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AGRO-CLIMATIC CHARACTERIZATION OF TWO SELETED STATIONS IN THE SOUTHERN WEST BENGAL, INDIA

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ABSTRACT

Maximum temperature, minimum temperature and rainfall data of Bankura (1992-2007) and Canning (1960-2006) were analyzed for assessing climatic trend and agro-climatic characterization of red-lateritic and coastal Zones of West Bengal respectively. These two zones are the most vulnerable regions to climate change in West Bengal, hence selected for the present study. While average values of annual maximum temperature and annual minimum temperature were used for climatic trend analysis, no definite trend was observed. So, maximum temperature of the hottest month and minimum temperature of the coldest month were used for detecting climatic trend. The maximum temperature shows positive trend for both the stations. An increasing trend of annual rainfall was also observed. In case of agro-climatic characterization the agricultural draught, meteorological draught, seasonal rainfall and rainfall probability using Markov-chain model were analyzed for the said two stations. *Kharif* crops of Bankura encountered two years (2000 & 2005) agricultural draught within 2000 -2007, whereas *kharif* crops of Canning encountered agricultural draught in 2006 within the said period. Likewise, the deviation of seasonal rainfall and probability of two consecutive wet weeks with different levels (10, 20,30,40,50 and 60 mm) of weekly total rainfall was worked out.

Keywords: climatic trend, agro-climatic characterization, Markov chain model, rainfall probability

INTRODUCTION

The elevated temperature and CO_2 level by induced climate change are not only affecting the growth of the crop but also the cropping pattern of a region. High temperature enhancing evaporation may give rise to higher rainfall which may be different from that expected. Moreover, in recent past abnormalities in monsoon is also observed.

Several rainfall related risk analysis have been done for West Bengal with the help of incomplete gamma distribution as well as markov chain method which are done mostly in discrete places (Chakraborty and Chakraborty, 1991; Chakraborty *et al.*, 1990). In case of rainfall probability analysis it is considered that the crop water requirement of *Kharif* rice is high as it is cultivated in standing water. It has been observed that 3.5 mm evapotranspiration per day and 3.5 mm percolation per day are optimum. So the water requirement per day is 7 mm. So the weekly water requirement is 49 mm which is rounded to 50 mm weekly.

Based on this threshold value the rainfall probability analysis is the most common one (Thom, 1966). In the present paper, the agricultural, meteorological and seasonal drought was analysed along with rainfall probability and climatic trend.

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MATERIALS AND METHODS

Study area:
The study was carried out taking the weather data of Bankura and Canning, representing the Red-lateritic zone and the Coastal-saline zone of West Bengal. These two zones are the most vulnerable regions to climate change in West Bengal.

Agriculture accounts for almost 70% of the Bankura district's income whereas 80% of the farmers are small & marginal. However due to protective irrigation system, land reforms and use of high fertile & hybrid crops the district is now not so poor as it was. A vast area of bankura is not cultivable due to undulation of land and morum soil. About 46% of the net cropped area is under Irrigation. The gross cropped area is about 6 lakh ha. and cropping intensity is 147%. Rice, Wheat, Oil seeds and Vegetables are the Principal Crop occupied major of the gross cropped area. Most of the Pre-Kharif and Kharif rice are grown in rainfed condition. H.Y.V. crops occupied about 9% in this district considering 100% in summer rice. Agriculture is largely dependent on the vagaries of monsoon. Drought constitutes a major hazard in the district. Intermittent gaps of in precipitation and moisture stress during the monsoon gives rise to serious set back in production during the Kharif, which is the main stay of Agriculture in the district (www.Bankura.com).

Mono-cropping is the main practices in the Coastal-saline zone and this zone needs special attention from the agricultural researchers. Research on multiple cropping, identification of elite genetic resources, particularly for rice, introduction of new crops needs the knowledge base of rainfall and run-off, soil moisture regime, residual moisture and some other basic data. Recent success of sunflower besides traditional vegetable chilli during winter after rice has drawn attention to improve the knowledge on crop-climate-soil relationship issues.

Markov-chain model:
The model is used here for the rainfall probability analysis for receiving 10, 20, 30, 40, 50 and 60 mm rainfall in the said two zones.

RESULT AND DISCUSSION

Rainfall and temperature trend analysis:
Maximum and minimum temperature data of Bankura station were analysed for detection of temperature change over years. No significant positive or negative trend was observed for the said station. However, in 1995 onwards, during monsoon months, both the maximum and minimum temperature was more (Fig. 1).

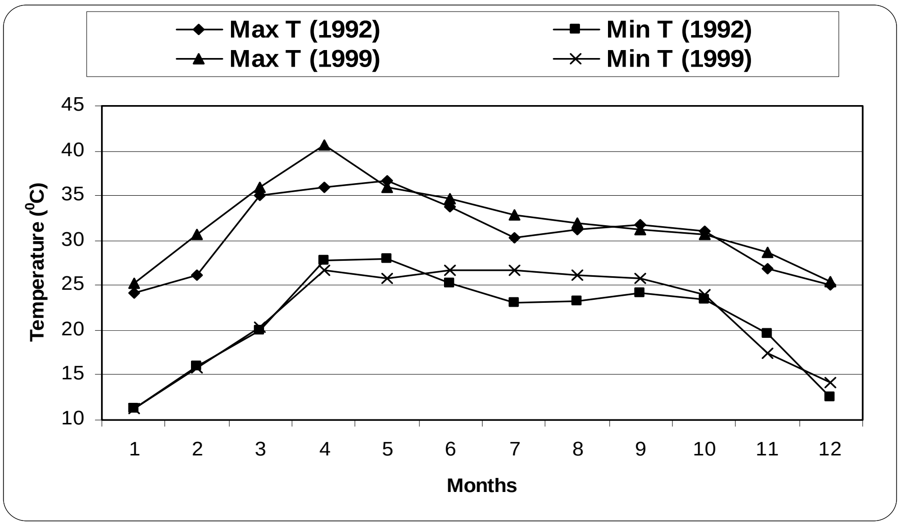

Fig. 1: Variation of monthly maximum and minimum

temperature of Bankura for two selected years

The total annual rainfall of Canning station was collected from India Meteorological Department for the period 1959 to 2003. The annual average rainfall of this region is 2114 mm (Fig. 2). It was observed that the amount of rainfall increase gradually with progress of year. The increment was highly remarkable during 1975 to 1990. During this period almost all year's rainfall amount was higher than the normal value. However after 1990 the rainfall amount decreased drastically and became at par with nineteen fifties database.

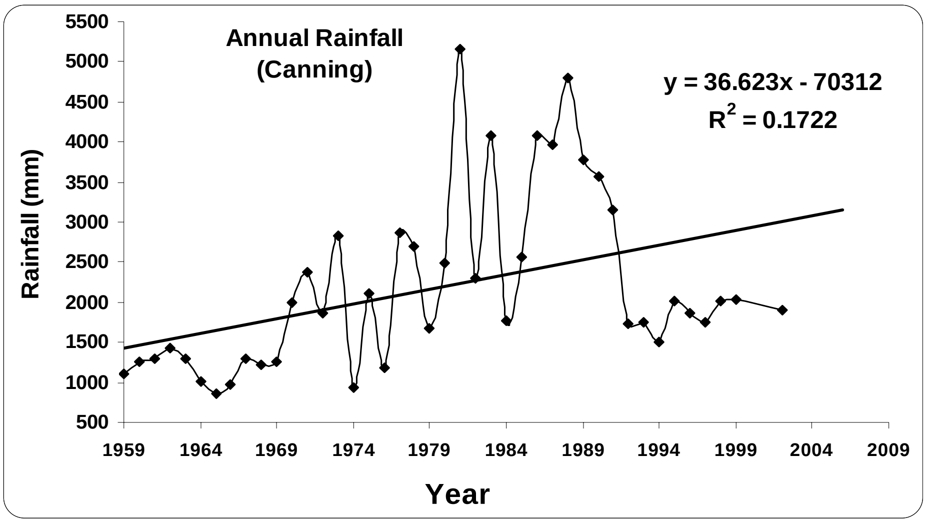

Fig. 2: Variation of annual rainfall in Canning station

Agricultural drought analysis:

Bankura station: Among eight years data, only two years (2000 & 2005) crop encountered agricultural drought during Kharif season. In contrast to Kharif season, except 2003 all years under study showed Rabi season agricultural. drought. During 2000, two spell of consecutive four weeks drought period was noticed for both Kharif & rabi season (Table 1).

Table 1: Kharif and rabi season agricultural drought for Bankura station

Kharif		**Rabi**	
Year	Week	Year	Week
2000	24-27	2000	40-45
	39-42		46-51
2005	38-41	2001	42-47
		2002	47-52
		2004	42-47
		2005	44-49
		2006	46-51
		2007	47-52

Canning station: During Kharif season only two years (1998, 2006) showed agricultural drought. However, except 1998 all other years showed agricultural drought during Rabi season. The intensity of agricultural drought during Rabi season was higher during 2006 (Table 2).

Meteorological drought analysis:

Bankura: Except 2000, all years showed increased annual rainfall from average annual rainfall value. During 2000, the annual rainfall decreased by around 24% from the normal value and this caused a mild drought during this year (Table 3).

Canning: Except1994, all years showed above rainfall from average yearly rainfall. During the year 1994, the annual rainfall decreased by around 13% from the normal value and this caused a mild drought during this year (Table 4).

Table 2: Kharif and rabi season agricultural drought for Canning station

Kharif		**Rabi**	
Year	Week	Year	Week
1998	38-41	1992	43-48
2006	39-42	1993	45-50
		1994	47-52
		1995	46-51
		1996	46-51
		1997	40-45
		1999	44-49
		2002	47-52
		2003	45-50
		2004	42-47
		2005	44-49
		2006	40-45
			46-51

Table 3: Meteorological drought for Bankura station

Year	**Annual Rainfall**	**Deviation (%)**	**Drought**
2000	956.7	-24.26	Mild
2001	1328.7	5.19	No
2002	1872.7	48.26	No
2003	1493.1	18.21	No
2004	1709.7	35.35	No
2005	1437.8	13.82	No
2006	1306.3	3.42	No
2007	1845.9	46.14	No

Mild drought- 13 % and No drought - 87%

Table 4: Meteorological drought for Canning station

Year	**Annual Rainfall**	**Deviation (%)**	**Drought**
1992	1751.3	0.66	No
1993	1745.1	0.30	No
1994	1510.8	-13.17	Mild
1995	2019.0	16.04	No
1996	1862.2	7.03	No
1997	1746.7	0.39	No
1998	2020.1	16.11	No
1999	2038.9	17.19	No
2002	1907.1	9.61	No
2003	2152.2	23.70	No
2004	1745.3	0.31	No
2005	2119.9	21.84	No
2006	1966.9	13.05	No

Seasonal rainfall analysis:

Bankura: The annual average rainfall at Bankura station was 1494mm. The rainfall amount during different season namely winter, summer, south-west and north east rainfall were respectively 2, 13, 77 and 8 % of the total rainfall. The coefficient of variation of seasonal rainfall was highest (98%) during winter season followed by North-East monsoon season (79%). However, the coefficient of variation (CV) was moderate during south-west monsoon season and lowest (11%) during summer season. (Table 5)

Canning station: The annual average rainfall for Canning station was 1891mm. The contribution of winter, summer, south-west, north-east monsoon was respectively 1, 12, 75 & 12%. During winter and north-east monsoon the CV values followed more less similar trend like Bankura station. However, reversed trend of CV was observed for summer and south-west monsoon season (Table 6).

Table 5: Seasonal rainfall analysis of Bankura station

	Winter	**Summer**	**South-West**	**North-East**	**Annual**
Mean	32.1	193.9	1153.5	114.4	1493.9
SD	31.6	22	291	90.1	309
CV	98.4	11.3	25.2	78.7	20.7

Table 6: Seasonal rainfall analysis of Canning station

	Winter	**Summer**	**South-West**	**North-East**	**Annual**
Mean	23.7	219.8	1414.2	233.5	1891.2
SD	22.2	79.2	156.2	159.7	184.8
CV	93.6	36	11	68.4	9.8

Rainfall probability analysis (Two wet weeks):

Bankura: Probability of two consecutive wet weeks with different level (10, 20, 30, 40, 50 and 60mm) of weekly total rainfall was estimated (Fig. 3). When only 10mm is considered, more than 75% probability is assured at 21st SMW, which continued upto 37th SMW followed by gradual decrease. In case of 20 mm rainfall, 75% probability of two consecutive week starts at 24th SMW and end at 30 SMW. For 30 mm weekly total rainfall the same confined between 24th SMW and 28th SMW. If we consider 50% probability of getting two consecutive wet weeks with 30mm rainfall the span extended from 23rd SMW to 30th SMW. In case of 40mm weekly total rainfall 75% probability of getting two consecutive wet weeks is only happened on 28th SMW. But 50% probability of getting such wet weeks starts from 24th & ends at 29th SMW. There is no chance of getting two wet weeks (50mm weekly total rainfall) with 75% probability level. At 24th & 25th week there is a chance of getting 50mm rainfall with 63% probability level (more than 50%). There is a chance of getting two wet weeks (within 60mm rainfall) with 50% probability level only on 25th SMW.

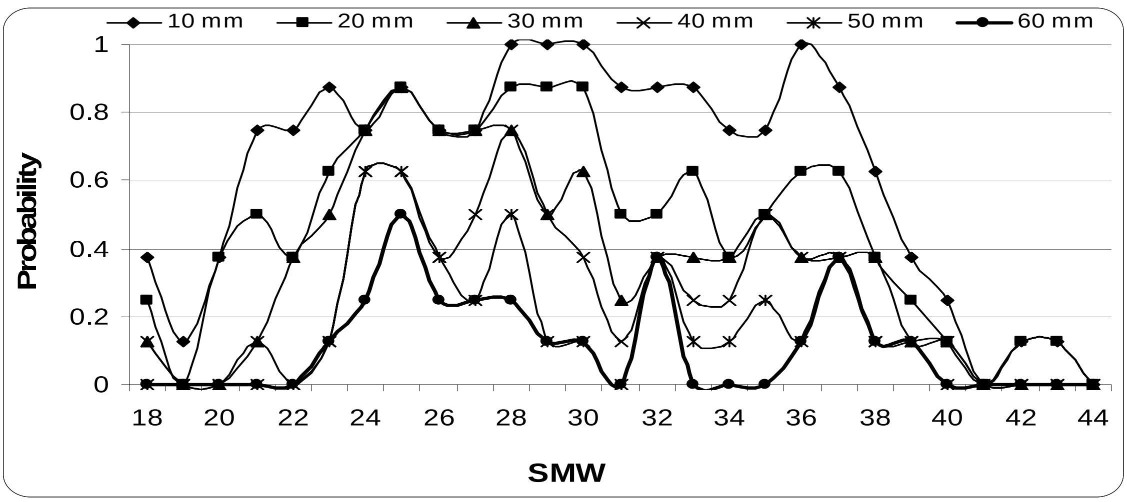

Fig. 3: Probability of getting consecutive two wet week for Bankura

Canning: Probability of two consecutive wet weeks with different level (10, 20, 30, 40, 50 and 60mm) of weekly total rainfall was estimated (Fig 4). When only 10mm is considered, more than 75% probability is assured at 25th SMW, which continued upto 38th SMW followed by gradual decrease. In case of 20 mm rainfall, 75% probability of two consecutive week starts at 28th SMW and end at 32 SMW. For 30 mm weekly total rainfall the same confined between 28th SMW and 32nd SMW. If we consider 50% probability of getting two consecutive wet weeks with 30mm rainfall the span extended from 28th SMW to 36th SMW. In case 40mm weekly total rainfall 75% probability of getting two consecutive wet weeks is only happened on 30 and 31st SMW. But 50% probability of getting such wet weeks starts from 25th & ends at 36th SMW. There is only one (30 SMW) chance of getting two wet weeks (50mm weekly total rainfall) with 75% probability level. From 28th to 32nd SMW there is a chance of getting 50 mm rainfall with more than 50% probability level. There is a chance of getting two wet weeks (within 60mm rainfall) with 50% probability level from 30-32 SMW. However there is no chance no chance at 75 % probability level.

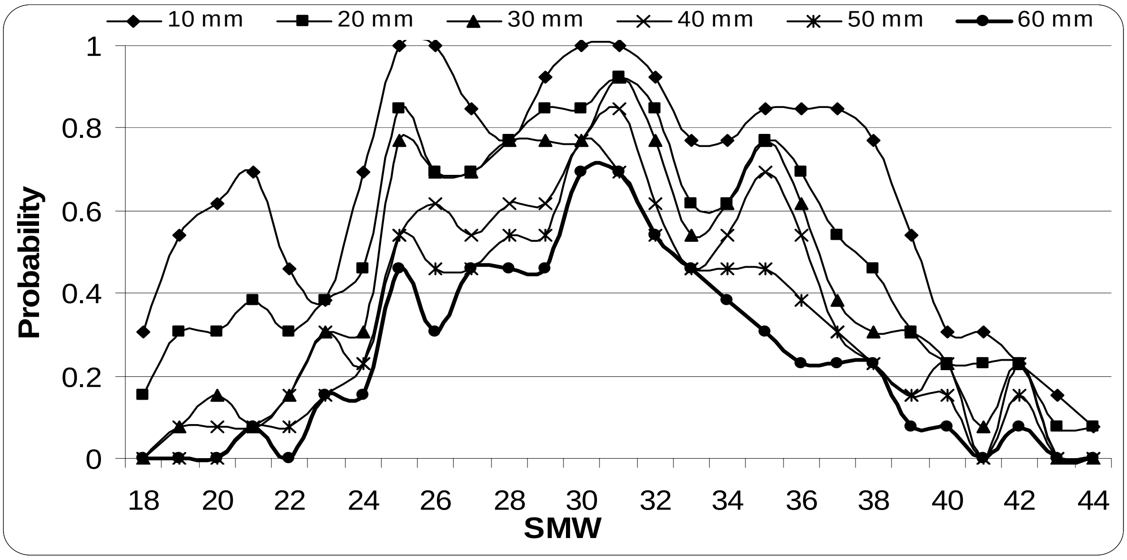

Fig. 4 Consecutive two wet week for Canning

Hence, it can be concluded that for both the station, no wide stretch of wet weeks (getting about 40 to 50mm rainfall) was obtained. So, supplemented irrigation will be very much useful for these two zones under study.

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