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Research Article

CROP PLANNING USING PROBABILISTIC APPROACH FOR MAYURBHANJ DISTRICT OF ODISHA

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Abstract- Rainfall data of 19 years (1979-2015) of Mayurbhanj district were analysed whose annual average rainfall is 1808.2 mm, with 100 numbers of rainy days, to determine the sowing period, seasonal distribution of rainfall and probability of receiving particular amount of rainfall in a week, month and season . Out of this 292.3, 1397.27 and 292.3 mm is received in pre-monsoon (January-May), monsoon (June-September), and post monsoon (October-December) season respectively. Probability for receiving more than 100 mm of rainfall can be expected even at 90% probability level in the month of June leading to the interpretation that rainfed rice can be taken in the district without any risk. It has been found that at 70 per cent assured probability level rainfall of more than 350 mms can be expected in July and this rainfall can be utilised in medium to lowland paddy areas for transplanting of paddy. On seasonal basis, rainfall at assured probability level of 75% the expected rainfall is 1260.6 mm, which is sufficient for meeting the water requirement of medium to long duration rice variety.

Keywords- Crop planning, Rainfed agriculture, Probability analysis, Mayurbhanj.

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Introduction

Rainfall is the single most important factor in crop production programme particularly under dry land areas. In agricultural planning, rainfall variability analysis aids to take farm decisions on time of sowing, inter culture operations, fertilizer application and other agricultural operations The agricultural operations in the rainfed agriculture in Eastern India largely depends upon the onset of South West Monsoon and if there is delay in sowing of rainfed upland crops even by few days there may be huge yield loss [1]**.** Therefore, the detailed knowledge of rainfall pattern helps in planning the cultivation of crops, their varieties, adoption of cultural operations, designing of different storage structures [15] and harvesting of excess rain water of any region [5] to meet out irrigation requirement during drought period. The rainfall probability and onset of effective monsoon analysis for crop planning were thus essential basic tools for cropping system characterization in rainfed areas [3].

Probability and frequency analysis of rain fall data enables us to determine the expected rain fall at various chances [2]. Probability analysis can be used for prediction of occurrence of future events from available records of rainfall with the help of statistical methods [8]. Therefore, probability analysis of rainfall is necessary for solving various water management problems and to access the crop failure due to deficit or excess rainfall. Scientific prediction of rains and crop planning done analytically may prove a significant tool in the hands of farmers for better economic returns [2]. Generally, the cropping pattern is suggested considering the rainfall probabilities at different levels [9]. Probability and frequency analysis of rainfall data enables us to determine the expected rainfall at various chances. Studies on rainfall probability in India have also been carried out earlier by many workers [16]. Rainfall at 80 percent probability can be safely taken as assured rainfall, while 50 per cent chance can be considered as the maximum limit for taking any risk [2].

The weekly distribution of rainfall and its probability is helpful in crop planning by identifying the period of drought, normal and excess rainfall [14]. In most of studies the workers have suggested the cropping pattern considering the rainfall amount at different probability levels [1] and [13]. The advantage of working out weekly rain fall probabilities for a station or for an agro-climatic region has been reported from by [12].

[7] analysed the daily precipitation data of Coimbatore for a period of 70 years for weekly totals by fitting incomplete Gamma distribution model. The data indicate the likely commencement of rains, period of drought length of growing season and end of growing season. Based on the assured rainfall at (50%) probability level, suitable cropping system was suggested for Coimbatore.[4] suggested that for modelling daily rainfall amounts, the weibull and to a lesser extent the exponential distribution is suitable.

Materials and Methods

The study place, Mayurbhanj has an area of 10,418 km², and is located at 22.0087°N latitude and 86.4187°E longitude with an altitude of 559 m above mean sea level. The amount of rainfall and number of rainy days in a week at Mayurbhanj, Odisha from historic daily rainfall records (1997-2015) collected from India Meteorological Department (IMD), Pune are calculated using probabilistic approach. Probability analysis is carried out to estimate the expected amount of rainfall at various probability levels of (25-90%) at Mayurbhanj station using Weibull's plotting position method [10].

The weekly rainfall data have been analysed at different levels of probability by using Weibull's method. In this method, the weekly rainfall was arranged in descending order of magnitude. The highest one assigned rank 1; next magnitude was given rank 2 and so on. The probability 'P' of the week having rainfall exceeding or equalling normal value was calculated by using Weibull's formula [Eq-1].

$$P = \frac{m}{n+1} \quad \text{[Eq-1]}$$

Where,
P = probability of occurrence m = rank number;
and n = number of years of data used
Rainfall at various probability levels (25, 50, 70, 80 and 90 percent) for weekly, monthly, seasonal and annual basis has been worked out and are presented in [Table-1] and [Table-2].

Results and Discussion

Nineteen years (1997-2015) of daily point, rainfall data was analysed and the average annual rainfall of Mayurbhanjis worked out to be 1808.2 mm, with 100 numbers of rainy days. The maximum rainfall of 2174.4 mm occurred in the year 1999 and the minimum quantum 1498 mm of rainfall was received during the year 2010). The average monthly rainfall of the place for the months of March, April, May, June, July, August, September and October is 24.03, 53.56, 181.55, 302.04, 429.93, 360.07, 283.28 and 95.65 mm respectively. The maximum average rainfall is received during the month of July to a tune of 429.93 mm and the minimum average rainfall is received during the month of December to a tune of 7.95 mm. It was analysed that when the monthly statistics was put to probability analysis the rainfall quantity came down drastically at 90%. 90 per cent probability means that we can expect this rainfall quantity in 9 out of 10 years. However, the assured probability level of 70% which is considered as assured rainfall in 3 out of 4 years. At 90%, probability level 129.6 mm of rainfall occurred during the month of June while at 70% it was 271.5 mm [Table-1]. Therefore at highly assured level also sufficient amount of rainfall may be expected for sowing of cow pea, pigeon pea, groundnut, blackgram, green gram, maize etc which require less water for establishment during the monsoon season in 23rd SMW(4th to 10th June) with the arrival of South West Monsoon in the district. Maximum amount of rainfall occurred during July i.e 303.4 mm and 381.9 mm at 90% and 70% probability levels respectively. The expected amount of rainfall at 70% probability can be utilised in medium to lowland paddy areas for transplanting of paddy from 1st to 15th of July.

Table-1 *Monthly and seasonal expected rainfall amount (mm) at different probability levels at Mayurbhanj (Odisha)*

Months	Probability Levels				
	25%	50%	70%	80%	90%
January	25.5	5.4	3.8	1.2	0.1
February	23.8	12	8.4	4.2	0
March	27.5	17.4	11.7	10.6	3.5
April	78.6	50.5	38	21.1	1.6
May	232	171.7	155.2	113.7	76.3
June	339	289.9	271.5	231.8	129.6
July	479.3	433.5	381.9	361.2	303.4
August	412.8	351.7	333.2	301.1	269.9
September	341.3	257.8	235.2	223.5	187
October	113.7	55.2	47.9	46.1	26.4
November	23.1	8.7	1.5	0.2	0
December	14.2	0.8	0.1	0	0
Seasons					
Pre-monsoon(Jan-May)	332	283.4	268.1	255.6	225.7
Monsoon(Jun-Sept)	1575.6	1328.5	1260.6	1256.7	1098.1
Post-monsoon(Oct-Dec)	146	104.2	57.8	53.8	40.8

Similarly seasonal basis analysis has been carried out at different probability levels. At 50 per cent probability, there is expected rainfall of 1328.5 mm in monsoon season while at 75% probability level assured rainfall of 1260.6 mm, which is sufficient for meeting the water requirement of medium to long duration rice variety. The major thrust has to be given on construction of water harvesting structures to store excess water during rainy season, which can be utilised as life saving irrigation for the crops growing in the *rabi* season. *In pre* monsoon season the expected rainfall is 283.4 mm and 268.1 mm at 50% and 70% probability levels respectively, which can be used for performing summer tillage and land preparation for upland crops. 104.2 mm of rainfall is expected in post monsoon season at 50% probability which can play a very crucial role for sowing and establishment of second short duration low water requiring *rabi* crops like Sesamum, Horsegram, Niger etc. in rain fed upland rice field, after the harvest of rain fed *kharif* crop.

Table-2 *Weekly rainfall at Mayurbhanj station at different probability levels in a year*

Standard Met Week (SMW)	Probability Levels				
	25%	50%	70%	80%	90%
23 (4th to 10 June)	114.2	64.4	52.1	29.2	17
24 (11thto 17th June	94.8	56.5	39.2	26.4	20.9
25 (18th to 24th June	87	61.3	49.9	29.3	11.9
26 (25th to 1st July)	104.5	72.5	45.3	32.7	17.5
27 (2nd to 8th July)	138.2	79.6	38.6	24.5	11.3
28(9th to 15th July)	162.2	106.6	89.8	68.3	32.3
29(16th to 22nd July)	117.4	101.8	92.1	82.4	26.1
30(23rd to 29th July)	129.1	106.4	68.8	56.3	35.2
31(30th to 5th August	101.8	70.9	59.5	44	26
32(6th to12th August)	129.2	72.8	60.3	33	9.4
33(13th to19th August	137.9	77.6	58.5	55.7	46.7
34(20th to 26th August	93.4	67.9	35.1	17.3	92.6
35(27th to 2nd September)	109.3	59.6	34.8	27.8	7.4
36(3rd to 9th September)	111.9	74	45.8	39.2	32
37(10th to 16th September)	79.2	56.7	33.4	24.8	0.6
38(17th to 23rd September)	135.8	72.1	61.6	29.4	4.8
39(24th to 30th September)	75.7	26.3	4.7	0.9	0
40(1st to 7th October)	51.6	39.4	19.5	10.6	2.5
41(8th to 14th October)	36.3	5.9	2.4	0.2	0
42(15th to 21st October)	31.4	4	0	0	0

However, it is the distribution of rainfall on weekly basis, which is very important and is presented in [Table-2]. It was found that there are 70% chances of getting rainfall more than or almost equal to 40 mm during 23rd to 38th SMW. Therefore land preparation and sowing of upland crop can be done from 23rd SMW (4th to 10th June) in the district of Mayurbhanj at 70% probability level. During 1st to 15th SMW and 43rd to 52nd SMW the amount of rainfall received was nil at all probability levels, hence it indicates that during winter and summer crop the assured irrigation facilities need to be there , so that the cropping intensity may be enhanced. During 21st to 38th SMW even at 90% probability level there are every chances of getting rainfall hence direct seeded upland crops can be well established in upland rice soils.
At 18th to 22nd SMW (pre monsoon period) there are chances of getting about 15 mm or more rainfall. So in these weeks light showers can be expected which can be utilised for off season tillage and preparation of seed beds for rain fed upland rice.

Conclusion

As there is definite rainfall receipt of more than or almost equal to 40 mm per week during the period between 23 and 38 standard weeks not only paddy but also some other direct seeded upland crops can be well established and sowing can be started from 23rd SMW (4th to 10th June) at 70% (dependable) probability level.
During the month of May at 70% probability, there is 155.2 mm of rainfall, which can be utilised for summer tillage of inversion type for in situ moisture conservation, reducing of pest and weed problem and to facilitate early sowing. In monsoon season, rain water can be stored to be utilized as life saving irrigation. Agricultural strategies, farming operations need to be based on this type of analysis and advisories should be planned accordingly

Conflict of Interest: None declared

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