CLIMATOLOGICAL DIAGNOSTIC ANALYSIS: A CASE STUDY FOR PARBHANI DISTRICT IN MARATHWADA REGION OF INDIA

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ABSTRACT

A daily climatological data viz. rainfall, evaporation Maximum temperature, minimum temperature, relative humidity, wind speed, bright sunshine hours data during the 1961 to 2010 was collected and analysed. The climate change from global perspective by comparison of last five decade's rainfall data observed and recorded 1216.2mm as an average and highest whereas evaporation noticed more than 80 mm for seven pentagonal years and less than 80mm for three pentagonal years within a decade span an in Parbhani district of Marathwada region.

The Comparison of 50 years evaporation data indicated that maximum annual average evaporation of 89.76 mm was recorded as highest. The temperature gradually increased from 1961 up to 1980 and then decreased up to 2000 and increased continuously thereafter. The maximum value of minimum temperature occurred in the forth pentagon i.e. in 1976-1980. During the span of 2001-05, 242.9 mm of rainfall occurred in 24 hrs during July 2005. Similarly comparable 24 hrs rainfall was recorded as 235 mm in 1986 -1990 and 234 mm

during 2006-2010. However, all other pentagonal yearly spans received very less rainfall as compared to above years.

Keywords: climate change, rainfall, pentagonal data, temperature, evaporation.

INTRODUCTION

Earth's climate is the average weather over a long period of time. Climate change in a given region or over the Globe is characterized by the difference between some climatic variables for two given intervals of time. Climate change impacts on agriculture are being witness all over the world, but countries like India are more vulnerable in view of the high population depending on agriculture, excessive pressure on natural resources and poor coping mechanisms. India has a distinctive continental arid and semi-arid climate with hot cloudiness, dry summers and moist, relatively warm winters in the south and cold winters with severe frosts in the north.

India's dry lands will face not only increasing temperature with climate change but also disruption in their hydrological cycles resulting in less and more unpredictable rainfall that may worsen the already critical state of water scarcity and conflicts over water distribution. Climate change impacts are likely to vary in different parts of the country. Parts of western Rajasthan, Southern Gujarat, Madhya Pradesh, Maharashtra, Northern Karnataka, Northern Andhra Pradesh and southern Bihar are likely to be more vulnerable in terms of extreme events (Mall *et. al.* 2006). With this view an exercise is made to study the climate change in Parbhani district of Marathwada region, which is a representative district of assured rainfall region. The study was undertaken with the objectives as to study the pentagonal climate variability, to study the climatic extremity and to study the pentagonal rainfall analysis for designing of soil and water conservation structures.

MATERIALS AND METHODS

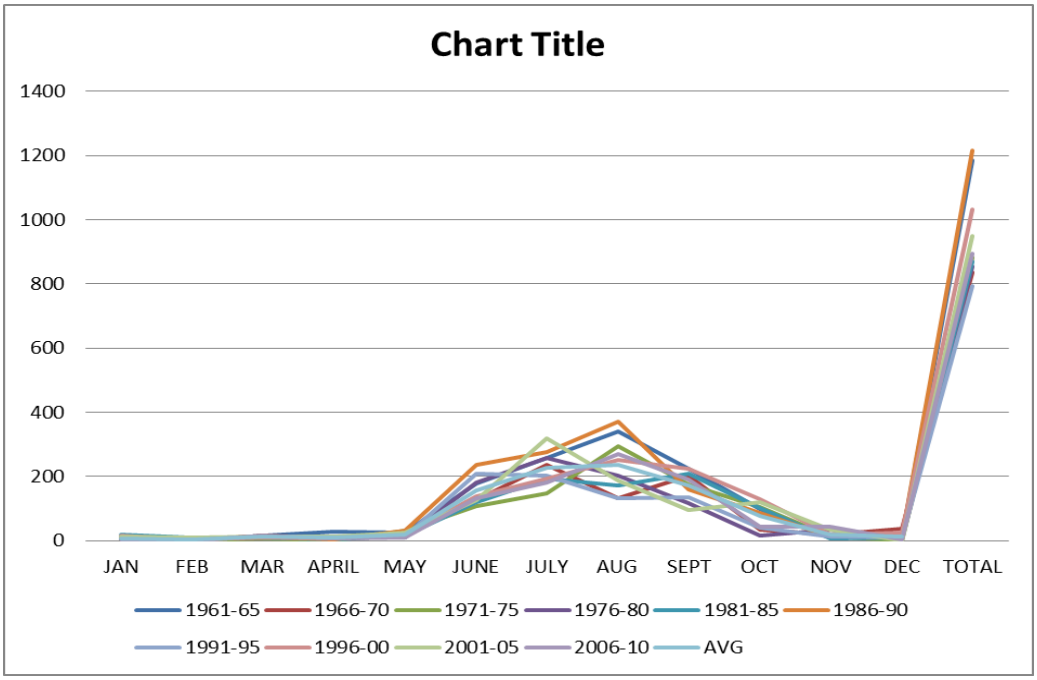
The daily climatological data viz. rainfall, evaporation Maximum temperature, and minimum temperature during the 1961 to 2010 was collected and analysed. The annual averages from January – December was worked out & the pentagonal averages were worked out. Similarly the extreme events in pentagonal yearly span were also worked out and these extreme events of rainfall were used to redesign the field bunds as well as graded bund as these are the main activities in any watershed development in assured rainfall zone of Marathwada region.

RESULTS AND DISCUSSIONS:

Rainfall Analysis:The daily rainfall data during the 1961 to 2010 was collected and analysed. The annual sum and averages of the rainfall data from JAN – DEC was worked out with pentagonal yearly averages and presented in table 1.

Table 1: Pentagonal yearly averages of rainfall

	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-00	2001-05	2006-10	AVG
JAN	0.26	3.24	0	2.28	18.72	8.12	11.6	14.33	12.28	2.02	7.29
FEB	0.96	0.2	0	7.4	9.76	6.02	0.84	3.87	8.56	0.4	3.80
MAR	14.64	14.48	5.88	8.12	8.48	13.48	13.7	10.72	11.96	14.06	11.55
APRIL	26.4	9.44	1.66	8.04	4.36	2.08	10.2	7.55	12.04	4.96	8.67
MAY	23.96	18	30.08	10.14	14.6	31.62	12.28	19.63	24.54	10.84	19.57
JUNE	178.82	126.76	107.08	182.2	119.72	235.72	209.36	138.48	125.7	131.86	155.57
JULY	258.06	237.1	148.5	255.8	193.1	276.64	203.48	192.37	319.9	180.8	226.58
AUG	340.46	132.68	292.96	202.72	172.92	370.58	132.54	251.95	185.88	269.82	235.25
SEPT	223.82	203.22	175.7	117.88	208.14	160.58	133.46	222.28	94.28	189.34	172.87
OCT	98.92	34.92	105.8	17	102.74	86.78	41.49	127.5	118.9	42.44	77.65
NOV	10.04	17.2	13.4	34.14	5.68	11.96	13.76	17.13	33.68	42.6	19.96
DEC	9.84	38.08	0	7.14	9.8	12.64	10.86	24.8	0	3.78	11.69
TOTAL	**1186.**	**835.32**	**881.0**	**852.8**	**868.02**	**1216.2**	**793.57**	**1030.6**	**947.72**	**892.92**	



Analysis of rainfall data revealed that, the maximum rainfall was observed during 1986-1990. Out of the ten pentagonal yearly averages of annual rainfall, seven pentagonal years were received average annual rainfall i.e. in the range of 800-900 mm. However, three pentagonal years received more than 1000 mm rainfall. In the 1st pentagon since 1961-65, 1186 mm of rainfall was received and

then in 1986-90 again 1216.2 mm of rainfall was received. Comparison of 50 years rainfall data indicated that maximum annual average rainfall of 1216.2 mm was recorded in 1986-90. Comparison of pentagonal average rainfall indicates that certainly there was a climatological change in the occurrence and distribution of rainfall in the region.

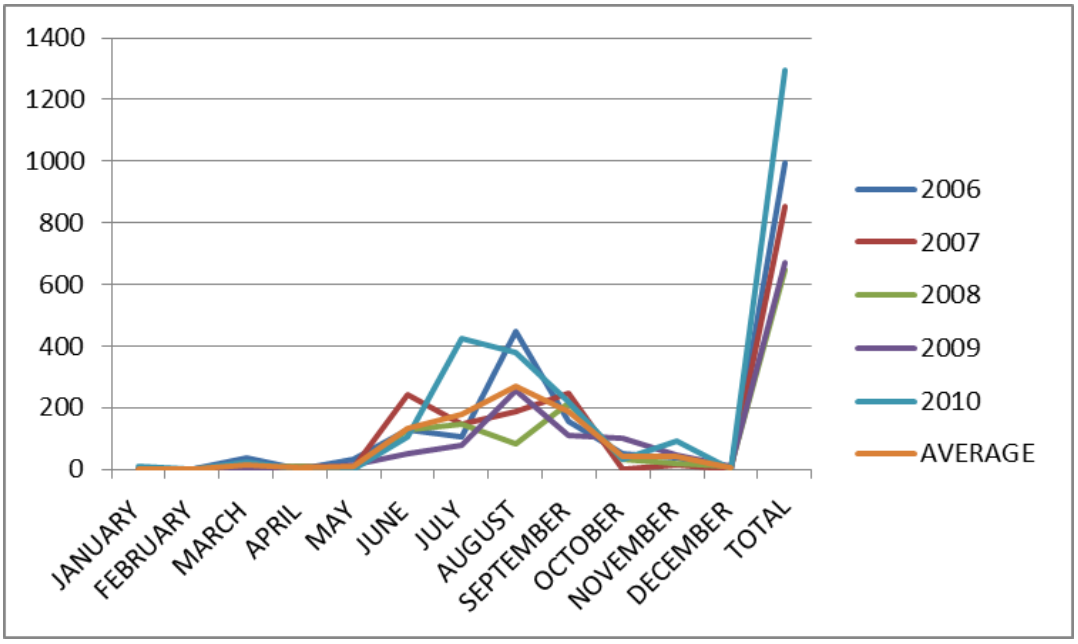
Rainfall analysis of last five years data:

The daily rainfall data during 2006-2010 was collected and analyzed. The total monthly rainfall for each year was calculated which is given in table 2

It was observed that out of five years, two years were received annual rainfall i.e. 800-900 mm and two years were received annual rainfall less than 700 mm. However, last year received more than 1000 mm annual rainfall. The data indicate that the annual rainfall goes on decreasing from 2006 up to 2009, but it increased tremendously in 2010.

Table 2: Monthly and yearly rainfall analysis of last five years data

	2006	**2007**	**2008**	**2009**	**2010**	**AVERAGE**
JANUARY	0	0	2	0	8.1	2.02
FEBRUARY	0	0	0	0	2	0.4
MARCH	36.9	0	5	3.4	25	14.06
APRIL	0	10.4	11.6	2.4	0.4	4.96
MAY	32.3	5.3	0	16.6	0	10.84
JUNE	130.4	242.4	128.2	52.2	106.1	131.86
JULY	106.4	146.8	147	77	426.8	180.8
AUGUST	446.6	186	81.6	254.2	380.7	269.82
SEPTEMBER	153.8	246.7	215.6	109.5	221.1	189.34
OCTOBER	50.2	0	30.7	100.1	31.2	42.44
NOVEMBER	38	16.2	17.8	47.7	93.3	42.6
DECEMBER	0	0	8.6	9.8	0.5	3.78
TOTAL	994.6	853.8	648.1	672.9	1295.2	



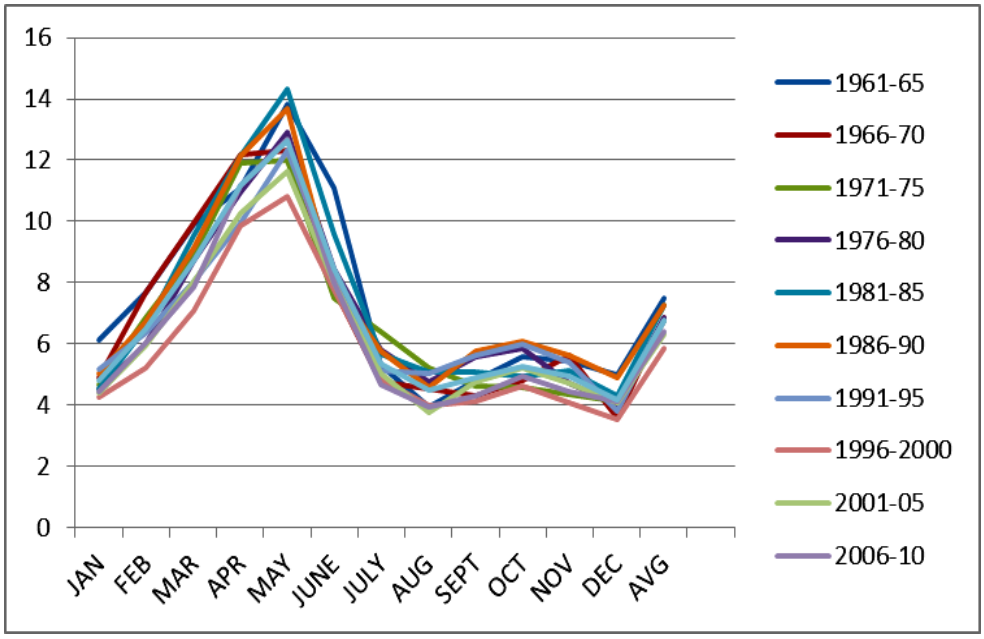
In the year 2010, almost all the month received rain. Comparison of five years rainfall data indicated that the maximum annual rainfall of 1295.20 mm in the year 2010 was recorded as highest.

Evaporation Analysis

The daily evaporation data during the 1961 to 2010 was collected and analysed. The data of pentagonal averages of evaporation are presented in table 3.

Table 3: Pentagonal yearly averages of evaporation

	1961-65	**1966-70**	**1971-75**	**1976-80**	**1981-85**	**1986-90**	**1991-95**	**1996-2000**	**2001-05**	**2006-10**	**AVG**
JAN	6.13	4.87	4.67	4.54	4.54	5.01	5.18	4.26	4.39	4.44	4.80
FEB	7.68	7.68	6.84	6	6.55	6.7	6.37	5.2	5.92	6.02	6.50
MAR	9.89	9.94	8.88	8.73	9.54	9.12	8.03	7.07	8.04	7.85	8.71
APR	11.08	12.2	11.9	10.96	12.15	12.14	9.93	9.85	10.26	11.16	11.16
MAY	13.83	12.31	12	12.89	14.32	13.7	12.31	10.81	11.63	12.69	12.65
JUNE	11.08	7.82	7.51	8.43	9.59	7.93	8.3	7.74	8.01	7.97	8.44
JULY	5.32	4.75	6.41	5.8	5.66	5.75	5.1	4.86	5.05	4.68	5.34
AUG	3.92	4.53	5.2	4.75	5.07	4.58	5.03	3.98	3.77	3.94	4.48
SEPT	4.8	4.32	4.61	5.56	5.09	5.78	5.64	4.12	4.76	4.28	4.90
OCT	5.59	4.81	4.59	5.86	4.92	6.07	5.97	4.61	5.19	4.94	5.26
NOV	5.46	5.61	4.35	4.71	5.12	5.64	5.39	4.05	4.72	4.43	4.95
DEC	4.97	3.59	4.14	4.04	4.3	4.91	3.81	3.51	4.08	4.12	4.15
AVG	7.48	6.87	6.76	6.86	7.24	7.28	6.76	5.84	6.32	6.38	6.78



The daily evaporation data during 1961-2010 was collected and analysed. Analysis of evaporation data revealed that, the evaporation decreasing trend from 1961 up to 1975 and then it showed trend increasing again up to 1990. The trend in change in evaporation was observed every after 15 year span. The maximum evaporation occurred in 1961-1965. Out of the ten pentagonal yearly averages of annual evaporation, seven pentagonal years were recorded average annual evaporation more than 6.75 mm. However, three pentagonal years recorded less than 6.75 mm evaporation.

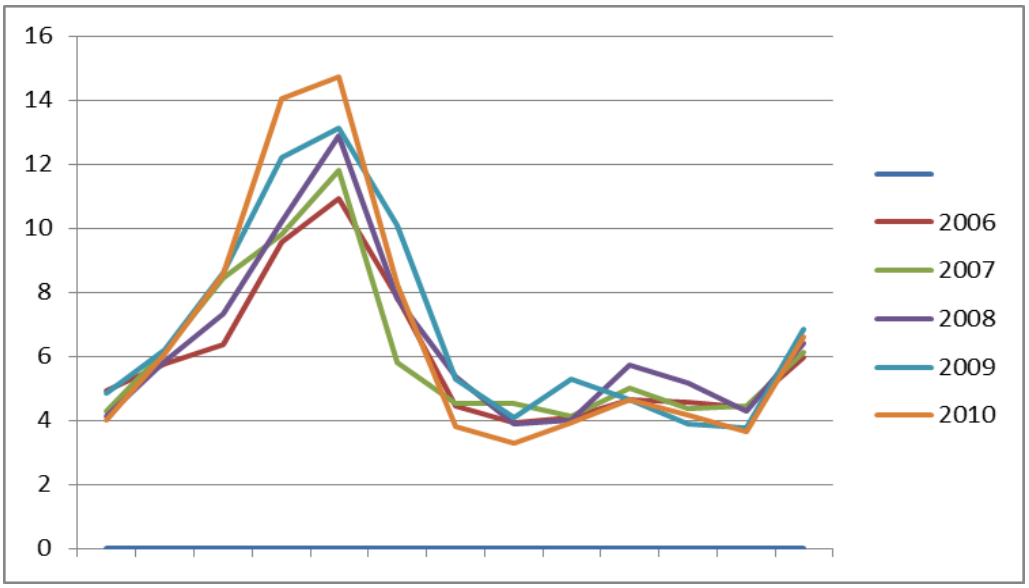
In the 1st pentagon since 1961-65, 7.48 mm of evaporation was recorded and then in 1986-90 again 7.28 mm of evaporation was recorded. Comparison of 50 years evaporation data indicated that maximum annual average evaporation of 7.48 mm was recorded as highest. Though the average annual evaporation was more in 1st and 6th pentagon, i.e. in 1961-65 and 1986-90, in 4th pentagon i.e. in 1981-85, the average monthly evaporation in the month of May recorded as 14.32 mm, which was the highest average monthly evaporation.

Evaporation of last five years:

The daily evaporation data during 2006-2010 was collected and analysed. The monthly average of evaporation for each year was calculated and presented in table 4.

Table 4: Monthly and yearly pan evaporation analysis of last five years data

	2006	2007	2008	2009	2010	AVERAGE
JANUARY	4.92	4.3	4.12	4.84	3.99	4.44
FEBRUARY	5.75	6.16	5.86	6.21	6.1	6.02
MARCH	6.35	8.44	7.32	8.6	8.55	7.85
APRIL	9.57	9.79	10.2	12.19	14.03	11.16
MAY	10.93	11.79	12.89	13.13	14.71	12.69
JUNE	7.86	5.82	7.82	10.1	8.24	7.97
JULY	4.44	4.51	5.35	5.3	3.82	4.68
AUGUST	3.91	4.52	3.9	4.1	3.28	3.94
SEPTEMBER	4.08	4.11	4	5.27	3.92	4.28
OCTOBER	4.65	5.02	5.71	4.66	4.66	4.94
NOVEMBER	4.55	4.37	5.16	3.9	4.17	4.43
DECEMBER	4.42	4.44	4.3	3.78	3.65	4.12
AVERAGE	5.95	6.11	6.39	6.84	6.59	6.38



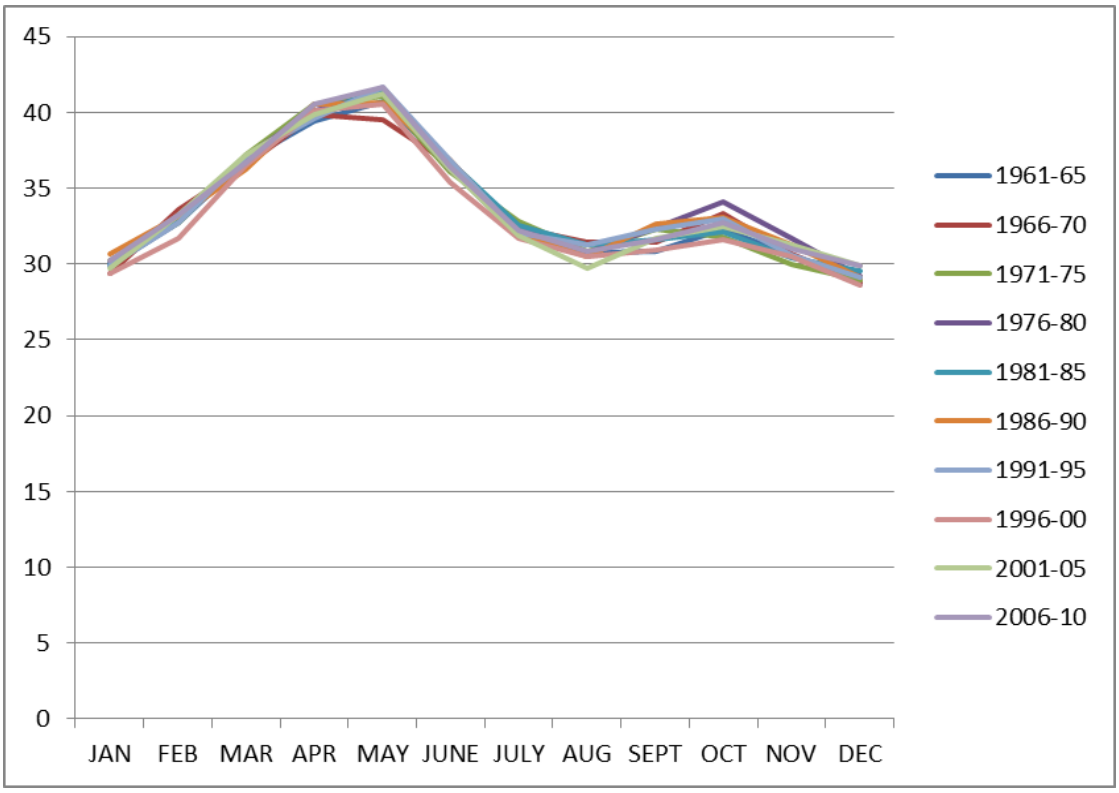
It was observed that out of five years, four years recorded average annual evaporation more than 6 mm. However, one year recorded less than 6 mm average annual evaporation. The data indicated that the average monthly evaporation showedincreasing trend upto the month of April and May. In the month of May highest evaporation was recorded 14.71 mm in the year 2010.

Maximum Temperature Analysis

The daily maximum temperature data during the 1961 to 2010 was collected and analyzed and accordingly the annual averages of the maximum temperature considering the meanmonthly max temperature from January – December were worked out with pentagonal yearly averages. The data of pentagonal averages of maximum temperature are presented in table 5.

Table 5: Pentagonal yearly averages of maximum temperature

	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-00	2001-05	2006-10	AVG
JAN	29.87	29.38	30.21	30.06	29.95	30.68	29.85	29.37	29.68	30.25	29.93
FEB	32.75	33.62	32.74	32.86	32.78	33.16	32.71	31.72	33.27	33.28	32.89
MAR	36.81	36.51	37.23	37.09	37.04	36.25	37.13	36.49	37.22	36.71	36.85
APR	39.4	39.86	40.56	40.15	39.83	40.55	39.56	40.11	39.86	40.53	40.04
MAY	40.73	39.53	41.04	41.34	41.59	40.61	41.62	40.55	41.19	41.66	40.99
JUNE	36.31	36.62	36.08	36.24	36.75	36.83	36.88	35.35	36.26	36.43	36.38
JULY	31.85	32.38	32.83	32.42	32.59	31.95	32.04	31.71	31.83	32.23	32.18
AUG	30.79	31.41	30.83	30.73	31.29	30.48	31.23	30.46	29.76	30.86	30.78
SEPT	30.84	31.42	32.32	32.41	31.6	32.61	32.3	30.93	31.68	31.65	31.78
OCT	32.33	33.37	31.81	34.12	32.16	33.03	33.01	31.61	32.45	32.76	32.67
NOV	30.56	30.68	30.02	31.72	30.39	31.27	30.62	30.51	31.25	30.99	30.80
DEC	28.7	28.79	28.94	29.24	29.55	29.13	29.16	28.62	29.93	29.86	29.19



Analysis of maximum temperature data revealed that, there were ups and downs in yearly pentagonal annual average of max. temperature.

Data shows that the average monthly maximum temperature of summer month was more than 35 ^{0}C. In the month of April and May it increases up to 40 ^{0}C. In the recent i.e. 2006-10, the average monthly maximum temperature in the month of May was recorded as 41.66 ^{0}C, which was the highest maximum temperature. All the monthly averages of maximum temperature were greater than average values.

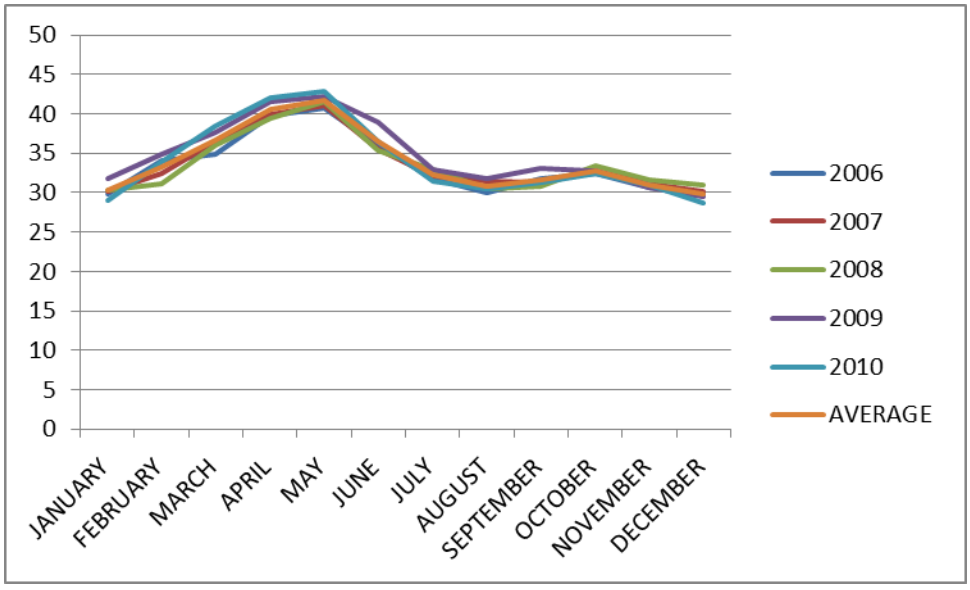
Maximum temperature analysis of last five years data:

The daily maximum temperature data during 2006-2010 was collected and analyzed. The monthly average of maximum temperature for each year was calculated and shown in table 6.

Table 6: Monthly and yearly maximum temperature analysis of last five years data

	2006	2007	2008	2009	2010	AVERAGE
JANUARY	29.86	30.2	30.34	31.73	29.09	30.25
FEBRUARY	34.05	32.39	31.21	34.9	33.85	33.28
MARCH	34.9	36.52	35.97	37.64	38.51	36.71
APRIL	39.69	40	39.48	41.51	41.98	40.53
MAY	40.66	41.05	41.52	42.18	42.89	41.66

JUNE	36	35.46	35.33	38.93	36.46	36.43
JULY	31.77	32.15	32.87	32.89	31.46	32.23
AUGUST	29.96	31.47	30.56	31.8	30.5	30.86
SEPTEMBER	31.71	31.36	30.78	33.08	31.31	31.65
OCTOBER	32.46	32.68	33.41	32.76	32.49	32.76
NOVEMBER	30.69	31.15	31.54	30.66	30.9	30.99
DECEMBER	29.98	30.13	30.97	29.57	28.68	29.86



It was observed that the maximum temperature in the month of May goes on increasing from 2006 to 2010. In 2010, the highest average monthly temperature was recorded i.e. 42.89 ^{0}C which was greater than average temperature of May. In January, the maximum temperature increased from 2006 up to 2009, but in the year 2010 it decreased. In June, the temperature decreased from 2006 to 2008 and again it increased in 2009 and then decreased in 2010. In October, the maximum temperature increased from 2006 to 2008 and again decreased.

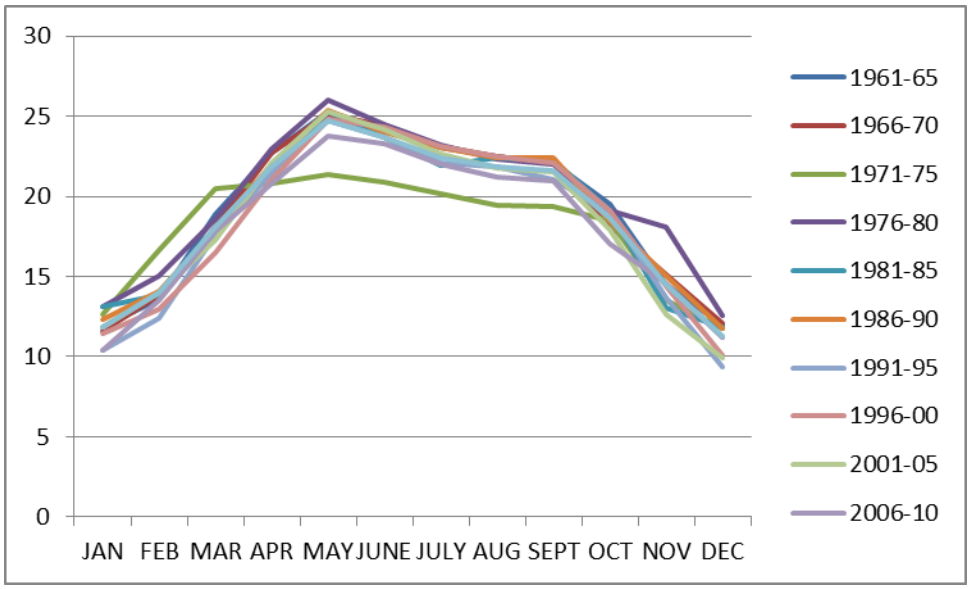
Minimum Temperature Analysis

The daily minimum temperature data during the 1961 to 2010 was collected and analysed. The data of pentagonal averages of minimum temperature are presented in table 7.

Table 7: Pentagonal averages of minimum temperature

	1961-65	1966-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-00	2001-05	2006-10	AVG
JAN	11.86	11.63	12.6	13.08	13.08	12.32	10.4	11.47	11.84	10.42	11.87
FEB	13.62	13.82	16.66	15.05	13.85	14.07	12.4	12.99	13.98	13.49	13.99
MAR	18.85	18.06	20.47	18.54	17.42	17.96	17.6	16.48	17.26	17.87	18.05
APR	22.75	22.72	20.84	22.97	21.7	22.01	21.48	21.05	22.07	20.83	21.84
MAY	25.25	25.13	21.39	26.02	25.28	25.35	24.73	24.84	25.25	23.74	24.70

JUNE	24.16	24.37	20.85	24.51	23.69	24.02	23.68	24.3	24.19	23.25	23.70
JULY	23.03	23.15	20.14	23.22	21.96	23.08	22.08	23.1	22.65	22.03	22.44
AUG	22.52	22.49	19.44	22.3	22.42	22.42	21.82	22.46	21.76	21.21	21.88
SEPT	22.07	22.08	19.37	22.02	22.26	22.44	21.01	22.07	21.51	20.97	21.58
OCT	19.52	18.2	18.47	19.1	19.14	18.52	19.06	19.09	17.92	17.03	18.61
NOV	14.47	15.12	13.5	18.07	13	15.07	13.65	14.38	12.63	14.58	14.45
DEC	11.97	12.1	11.73	12.53	11.86	11.77	9.36	10.04	9.89	11.19	11.24



The data showed that there were ups and downs in the monthly minimum temperature which indicated the variation in minimum temperature. During the pentagon 1991-95, in December, 9.36 ^{0}C was recorded the lowest minimum temperature. In the recent i.e. 2006-10, all the months except September, October and November, recorded the minimum temperature less than average monthly temperature.

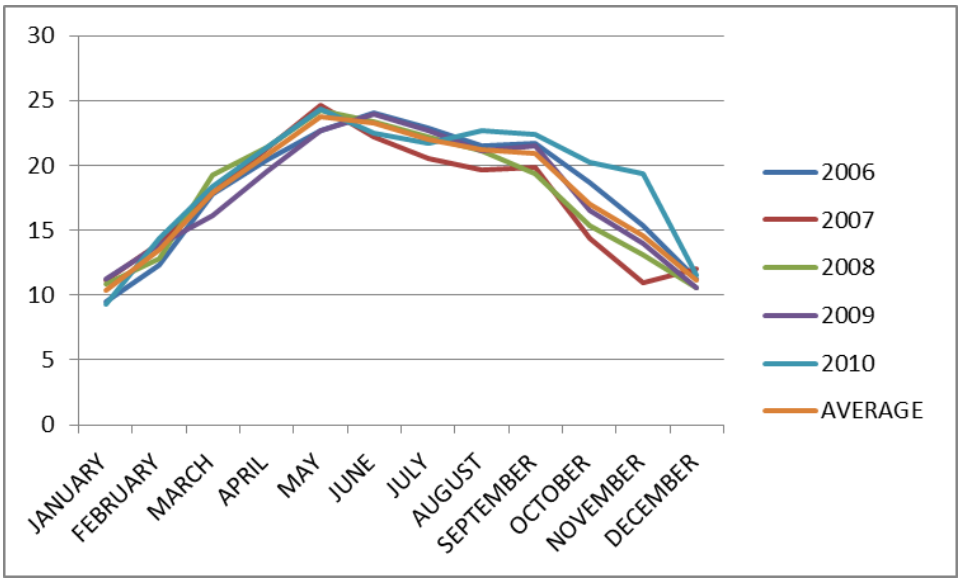
Minimum temperature analysis of last five years data:

The daily minimum temperature data during 2006-2010 was collected and analyzed. The monthly average of minimum temperature for each year was calculated and shown in table 8.

Table 8: Monthly average of minimum temperature of last five years data

	2006	2007	2008	2009	2010	AVERAGE
JANUARY	9.48	11.19	10.85	11.28	9.29	10.42
FEBRUARY	12.36	14.01	12.86	13.86	14.36	13.49
MARCH	17.76	17.87	19.24	16.09	18.38	17.87
APRIL	20.4	21.33	21.45	19.59	21.4	20.83
MAY	22.7	24.61	24.26	22.72	24.38	23.74
JUNE	24.1	22.24	23.4	23.96	22.53	23.25
JULY	22.91	20.58	22.21	22.72	21.74	22.03

AUGUST	21.5	19.67	21.09	21.16	22.65	21.21
SEPTEMBER	21.69	19.82	19.39	21.56	22.4	20.97
OCTOBER	18.63	14.42	15.31	16.52	20.27	17.03
NOVEMBER	15.4	10.97	13.14	13.97	19.41	14.58
DECEMBER	11.28	12.05	10.54	10.55	11.56	11.19



It was observed that, there was variation in minimum temperature. It increased in one year and again deceased in next year. In January 2010, the lowest average monthly minimum temperature was recorded i.e. 9.29 ^{0}C. In the month of October, the minimum temperature goes on decreasing from 2006 to 2008 and again increased up to 2010.

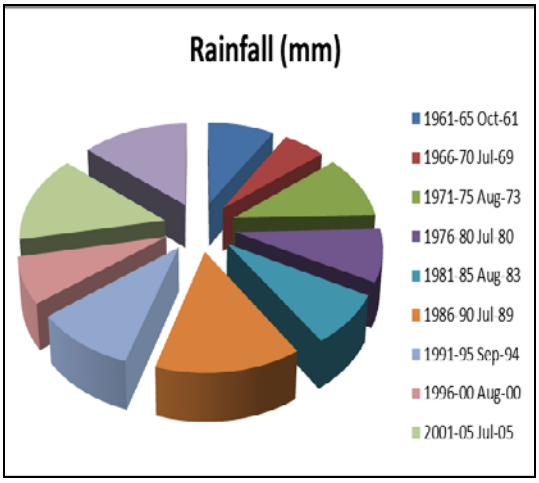
Extreme Rainfall Events: The data of daily extreme rainfall events during each pentagonal year span were presented in table 9.

The extreme events with respect to the maximum daily rainfall during 1961 to 2010 were sorted out and accordingly the maximum value of daily rainfall during each pentagonal yearly span was analysed. Data presented in the table indicated that during the span of 2001-05, 242.9 mm of rainfall occurred in 24 hrs during July 2005. Similarly, comparable 24 hrs rainfall was recorded as 235 mm in 1986 -1990 and 234 mm during 2006-2010.

Table 9: Daily extreme rainfall events

Year	Month	Rainfall (mm)
1961-65	Oct-61	146.1
1966-70	Jul-69	93
1971-75	Aug-73	176

1976-80	Jul-80	143
1981-85	Aug-83	136
1986-90	Jul-89	235
1991-95	Sep-94	166.5
1996-00	Aug-00	125
2001-05	Jul-05	242.9
2006-10	Aug-06	234



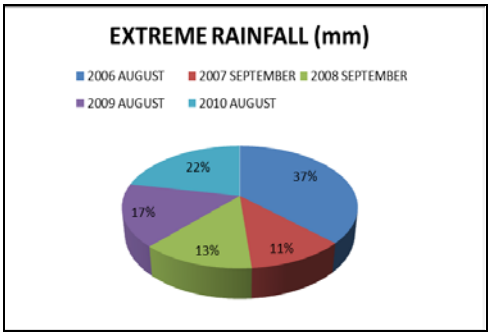
However, all other pentagonal yearly spans received less rainfall in a day as compared to above years. Hence, these extreme values have been utilized for designing of field bunds and graded bunds.

Last five years extreme rainfall events:

The extreme events with respect to maximum daily rainfall during 2006-2010 were determined and accordingly the maximum value of daily rainfall in each year was analysed and given in table 10.

Table 10: Last five years extreme rainfall events

YEAR	MONTH	EXTREME RAINFALL (mm)
2006	AUGUST	234
2007	SEPTEMBER	71.2
2008	SEPTEMBER	82
2009	AUGUST	103.5
2010	AUGUST	136.6



Data presented in the table indicated that in 2006, 234 mm of rainfall occurred in 24-hrs in the month of August. After that there were no heavy rainfall in two years and again in 2009, 103.5 mm rainfall was occurred. In last year, the maximum daily rainfall recorded was 136.6 mm in the month of August. The data indicated that all the extreme events were occurred in the months of August and September.

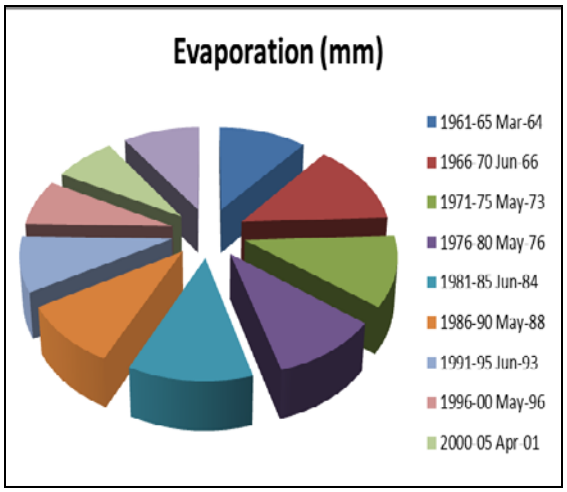
Extreme Evaporation Events

The extreme events with respect to the maximum daily evaporation during 1961 to 2010 were determined and accordingly the maximum value of daily evaporation during each pentagonal year span was analyzed. The data of daily extreme evaporation events during each pentagonal year span were presented in table 11.

Table 11: Daily extreme evaporation events

Year	Month	Evaporation (mm)
1961-65	Mar-64	24
1966-70	Jun-66	29

1971-75	May-73	24.4
1976-80	May-76	22.3
1981-85	Jun-84	25
1986-90	May-88	21
1991-95	Jun-93	19.1
1996-00	May-96	16.2
2000-05	Apr-01	16.6
2006-10	May-10	20.9



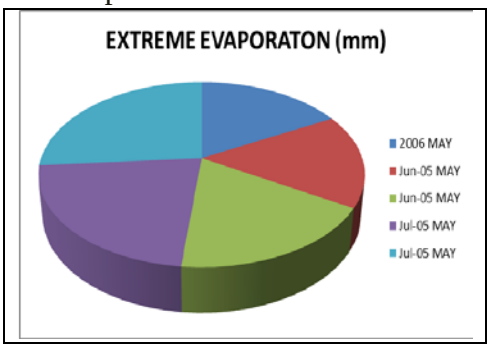
Data presented in the table indicated that during the span of 1966-70, 29 mm of evaporation occurred in 24 hrs during May-73. Similarly near about 24 hrs evaporation was recorded as 24 mm in 1961-65. However, all other pentagonal yearly spans received very less evaporation as compared to above years.

Last five years extreme evaporation events:

The extreme events with respect to maximum daily evaporation during 2006-2010 were determined and accordingly the maximum value of daily evaporation in each year was analysed and given in table 12.

Table 12: last five years extreme evaporation events

YEAR	MONTH	EXTREME EVAPORATON (mm)
2006	MAY	13.6
2007	MAY	13.1
2008	MAY	14.5
2009	MAY	17.6
2010	MAY	20.9



Data presented in the table indicated that in 2010, 20.9 mm evaporation was occurred in 2-hrs. All the extreme events were observed in the month of May. Data showed that the rate of evaporation goes on increasing continuously.

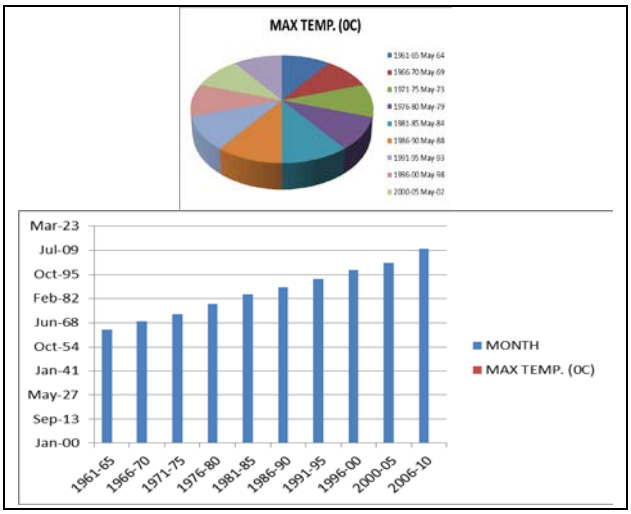
Extreme Maximum temperature Events

The extreme events with respect to the maximum daily maximum temperature during 1961 to 2010 were determined and accordingly the maximum value of daily maximum temperature during each pentagonal year span was analysed. The data of daily extreme maximum temperature events during each pentagonal year span were presented in table 11.

Table 13: Extreme maximum temperature

YEAR	MONTH	MAX TEMP. (^{0}C)
1961-65	May-64	45.8

1966-70	May-69	45
1971-75	May-73	45.5
1976-80	May-79	44.2
1981-85	May-84	46.8
1986-90	May-88	46.6
1991-95	May-93	45.5
1996-00	May-98	44.5
2000-05	May-02	45
2006-10	May-10	46



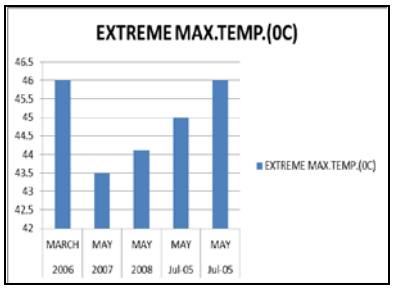
Data presented in the table indicate that during the span of 1981-85, 46.8 ^{0} C of maximum temperature occurred in 24 hrs during May 1984. Similarly comparable 24 hrs maximum temperature was recorded as 46.6 ^{0}C in 1986 -1990. Again in last pentagon i.e. 2006-10, the highest maximum temperature recorded was 46 ^{0}C in the month of May-2010. The data showed that the extreme events of maximum temperature were observed in between 44^{0}C to 47^{0}C.

Last five years extreme maximum temperature events:

The extreme events with respect to daily maximum temperature during 2006-2010 were determined and accordingly the maximum value of daily temperature in each year was analyzed and given in table 14.

Table 14: last five years extreme maximum temperature events

YEAR	MONTH	EXTREME MAX.TEMP.(^{0}C)
2006	MARCH	46
2007	MAY	43.5
2008	MAY	44.1
2009	MAY	45
2010	MAY	46



Data presented in the table indicated that in 2010, 46 ^{0}C maximum temperature was observed. All the extreme events were observed in the month of May.

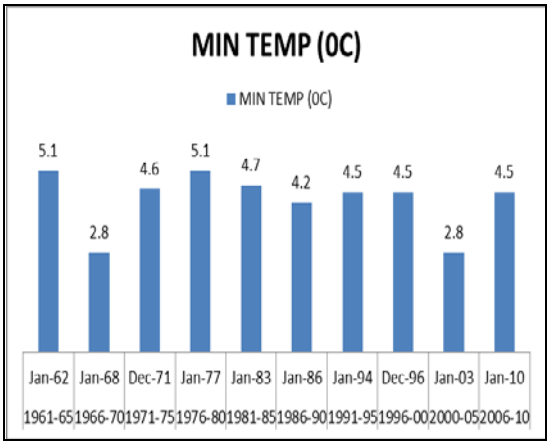
Extreme Minimum Temperature Events

The extreme events with respect to the minimum daily temperature during 1961 to 2010 were determined and accordingly the lowest value of daily minimum temperature during each pentagonal year span was analyzed. The data of daily extreme minimum temperature events during each pentagonal year span were presented in table 15.

Table 15: Daily extreme minimum temperature

YEAR	MONTH	MIN TEMP (^{0}C)
1961-65	Jan-62	5.1

1966-70	Jan-68	2.8
1971-75	Dec-71	4.6
1976-80	Jan-77	5.1
1981-85	Jan-83	4.7
1986-90	Jan-86	4.2
1991-95	Jan-94	4.5
1996-00	Dec-96	4.5
2000-05	Jan-03	2.8
2006-10	Jan 10	4.5



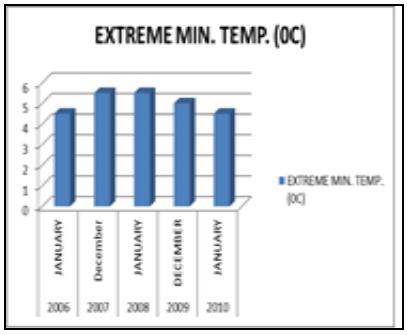
Data presented in the table indicated that during the span of 1966-70 and 2000-05, 2.8^{0}C of minimum temperature was observed which was the lowest minimum temperature. However, all other pentagonal yearly spans recorded more minimum temperature as compared to above years.

Last five years extreme minimum temperature events:

The extreme events with respect to daily minimum temperature during 2006-2010 were determined and accordingly the minimum value of daily temperature in each year was analysed and given in table 16.

Table 16: Last five years extreme minimum temperature events

YEAR	MONTH	EXTREME MIN. TEMP. (^{0}C)
2006	JANUARY	4.5
2007	December	5.5
2008	JANUARY	5.5
2009	DECEMBER	5
2010	JANUARY	4.5



Data presented in the table indicated that in 2010, 4.5 ^{0}C minimum temperatures was occurred in the month of January, which was recorded as the lowest temperature.

CONCLUSIONS:

The climate variations with respect to rainfall, evaporation and temperature was observed since 1961-2010 in recent from 2006-10, the seasonal variation in rainfall was observed. However, the daily evaporation and maximum temperature goes on increasing continuously and similarly the minimum temperature goes on decreasing during last five year span.

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