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A climatic assessment of crop potential in Andhra Pradesh

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सार — आंध्र प्रदेश में कुछ चुने हुए स्थानों के लिए वर्षा सिंचित स्थितियों के अन्तर्गत सस्य संभाव्यता का आकलन किया गया जो आर्द्रता उपलब्धता सूचकांक (आ० उ० सू०) तथा संगृहीत मृदा आर्द्रता (सं० मृ० आ०) पर आधारित था। फिर आ० उ० सू० का उपयोग करके विभिन्न अवधियों की फसल तथा बीज बोने की अनुकूलतम तिथियां मालूम की गईं। पता चला कि निजामाबाद जिले का सस्य सम्भाव्यता उच्चतम थी और अनन्तपुर जिले की सबसे कम। आमतौर पर यह देखा गया कि आंध्र प्रदेश में तेलंगाना के तटीय और उत्तरी जिलों में शेष जिलों से अधिक सस्य संभाव्यता है।

ABSTRACT. Crop potential under rainfed conditions based on Moisture Availability Index (MAI) and Stored Soil Moisture (SSM) was assessed for selected stations in Andhra Pradesh. Using MAI, crops of different durations and optimum dates of sowing are indicated. Nizamabad district has the highest crop potential and Anantapur district has the lowest crop potential. In general, coastal districts and northern districts of Telangana have higher crop potential than the remaining districts of Andhra Pradesh.

1. Introduction

The overall strategy of agriculture is to provide a system for maximum production per unit area. To achieve this objective, man tries to interfere with the natural system in a number of ways like selection of crop variety and season, irrigation, fertilizers etc. The kind of crop that will do best in any given habitat will be primarily determined by climate, the soil type and moisture availability. The natural source of moisture supply is rainfall which is a major constraint in semi-arid areas for crop production.

Agricultural planning based on monthly/annual totals of rainfall alone or other agricutural indices derived from monthly totals, used to express moisture adequacy will lead to misleading results. The tracts classified as arid/semi-arid by normal agroclimatic classification include some of the best agricultural areas in India where a variety of crops like jowar, bajra, groundnut, cotton and tobacco are grown (Raman and Murthy 1971). Thus normal agroclimatic classification based on the techniques such as the Thornthwaite and Mather (1955) fail to bring out the optimum crop potential at a place. The interval chosen in normal agroclimatic classification is also long compared to the life cycle of the present crop varieties. Hence a shorter interval such as a week is preferable for studying the moisture adequacy during various stages of crop growth.

The present day forming requires heavy investments and hence agricultural planning has to be based on calculated risks and advantages. In order to minimise risks, weekly data on minimum assured rainfall in the probability range of 10 to 90 per cent and potential evaportranspiration (PET) are needed to study whether water needs of crops are met to the required optimum extent at various stages of crop growth. Thus a study of assured weekly rainfall in relation to weekly potential evapotranspiration will help in developing a moisture availability index which can be used to express moisture adequacy for maximum crop production. Using the above concepts, Murthy (1973), Virmani (1975) and Sarker and Biswas (1980) carried detailed studies in India.

In the present investigation, an attempt is made to assess the crop potential under rainfed conditions in some selected districts of Andhra Pradesh where the semi-arid areas is about 75 per cent as per revised agroclimatic classification of Thornthwaite and Mather (Subba Rao 1981).

2. Materials and methods

Hargreaves (1971) defined a moisture availability index (MAI) as the ratio of monthly dependable precipitation at the 75 per cent probability level to the monthly PET. He introduced the risk factor which is quite relevant to the present day farming. According

TABLE 1(a)

Moisture availability index at (1) 30 per cent (2) 50 per cent, and (3) 70 per cent probability levels

Std. wk.	Visakhapatnam			Kakinada			Machilipatnam			Ongole			Nellore			Kurnool		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
23	0.68	0.29	0.06	0.46	0.12	—	0.50	0.20	—	0.20	0.02	—	0.17	0.02	—	0.67	0.33	0.13
24	0.83	0.36	0.07	0.85	0.41	0.15	0.49	0.21	0.05	0.43	0.15	—	0.23	0.08	—	0.40	0.15	0.04
25	1.17	0.55	0.17	0.97	0.53	0.24	0.90	0.56	0.29	0.46	0.23	—	0.37	0.13	—	0.51	0.28	0.12
26	1.32	0.75	0.36	1.28	0.69	0.33	1.00	0.53	0.47	0.38	0.14	—	0.35	0.16	0.08	0.59	0.34	0.17
27	1.37	0.74	0.33	1.56	0.97	0.56	1.42	0.86	0.47	0.63	0.26	0.06	0.50	0.22	0.06	0.60	0.30	0.13
28	1.15	0.62	0.26	1.56	0.94	0.50	1.52	0.91	0.45	0.68	0.29	0.06	0.46	0.20	0.06	0.79	0.45	0.21
29	1.26	0.74	0.37	1.61	1.00	0.55	1.88	1.13	0.59	0.81	0.32	—	0.71	0.38	0.15	0.97	0.55	0.28
30	1.19	0.67	0.33	2.17	1.43	0.90	1.77	1.10	0.58	0.72	0.37	0.16	0.67	0.33	0.15	1.19	0.72	0.42
31	1.26	0.67	0.30	1.80	1.03	0.50	1.39	0.84	0.48	0.76	0.36	0.12	0.55	0.24	0.09	1.00	0.61	0.33
32	1.04	0.56	0.22	1.43	0.80	0.37	1.16	0.65	0.29	0.52	0.21	—	0.59	0.26	0.09	0.66	0.37	0.17
33	0.93	0.52	0.26	1.47	0.63	0.29	1.45	0.81	0.39	0.88	0.37	0.03	0.68	0.30	0.06	0.89	0.43	0.17
34	2.48	0.89	0.37	1.40	0.83	0.43	1.57	0.90	0.47	0.94	0.39	0.13	0.85	0.32	0.09	1.00	0.46	0.14
35	1.88	0.85	0.42	1.28	0.72	0.34	1.97	1.20	0.67	0.94	0.45	0.13	0.65	0.32	0.09	0.91	0.44	0.18
36	2.27	0.85	0.42	1.17	0.59	0.26	1.62	0.90	0.45	1.00	0.53	0.23	0.88	0.33	—	1.00	0.48	0.15
37	2.54	1.11	0.58	1.57	0.96	0.50	1.41	0.79	0.34	1.31	0.72	0.28	1.09	0.48	0.09	1.00	0.47	0.16
38	2.96	1.20	0.56	1.46	0.86	0.43	1.71	0.93	0.43	1.86	0.93	0.32	0.97	0.44	0.09	1.68	0.87	0.35
39	3.44	1.28	0.56	2.39	1.25	0.57	2.11	1.14	0.57	1.48	0.92	0.52	1.06	0.48	0.13	1.53	0.87	0.43
40	2.96	0.76	0.16	2.39	1.14	0.39	1.75	0.86	0.29	1.50	0.61	0.08	1.17	0.45	—	0.66	0.24	—
41	3.48	1.24	0.44	1.75	0.75	0.21	2.15	0.93	0.19	1.88	0.80	0.16	1.68	0.61	—	0.79	0.34	—
42	4.04	1.00	—	2.43	0.93	—	2.81	1.22	0.37	2.58	0.83	—	3.11	1.12	—	0.86	0.31	—
43	3.21	0.54	—	2.37	0.77	—	2.08	0.54	—	2.58	0.96	—	3.36	1.44	0.28	—	—	—
44	3.08	0.21	—	2.30	0.59	—	2.58	0.88	—	2.63	1.04	0.16	4.63	2.21	0.71	—	—	—
45	—	—	—	1.58	0.27	—	1.88	0.40	—	2.71	0.67	—	4.70	1.83	0.39	—	—	—
46	—	—	—	—	—	—	—	—	—	1.67	0.25	—	3.57	1.39	—	—	—	—
47	—	—	—	—	—	—	—	—	—	—	—	—	2.35	0.65	—	—	—	—
48	—	—	—	—	—	—	—	—	—	—	—	—	1.73	0.36	—	—	—	—

TABLE 1 (b)

Moisture availability index at (1) 30%, (2) 50% and (3) 70% probability levels

Std. wk.	Cuddapah			Anantapur			Nizamabad			Hanamkonda			Hyderabad			Mahabubnagar		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
23	0.52	0.26	0.07	0.58	0.23	0.05	0.48	0.19	—	0.50	0.19	0.04	0.43	0.17	0.09	0.85	0.41	0.10
24	0.60	0.25	0.03	0.14	—	—	0.68	0.32	0.10	0.77	0.39	0.14	0.53	0.29	0.04	0.70	0.30	0.07
25	0.47	0.21	0.05	0.17	0.05	—	1.71	1.05	0.58	0.85	0.80	0.44	0.95	0.54	0.22	1.15	0.62	0.15
26	0.62	0.30	0.08	0.40	0.17	0.03	2.06	1.17	0.58	1.76	1.08	0.58	1.21	0.71	0.45	1.53	0.94	0.53
27	0.69	0.33	0.11	0.24	0.08	—	2.24	1.35	0.74	1.71	1.06	0.57	1.18	0.68	0.41	1.37	0.83	0.47
28	0.79	0.32	0.06	0.32	0.11	—	2.50	1.63	1.00	2.03	1.16	0.56	1.32	0.71	0.52	1.76	1.07	0.55
29	1.00	0.47	0.16	0.56	0.19	—	3.11	1.93	1.07	2.07	1.27	0.73	1.68	0.97	0.65	2.19	1.33	0.74
30	1.22	0.59	0.19	0.47	0.17	—	3.14	2.11	1.32	2.50	1.53	0.87	1.81	1.13	0.74	2.33	1.48	0.85
31	0.81	0.34	0.09	0.47	0.14	—	2.96	1.93	1.21	1.67	1.17	0.67	1.55	0.97	0.45	1.89	1.07	0.52
32	0.91	0.44	0.13	0.23	—	—	2.21	1.28	0.64	1.57	0.83	0.40	1.03	0.55	0.32	1.44	0.78	0.37
33	1.19	0.56	0.19	0.60	0.20	—	2.11	1.28	0.71	1.60	0.87	0.40	1.12	0.61	0.33	1.74	0.96	0.41
34	1.25	0.53	0.13	0.74	0.18	—	2.89	1.64	0.82	1.73	0.87	0.33	1.40	0.67	0.27	1.81	0.93	0.30
35	1.03	0.55	0.23	0.62	0.21	—	2.11	1.18	0.54	1.62	1.00	0.52	1.48	0.79	0.24	1.48	0.74	0.26
36	1.16	0.52	0.10	0.55	0.21	—	2.46	1.43	0.71	2.17	1.14	0.48	1.68	0.89	0.50	2.08	1.15	0.54
37	1.10	0.48	0.13	0.94	0.27	—	2.46	1.28	0.50	1.93	1.03	0.46	1.75	0.86	0.36	1.88	0.92	0.38
38	1.84	0.84	0.26	2.00	0.84	0.22	2.22	1.15	0.44	2.29	1.21	0.14	2.04	1.11	0.63	2.19	1.27	0.65
39	1.83	0.97	0.40	1.57	0.73	0.27	1.89	0.85	0.19	1.24	0.52	0.10	1.70	0.78	0.48	2.23	1.19	0.50
40	0.93	0.45	0.14	1.17	0.52	—	0.89	0.18	—	0.83	0.24	—	0.64	0.21	—	1.15	0.38	—
41	1.36	0.53	0.11	1.43	0.53	—	0.33	—	—	0.62	0.14	—	0.61	0.11	—	0.50	0.11	—
42	1.18	0.46	—	0.61	0.21	—	0.30	—	—	0.62	0.07	—	0.59	—	—	0.58	0.15	—

to Hargreaves, an index value less than 0.34 is not suitable for rainfed agriculture. A value of 1.00 means that the dependable precipitation equals the PET. However, the probability level appears to be high. The period, one month, is also too long for many present day crops.

Sarker and Biswas (1980) suggested the following modifications to Hargeaves's method :

(*i*) Consider the weekly MAI rather than monthly.

(*ii*) Consider 50 per cent probability level since the minimum assured rainfall data at this level indicates a chance of agricultural success higher than 50 per cent and

(*iii*) Consider MAI $\geqslant 0.3$ and $\geqslant 0.7$ depending upon the crop growth stage instead of MAI values $\geqslant 0.34$.

The authors have also suggested the following criteria for agroclimatic zoning :

Zone	*Crop potential*	*Number of weeks of MAI* $\geqslant 0.3$	$\geqslant 0.7$
D	Very low	<10	<1
E	Low	>10	>1
F	Moderate	>11	>4
G	High	>14	>7

Any water stress periods (when MAI < 0.3) during the growing season are designated with a suffix to the above classification. Suffix 1 indicates that there is hardly one week's water stress while suffixes 2, 3 and 4 indicate 2 to 3 weeks', 4 to 5 weeks' and more than 5 weeks' water stress respectively. Stored Soil Moisture (SSM) was not taken into account by them.

2.1. *Optimum dates of sowing*

In the low rainfall tracts, there is considerable variability in the annual rainfall and wide variation in the distribution of weekly rainfall. Hence it may be expected that the incidence of spells of inadequate rainfall and water availability can be frequent in these tracts. A non-growth spell (MAI < 0.3) of duration 3 weeks or longer can be detrimental to crop growth (Murthy 1973). Such spells are likely to occur more frequently in areas where the water holding capacity of the soils is low. If such non-growth spells occur immediately after sowing, the crop may not be able to establish itself. It is, therefore, necessary to select a sowing week which will be followed by weeks having assured rainfall. It will, however, be modified by the duration of the crop which has to escape the last rainy month for harvest. In the present investigation, a week with MAI $\geqslant 0.3$ in the beginning of the season is considered as optimum date of sowing.

2.2. *Selection of crops*

Since the crop production depends upon the moisture availability at various stages of crop growth, a crop of particular duration has to be matched to the moisture availability indices.

Hargreves and Christiansen (1974) and Hargreaves (1975) reported that the ratio of actual evapotranspiration (AET) to PET varies between 0.2 & 0.8.

Hence in the present investigation, MAI values greater than 0.3, 0.5, 0.7, 0.5, 0.3 are considered during seedling, vegetative, flowering and reproduction, physiological maturity and harvest stages of crop growth respectively for selection of crops of various durations.

2.3. *Data*

The following data are used :

(*i*) Weekly assured rainfall at 30, 50, and 70 per cent probability computed by Sarker *et al.* (1978) and Biswas and Khambete (1980).

(*ii*) Soils as reported in the NARP report of APAU (1978),

(*iii*) Weekly PET obtained by suitable interpolation of the monthly average PET computed by Rao *et al.* (1971),

(*iv*) Weather hazards as reported in climate of Andhra Pradesh (1975), and

(*v*) Stored soil moisture (in a soil column of 1 metre deep) as determined by Subba Rao (1981) on monthly basis.

For maximum yields, crops most suited to particular environment in terms of moisture adequacy, temperature, radiation, length of growing season, temperature range etc, are to be considered.

The mean maximum temperature in the State varies from about 28 deg. C in winter to 41 deg. C in summer. The mean minimum temperature varies from about 15 deg. C in winter to 28 deg. C in summer. Although there are some districts in the northern parts of the State which are affected by cold waves, the average temperature conditions during the normal crop season were not considered as constraints for crop growth. The average daily global solar radiation in the State varies from 389 in winter to 585 cal in summer. Thus this parameter also does not seem to be a constraint. The above parameters are indirectly reflected in PET and hence discarded for assessing crop potential. However, weather hazards like cyclones are considered in assessing crop potential.

It is presumed that crops are grown under optimum use of nutrients and prophylactic measures are undertaken whenever necessary.

3. Results and discussions

The weekly MAI values at 30, 50 and 70 per cent probability level are presented in Table 1. Agroclimatic types and optimum dates are presented in Table 2. Monthly stored soil moisture data are presented in Table 3.

TABLE 2

Agroclimatic type and optimum date of sowing (ODS)

Station	No. of weeks with moisture availability index at 50 per cent probability of rainfall			AAR		APET	Agro-climatic type	ODS
	0.3	0.5	0.7	30 per cent (mm)	50 per cent (mm)	(mm)	(mm)	(mm)
Visakhapatnam	20	19	12	1057	417	530	G1	11-17 Jun
Kakinada	21	20	16	1050	536	640	G1	Do.
Machilipatnam	21	19	16	1067	544	637	G1	18-24 Jun
Ongole	16	10	7	672	280	484	G1	16-22 July
Nellore	18	7	5	929	318	456	F1	13-19 Aug
Kurnool	17	5	3	542	280	579	E1	25 Jun-1 Jul
Cuddapah	17	8	2	591	272	538	E1	Do.
Anantapur	4	4	2	—	—	574	D4	Variable
Nizamabad	16	15	15	1055	638	484	G1	11-17 Jun
Hanamkonda	16	15	14	859	501	513	G1	Do.
Hyderabad	15	15	10	673	369	470	G1	Do.
Mahabubnagar	18	15	14	835	459	521	G1	4-10 Jun

TABLE 3

Stored soil moisture (SSM) (mm)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Visakhapatnam	78.1	50.1	24.9	13.2	8.0	7.5	27.9	52.1	133.0	200.0	182.9	120.8
Kakinada	68.8	46.1	22.6	11.3	5.9	4.9	71.9	109.5	171.5	200.0	192.8	122.0
Machilipatnam	30.9	14.8	5.5	1.9	0.6	0.4	41.7	67.2	102.2	138.7	120.2	62.3
Ongole	33.3	18.8	8.7	4.0	1.8	1.0	0.7	0.6	0.6	54.7	82.5	55.3
Nellore	133.9	74.6	33.1	14.2	6.5	3.4	2.3	1.6	1.3	131.0	200.0	193.7
Kurnool	3.1	1.6	0.6	0.3	0.1	0.0	0.0	0.0	16.1	13.0	9.0	5.4
Cuddapah	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	1.2	1.1	1.0	0.7
Anantapur	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nizamabad	67.9	46.3	25.9	13.7	6.4	5.9	162.8	250.0	250.0	191.6	138.3	98.7
Hanamkonda	35.1	19.6	9.3	3.4	1.2	1.1	141.6	200.0	200.0	145.1	95.8	60.0
Hyderabad	9.5	4.8	1.4	0.4	0.1	0.0	18.5	26.0	92.9	61.0	36.0	19.2
Mahabubnagar	10.4	5.5	2.3	1.0	0.4	0.3	14.7	22.1	65.7	50.2	31.8	18.5

3.1. *Visakhapatnam*

The soils of this district are red (with clayey sub-soils) with small pockets of fine to medium textured laterite. The stored soil moisture (SSM) from June to August is low. The crop cannot withstand to any dry spell during the above period. However, the crop is likely to meet its moisture requirements once in two years as seen from the MAI values. During September and October, the crop can withstand easily to a dry spell of about 15 days.

The accumulated rainfall (AAR) at 50 per cent probability accounts for 80 per cent of PET. The weeks with MAI greater than 0.5 and 0.7 at 50 per cent probability are 19 and 12 respectively. However, at 70 per cent probability level, the MAI remains below 0.4 for a greater part of the normal growing season. This district has the potential for two short duration crops which can be raised successfully once in two years. Since the average number of rainy days does not exceed 10 during any month, the chances of harvesting the first crop are bright. The district has also good potential for coffee, cocoa and other fruit trees on the hilly regions of the west and northwest. It comes under zone G1. The only danger is due to depressions cyclones during September and October.

The optimum date of sowing appears to be 11-17 June.

3.2. *Kakinada* (*East Godavari district*)

This district consists of alluvial soils in the southeast and red soils with clayey sub-soils in the north. The amount of SSM is negligible during June and July. Hence the crop cannot withstand to any dry spell. An examination of the values of MAI reveals that a crop can meet its moisture requrements during these months once in two years. During the other months, the crops can withstand to a dry spell of about 15 days.

The AAR at 50 per cent probability accounts for 83 per cent of PET. The weeks with MAI greater than 0.5 and 0.7 at 50 per cent probability are 20 and 15 respectively. However at 70 per cent probability, the MAI is around 0.5. Hence this district comes under zone G1 having a potential for a medium duration crop followed by a short duration crop which can be raised successfully once in two years. This district also is likely to be affected by depressions and cyclones from September to November.

The optimum date of sowing appears to be 11-17 June.

3.3. *Machilipatnam* (*Krishna district*)

This district consists of deep to very deep red loamy soils and deltaic alluvium to the southeast. The amount of SSM is much less compared to Visakhapatnam and East Godavari districts. Hence the effect of dry spell is likely to be more in this district. However, the crops are likely to meet their water requirements once in two years.

The AAR at 50 per cent probability accounts for 85 per cent of PET. The weeks with MAI greater than 0.5 and 0.7 are 20 and 16 respectively. At 70 per cent probability, the values of MAI remain below 0.6 for a greater part of the growing season. The crop potential in this district is similar to Visakhapatnam and East Godavari districts. This district is also likely to be affected by depressions/cyclones from September to November.

The optimum date of sowing appears to be 18-24 June.

3.4. *Ongole* (*Prakasam district*)

The soils of this district are deep to very deep black cotton to the northeast, red earths (chalkas) to the south and west. The maximum SSM of 82.5 mm occurs during the month of November. Dry spells may reduce the yields especially during July and August when the MAI does not exceed 0.45 at 50 per cent probability. Once the crop establishes itself, it can be a success once in two years. However at 30 per cent probability (once in three years) a crop can be raised successfully.

Although the optimum date of sowing appears to be 16-22 July, cash crops like tobacco and cotton which are very popular in this district, are transplanted/sown only during August. By this time, the values of MAI at 50 per cent probability begin to rise.

The weeks with MAI greater than 0.5 and 0.7 at 50 per cent probability are 10 and 7 respectively. The corresponding AAR accounts for only 57 per cent of PET. At 70 per cent, the values of MAI remain well below 0.35. A crop of duration of about 15 weeks can be raised successfully once in two years. Hence this district comes under G1. However, the number of

weeks with MAI greater than 0.3 and 0.7 at 50 per cent probability shows that this district is a transition zone (between G1 and F1). This district also is in danger of cyclones during October and November.

3.5. *Nellore*

This is the last coastal district. It consists of mainly red earths (chalkas), red sandy soil to the west and small pockets of black cotton soils (moderately deep to deep) in the south. This is the only district in which the SSM is quite high during January. However, SSM is negligible upto September. The values of MAI are also low. Hence the crop cannot withstand to any dry spell upto September. Beyond September, the crop can withstand to short dry spells. Since there are two consecutive weeks with MAI less than 0.30 (weeks 31 and 32) after the initial value of 0.30 during the week 29, the optimum date of sowing appears to be 13-19 August.

The weeks with MAI greater than 0.5 and 0.7 at 50 per cent probability after 13-19 August are only 7 and 5 respectively. The corresponding AAR accounts for 70 per cent of PET. The analysis shows that there are no crop prospects at 50 per cent probability. However, the SSM beyond 48th weeks (November) is quite and hence the crop season can extend well beyond November. Hence a crop of duration of about 15 weeks can be raised successfully once in two years. This district, thus comes under the zone F1. It is also likely to be affected by cyclones during October and November.

3.6. *Kurnool*

This district consists of red loamy soils in the central parts, light black cotton soils bordering the west and north and heavy black cotton soils to the east. SSM is negligible during the entire growing season. Hence the crop cannot withstand to any dry spell during any month. August and first fortnight of September appear to be critical when moisture deficiency is likely to coincide with flowering and reproductive period. Supplemental irrigation during this period may increase the crop yields.

The weeks with MAI greater than 0.5 and 0.7 at 50 per cent probability are only 5 and 3 respectively. The corresponding AAR accounts for only 48 per cent of PET. The probability of raising a long duration crop successfully once in two years is less. However, a short duration (drought resistant) crop may be raised successfully. Hence this district is characterised as low potential area, E1.

The optimum date of sowing appears to be 25 June-1 July.

3.7. *Cuddapah*

This district consists of mainly red loamy soil (shallow to moderately deep) with loamy or clayey subsoils and deep to deep heavy black cotton soil to the northwest. The SSM is negligible during the normal season. The value of MAI are also low except weeks 38 and 39. The crop cannot withstand any dry spell. The yields are likely to be low since the crop does not meet its water requirements. Drought resistant short duration crops may be preferred.

The weeks with MAI greater than 0.5 and 0.7 at 50 per cent probability are only 8 and 2 respectively. The corresponding AAR accounts for only 50 per cent of PET. The probability of raising a long duration crop successfully once in three years is high. Based on MAI values, this district comes under low crop potential, E1.

The optimum date of sowing appears to be 25 June to 1 July.

3.8. *Anantapur*

This district consists of mainly loamy with clayey sub-soils and light black cotton soils (moderate deep to deep) to the northwest. The SSM is zero throughout the year. The values of MAI are very low up'o week 37. The crops will be under moisture stress during this period. The crop is likely to meet its water requirements once in three years only.

The weeks with MAI greater than 0.5 and 0.7 at 50 per cent probability are only 4 and 2 respectively. Hence this district comes under zone D4. Farmers have to gamble.

3.9. *Nizamabad*

This district consists of mainly light black cotton (moderately deep to deep) soil. The SSM right from July to November is quite high. The crop is not likely to suffer from moisture stress even in June as seen from MAI values. Even at 70 per cent probability, the values of MAI are greater than 0.4 from the second forthight of June.

The weeks with MAI greater than 0.7 at 50 per cent probability are 15. The weeks with MAI greater than 0.5 and 0.7 at 70 per cent probability are 13 and 8 respectively. The AAR amounts at 50 and 70 per cent probability account for 132 and 68 per cent of PET respectively. Hence a medium duration crop can be raised successfully in three out of four years by adjusting the sowing date suitably. A long duration crop can be raised successfully once in two years. Hence this district has very high crop potential.

The optimum date of sowing appears to be 11-17 June.

3.10. *Hanamkonda (Warangal district)*

This district consists mainly of red earths with loamy sub-soils. The data reveal that crops are not likely to suffer from moisture stress in three out of four years. The crop can easily withstand a dry spell of about 15 days except during June.

The weeks with MAI greater than 0.5 and 0.7 at 50 and 70% probabilities are 14 and 2 respectively. The AAR amounts at 50 and 70 per cent probabilities account for 97 and 47 per cent of PET respectively. A short duration crop of about 12 weeks may be raised successfully in three out of four years by adjusting the sowing date suitably. A long duration crop can be raised successfully once in two years. Hence this district also comes under zone, G1.

The optimum date of sowing appears to be 11-17 June.

3.11. *Hyderabad*

This station is considered to represent Ranga Reddy district. This district consists of mainly red sandy soil and black soil moderately deep to deep. Virmani (1975) carried out a detailed study of the agricultural climate of Hyderabad region in relation to crop planning. He suggested crops of various durations based on the probability of crop water availability. The maximum SSM of 92.9 mm occurs during September. The crop cannot withstand to any dry spell from June to August. However, the crop is likely to meet its moisture requirements once in two years as seen from MAI values.

The weeks with MAI greater than 0.5 and 0.7 at 50 per cent probability are 15 and 10 respectively. The corresponding AAR accounts for 78 per cent of PET. A crop of duration of about 15 weeks can be raised successfully once in two years. This is in agreement with earlier work of Virmani. Hence this district comes under zone G1.

The optimum date of swoing appears to be 11-17 June.

3.12. *Mahabubnagar*

This district consists of mainly red sandy soils to the north, red earths with clayey sub-soil to the south and black soil to the west. This is the only district in which the rainfall during the week 23 is high, both at 50 and 70 per cent probability. The maximum SSM of 65.7 mm occurs in September. The crop cannot withstand to any dry spell.

The weeks with MAI greater than 0.5 and 0.7 at 50 per cent probability are 15 and 14 respectively. The corresponding AAR accounts for 88 per cent of PET. Hence a crop of duration of about 15 weeks can be raised successfully once in two years. This district also comes under zone G1.

The optimum date of sowing appears to be 4-10 June.

4. Conclusions

(*i*) The present investigation helps in assessing crop potential in various districts of Andhra Pradesh at different probability levels.

(*ii*) Optimum dates of sowing may also be assessed from the values of MAI.

(*iii*) Selection of crops may also be made from the values of MAI.

(*iv*) Water stress periods may also be identified with the values of MAI and SSM for supplemental irrigation.

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