Journal of Agrometeorology 3(1 & 2) : 39 -55 (June-December-2001)

Agroclimatic features of LASPEX sites

V. PANDEY, M. KUMAR AND A. M. SHEKH

Department of Agricultural Meteorology, GAU., Anand - 388 110

ABSTRACT

Paper deals with the physiography, soils and climate of Gujarat in general and Sabarmati and Mahi river basin area where in LASPEX-97 was conducted in particular. The LASPEX region was relatively homogeneous uniform terrain with altitude ranging between 25 to 85 m. Although all stations fall under semi-arid climatic region, the western part of LASPEX (Arnej and Sanand) is more prone to experience arid environment as the rainfall was less and evaporation rates are high. On the other hand the southeastern parts of grid receive higher rainfall and have less evaporation rates resulting in semi-arid environment. During experimental period (1997) all the stations recorded 40-70% higher rainfall than normal. This resulted in lower water deficit and higher amount of surplus water. All parameters were found to vary significantly among the stations.

Key words: Agroclimatology of LASPEX, Water balance, Weather during 1997.

The Land Surface Processes Experiment over Sabarmati River Basin (LASPEX-97) was conducted during 1997 and 1998. Five stations (Anand, Khandha, Derol, Sanand and Arnej) were selected which are 35 to 125 km apart from each other. Basic information on agroclimatic features form the background for inter-comparison of results obtained from the experiment. This paper describes general physiography, soils, and agroclimatic parameters such as rainfall, temperature, humidity, evaporation, wind speed, and water balance components over the LASPEX region observed on normal basis as well as during the experimental year 1997.

PHYSIOGRAPHY AND CLIMATE OF THE GUJARAT STATE, INDIA

The region, wherein the LASPEX-97 was conducted, is part of the mainland of Gujarat state, India extending from Runn of Kutch and Aravali Hills in the north to river Damanganga in the south. The mainland is almost flat plain between altitudes 0 to 75 m abave mean sea level (AMSL) made up of alluvial soil except for some sandy soils in the north. The plains of Gujarat are traversed by big rivers notable among them being Sabarmati, Mahi, Narmada and Tapi. The smaller rivers include Banas, Saraswati, Meshvo, Vatrak, Shedhi, Vishwamitri, Dhadhar, Kim, Purna, Ambika and Damanganga. Towards the west of this mainland is peninsular region of Saurashtra and in the east are the hilly tracts which are generally at altitudes of 300 m, and at some locations they attain height of 600 m also (Anonymous, 1989).

In terms of the standard climate types arid, semi arid and dry sub-humid climates are spread over different regions of the state. The regions in the extreme north comprising of districts of Kutch, western part of Banaskantha and Mehsana, western and

Table 1: Eight agroclimatic zones of Gujarat

Zone No.		Name	
Zone I	:	South Gujarat Heavy Rainfall Zone	(SGHRZ)
Zone II	:	South Gujarat Agroclimatic Zone	(SGAZ)
Zone III	:	Middle Gujarat Agroclimatic Zone	(MGAZ)
Zone IV	:	North Gujarat Agroclimatic Zone	(NGAZ)
Zone V	:	North-West Gujarat Agroclimatic Zone	(N-WGAZ)
Zone VI	:	North Saurashtra Agroclimatic Zone	(NSAZ)
Zone VII	:	South Saurashtra Agroclimatic Zone	(SSAZ)
Zone VIII	:	Bhal Zone	

north part of Saurashtra are under arid climate. The districts of Valsad, Dang, southeastern part of Surat, and Bharuch are under dry sub humid climate and rest of the region of the state falls under semi-arid climatic conditions. Annual rainfall in the state vary between 350 mm in north-west part of Kutch district to more than 2000 mm in parts of Valsad district (Fig.1). Based on climate, topography, soil characteristics and cropping pattern eight agroclimatic zones have been delineated in the state of Gujarat. (Table-1)

AGROCLIMATIC FEATURES OF LASPEX REGION

Department of Agricultural Meteorology, GAU, Anand has published an Agroclimatic Atlas of Gujarat (Anonymous, 1997) which describes normal agroclimatic features, such as rainfall, temperature, humidity, evaporation, soil temperature etc. Initial and conditional rainfall probability analysis carried out for different stations of the region, are reported by Pandey *et al.* (1997). The normal agroclimatic features for LASPEX region extracted from atlas are described hereunder.

The LASPEX region lies between latitudes 22°02' to 23°04'N and longitudes 72°15' to 73°45'E with elevation ranging from 28 to 85 m above mean sea level. In the south of the region annual rainfall is more than 1000 mm (Fig. 1), which is suitable for cotton, sorghum, pigeonpea etc., under rainfed condition. Towards east of the grid hilly areas with shallow medium black soils are suitable for maize crop. Saurashtra region, which is to the west of LASPEX region, and comprises the peninsular part of Gujarat, has low to medium rainfall and shallow to medium black soil. Groundnut and pearl millet are major crops of this region. In the north, the zone has mainly loamy sand to sandy soils with castor, pearl millet and green gram as major crops under rainfed condition.

Rainfall

The mean annual rainfall over LASPEX region varies between 600 to 1000 mm, with coefficient of variation (CV) of 40-45%. Higher CV percents were associated with low rainfall. Out of annual rainfall 95-96% are received in four months (June to September) due to influence of S-W monsoon. The rain is distributed in 30 to 40 days in different parts of the region. In general annual rainfall is lower in western part and higher in southeastern part of the region (Fig. 1). In the central region the

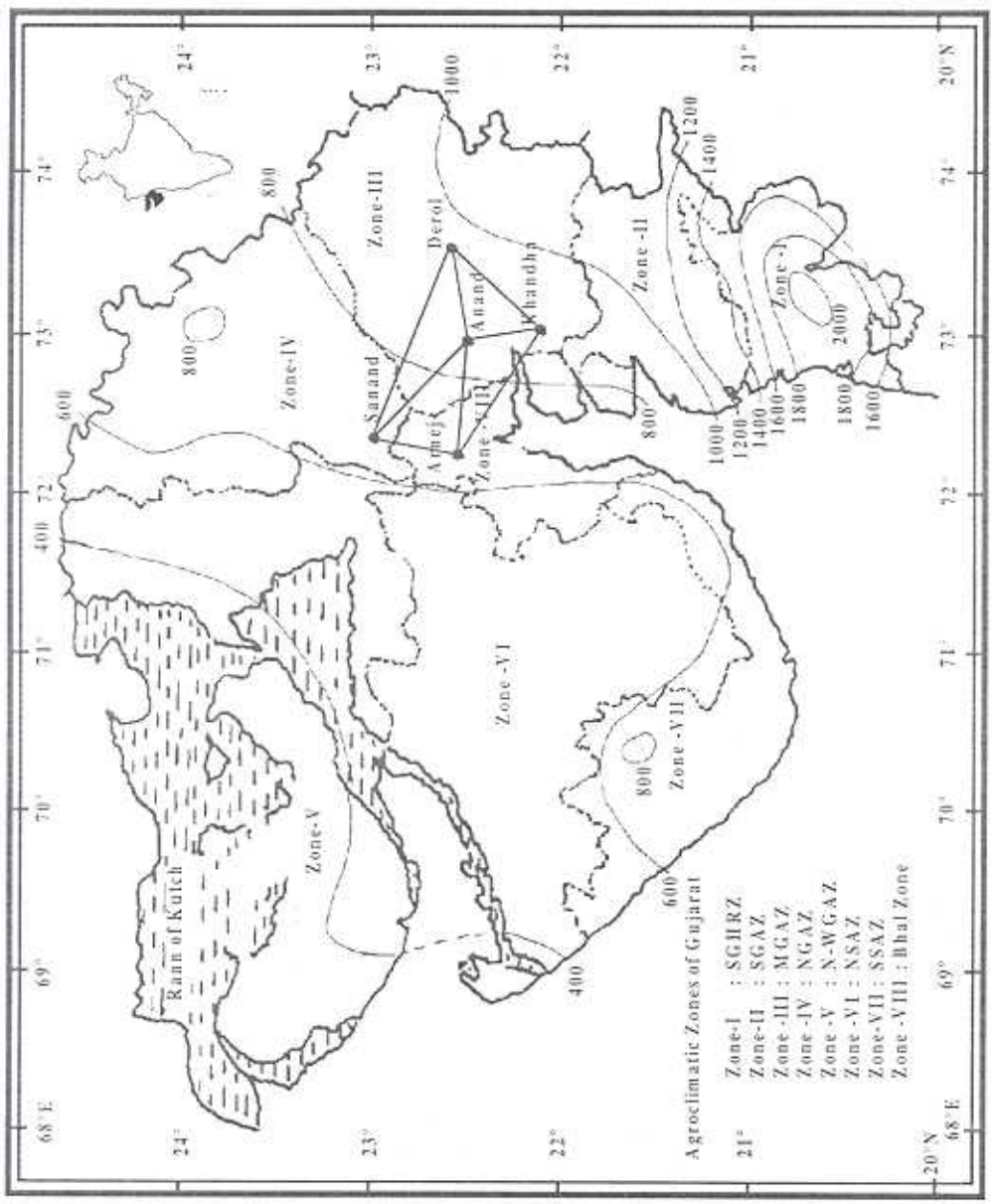

Fig. 1: Map showing agroclimatic zones, LASPEX sites and noraml rainfall (mm) of Gujarat.

Table 2: Normal climatic features of LASPEX sites.

Station	Region	Climatic type	Annual rainfall			Tmax (°C)	Tmin (°C)	Evaporation (mm day^{-1})
			Amount (mm)	CV %	Rainy days			
Anand Lat 22° 35' N Long. 72° 55'E Alt. 45. lm	Middle Gujarat Agrickunatu Zone	Semi-arid	850.5	40.1	37	33.4	19.8	5.4
Derol Lat. 22° 40'N Long. 73° '45'E Alt. 84.73m	Middle Gujarat Agroclimatic Zone	Semi-arid	960.0	41.8	39	34.0	17.9	4.3
Khandha Lat. 22° 02' N Long. 73° 11' E Alt. 28.12m	Middle Gujarat Agroclimatic Zone	Semi-arid	876.9	42.4	35	34.2	19.8	4.9
Arnej Lat.22°m 40' N Long. 72° 15" E Alt. 31.8m	Bhal Zone	Semi-arid	679.0	44.9	32	35.0	19.7	7.3
Sanand Lat. 23° 04' N Long. 72° 22' E Alt. 35.1m	North Gujarat Agroclimatic	Semi-arid	665.1	40.9	31	34.5	19.4	6.5

annual rainfall is about 850 mm.

Temperature

Within the LASPEX region temperature is the lowest in the month of January. The maximum temperature varies between 27 to 30 °C while the minimum varies between 10-12 °C during January across the region. Temperature increases with the advancement of the summer season and peak is reached during May when the maximum temperature is more than 40 °C. The spatial variation of temperature reveals that during winter, temperature increases from northwest to southeast direction where as during summer (May) temperature increase is in reverse direction. Maximum temperature decreases with the onset of monsoon and reaches to the lowest value of 31-32 °C during August. Again with withdrawal of monsoon maximum temperature increases up to 35 °C during October before further decreasing during winter season. However, minimum temperature, which is the highest in June ranging between 26-27 °C, decreases continuously during successive months attaining the lowest values of 10-12 °C in January.

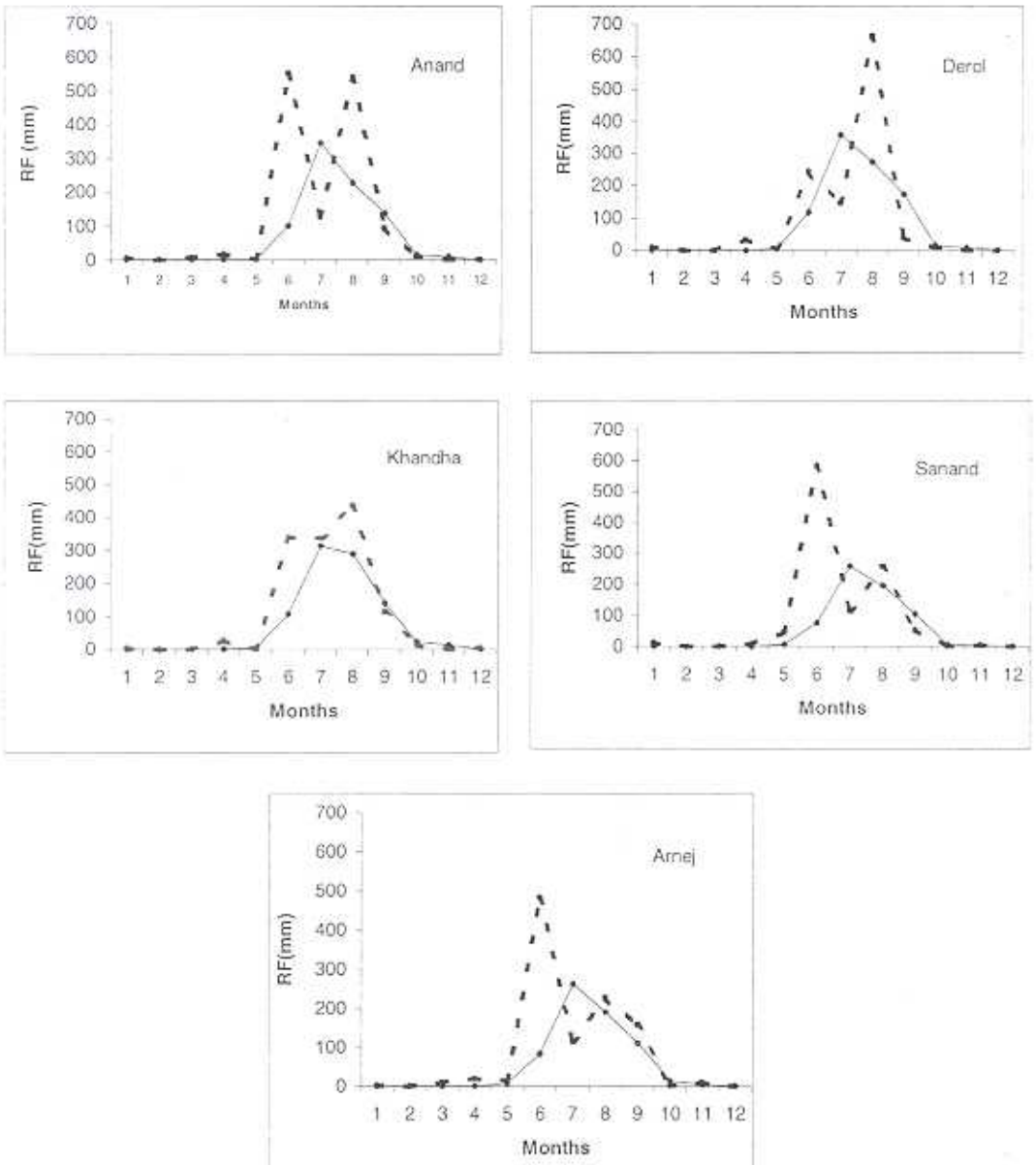

Fig. 2: Monthly normal rainfall (solid lines) and for year 1997 (dashed lines) at five LASPEX sites

Table 3: Soil characteristics of LASPEX sites

Station	Soil type	pH	EC (mhos cm $^{-1}$)	Bulk density (g cm $^{-3}$)	WHC (%)	PWP (%)
Anand	Loamy sand	8.3	0.22	1.50	17.0	5.0
Derol	Sandy loam	8.3	0.22	1.50	17.0	5.0
Khandha	Clayey	7.3	0.94 - 1.05	1.08 - 1.32	34.4	15.9
Arnej	Loamy Clay	8.2	0.48	1.24	28.0	12.2
Sanand	Sandy Clay loam	7.01 - 8.31	0.14 - 2.4	1.60	14.0	3.0

Evaporation

During the year the mean monthly evaporation rate varies between 3 mmday^{-1} to 12 mmday^{-1} within the LASPEX region. The lowest monthly mean evaporation rates of 3 to 5 mmday^{-1} are observed in January and August and the highest of the order of 9-12 mmday^{-1} in May. In northwestern side the evaporation is higher and in southeastern side it is lower. The average rate of evaporation generally follows the trend of maximum temperature.

AGROCLIMATIC FEATURES OF LASPEX SITES

Soils and climate

The sites selected for LASPEX are located at five agricultural research stations of Gujarat Agricultural University at Anand, Derol, Khandha, Arnej and Sanand (Table 2). Out of five stations of LASPEX three stations (Anand, Khandha and Derol) fall in middle gujarat agroclimatic zone, Sanand comes under north Gujarat and Arnej in Bhal region. Bhal Zone is characterized by alkaline/saline nature of soil created due to long time water logging.

Soils of the sites (Table 3) vary from sandy loam (Derol), loamy sand (Anand) to loamy clay (Arnej), sandy clay loam (Sanand) and Clayey (Khandha). The pH of the soils does not vary (7.0 to 8.3) much among the sites, but the electrical conductivity (EC_{25}) is found to vary between 0.14 to 2.4 mhos cm^{-1} not only from one site to other but also with depth at same station particularly at Sanand and Khandha. Bulk density varies between 1.24 g cm^{-3} (at Arnej) to 1.60 g cm^{-3} (at Sanand). Field capacities (FC) of the soils of LASPEX sites vary between 14% at Sanand to 34.4% at Khandha while the permanent wilting point (PWP) varies between 3% at Sanand and 15.9% at Khandha. (Table 3).

All the five stations fall under semi-arid climate type. The lowest annual rainfall of 665.1 mm is received at Sanand in 31 days with coefficient of variation (CV) of 40.9%

Table 4: Normal climatic parameters for representative months for summer, monsoon, post-monsoon and winter seasons. Values in parenthesis indicate extremes observed.

4(a): Anand

Climatic parameters	May	July	September	December
1. Rainfall				
Amount (mm)	4.1	346.1	138.4	0.8
CV(%)	352.6	66.3	97.4	446.0
Highest in 24 hrs(mm)	65.0	163.6	187.5	21.3
Rainy days	0.3	12.3	4.9	0.2
2. Temperature (°C)				
Mean temperature	32.4	29.1	28.6	21.2
Highest Max. Temp.	40.4(47.2)	34.7(41.1)	34.5(43.1)	34.7(37.8)
Lowest Max Temp	39.2(30.2)	31.2(24.4)	31.6(24.4)	27.5(20.0)
Highest Min. Temp	26.7(37.8)	26.6(31.1)	24.8(33.9)	14.0(22.8)
Lowest Min Temp	23.2(16.5)	25.0(12.2)	23.9(15.1)	10.7(2.6)
3. Afternoon relative humidity (%)	19.6	40.2	34.3	20.6
4. Pan evaporation (mm)				
Monthly total	272.5	142.4	137.2	104.1
Highest daily mean	9.4(14.5)	6.2(11.2)	5.2(7.2)	4.6(6.7)
Lowest daily mean	8.1(4.4)	3.5(0.3)	3.8(0.8)	2.9(0.1)

4(b): Derol

Climatic parameters	May	July	September	December
1. Rainfall				
Amount (mm)	4.9	346.1	173.3	2.0
CV(%)	385.7	65.9	90.4	313.6
Highest in 24 hrs(mm)	27.0	160.5	296.0	15.0
Rainy days	0.6	11.1	4.8	0.3
2. Temperature (°C)				
Mean temperature	31.5	28.5	27.7	20.3
Highest Max. Temp.	41.4(45.0)	34.5(42.0)	34.5(37.5)	31.8(34.5)
Lowest Max Temp	39.5(21.5)	31.5(25.0)	31.6(26.0)	29.2(24.5)
Highest Min. Temp	25.3(28.6)	24.7(28.0)	23.2(26.0)	11.3(22.5)
Lowest Min Temp	19.8(13.0)	23.1(17.5)	22.1(17.0)	8.8(3.5)
3. Afternoon relative humidity (%)	44.2	76.5	69.1	45.0
4. Pan evaporation (mm)				
Monthly total	274.8	125.2	95.6	56.5
Highest daily mean	9.6(11.4)	6.3(8.6)	4.8(6.5)	2.6(4.5)
Lowest daily mean	7.2(4.5)	0.0	0.9(0.4)	1.2(0.4)

4(c): Khandha

Climatic parameters	May	July	September	December
1. Rainfall				
Amount (mm)	5.7	303.8	135.5	2.0
CV(%)	277.6	56.7	91.3	324.0
Highest in 24 hrs(mm)	25.0	348.2	116.0	4.0
Rainy days	0.8	12	4.8	0.2
2. Temperature (°C)				
Mean temperature	32.2	28.7	29.6	21.5
Highest Max. Temp.	40.8(43.6)	34.7(38.2)	35.6(38.1)	31.7(35.0)
Lowest Max Temp	37.5(33.0)	30.0(26.1)	32.2(29.0)	28.6(25.0)
Highest Min. Temp	26.7(28.1)	26.3(30.5)	28.0(30.0)	15.1(20.0)
Lowest Min Temp	23.0(19.4)	23.6(21.0)	23.6(18.5)	9.9(6.5)
3. Afternoon relative humidity (%)	42.5	68.7	49.7	33.9
4. Pan evaporation (mm)				
Monthly total	259.9	126.1	116.1	99.7
Highest daily mean	9.6(15.3)	6.5(10.0)	4.8(6.1)	3.8(6.7)
Lowest daily mean	7.2(3.3)	2.5(0.4)	2.9(0.5)	2.7(1.2)

4(d): Arnej

Climatic parameters	May	July	September	December
1. Rainfall				
Amount (mm)	6.8	262.6	111.2	1.9
CV(%)	323.0	75.3	104.2	496.0
Highest in 24 hrs(mm)	104.0	198.0	154.6	7.8
Rainy days	0.6	9.7	5.6	0.1
2. Temperature (°C)				
Mean temperature	34.0	30.0	29.1	21.0
Highest Max. Temp.	43.0(48.0)	36.9(43.5)	35.6(40.0)	31.7(36.5)
Lowest Max Temp	41.3(34.5)	32.1(26.5)	32.5(25.0)	27.7(21.5)
Highest Min. Temp	28.1(30.5)	26.5(29.5)	25.1(27.4)	13.4(18.8)
Lowest Min Temp	23.1(19.5)	24.8(22.5)	23.6(20.5)	10.0(3.0)
3. Afternoon relative humidity (%)	24.5	57.7	56.0	28.8
4. Pan evaporation (mm)				
Monthly total	411.5	186.8	154.7	130.0
Highest daily mean	14.8(20.2)	8.8(16.0)	5.9(10.0)	5.0(8.0)
Lowest daily mean	11.9(7.0)	4.3(0.8)	4.0(0.5)	3.8(1.0)

4(e): Sanand

Climatic parameters	May	July	September	December
1. Rainfall				
Amount (mm)	7.0	284.1	110.2	2.5
CV(%)	249.5	77.1	103.2	432.8
Highest in 24 hrs(mm)	22.6	270.0	150.0	30.0
Rainy days	0.4	10.2	4.5	0.1
2. Temperature (°C)				
Mean temperature	33.9	29.3	28.9	20.0
Highest Max. Temp.	43.4(46.0)	36.7(43.0)	35.6(39.5)	31.0(35.0)
Lowest Max Temp	40.7(32.5)	30.8(25.0)	31.7(26.0)	26.9(20.0)
Highest Min. Temp	26.9(31.0)	26.3(30.0)	24.9(29.5)	12.5(20.5)
Lowest Min Temp	24.0(14.0)	24.1(14.0)	23.4(19.0)	8.2(3.0)
3. Afternoon relative humidity (%)	24.9	58.5	52.4	30.4
4. Pan evaporation (mm)				
Monthly total	352.0	165.6	167.0	119.2
Highest daily mean	13.1(18.0)	8.1(14.0)	6.7(14.2)	5.2(9.0)
Lowest daily mean	10.0(3.2)	3.6(0.1)	4.1(0.4)	3.2(0.5)

while the highest of 960 mm is received at Derol in 39 days with CV of 41.8%. Annual mean maximum temperature is highest (35 °C) at Arnej and the lowest (33.4 °C) at Anand. Mean annual minimum temperatures are more or less same (19.4-19.8 °C) at all stations except at Derol where it is slightly less (17.9 °C). Annual evaporation rates are higher at Arnej (7.3 mmday^{-1}) and lower (4.3 mmday^{-1}) at Derol (Table 2).

The mean monthly agroclimatic parameters were worked out using available data at each site of LASPEX. Anand is having the longest record of 40 year 1960 to 2000 while Derol, Arnej and Sanand having 12 years (1989-2000) and Khandha having only 6 years (1995-2000). However, the rainfall records were of sufficiently long period (more than 30 years at all the stations). Presentations have been made here for four representative months for different seasons viz. summer (May), active monsoon (July), withdrawal phase of monsoon (September), and winter (December) during which intevisive opervation period (IOP) were conducted and results were discussed at the workshop.

Average normal for representative months are presented in Table 4(a-e) whereas weather during 1997 is presented in Table 5(a-e). Salient features for each station are described here under.

Rainfall

All five sites receive about 95-96% of their annual rainfall in four months (June - September). July contributes maximum (35-40%) to annual rainfall followed by August

(Fig. 2). The coefficient of variation (CV) of monthly rainfall in July is minimum (60%) at Khandha and maximum (77.1%) at Sanand revealing that high CVs are associated with low rainfall. The maximum rainfall received in 24 hrs (one day) in the month of July is as high as 348.2 mm at Khandha. September also contributes considerably to annual rainfall (105-175 mm) with CV of 90-103% at different sites. Derol recorded the highest one-day (24 hrs) rainfall of 296.0 mm in September. Other stations had recorded 24 hrs maximum rainfall of 115-190 mm in September. LASPEX sites receive very little rain (0.5-2.5 mm) in the month of December.

Temperature

May is the hottest month of the year. Mean monthly temperature varies between 31.5 °C at Derol to 34 °C at Arnej. Daily maximum temperatures vary between 39 to 41 °C at Anand, Derol and Khandha, while it is between 41 to 44 °C at Arnej and Sanand. However, under intense summer conditions the maximum temperature can reach to 47.2 °C at Anand and even to 48 °C at Arnej. The minimum temperature during summer ranges between 20 to 27 °C at different stations with extremes values of 13 to 37.8 °C.

During July and September, the variation in maximum temperature is more or less same at all the stations. However, the minimum temperature in September is less than that in July by 1 to 2 °C. The minimum temperatures at Derol in July (23-24 °C), September (22-23 °C) and December (8.8-11.3 °C) are lower than any other station of LASPEX (Table 4).

Pan evaporation

Normal monthly pan evaporation for each LASPEX site is depicted in Fig. 3 and that for representative months are furnished in Table 4. Along with the extreme values of daily evaporation. The mean monthly evaporation reaches to its peak value in the month of May, then it decreases to the lowest value in August. It further increase slightly during October and than again decreases to minimum value in December. Among all the stations Arnej has the highest rate of evaporation reaching 14.8mm day^{-1} during May aggregating total highest maximum monthly evaporation of 411.8 mm followed by Sanand (352.0 mm). During May the lowest evaporation occurs at Khandha (260 mm). However, during August,the month of lowest evaporation rates; the lowest evaporation among all the sites, is observed at Derol (1.2-2.6 mmday^{-1}) at and the highest is at Sanand (3.2-5.2 mm day^{-1}).

WEATHER DURING 1997

Rainfall

Year 1997 was one of the good rainfall years over Gujarat. LASPEX stations also received 185-500 mm excess rainfall contributing about 19 to 62 % higher than the normal. Most of these rains (94-97%) were received during June to September. Anand received the highest seasonal rainfall (1313.3 mm) in 39 days (Table 5) followed by Khandha (1222.2 mm) whereas Arnej received the lowest rainfall (984.0 mm). The distribution was quite different than the normal (Fig. 2). In contrast to July getting the highest monthly rainfall, in year 1997, June and August recorded higher rainfall than July at all the sites. In July rainfall was less than even the normal. Arnej and Sanand received highest rainfall of 482.8 mm and 585.5 mm respectively only in June while it was between

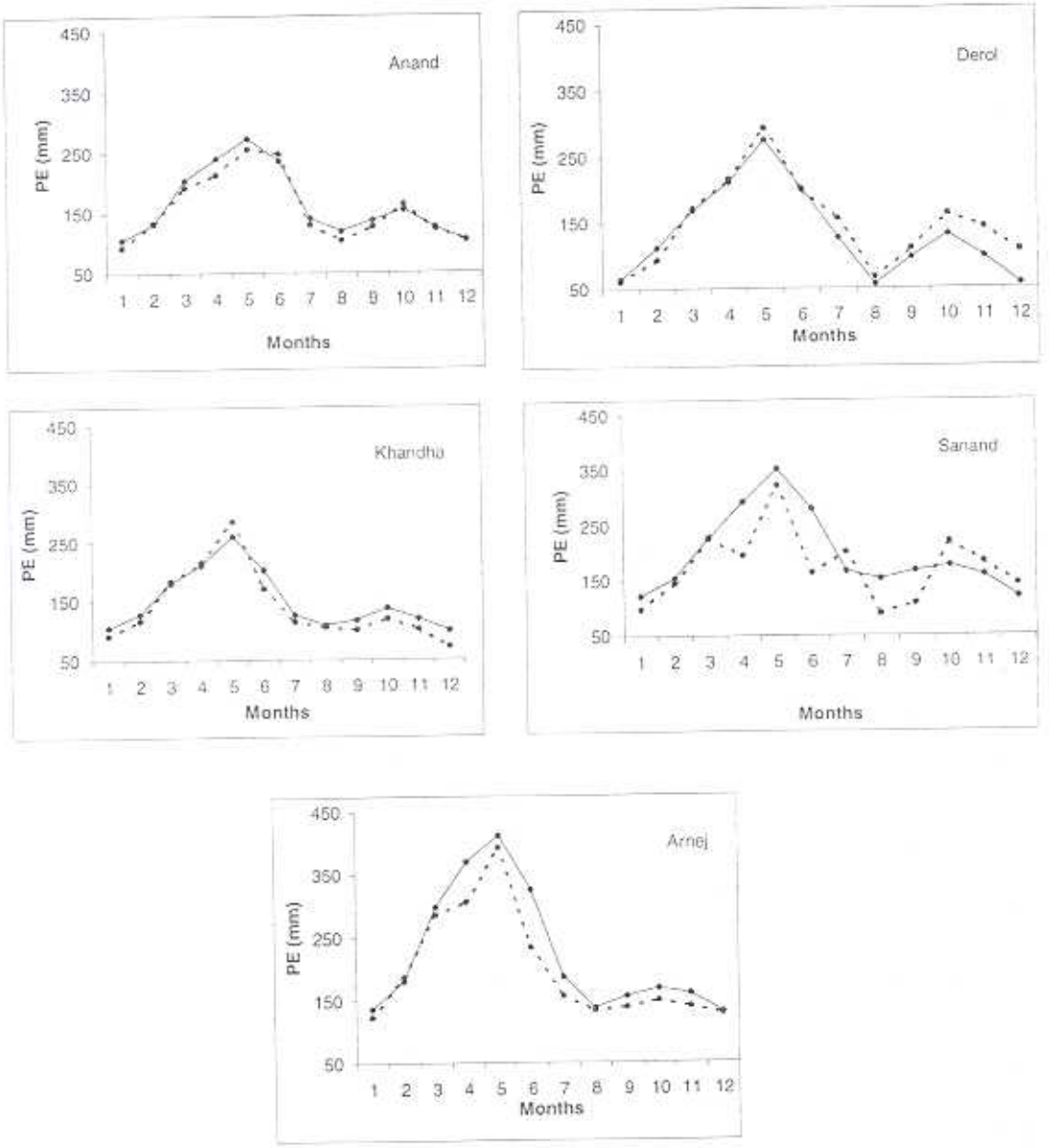

Fig. 3: Monthly normal pan evaporation (solid lines) and for year 1997 (dash lines) at five LASPEX sites

Table 5: Weather during 1997 for each station for representative months

5(a): Anand

Climatic parameters	May	July	September	December	June to September
1. Rainfall					
Amount (mm)	1.4	127.8	95.4	1.5	1313.3
Highest in 24 hrs(mm)	1.4	27.0	49.2	1.0	176.9
Rainy days	0	9	6	0	39
2. Max. Temperature (°C)					
Average	38.1	32.6	32.4	26.9	
Highest	42.0	35.2	34.5	31.5	
Lowest	31.0	28.0	29.4	22.5	
3. Min. Temperature (°C)					
Average	23.5	26.3	24.9	14.7	
Highest	26.5	27.6	26.2	19.5	
Lowest	19.3	24.6	23.0	9.5	
4. Afternoon RH (%)	38.0	72.5	64.1	52.9	
5. Pan evaporation (mm)					
Total	255.1	128.8	125.8	103.9	521.1
Highest in 24 hrs	10.6	9.0	5.8	5.0	9.5
Lowest in 24 hrs	5.3	1.5	2.0	2.0	0.5
6. Wind speed(km h^{-1})	5.1	6.2	3.5	4.1	

5(b): Derol

Climatic parameters	May	July	September	December	June to September
1. Rainfall					
Amount (mm)	4.0	145.6	38.8	0.0	1091.1
Highest in 24 hrs(mm)	4.0	67.6	13.8	0.0	221.9
Rainy days	1	9	4	0	34
2. Max. Temperature (°C)					
Average	38.7	32.4	32.0	28.6	
Highest	42.0	34.5	34.0	30.0	
Lowest	35.2	27.0	28.5	24.5	
3. Min. Temperature (°C)					
Average	22.7	24.4	23.0	11.7	
Highest	26.0	25.5	24.5	15.5	
Lowest	19.5	22.5	21.5	7.5	
4. Afternoon RH (%)	44.5	79.6	71.5	63.9	
5. Pan evaporation (mm)					
Total	291.7	129.5	101.6	54.5	445.0
Highest in 24 hrs	11.4	7.2	6.3	3.8	10.0
Lowest in 24 hrs	4.5	1.2	1.0	3.0	0.0
6. Wind speed(km h^{-1})	8.6	10.0	5.3	3.0	

5(c): Khandha

Climatic parameters	May	July	September	December	June to September
1. Rainfall					
Amount (mm)	0.0	337.4	113.1	4.0	1222.2
Highest in 24 hrs(mm)	0.0	107.6	27.2	4.0	145.5
Rainy days	0	15	7	1	49
2. Max. Temperature (^{0}C)					
Average	39.1	32.5	32.8	28.2	
Highest	43.6	35.6	35.5	31.0	
Lowest	33.0	28.0	30.0	25.0	
3. Min. Temperature (^{0}C)					
Average	24.3	25.8	—	14.1	
Highest	27.3	27.4	—	19.0	
Lowest	19.4	24.2	—	9.2	
4. Afternoon RH (%)	47.7	73.6	62.7	52.5	
5. Pan evaporation (mm)					
Total	285.5	113.5	99.4	70.7	470.9
Highest in 24 hrs	12.0	5.9	5.6	3.3	11.2
Lowest in 24 hrs	5.7	1.9	0.9	1.2	0.0
6. Wind speed(km h^{-1})	11.9	10.8	5.5	3.3	

5(d): Arnej

Climatic parameters	May	July	September	December	June to September
1. Rainfall					
Amount (mm)	15.5	115.6	158.2	0.0	984.0
Highest in 24 hrs(mm)	105	61.6	63.4	0.0	126.5
Rainy days	2	5	9	0	38
2. Max. Temperature (^{0}C)					
Average	41.5	33.5	33.2	27.6	
Highest	45.0	36.0	34.5	31.0	
Lowest	37.2	28.0	30.2	23.2	
3. Min. Temperature (^{0}C)					
Average	23.7	26.6	25.2	13.0	
Highest	27.0	27.5	26.8	17.5	
Lowest	20.0	24.8	23.0	8.0	
4. Afternoon RH (%)	22.1	66.3	61.9	43.8	
5. Pan evaporation (mm)					
Total	341.5	155.7	137.0	127.6	634.9
Highest in 24 hrs	19.0	7.4	6.2	5.8	11.1
Lowest in 24 hrs	7.0	1.2	0.8	2.0	0.8
6. Wind speed(km h^{-1})	-	-	-	-	

5(e): Sanand

Climatic parameters	May	July	September	December	June to September
1. Rainfall					
Amount (mm)	45.2	114.5	53.7	0.0	1011.7
Highest in 24 hrs(mm)	19.0	33.5	19.0	0.0	153.0
Rainy days	3	7	7	0	29
2. Max. Temperature (^{0}C)					
Average	41.3	33.1	33.3	27.2	
Highest	44.5	35.5	35.0	30.0	
Lowest	36.0	28.0	31.5	25.0	
3. Min. Temperature (^{0}C)					
Average	24.5	23.6	24.2	10.9	
Highest	29.0	26.5	25.5	15.0	
Lowest	14.0	20.0	22.0	8.0	
4. Afternoon RH (%)	36.8	71.4	61.6	57.6	
5. Pan evaporation (mm)					
Total	208.0	168.1	83.0	110.0	517.8
Highest in 24 hrs	16.5	10.0	7.0	6.5	10.0
Lowest in 24 hrs	6.5	1.0	0.5	3.5	0.5
6. Wind speed (km h^{-1})	8.9	8.4	6.5	5.1	

225 to 250 mm in September. In contrast to this, Derol received 664 mm only in the month of September. At central station Anand there were two peaks of 540 mm and 550 mm rains in June and September respectively (Fig. 2).

Maximum temperature

Maximum temperature at Anand was considerably (1-3 ^{0}C) below the normal during April to June and also in December (Fig. 4). It was very close to the normal values during rest of the period. However it was only during May, that the highest observed daily maximum temperature was higher than the normal highest temperature of the month (Table 5). Rest of the months recorded lower maximum temperature. As usual the mean monthly maximum temperature was the highest (41.3- 41.5 ^{0}C) at Arnej and Sanand and the lowest (38.1-38.7 ^{0}C) at Anand and Derol.

Minimum temperature

Mean monthly minimum temperature at Anand was slightly less (0.5-1.5 ^{0}C) than normal during April to June and higher than the normal during November and December (Fig. 4). In rest of the months it was very close to the normal values. Similar trends were observed at all the stations. The variation in daily minimum temperature during different months however, was slightly larger than the normal. In December, the lowest minimum temperature (7.5 ^{0}C) was recorded at Derol (Table 5).

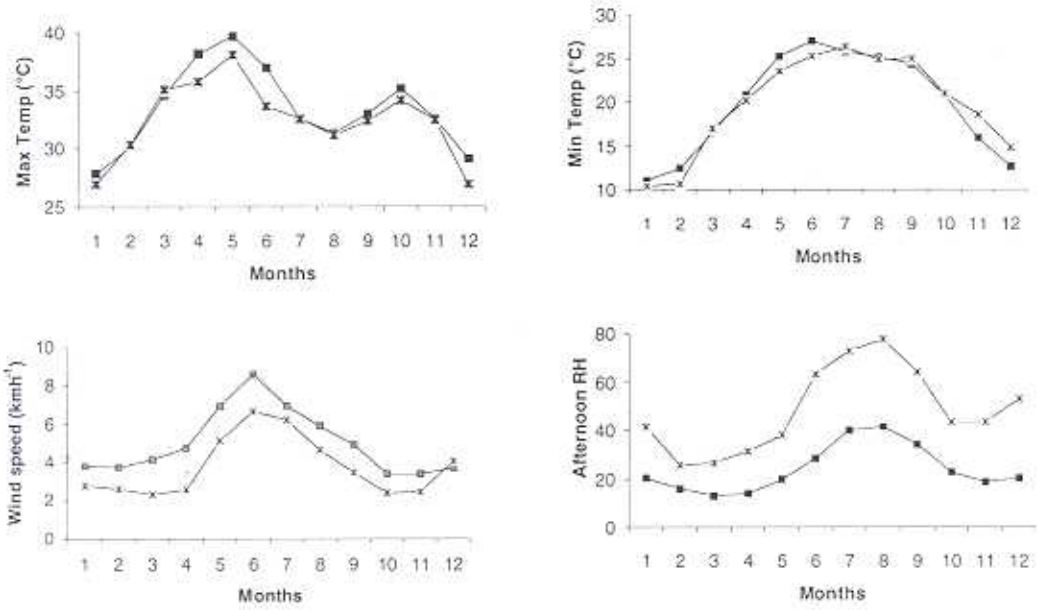

Fig. 4: Weather at Anand during 1997 (---*----) along with normal (---■---)

Relative humidity

The mean monthly afternoon relative humidity at Anand in 1997 was higher than the normal (Fig. 4) in all the months. During monsoon months it varied between 60-80% against the normal of 30-40%. All the stations experienced relative humidity higher than the normal. Amongst LASPEX stations, Derol was the most humid one (Table 5).

Pan evaporation

Monthly total pan evaporation during year 1997 along with the normal values are shown in Fig. 3. Evaporation was slightly less than the normal at all the stations except at derol where it was higher than the normal. During the year evaporation varied between 1741 mm at Derol to the maximum of 2363 mm at Arnej. During monsoon season (June-September) evaporation was only between 445 mm to 635 mm (Table 5). At all the stations the trends of monthly evaporation during 1997 was similar to that observed on average (Fig. 3), however, at Sanand it was quite different i.e. evaporation in April was less that that in March and July evaporation was higher than that in June (Fig. 3).

Wind speed

Mean monthly wind speed at Anand during 1997 (Fig.4) was quite low (2.3 to 6.7 kmh^{-1}) in comparison to normal wind speed

Table 6: Climatic water balance parameters at five stations of LASPEX

Station		RF	AET	WD	WS
Anand	Normal	851	715	1236	139
	1997	1359	605	1381	696
Derol	Normal	960	601	987	360
	1997	1145	544	1183	597
Khandha	Normal	877	745	1041	133
	1997	1270	712	955	558
Arnej	Normal	679	679	1935	-
	1997	1042	884	1479	159
Sanand	Normal	665	665	1662	-
	1997	1076	646	1501	436

(All values in mm)

(3.4 to 8.6 kmh^{-1}). Wind speed was maximum in the month of July at all the stations except at Khandha (Table 5) where the highest wind speed (11.9 kmh^{-1}) was observed in May followed by July (10.8 kmh^{-1}).

Water balance components

Thornthwaite and Mather (1955) technique has been used to assess the agroclimatic features of LASPEX stations for normal year as well as for year 1997. The weekly water balance computations made under both conditions are summarized in Table 6. The actual evapotranspiration (AET) showed less variation than that in rainfall. On normal basis it varied between 601 mm at Derol to 745 mm at Khandha whereas during 1997 it was between 544 mm at Derol to 883 mm at Arnej. AET during 1997 was less than the normal at most of the stations. This was due to less atmospheric demand and heavy rainfall received in one or two spells. These heavy spells of rain during 1997 resulted in surplus water (WS) between 159 mm at Arnej to 696 mm at Anand against the normal of 0 to 360 mm. It may be noted that Arnej and Sanand which do not expect excess water on normal basis, experienced surplus water of 159 and 436mm respectively. Water deficiency is observed during January to mid June and again during October to December month. The water deficit is the highest (1935 mm) at Arnej followed by Sanand (1662 mm), Anand (1236 mm) and Khandha (1041 mm) under normal condition. During year 1997, the water deficit was considerably less than the normal. It varied between 955 mm to 1501 mm at different stations.

REFERENCES

Anonymous. 1989. Status report of Middle Gujarat Agroclimatic zone, Vol-I, Director of Research, Gujarat Agricultural University, Ahmedabad (India). pp 266.

Anonymous. 1997. Agroclimatic Atlas of Gujarat, Department of Agril. Meteorology,

Gujarat Agricultural University, Anand (India) pp. 26.

Pandey, V. Shekh, A. M. and Parmar, R. S. 1997. Initial and Conditional rainfall probability of Middle Gujarat Agroclimatic zone. Res. Report no. 6. Dept. of Agril. Meteorology, BACollege of Agriculture, Gujarat Agricultural University, Anand (India). pp.50.

Thornthwaite, C. W. and Mather, J. R. 1955. The water balance. Publications in Climatology, 8. pp. 104.