

RAINFALL POTENTIALS FOR CROP GROWING IN ARID KUTCH REGION

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ABSTRACT

The rainfall distribution pattern, crop growing season and their variability in arid Kutch district during 1901-1989 were analysed. The mean duration of growing season in Bhuj area was 9.8 weeks with a large standard deviation of 5.3 weeks. Large deficit of rain water was observed in 16 years, while rain water surplus occurred in 23 years. The existing cropping pattern and rain water use efficiency with respect to major crops of the region were analysed and suggestions have been made for improving the crop production potentials of the region.

INTRODUCTION

The climate of Kutch district is classified as arid because mean moisture index for the different raingauge stations in the district varies from -74.0 to -83.0 (Thornthwaite and Mather 1955). Low and erratic nature of rainfall, extremes of temperature and high atmospheric demand for water are the major climatic constraints for growing crops in the region. Agriculture of the region is largely dependent on success and failure of the southwest monsoon. Detailed agroclimatic studies of the Kutch district have not been attempted so far. The present study was therefore, undertaken to assess the agricultural potential of the region which would help in planning suitable cropping patterns for the district.

MATERIAL AND METHODS

Daily rainfall data of Kutch district (12 raingauge stations) for the period of 1901-1989 were used in this study. Water budgeting procedure of Thornthwaite and Mather (1955) was followed to work out various soil water balance components and mean actual evapotranspiration (AE) taking into account the estimated water holding capacity of the soil. For this, normal potential evapotranspiration values computed from Penman's formula by Rao et al. (1971) were used. The commencement of crop growing season under rainfed farming was defined as the period for which actual evapotranspiration (AE) exceeds half the value of potential evapotranspiration (PE) as also used by Krishnan and Thanvi (1977). The actual evapotranspiration (AE) during each Kharif growing season were computed taking length of growing period of 9 weeks for Kharif pulses, 13 weeks for pearl millet, 16 weeks for sorghum and 18 weeks for groundnut for the years from 1970 to 1988.

RESULTS AND DISCUSSION

Distribution of rainfall in Kutch district

The normal annual rainfall of the district was 384.0 mm with 15.4 rainy days. Mean annual rainfall Pattern at different locations indicated that rainfall varied from 338.4 mm at Lakhapat to 451.9 mm at Nalia (Table 1) representing coastal area with 12 to 20 rainy days (days receiving a rainfall of 2.5 mm or more). It was also observed that 90 per cent of the annual rainfall was received during SW monsoon period. The year to year fluctuation of rainfall was also very common in the region. The standard deviation of annual rainfall was 192.6 to 364.7 mm. The coefficient of variation (CV) varied from 52 per cent at Kandla to 81 per cent at Nalia (Table 1). On an average we can expect rainfall in the Bhuj region to be deficient (i.e. less than 75 per cent of normal) in 45 per cent of years. There was 20 per cent probability of severe deficiency in rainfall (viz. less than 50 per cent of normal). Similarly, we can expect an excess rainfall year (rainfall exceeding 150 per cent of normal) once in five years.

Since rainfall distribution in this region was highly erratic, the percentage frequency of weekly rainfall during 1901 to 1989 were also analysed (Fig. 1). Study revealed that percentage frequency of getting > 20 mm weekly rainfall was highest (39 %) during 30th week followed by 27th week (35%) and 28th week (33%). Chances of getting > 50 mm weekly rainfall were almost same as those receiving > 20 mm. This indicated that major part of the seasonal rainfall was received in few intense showers associated with low pressure system passing over the region. The median values of rainfall worked out for each week were also found to be much smaller than the mean values of the week as a result of the extreme skewness and variability in their distribution.

Commencement and duration of crop growing season

Percentage frequencies of commencement of crop growing season from different standard weeks showed that the highest frequencies of the growing season commencement were during 25th June to 15th July (53% of occasions). In general, crop sowing period in this region commences after 10th June and ends before 6th August.

The percentage frequencies of years with different duration of crop growing season (either drought free or with slight or moderate droughts) revealed that in 63 per cent of years, crop growing season would be more than or equal to 9 weeks. Hence, Kharif pulses of short duration (60 to 70 days) can be harvested successfully at least in 63 per cent of occasion in the Bhuj region. The extremes include longest growing period of more than 20 weeks that prevailed in 1917 and no crop growing season in 3 years viz. 1911, 1939 and 1987 during the entire period under study. The mean duration was 9.8 weeks with a standard deviation of 5.3 weeks indicating a high variability in crop growing period at Bhuj. This information would be of use

Table 1. Mean annual and extreme rainfall in Kutch district and its variability.

Station	Normal Annual rainfall (mm)	SD (mm)	CV (%)	Extremes of annual rainfall (mm)					
				Highest		Lowest			
				Amount	Year	Amount	Year		
Bhuj	342.4	224.6	65.6	1311.4	1959	383.0	5.0	1987	1.5
Anjar	343.5	192.6	56.1	982.0	1979	285.9	14.0	1987	4.1
Rahapur	365.4	223.3	61.1	1139.6	1975	311.9	16.0	1987	4.4
Bachau	383.0	253.4	66.1	989.0	1979	258.2	12.0	1987	3.1
Mundra	439.7	247.7	56.3	957.5	1959	217.2	26.0	1987	5.9
Kandla	433.2	226.9	52.4	893.2	1967	206.2	73.6	1974	17.0
Nalia	451.9	364.7	80.7	1372.6	1959	303.7	0.0	1987	0.0
Mandvi	401.8	283.9	70.7	949.2	1967	236.2	3.0	1987	0.7
Lakhapat	338.4	266.5	78.8	956.9	1959	282.8	0.0	1987	0.0
Nakhatarana	381.6	234.6	61.5	864.7	1979	226.8	0.0	1987	0.0
Khavada	345.5	245.5	71.1	988.2	1961	286.2	75.1	1985	21.7
Khadir*	381.4	211.5	55.5	853.0	1959	223.6	100.7	1977	26.4

*Based on data of 10 years period

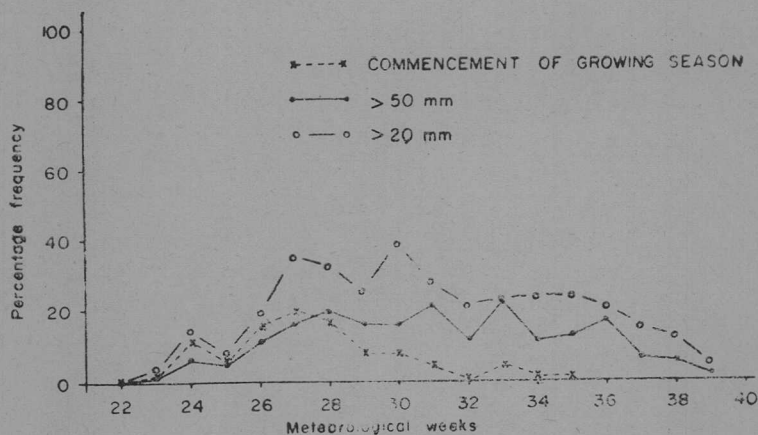


Fig. 1. Percentage frequencies of weekly rainfall and commencement of growing season at Bhuj

for proper assessment of potential and suitability of the existing varieties of cereals, oilseeds, legumes and grasses being grown in the region and in planning the introduction of suitable short duration varieties for stabilising the productivity for the Kutch region.

Rain water deficit and surplus in Bhuj area

Week wise amount of deficit water (PE-AE) were worked out for the Kharif season of individual years. It was found that the years 1904, 1911, 1915, 1918, 1925, 1931, 1939, 1948, 1960, 1968, 1969, 1972, 1974, 1982, 1986 and 1987 experienced large deficit of rain water which resulted into severe drought conditions and no rainfed crop production in the region.

When the weekly precipitation is in excess of the sum of the actual evapotranspiration for the week and the quantity required for raising the soil reservoir to its capacity, this surplus becomes available for surface and subsurface runoff and ultimately recharges aquifer of the region. Out of 89 years under study, rain water surpluses occurred considerably during 23 years. The actual amount of surplus (mm) presented in parenthesis during these year was 1903 (61), 1909 (60), 1910 (73), 1912 (130), 1913 (426), 1917 (146), 1921 (90), 1926 (67), 1927 (33), 1929 (123), 1941 (159), 1944 (27), 1950 (368), 1952 (44), 1953 (178), 1959 (641), 1961 (90), 1967 (262), 1975 (24), 1976 (124), 1979 (371), 1980 (167) and 1988 (91). This study revealed that surplus water could be expected to occur in 25.8 per cent of years (i.e. once in four years) at Bhuj. Mean values worked out to be 163.0 mm with standard deviation of 150 mm. There had been no rain water surplus from 1930 to 1940 in this region.

Cropping pattern and water use efficiency in Kutch district

The average net sown area in the Kutch district is 6,21,300 hectare which accounts only about 15 per cent of the total geographical area of the district. The areas under major crops in this region revealed that pearl millet and Kharif pulses (green gram and moth bean) covered maximum area (18% each) of the total cropped area of the region followed by sorghum (12%) and groundnut (9%). Remaining area was under important non food crops of the region like cotton, castor etc. The average yield of groundnut was highest (848 kg/ha) followed by pearl millet (658 kg/ha), Kharif pulses 343 (kg/ha) and lowest for sorghum (321 kg/ha). Also, year to year fluctuation in yields of these crop was a common feature of the region. Analysis of yield pattern revealed that pearl millet production was comparatively more stable (CV 34.6%) in the region. The coefficient of variation with respect to sorghum yield was the highest (83.9%) followed by kharif pulses (53.4%) and groundnut (44.5%).

Since rain water is a major limiting factor for growing the crops in the Kutch region, water use efficiency (WUE) of the four crops were worked out to identify the best crop of the region (Table 2). The WUE of kharif pulses varied from 0.15 to 2.81 kg/ha/mm with an average value of 1.57. Whereas in the case of pearl millet it was considerably high and varied from 1.73 to 4.20 kg/ha/mm with an average value of 2.57 kg/ha/mm. The water use efficiency with respect to sorghum crop was found lowest and it varied from 0.05 to 2.62 with an average value of 0.96 kg/ha/mm. WUE for groundnut was found highest among all these crops and it varied from 1.74 to 4.03 with an average value of 2.70 kg/ha/mm for arid Kutch district of Gujarat State. The analysis brought out that growing sorghum for grain purpose is not economical in the Kutch district. However, it can be grown as fodder crop to feed the animals of the region.

Table 2. Average consumptive use (AE) and water use efficiency (WUE) of crops in arid Kutch district.

Kharif crop	Consumptive use (mm)	WUE in (kg/ha/mm)
Kharif pulses (Green gram and Moth bean)	210	1.57
Pearl millet	269	2.54
Sorghum	299	0.96
Groundnut	314	2.70

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