district is hilly with the blocks of Ootacamund, Kotagiri and Coonoor at an altitude of 1500 to 2500m above mean sea level. The elevation of Gudalur block is around 1000m. Rainfall plays a major role in the agricultural economy of the Nilgiris, which is blessed with a unique agroclimatic condition, where the rainfall is distributed almost uniformly throughout the year. It falls under high rainfall zone of Tamil Nadu. The annual rainfall of Nilgiri plateau ranges between 3000mm along the western slopes to about 1200mm in the interior regions (Von Lengerke, 1977). The predominant soil type of the district is laterite. Analyzing the rainfall of the region season wise, month wise and standard week wise would give a better picture about its pattern and thereby help in planning the crop operations.

The product obtained from past climate data analysis helps to improve agricultural production in many ways viz., through designing effective cropping systems, planting of crops at appropriate time, selection of crops, introducing new crops (Veeraputhiran *et al.*, 2003). Hence, an attempt was made to analyse the rainfall pattern of the region using 30 years of time series data.

MATERIALS AND METHODS

For analyzing the rainfall distribution pattern of the region, the following three parameters were used for the time series data of 30 years (1971 to 2000). The rainfall data was collected from Central Soil and Water Conservation Research and Training Institute sub centre, Ooty.

Coefficient of variation

It measuresthe variability of rainfall. This measure is indicative of dependability

of rainfall expressed in percentage.

The threshold levels for CV for any interpretation are

Yearly rainfall	:<25%
Weekly rainfall	:<150%
Seasonal rainfall	:<50%
Daily rainfall	:<250%
Monthly rainfall	:<100%

If CV is within the threshold limits of variability, it is considered that the rainfall is dependable (Veeraputhiran *et al*., 2003)

Initial probability

The minimum quantity of rainfall to be expected for a particular time series data was computed by arranging the time series data in descending order. In present analysis the sample size n = 30. Depending upon the probability required p at 30, 50 or 75% can be as follows:

For example :

$$IP_{(30)} = \frac{30 \times 30}{100} = 9$$

$$IP_{(50)} = \frac{30 \times 50}{100} = 15$$

$$IP_{(75)} = \frac{30 \times 75}{100} = 23$$

That means for this data series when arranged in descending order, the 9th value represents 30% probability, 15th value represents 50% probability and 23rd value represents 75% probability. It was calculated for annual, seasonal, monthly and weekly rainfall series.

Probability of getting certain amount of rainfall

The probability level at which a certain quantity of rainfall is anticipated for a particular place over a specified time series data was worked out for annual, seasonal, monthly and weekly rainfall series in the present study.

It was worked out by

$$Z = \frac{\overline{X} - X}{SD}$$

Where,

$\overline{X}$: Mean rainfall for a particular period (mm)

X : Required level of rainfall (mm)

SD : Standard deviation of dataset

The calculated value is to be referred to normal probability Z table and multiplied by 100 to find out the actual probability in percentage. More than 60% probability can be used for crop planning.

RESULTS AND DISCUSSION

Annual rainfall

For Nilgiris, by analyzing 30 years of rainfall data (from 1971 to 2000), the coefficient of variation was found to be 19.8 which indicates that occurrence of mean annual rainfall is highly dependable and the variation is very minimal. The mean annual

Table 1: Probability analysis of annual rainfall in Nilgiris

Rainfall (mm)	1000	1200	1400	1600
Probability (%)	83	56	25	7

Table 2: Seasonal rainfall (mm) analysis in Nilgiris

Season	Probability level			SD	Mean rainfall	CV (%)
	30%	50%	75%			
Winter (Jan-Feb)	25	12	2	23	19	123
Summer (Mar-May)	214	183	147	64	191	33
SWM (June-Sep)	857	671	511	201	673	30
NEM (Oct-Dec)	437	357	236	136	349	39

rainfall of the region is 1239 mm. The initial probability of mean annual rainfall at 75, 50 and 30% levels were 1032.9, 1245.5 and 1364 mm respectively. The 50% probability level is more or less akin to that of mean annual rainfall indicating the possibility of occurrence of this much quantity in alternate years.

The probability of getting annual rainfall of 1000mm is 83.4% and 1200mm is 56.4%. however, the probability of getting 1400mm annual rainfall is 25% i.e., once in four years. From the above analysis, it is observed that an average annual rainfall of 1200mm is possible in Nilgiris in every alternate year.

Seasonal rainfall

The seasonal rainfall analysis of the region indicates the possibility of dependable rainfall during summer, southwest monsoon season and northeast monsoon seasons. However, winter rainfall is not dependable as its CV is very high (threshold level 50%). The variability is very high in winter and very low in SWM season and successful crop production is possible in this season. This is followed by NEM season where it is possible to grow short duration crops. Generally, cropping season starts here in the month of April (i.e., summer) hence, farmers are able to harvest two successive crops under rainfed conditions. With irrigation facility, third crop is also possible during winter season.

During SWM season, 671 mm of rainfall is possible at 50% level of probability i.e., during alternate years which is as good as the average (673 mm) rainfall of the season. Similarly, during NEM season also at 50% probability 356.8 mm rainfall is predicted. Hence, growing crops during these two seasons is highly dependable in

Table 3: Probability analysis of seasonal rainfall in the Nilgiris

Season	Probability (%) of getting different amount of rainfall				
Winter	10mm	25mm	50mm		
	65	39	1		
Summer	50mm	100mm	150mm	200mm	
	99	92.4	73.9	44.4	
SWM	400mm	500mm	600mm	700mm	800mm
	91.8	81	65	46	27
NEM	250mm	300mm	350mm	400mm	450mm
	77	64	46	35	23

Table 4: Expected amount of rainfall at different probability levels in the Nilgiris

Month	Probability levels			SD	Mean. rainfall	CV (%)
	30%	50%	75%			
January	9	5	0	11	8	146
February	8	2	0	18	11	168
March	19	15	1	28	20	141
April	68	56	3	37	59	62
May	125	103	72	58	112	52
June	182	153	117	92	163	57
July	242	167	113	119	200	60
August	173	128	92	79	142	56
September	205	153	103	74	168	44
October	211	171	119	67	162	41
November	184	95	49	123	138	89
December	77	30	9	51	48	105

the Nilgiris region.

Monthly rainfall

The CV of four months i.e., December to March is higher than the threshold level (100%), highest being in February followed by January and March indicating higher variation in rainfall in these winter months. Lowest CV was recorded in October, September, May and August showing lesser variation in these months.

At 50% probability the rainfall amount was closer to that of average rainfall in each of the months of April to October. As variation in rainfall is less during these months, agricultural crop planning is more appropriate.

The probability of receiving 200mm rainfall is possible in September and July months only. Up to 150mm rainfall can be

Table 5: Probability analysis of monthly rainfall in Nilgiris

Month	Probability (%) of getting different amounts of rainfall in a month								
	5mm	10mm	15mm	20mm	25mm	50mm	100mm	150mm	200mm
January	59	42	26	14	6	0	0	0	0
February	63	52	41	31	22	2	0	0	0
March	70	64	57	24	42	14	0	0	0
April	93	91	89	86	82	60	13	1	0
May	97	96	95	94	93	86	58	25	6
June	100	95	94	94	93	89	75	56	34
July	75	94	94	93	93	97	90	74	50
August	96	95	94	94	93	88	70	46	23
September	99	98	98	98	97	94	82	60	67
October	99	99	99	98	98	95	82	57	28
November	86	85	84	83	82	76	62	54	31
December	80	78	74	71	68	50	17	2	0

expected from June to November in alternate years. In May and November 100mm rainfall is expected in alternate years and with more than 70% probability from June to October.

Weekly rainfall

The CV was less than 150% (threshold level) in 39, 40, 41, 45 and 29th weeks. Hence, high rainfall can be expected during 39, 40 and 41st weeks which fall under NEM season. Probability analysis suggests that a heavy rainfall of 25mm per week is possible during 23 to 30 and 36, 38 to 42, 44, 45, and 47th standard weeks except during 31 to 35 standard weeks. About 10mm per week is expected from 15th to 48th standard week every alternate year. Among all the standard weeks 39th is the wettest week with low CV which coincides with 24th to 30th September. This shows that a successful crop rotation is possible in this period of 30/31 weeks which coincides with summer, SWM and NEM seasons.

Crop planning

Out of the total cultivable area of 12,000ha in Nilgiris, 25% is under crops like potato, cabbage, carrot, radish and other vegetables. Remaining area is under tea, coffee and mandarin oranges. As per the rainfall analysis of past 30 years, it is observed that there is about 30 to 31 weeks of cropping period available with a minimum of 5mm rainfall per week. This makes the crop planning easier for the region under rainfed conditions. Farmers of the region can harvest two crops in a year under rainfed conditions. In addition, third crop is possible in certain locations having irrigation facilities.

Hence, planting of crops like potato, cabbage, carrot etc. can be taken up in the third week of April and the second crop can be planted at the end of August by rotating among these vegetables.

Table 6: Weekly rainfall analysis of time series data (1971 to 2000) for Nilgiris

St. wk.	Probability levels			Rainfall			Probability (%) of getting rainfall of				
	30%	50%	75%	SD	Av. (mm)	CV (%)	5mm	10mm	15mm	20mm	25mm
1	0	0	0	2	0.7	261	1	0	0	0	0
2	0	0	0	5	2.2	241	30	7	1	0	0
3	0	0	0	7	2.6	282	37	15	41	1	0
4	0	0	0	2	0.3	548	0	0	0	0	0
5	0	0	0	1	0.2	478	0	0	0	0	0
6	0	0	0	5	2.2	244	30	7	1	0	0
7	0	0	0	7	2.1	322	33	12	3	0	0
8	0	0	0	5	1.8	261	25	4	0	0	0
9	0	0	0	7	2.9	244	38	16	4	1	0
10	0	0	0	16	4.2	392	48	36	25	17	10
11	0	0	0	5	2.2	217	21	5	0	0	0
12	0	0	0	10	3.4	302	44	26	13	6	0
13	3	0	0	10	5.0	200	49	0	16	7	2
14	8	4	0	11	8.3	141	61	44	28	16	8
15	14	4	0	14	10.1	138	64	53	36	22	14
16	14	7	0	17	11.4	150	64	53	42	30	21
17	19	6	2	14	12.7	107	71	58	44	70	8
18	15	10	3	23	18.1	128	72	64	55	47	38
19	13	9	1	11	10.9	99	71	53	35	20	9
20	12	9	4	16	13.0	120	69	57	45	33	22
21	31	11	0	26	21.6	121	74	67	60	52	45
22	24	12	2	14	15.1	95	78	64	50	37	24
23	33	11	5	48	29.9	162	70	66	62	58	54
24	31	16	6	38	25.9	148	70	66	61	56	51
25	23	11	4	61	32.6	186	68	64	61	58	55
26	28	14	5	34	27.3	126	74	69	64	58	53
27	23	14	4	18	19.1	96	78	69	59	48	37
28	29	14	4	48	30.9	157	70	67	63	59	55
29	36	9	4	43	30.1	143	72	68	64	60	55
30	30	12	5	64	37.5	171	69	67	64	61	58
31	22	13	6	28	21.5	131	72	66	59	52	45
32	16	8	5	27	18.5	145	69	63	55	48	40
33	35	12	5	23	24.0	97	96	73	65	57	48
34	15	11	2	26	19.2	138	70	64	56	49	41
35	25	12	4	22	18.0	120	73	64	66	42	37
36	14	10	3	68	27.5	247	63	60	57	54	52
37	17	6	1	19	14.5	132	69	60	49	39	29
38	32	14	3	38	28.3	135	73	68	64	59	54
39	67	27	5	46	40.0	114	78	74	71	67	63
40	44	21	6	35	32.4	108	78	74	69	64	58
41	49	28	9	30	33.5	90	83	78	73	67	61
42	38	24	2	27	26.5	100	79	73	67	59	52
43	29	10	6	31	23.3	132	72	67	61	54	47
44	29	8	2	38	27.2	140	72	67	63	57	52
45	51	22	4	31	30.7	102	79	74	69	63	57
46	19	6	0	47	22.4	209	64	60	56	52	47
47	20	2	0	24	15.1	162	66	58	50	42	66
48	6	1	0	34	13.8	244	60	54	42	42	37
49	3	1	0	15	6.3	241	53	40	28	18	11
50	4	0	0	15	9.1	165	61	48	35	24	15
51	2	0	0	6	2.9	213	36	13	2	0	0
52	5	0	0	14	7.4	187	57	43	43	18	10

ACKNOWLEDGEMENT

The authors thankfully acknowledge Central Soil and Water Conservation Research and Training Institute Regional Centre, Ooty for providing the rainfall data.

REFERENCES

Azariah, M.D.1986. General Features and Seasons. Book : A Complete Guide To Potato Farming. Published by United Printers, Madurai. Pp: 13 – 22.

Veeraputhiran, R., Karthikeyan, R., Geethalakshmi, V., Selvaraju, R., Sundersingh, S.D. and Balasubramanian, T.N. 2003. Crop planning-Climate Atlas. Pub. byA.E.Publications, Coimbatore. Pp : 1-45.

Von Lengerke, H. J.1977. The Nilgiris – Weather and Climate of a mountain area in South India (Wiesbaden : Franz Steiner Verlag) {Geeta Rajagopalan, Ramesh, R and Sukumar, R. Climatic implications of $d^{13}C$ and $d^{18}O$ ratios from C3 and C4 plants growing in a tropical montane habitat in southern India.