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Agroclimatic Classification of Arid and Semi-arid Regions of Gujarat State on the Basis of Humid and Moist Periods

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ABSTRACT

The different agroclimatic parameters viz., moisture index, humid and moist periods were worked out for twenty stations of Gujarat State which fall under arid and semi-arid climate. Since humid period promotes vegetative growth and development of crops and moist period supports them, these two parameters were selected for subdividing the arid and semi-arid regions of Gujarat into four zones viz., A, B, C and D.

The zone 'A' has been found to be a very low crop potential area and farmers may find it difficult to raise crops under rainfed conditions. Short to medium duration crops may be grown in area 'B'. The zone 'C' is favourable for medium and drought resistant long duration crops under dry farming. The cropping season exceeds 100 days in the zone 'D' and, therefore, it may be favourable for long duration crops. However, two short duration crops may be successfully harvested by adjusting dates of sowing suitably.

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INTRODUCTION

Heat and moisture are the vital determining factors for the natural plant growth while the energy and water budget largely set the pattern of vegetation. In tropical regions, the radiant energy assumed to be abundant for plant growth and precipitation becomes a dominant factor for successive change in vegetation.

More than 80 per cent of the area of Gujarat comes under arid and semi-arid regions where rainfall is generally less than 1000 mm. Only 15 per cent of the cultivated land is irrigated. It is, therefore, necessary to have the study of the climatic resources of the state so that the information evolved may be used for crop planning. A number of climatic classification methodologies based on rainfall, temperature and potential evapotranspiration have been developed by many scientists, (Koppen 1936, Thornthwaite and Mather 1955, Troll 1965, and Cocheme and Franquin 1967). Some of these methodologies have been applied to Indian Regions (Subramanyam *et. al.*, 1965; Krishnan, 1968 and Rao *et. al.* 1972). Biswas (1982) has classified dry farming tract of Gujarat state into four zones on the basis of optimum moisture availability index. The present study, aimed to classify the arid and semi-arid regions of Gujarat on the basis of humid

and moist periods, which promote and support, respectively, the vegetative growth and development in the plants, would be very much useful to agricultural scientists and farmers in crop planning.

MATERIAL AND METHODS

Weekly normals of rainfall were taken from daily accumulated normals of rainfall published by Indian Meteorological Department (IMD, 1965), whereas the weekly potential evapotranspiration (PET) values have been obtained by interpolating both in space and time from monthly values calculated by Rao *et al.* 1971. The moisture index has been determined by Thornthwaite and Mather's methodology. Humid period was defined as the period in which precipitation (P) exceeded the PET and moist period during which P lies in between PET and PET/2.

The following criteria were used for classifying the area.

Zone 'A' — Humid plus moist period for less than 60 days.

Zone 'B' — Humid period less than 60 days but humid plus moist period more than 60 days.

Zone 'C' — Humid period more than 60 days but less than 90 days.

Zone 'D' — Humid period more than 90 days.

RESULTS AND DISCUSSION

The different agro-meteorological parameters of twenty stations covering almost all areas of arid and semi-arid regions of Gujarat state have been presented in Table 1. On the basis of humid and moist periods, these stations were grouped into four zones. Within the same zone rainfall, PET and soil vary considerably; therefore, these zones have been discussed considering all these points together.

Zone 'A'

The zone 'A' comprises Bhuj, Rapar and Dwarka stations which cover most of Kutch district and a small part of Jamnagar district. The soil is mainly sandy except for some areas of medium black soils in and around Bhuj. The annual rainfall within this zone is less than 400 mm, whereas potential evapotranspiration is between 1700 mm to 1900 mm. This caused moisture index more than –80 per cent which characterized this area as extremely arid. The humid and moist period together does not exceed 60 days in this area and, therefore, it may be difficult to raise crops under rainfed conditions. However, pearl millet, sorghum and pulses like kidney bean and greengram may be grown in some parts of the zone.

Zone 'B'

This zone consists of Kandla, Radhanpur, Amreli, Veraval, Dhrangadhra and Dhoraji stations. These stations cover some south eastern part of Kutch, western part of Banaskantha and Mehsana districts and most of Surendranagar, Rajkot, Jamnagar, Junagadh and Amreli districts. The soil in the zone varies from sandy to coastal alluvial and medium black. Annual normal rainfall in the zone 'B' ranged between 400 mm to 600 mm. However, within this zone some patches of moderate rainfall of the order of 850 mm are found (IMD, 1962) in and around Junagadh and Girnar forest areas. The highest PET values have been found only in this zone (Rao *et al.*, 1971). Most of this zone falls under arid type climate and the moisture index ranged between -67 to -79 per cent.

TABLE 1

Different agroclimatic parameters at 20 stations of arid and semi-arid zones of Gujarat.

Climatic zones	*Stations*	*Rainfall mm*	*Potential evapotranspiration mm*	*Moisture Index %*	*Humid periods days*	*Moist periods days*	*Soil types*	*Climate type*
Zone 'A'	Bhuj	340.4	1896	–82.0	7	49	Medium black	Arid
	Dwaraka	358.3	1714	–79.1	21	35	Sandy	Arid
	Rapar	351.3	1862	–81.1	7	49	Sandy	Arid
B_1	Kandla	400.9	1896	–78.9	21	49	Sandy	Arid
	Radhanpur	433.0	1752	–75.3	42	35	Sandy	Arid
Zone 'B' B_2	Amreli	515.0	1901	–72.9	14	98	Medium black	Arid
	Dhrangdhra	507.8	1898	–73.2	35	49	Sandy to medium black	Arid
	Dhoraji	607.9	1854	–67.2	35	70	Medium black	Arid
	Veraval	526.2	1683	–68.7	42	56	Coastal alluvial	Arid
Zone 'C'	Deesa	622.5	1714	–63.7	70	14	Sandy	Semi-arid
	Patan	618.2	1725	–64.2	63	28	Sandy	Semi-arid
	Viramgam	586.6	1787	–67.2	63	28	Sandy loam	Arid
	Ahmedabad	782.8	1678	–53.3	84	14	Sandy loam	Semi-arid
	Lunawada	778.2	1591	–51.1	84	21	Medium black	Semi-arid
	Bhavnagar	663.6	1814	–63.4	77	21	Coastal alluvial	Semi-arid
Zone 'D'	Idar	974.0	1636	–40.5	98	14	Sandy to medium black	Semi-arid
	Dahod	810.4	1577	–48.6	98	14	Medium black	Semi-arid
	Baroda	916.6	1575	–41.8	98	7	Loamy	Semi-arid
	Broach	1000.2	1725	–41.9	98	21	Deep black	Semi-arid
	Surat	1071.1	1603	–33.2	105	14	Deep black	Semi-arid to dry subhumid

Although the humid periods are less than 60 days in the zone, the total periods (humid + moist) ranged from 70 days to 112 days indicating that there may be wide variations in the cropping pattern within this zone. Therefore, this zone can be further sub-divided into two sub zones. In the first zone 'B'_1, the soil is sandy and the crop growing season is found to be 60 to 80 days which may be favourable for short duration crops like pearl millet, sorghum and pulses only. The zone 'B'_2 in which soil is medium black and the total crop growing season is of about 100 days may be found suitable for medium duration crops like groundnut and cotton under rainfed conditions.

Zone 'C'

The most of the semi-arid areas are covered under this zone. This zone includes Deesa, Patan, Viramgam, Ahmeddabad, Lunawada and Bhavnagar stations. The districts covered under the zone are Banaskantha, Mehsana, Ahmedabad, Gandhinagar, Kaira, Bhavnagar and some eastern parts of Surendra-

nagar. Some western parts of Sabarkantha and Panchmahal districts are also covered under this zone. The annual rainfall ranged between 580 to 800 mm and potential evapotranspiration has been found ranging between 1600 to 1800 mm. The moisture indices were between -50 to -67 per cent. The soils are sandy, sandy loam, and black. The humid periods have been found between 60 to 90 days which indicate that the area has good potential for dry farming. Medium to short duration crops like pearl millet, sorghum, pluses, clusterbean, cotton, groundnut and drought resistant long duration crops like castor may be found suitable to this zone under rainfed conditions.

Zone 'D'

The fourth zone denoted as 'D' can also be called as "Transition zone" between semi-arid and dry sub-humid climate. The stations covered under this zone are Idar, Dahod, Baroda, Broach and Surat. The areas included are eastern half part of Sabarkantha and Panchmahal districts, western half part of Baroda and Broach districts, whereas only a small north-west part of Surat falls under this zone. The annual rainfalls in the zone ranged between 800 mm to about 1070 mm. Surat has been found at the boundary line of semi-arid and dry sub-humid climatic zone with moisture index value of -33.2 per cent. The soils are medium to deep black with high field capacity. The humid periods have been found more than 99 days indicating that the crop gowing prospect is very high in this region. During most of monsoon periods rainfall exceeded PET and thus generally caused soil moisture saturation and surplus water. Under these conditions maize crop in medium black soils and cotton, and paddy in the deep black soils may be found suitable. With suitable sowing adjustments, two short duration crops viz., pearl millet and pulses in *kharif* gram in *rabi* season can also be harvested under rainfed conditions. These areas may also be suitable for a long duration crop like pigeon pea.

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