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PROBABILITY STUDIES OF RAINFALL IN RELATION TO AGRICULTURE AT CHIRALA, A.P.

Farmers cropping strategies are undoubtedly influenced by the variability experienced in the onset and end of rainy season. Generally they plant or dry-seed their crop when a certain amount of rainfall has sufficienly moistened the top soil. Further, in rainfed agriculture many agricultural operations revolve around the probability of receiving given amounts of rainfall. Hence, a comprehensive idea regarding the probability of rainfall received is essential in view of the economic implications of certain weather-sensitive operations (Virmani *et al.* 1982).

The beginning of a cropping season is determined by the first rainfall that is sufficient for specific agricultural operations. The amount of early rain needed to permit land preparation practices such as ploughing, would depend on the moisture retention characteristics of the soil and the depth of the soil that must be moistened. Hence, the length of the growing season for rainfed crops in any region will be determined by the time between the first useful rainfall and the end of the useful rainfall, although droughts can occur during the middle of this period. However, the probability of late rain is important because later rains can severely damage mature crops that have not been harvested.

2. In this study an attempt has been made to compute the onset and end of rainy season followed by the method given by Oldeman and Frere (1982) and sequence of weekly wet and dry spells by the Markov Chain principle as described by Robtrtson (1976), for a coastal station Chirala (Lat. 15 deg. 50 min N, Long. 80 deg. 22 min. E) in Prakasam disrict of Andhra Pradesh.

Daily rainfall figures were collected from Indian Leaf Tobacco Development Division, Chirala for the period 1954-1983. Average annual rainfall of Chirala is 1121 mm. The Chirala region receives 656.6 mm (59.6%) in kharif, 379.9 mm (33.4%) in rabi and 86.6 (7.6%) in hot weather season. October is the peak rainy month.

3. Beginning from the first standard week, the weekly rainfall totals have been summed forward and backwards until a certain amount is accumulated and this process is repeated for a long period, to account for the year to year variability — then the probability of having received given amounts of rain can be given for each week. Morris and Zandstra (1979) chose 75 mm accumulation of rainfall as the onset time for the growing season for dry seeded crops, and 200 mm accumulated rainfall for initiation of puddling—wetland preparation of rice fields. The termination of the wet season was determined by backwards summing of rainfall data. They stated that 300-500 mm accumulated values represent dates after which sufficient rain would be expected to sustain a second rice crop or other short duration field crops, assuming a fully

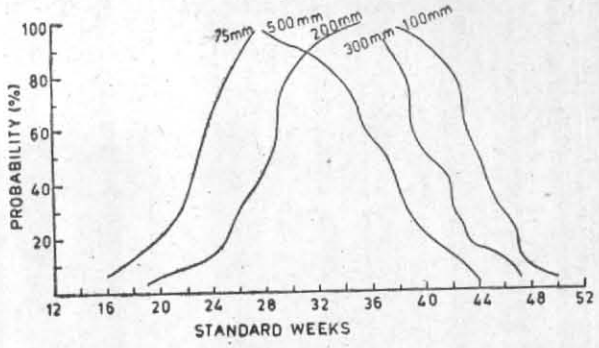
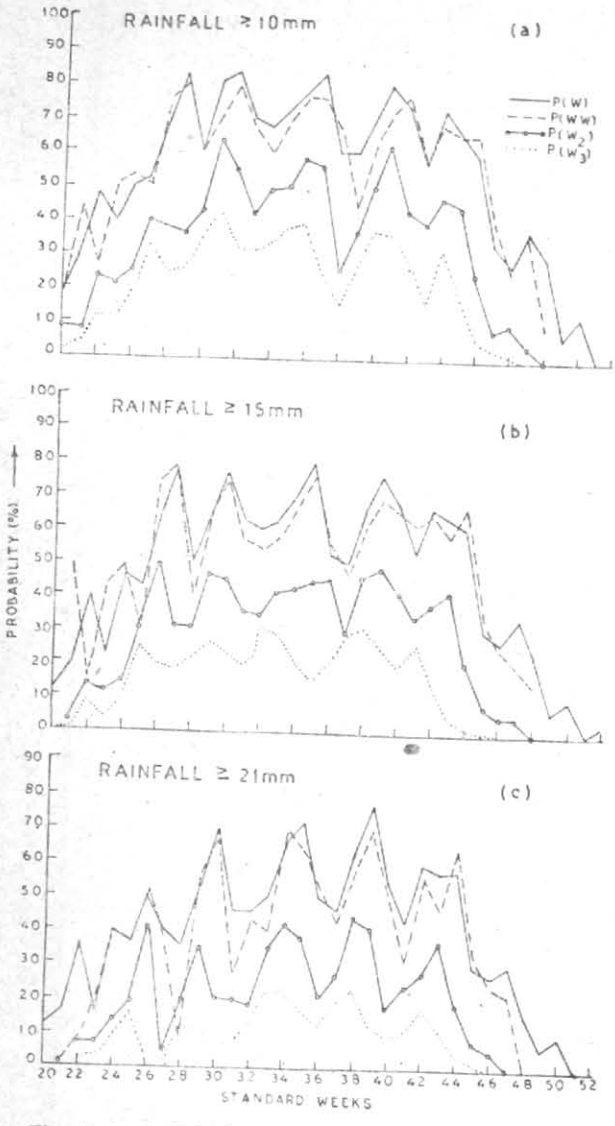


Fig. 1. Cumulative probability of 75 mm & 200 mm and yet 500 mm, 300 mm & 100 mm rainfall

charged soil profile at planting. Fig. 1 illustrates the cumulative probability of having received 75 mm and 200 mm rainfall and of for receiving 500 mm, 300 mm and 100 mm of rainfall. This shows that the 75 mm accumulated rainfall with 50% probability received during 23rd week (4-10 June), whereas for 200 mm, it is during 28th week (9-15 July). Further, at least 300 mm and 100 mm of rainfall is available in once in two years from 40th week (1-7 October) and 44th week (29 October-4 November) respectively.

4. Data on average rainfall are likely to be not helpful in planning agricultural operations whereas the estimates of the probability of rainfall in relation to the chances for specific agricultural practices can be more successfully employed. The rainfall amounts have been characterized in relation to their relevance for crop water availability. Seshagirirao *et al.* (1983) experimentally determined the average water requirements of Finger millet and Groundnut crops as 4.6 mm per day and for rice it is 8.7 mm per day. Ramachandra Reddy *et al.* (1984) reported that the observed pan evaporation for the nearest station Bapatla, is in between 3.8 mm per day (November) and 9.9 mm per day (June). Hence an attempt has been made to study the initial and conditional probabilities, *i.e.*, the probability of receiving certain amount of rainfall during a given week P(W) and the probability of rain next week if we had rain in this week P (W_2) by the Markov chain principle for 10, 15 and 21 mm for a week as described by Robertson (1976) and presented in Fig. 2. These threshold amounts represent approximately 0.2 to less than 1.0 of potential evapotranspiration rates for different seasons and different crop phenophases. The choice of any given amount would depend on the purpose for which the calculated probabilities would be used. These probability approaches help us in determining the relative chance (say, 0.1, 0.2 .....1.0) of receiving a given amount of rainfall.

In the present study, a wet week is defined as that week which receive 10 mm or more, otherwise as a dry week. Similarly, the analysis has been carried



Figs. 2. (a-c). Initial and conditional probabilities of rainfall at Chirala

out for 15 mm a week and 21 mm a week. Then probability of a week P(W), probability of a wet week followed by a wet week P(WW), probability of two consecutive wet weeks $P(W)_2$ and the probability of three consecutive wet weeks $P(W_3)$ are illustrated in Figs. 2(a-c) for Chirala with different amounts of rainfall received in a given week.

From the figure the period between 24th week to 44th week, has been considered as rainy period, if the rainfall received per week is 10 mm, at least once in two years. If one could know what is likely to happen in the next week or what is the chance of getting rainfall in the next week or in the subsequent two weeks, conditional probability estimates are obtained showing an irregular pattern. Conditions appears to be less favourable in 36th and 41st week, requiring supplementary irrigation. Since the crop water requirements vary from crop to crop, further knowledge is essential for the development of agriculture in any region. For this purpose, the rainfall requirements in a given week has increased to 15 and 21 mm in the analysis and illustrated in Figs. 2(b) and 2(c). From these figures, it can be seen that the probability of getting rainfall with higher amounts have been decreased.

5. From the above analysis, the mid-season breaks in the continuity of rainfall are likely to occur. Obviously one could not select a crop cultivar that could be in a active phase of development during this period. Either a sole short duration crop, *i.e.,* the crop which completes most of its life cycle prior to the break in a rainfall or a long duration base crop with short-duration inter-crop would be best suited for the study region under rainfed conditions. The cropping pattern suggested is Jowar or Bajra as first crop followed by Coriander or Pulses or Gingelly to be followed by Tobacco, irrigated Dry Paddy to be followed by Pulses. Chilli and Cotton as sole crops among others.

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