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Rainfall based crop planning in the Barak Valley zone of Assam

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ABSTRACT

Daily rainfall data for 47 years (1960-2006) of Karimganj, Assam were analysed. The overall mean annual rainfall was 4073.5 mm, which was distributed as 2613.6 mm, 1134.8 mm and 330.3 mm in *kharif* (June to September), summer (March to May) and *rabi* (October to February) seasons, respectively. The probability of 60 and 100 mm rainfall per week exceeds 70 per cent values between 18th to 37th and 22nd to 30th week, respectively. In flood free upland and medium land areas transplanting of *ahu* rice is suggested to complete within first week of April and the second crop of rice (*sali*) could be transplanted from 31st week onwards. In upland area, sowing of toria/potato/ vegetables may be started from 43rd week onwards. In areas where the second crop of rice is not possible due to flood, the *ahu* rice should be followed by potato/toria/pulses/vegetables etc from 43rd week onwards.

Key words: Rainfall, rainy days, rainfall probability, crop planning

Rainfall analysis is important for crop planning for any region. In order to stabilize crop yields at reasonable levels in rainfed situation, it is essential to plan rainfed crops and their management practices in consonance with the rainfall pattern prevalent in the region (Deka and Nath, 2000). Rainfall studies, particularly its variability and probability on weekly basis give more information for rainfed crop planning. In most of the studies the workers (Sharma *et al*., 1979, Shrivastav *et al*., 1998, Jadav *et al*., 1999, Deka and Nath, 2000, Mahale and Dhane, 2003, Saha *et al*., 2004, Singh, 2005, Manorama *et al*., 2007) have suggested the cropping pattern considering the rainfall amount at different probability levels.

The Barak Valley Zone (BVZ) in southern Assam comprises of three districts, namely Cachar, Karimganj and Hailakandi. The climate of BVZ is subtropical, warm and humid. The average annual rainfall is more than 3500 mm. The periods of March-April and October-November are characterized by low and erratic rainfall. The period between May to September is featured by high rainfall with apprehension of floods. However, the erratic behaviour of rainfall causes occasional droughts as well. In this preliminary analysis, rainfall data of Karimganj has been taken as the representative of the entire zone.

MATERIALS AND METHODS

Daily rainfall data for the past 47 years (1960-2006) recorded at the Agromet Observatory, Regional Agricultural Research Station, Karimganj ($26^0 47'$ N, $94^0 12'$ E, 87 m AMSL), were used for the study. Data were analysed for annual, seasonal, monthly and weekly values following Panse and Sukhatme (1985).

Probability (%) was calculated as follows:

a) Calculation of normal deviate= $x-\mu / \sigma$, where x= given observation,

b) The table value of $\frac{1}{2}(1+\alpha)$ corresponding to the value of normal deviate was computed. When these differed by 0.1, intermediate values of normal deviate were obtained by interpolation.

c) Probability (%) = [1 - table value of $\frac{1}{2}(1+\alpha)$] x 100

RESULTS AND DISCUSSION

Annual rainfall

The overall mean total annual rainfall of Karimganj for the last 47 years was found to be 4073.5 mm spread over 138.8 rainy days (Table 1). The coefficient of variation (CV) was 23 per cent between the mean values which revealed that the rainfall was more or less stable over the years. Maximum rainfall (7853.4 mm) in 150 days was recorded in 1989 which was 93 percent above normal. The lowest rainfall of 2706.8 mm received in 131 rainy days during 1981 was 34 per cent below normal. During the reported period, rainfall was above normal in 22 years and below normal in 25 years.

Seasonal rainfall

Average seasonal rainfall and its variability are presented in Table 1. For seasonal rainfall analysis, three distinct crop seasons have been identified: summer (March to May), *kharif* (June to September) and *rabi* (October to

Table 1: Mean monthly and seasonal rainfall and rainy days at Karimganj (1960-2006).

Months/ Seasons	Rainfall (mm)	Contribution to total (%)	S.Em ± (mm)	CV (%)	Rainy days	Contribution to total (%)	S.Em ±	CV (%)
March	164.1	4.0	20.8	87	7.0	5.1	0.59	58
April	386.9	9.5	36.3	64	14.0	10.1	0.56	8
May	583.8	14.3	37.7	44	17.7	12.8	0.56	22
Summer	1134.8	27.9	55.9	34	38.8	28.0	0.9	16
June	833.7	20.5	46.5	38	22.2	16.0	0.49	15
July	737.9	18.1	39.7	37	25.1	18.1	0.41	11
Aug	572.6	14.1	29.5	35	21.9	15.8	0.59	18
Sept	469.4	11.5	31.2	46	16.9	12.2	0.59	24
Kharif	2613.6	64.2	94.8	25	86.1	62.0	0.6	9
Oct	220.4	5.4	20.6	64	7.8	5.6	0.45	39
Nov	34.3	0.8	6.1	122	1.9	1.4	0.30	108
Dec	12.1	0.3	3.2	181	0.8	0.6	0.16	142
Jan	11.7	0.3	2.6	150	1.0	0.7	0.17	121
Feb	46.5	1.1	8.1	119	2.4	1.8	0.29	80
Rabi	330.3	8.1	24.0	50	14.1	10.0	0.6	30
Grand Total	4073.5	-	136.6	23	138.8	-	1.7	9

February). The highest rainfall was recorded in *kharif* season (2613.6 mm) followed by summer (1134.8 mm) and rabi (330.3 mm) seasons. The per cent contribution to total rainfall showed lowest CV in *kharif* (25%) followed by summer (34 %) and *rabi* (50%). During the period, *kharif* rainfall was above normal in 18 years and below normal in 29 years. Likewise, summer rainfall in 21 years and *rabi* rainfall in 19 years were found to be above normal. Seasonal rainfall ranged from 1343.1 mm to 2149.0 during *kharif*, 478.2 mm to 2149.0 during summer and 84.0 mm to 784.4 mm during *rab*i.

The distribution of rainy days per season also followed a similar trend as that of rainfall with 54 per cent occurring in *kharif* season followed by 28 per cent in summer and 18 per cent in *rabi*.

Monthly rainfall

Assam as a whole comes under south-west monsoon from 1st week of June which continues up to the end of September. However, pre-monsoon showers normally start from mid-March itself. Very often the transition from pre-monsoon to monsoon season is not well defined.

Weekly rainfall

The average weekly rainfall, the weekly probability of getting 10, 20, 40, 60 and 100 mm rainfall and number of weekly rainy days were worked out for the 52 standard meteorological weeks. Probability of getting 40, 60 and 100 mm rainfall from 11 to 44th weeks are shown in Table 2. At least two distinct sets of weeks were evident from the analysis. From 42nd week to 11th week through 52nd week, the weekly rainfall was below 50.0 mm with CVj about 15 per cent or more. The cumulative rainfall during these weeks was only 244.5 mm which is about 6 per cent of total annual rainfall. The 11th week (March 18-24) signifies the beginning of rainy season. Hailstorm associated with strong gusty winds is a regular feature during pre-monsoon season in the zone. From 12th to 41st meteorological week, rainfall per week was in the range of 52.1 to 212.7 mm and the cumulative rainfall during this period was 3828.6 mm (94 percent of the annual. Transition from pre-monsoon to monsoon season occurs in 22nd week which is well demonstrated by the rainfall amount received during that week as well as in the subsequent weeks. From 16th to 39th week (April 16 to September 30), weekly rainfall is almost always more than 100 mm.

The highest number of rainy days per week are 5.9 (27th week) and are at least 3 days per week between 14th and 39th week. The values are more stable during 25th and 31st week where the CV is less than 30 per cent with standard error of mean values less than 0.7 days.

Weekly rainfall probability

The probability of getting 10 mm rainfall per week is more than 60 per cent between 9th week (Feb 26 to March 4)

Table 2: Mean weekly rainfall (mm), rainy days and rainfall probability at Karimganj (1960-2006)

MW	Rainfall (mm)	S.Em± (mm)	CV (%)	Probability of getting rainfall amount			Rainy days	S.Em±	CV (%)
				40 mm	60 mm	100 mm			
1	32.5	8.2	143	44	28	7	1.7	1.1	86
2	52.1	9.8	136	57	46	25	2.0	1.3	88
3	60.2	9.0	116	61	50	29	2.4	1.2	78
4	73.9	12.8	149	62	55	41	3.0	1.2	67
5	93.6	8.3	86	75	66	47	3.7	1.0	54
6	100.5	12.1	121	69	63	50	3.5	0.9	46
7	93.5	9.6	99	72	64	47	3.7	0.9	45
8	120.2	9.2	84	78	72	58	4.1	0.8	41
9	129.4	9.5	84	79	74	61	4.1	0.8	41
0	120.2	9.6	88	77	72	58	3.7	0.9	45
1	115.0	9.3	87	77	71	56	3.9	0.9	48
2	209.6	12.9	89	82	78	72	4.5	0.8	39
3	212.7	11.8	81	84	81	74	4.6	0.7	34
4	189.6	10.0	73	86	65	74	5.0	0.7	33
5	177.5	7.9	59	91	87	77	5.5	0.5	22
6	186.7	8.9	65	89	85	76	5.7	0.5	22
7	175.4	7.5	57	91	88	77	5.9	0.5	21
8	149.5	8.1	66	87	78	69	5.6	0.6	26
9	178.1	9.9	74	85	81	72	5.8	0.5	21
0	156.8	8.3	67	87	82	71	5.5	0.6	27
1	134.8	6.1	52	91	86	69	4.9	0.7	33
2	132.1	8.3	73	83	77	63	4.8	0.8	39
3	138.7	9.1	78	82	77	64	4.9	0.7	32
4	132.3	8.1	71	84	78	64	5.0	0.7	29
5	114.5	6.6	62	85	78	58	4.7	0.7	30
6	100.7	8.1	81	77	69	50	4.6	0.9	41
7	128.2	7.8	69	84	77	62	4.4	0.8	39
8	87.1	8.0	86	74	64	43	3.6	0.9	48
9	123.9	11.0	99	75	70	58	3.5	1.1	57
0	77.0	9.2	104	68	58	39	2.9	1.0	61
1	64.8	9.6	120	63	53	33	2.0	1.2	82
2	40.5	10.4	164	50	39	19	1.6	1.1	84
3	29.4	10.3	190	43	29	10	1.0	1.4	138
4	14.2	7.7	203	19	6	0	0.7	1.2	146

and 43rd week. An amount of 10 mm rainfall per week can be taken as the minimum requirement for sowing rainfed summer crops. The probability of 40, 60 and 100 mm rainfall per week exceeds 70 per cent values between 15th and 39th, 18th and 37th and 22nd and 30th week, respectively. Flood can extend up to 34th week (August 20-26) from 22nd week (May 28 to June 3) as the probability of receiving 100 mm rainfall per week is more than 60 per cent and also the high rainfall in the preceding weeks contributes to flood water.

Existing cropping pattern

The net-cropped area of the zone is 2, 35,426 hectares with a cropping intensity of 134 per cent. Monocrop area estimate about 81 per cent of the net-cropped area. The diverse agro-ecological situations prevailing in the zone allow successful cultivation of a wide range of crops. Rice is the staple crop and therefore, the cropping system is rice based. In alluvial flood free situation winter rice (*sali*) as monocrop or autumn rice (*ahu*) followed by winter rice are the important cropping patterns. In lowland areas, shallow water winter rice (*asra*) is also grown. In upland areas, sugarcane, vegetables, french bean and toria are important.

In alluvial flood prone situation, rice is the dominant crop despite the risk of recurrent flood. All the agricultural classes of rice are grown in this situation depending on specific locations. As a normal practice *ahu* rice followed by late *sali* is popular among the rice farmers. Similarly, *ahu* rice followed by potato, pulses, toria or winter vegetables,

as mixed or pure crops, is popular cropping pattern. Pre-flood summer vegetables are also important in this situation.

Proposed cropping pattern

Based on present study, the following recommendations could be made to increase production per unit area under rainfed condition. In flood free upland and medium land areas, transplanting of *ahu* rice could be completed within first week of April when probability of getting 40 mm rainfall exceeds 60 per cent limit. Cultivars chosen should be ready for harvest before 22nd week (May 28 – June 3) and this will minimize the loss due to high intensity rain that follows. The second crop of rice (*sali*) could be transplanted during 31st week (July 30-Aug 5) as the probability of receiving 100 mm rainfall is below 70 per cent and probability of flood gradually recedes.

In flood free lowland areas where *sali* rice-*boro* rice sequence is followed, transplanting of long duration (150-155 days) *sali* rice varieties should be started after 31st week when the probability of getting 100 mm rainfall drops below 70 per cent. The crop will be ready for harvest during later part of November. On the other hand, transplanting of *boro* rice seedlings should be completed by 51st week so that the same may be harvested before 14th week where the probability of receiving 60 mm or more rainfall is below 60 per cent.

In areas where *ahu* rice–toria/potato/vegetable sequence is followed, the transplanting of short duration rice varieties (95-100 days) could be completed by 15th week during which the probability of getting 40 and 60 mm rainfall exceeds 70 and 60 per cent limits. On the other hand, sowing of toria/potato/vegetables may be started after 43rd week as the probability of receiving 20 mm or more rainfall is below 60 per cent.

In alluvial flood prone situation where *ahu* rice-*sali* rice sequence is followed it is suggested to go for early *ahu* by giving supplemental irrigation by harvesting rain water during monsoon season and harvested before 22nd week (May 28 to June 3). The second crop of rice having shorter duration should be direct seeded in puddled soil or transplanted during 35th week because the probability of getting 100 mm rainfall is below 60 per cent from this week onwards. In low land areas, the period from 22nd to 31st week (May 28 to August 5) may be avoided as rainfall probability is high (69 to 77% up to 100 mm). In areas where the second crop of rice is not possible due to flood, the *ahu* rice should be followed by potato/toria/pulses/vegetables etc after 43rd week.

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