3.   RAINFALL PATTERN & ANALYSIS

The normal rainfall for Kutch district ranges between 300 to 400 mm. The district receives an average annual rainfall of 356 mm (for study period of 1878 to 2007), which is erratic and depends on the strength of the summer monsoon. It ranges from 335 mm at Bhuj to 331 mm at Naliya. It varies from 414 mm at Mandvi on the southern coast to 322 mm at Lakhpat on the northwest coast. The variation in the annual rainfall from the year to year is very large. The monsoon rains usually set in by the third week of June in the coastal belt and withdraws by the end of September. The maximum rainfall takes place during the month of July and very less rain occurs during the month of August and September. Most of annual rainfall in the district is received during the southwest monsoon season, July being the rainiest month. Rainfall of about 178 to 468 mm in a single day has also been recorded at many stations.

3.1 RAINFALL DATA COLLECTED

The annual rainfall data was obtained for all talukas from the State Water Data Centre, Gandhinagar for a period of 130 years from 1878 to 2007. Daily rainfall data was obtained for the period of 1989 to 2007. Detailed analysis has been done for the data for the period of 1989 to 2007.

Out of total area of 45,652 km^2 of the district the Rann covers about 19039 km^2 area. The area consisting of the Kutch mainland and Wagad having a total area of 20471.79 km^2 has been selected as the study area. For the purpose of the study, a separate map has been prepared where the study area has been separated from the desert region and all the figures have been developed using the study area only. Figure 3.1 shows the study area separated from the total area of the district.

Figure 3.1 Study area separated from total area of district

3.2 ANALYSIS OF 130 YEAR ANNUAL RAINFALL DATA

Annual rainfall data was collected for all the talukas. The analysis for the rainfall has been done for all the talukas, its comparison with that of the district has been done and three year and five year moving mean graphs have been. Figure 3.2 shows the 130 year average annual rainfall pattern for study area for portion of study area.
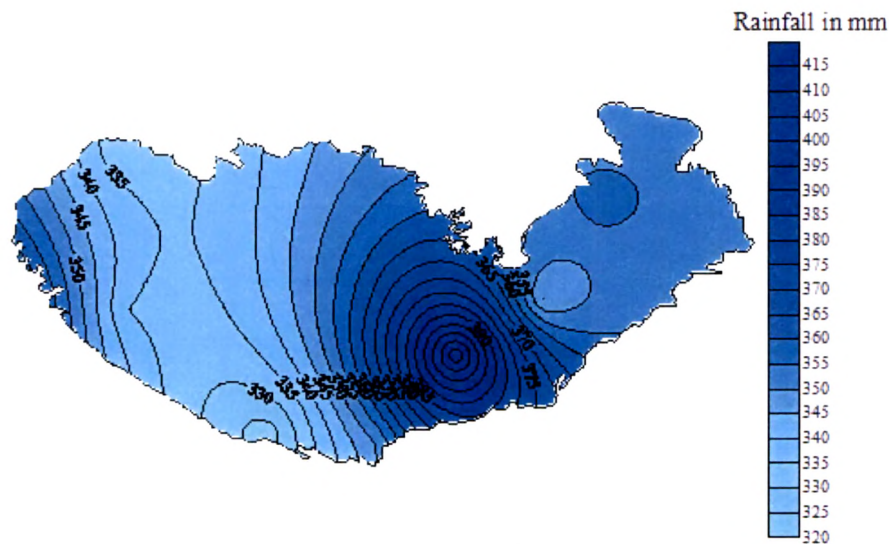

Figure 3.2 Average Annual Rainfall Pattern for Kutch
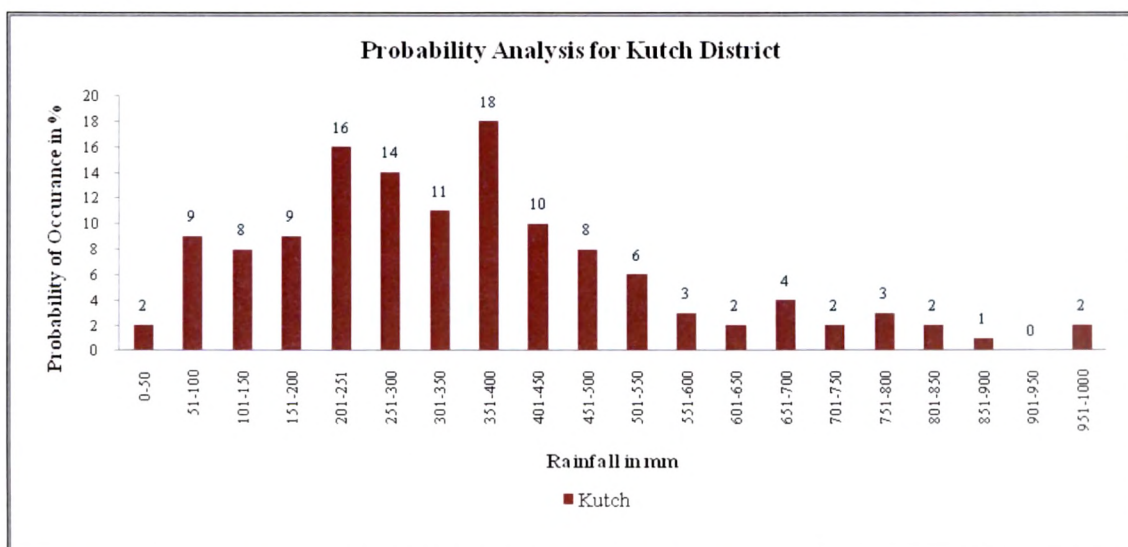
3.2.1 Analysis for Kutch district

3.2.1.1 Rainfall Pattern Analysis

The analysis was done for finding out the pattern of rainfall for whole district. During period 1878 to 2007 the highest annual rainfall amounting to 996 mm occurred in the year 1959. Three year and five year moving mean graphs have been developed to find out the dry and wet period for the district. The graph 3.1 shows that the pattern of rainfall is very erratic. It has been observed that there is atleast one drought or rainfall deficit year once in every cycle of three to four years. Annexure 1 shows the values of annual rainfall for 130 years.
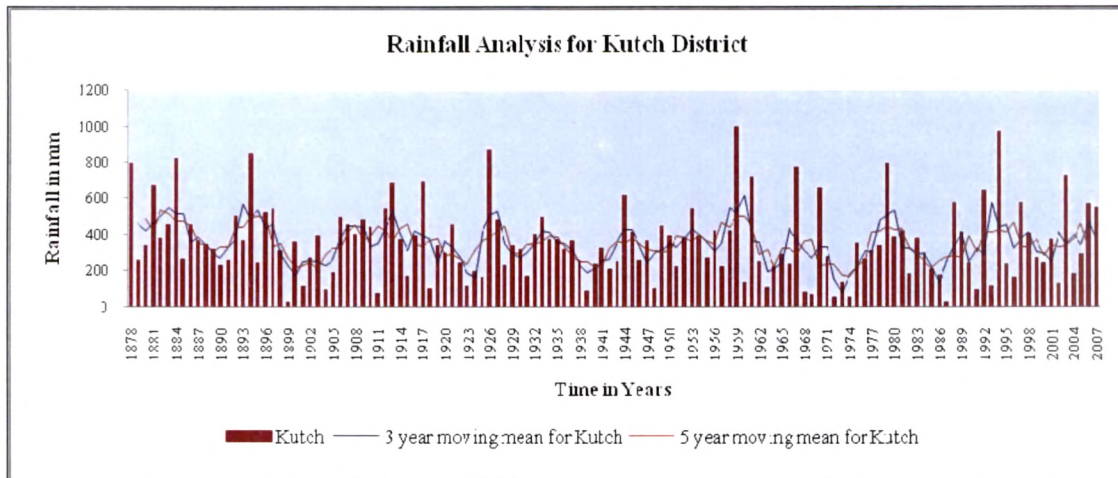
Graph 3.1 Rainfall Analysis for Kutch District

3.2.1.2 Probability Analysis

The probability analysis for the rainfall has been done for the period of 130 years and the results for the same have been tabulated. The probability of rainfall occurring between 350 to 400 mm for Kutch district is maximum. Graph 3.2 shows the probability analysis for the district and Table 3.1 shows the probabilities of occurrence of rainfall for the district.

Graph 3.2 Probability Analysis for Kutch District

Table 3.1 Probability of Occurrence of Rainfall for Kutch District

Rainfall in mm	Number of events	% Probability of Occurrence
0-50	2	1.54
51-100	9	6.92
101-150	8	6.15
151-200	9	6.92
201-251	16	12.31
251-300	14	10.77
301-350	11	8.46
351-400	18	13.85
401-450	10	7.69
451-500	8	6.15
501-550	6	4.62
551-600	3	2.31
601-650	2	1.54
651-700	4	3.08
701-750	2	1.54
751-800	3	2.31
801-850	2	1.54
851-900	1	0.77
901-950	0	0.00
951-1000	2	1.54
Total	130	100 .00

3.2.1.3 Rainfall Distribution Analysis for District

The annual rainfall during the study period has been classified as drought, deficit, normal, above average and surplus based on Central Arid Zone Research Institute (CAZRI) report prepared by Singh R S et. al (1990,1991) . The criteria for analysis in CAZRI report were as follows:

Table 3.2 Criteria for analysis in CAZRI report

Surplus years	A year receiving a rainfall of 150 % or more of the normal annual rainfall
Above normal years	A year receiving a rainfall between 125% to 150% of the normal annual rainfall
Normal years	A year receiving a rainfall between 75 to 125 % of the normal annual rainfall
Below normal years	A year receiving rainfall between 50 to 75 percent of the normal annual rainfall
Deficit years	A year receiving rainfall less than 50% of the normal annual rainfall

(Source :CAZRI)

Based on the above criteria, following criteria as shown in Table 3.2 have been framed and analysis for 130 year annual rainfall data has been done for the district as well as all the talukas. Graph 3.3 shows the distribution of rainfall for the district.

Table 3.3 Criteria for Analysis of Rainfall

Description	Rainfall in mm
Drought years	<150
Rainfall deficit years	151-300
Normal Rainfall years	300-400
Above average rainfall years	400-500
Surplus rainfall years	> 500
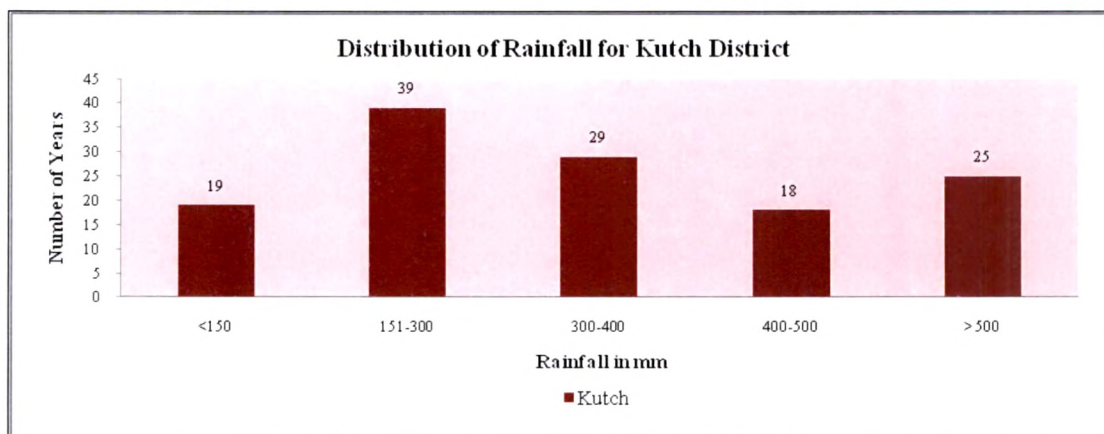
Graph 3.3 Distribution of Rainfall for Kutch District

Table 3.4 Rainfall Analysis for Kutch District

| Drought years	Rainfall deficit years	Normal Rainfall years	Above average rainfall years	Surplus rainfall years
1891, 1899, 1901, 1904, 1911, 1913, 1918, 1921, 1923, 1925, 1931, 1948, 1966, 1968, 1969, 1972, 1974, 1985, 1986, 1987, 1991, 1993, 1996, 2002, 2004	1879, 1880, 1886, 1887, 1888, 1890, 1892, 1902, 1905, 1914, 1915, 1920, 1922, 1924, 1928, 1930, 1932, 1935, 1936, 1937, 1938, 1939, 1940, 1942, 1943, 1946, 1947, 1951, 1955, 1957, 1958, 1960, 1962, 1963, 1971, 1973, 1977, 1982, 1983, 1990, 1995, 2000, 2001, 2005	1882, 1885, 1893, 1895, 1897, 1898, 1907, 1908, 1916, 1919, 1929, 1934, 1941, 1952, 1964, 1965, 1976, 1978, 1980, 1981, 1984, 1997, 1999	1881, 1883, 1889, 1900, 1903, 1906, 1909, 1912, 1927, 1933, 1944, 1945, 1953, 1954, 1975, 1998	1878, 1884, 1894, 1896, 1910, 1917, 1926, 1949, 1950, 1956, 1959, 1961, 1967, 1970, 1979, 1988, 1989, 1992, 1994, 2003, 2006, 2007
Total 19 years	Total 39 years	Total 29 years	Total 18 years	Total 25 years

The analysis shows that of the total study period of 130 years, there have been 19 (14.62 %) drought years, 39 (30.00 %) rainfall deficit years, 29 (22.31%) years having normal rainfall, 18 (13.58%) years having above average rainfall and 25 (19.23 %) years having surplus rainfall.

3.2.2 Analysis for Anjar Taluka

The detailed analysis for rainfall for Anjar taluka has been shown here. Analysis for all other talukas has been done on the similar guidelines as done for Anjar Taluka and only the final graphs have been included here for reference in the alphabetical order of the names of the talukas.

3.2.2.1 Rainfall Pattern Analysis for Anjar

The average annual rainfall for Anjar taluka is 345 mm. During period 1878 to 2007 the highest annual rainfall amounting to 1060 mm for Anjar taluka occurred in the year 1967. Graph 3.4 shows the bar graphs and 3 year and 5 year moving mean graphs for Anjar taluka as well as Kutch district. Compared to the average annual rainfall of Kutch district, the average annual rainfall for Anjar taluka is less by approximately 3 percent. Also, the Anjar taluka has experienced more number of years with less than average annual rainfall as compared to the Kutch district.
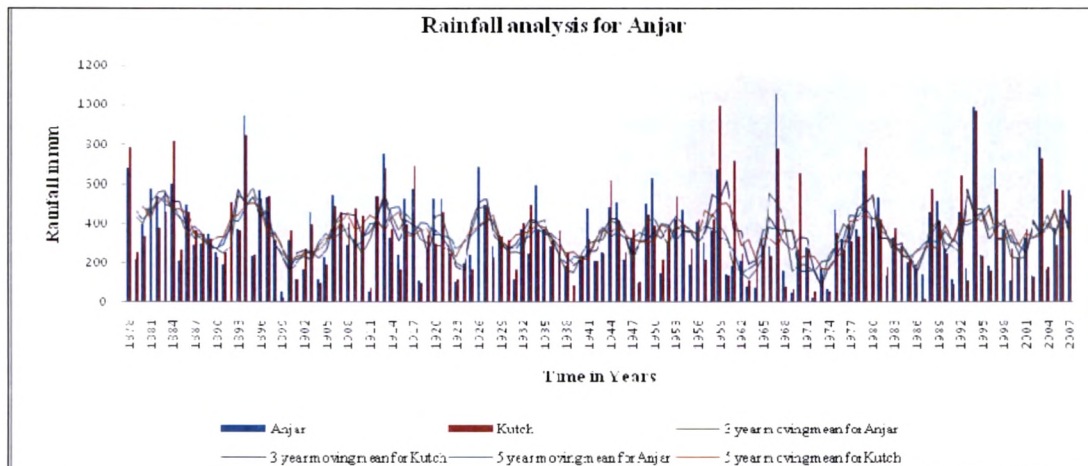
Graph 3.4 Rainfall analysis for Anjar taluka and Comparison with Kutch District

3.2.2.2 Probability Analysis for Anjar

Based on the above data, the probabilities of occurrence of different magnitudes of rainfall have been found out for Anjar taluka. The probability for rainfall occurring between 251 to 300 mm for Anjar taluka is maximum while probability of the rainfall deviating from the average annual value by very high range i.e. below 50 mm or above 800 mm is very less. Graph 3.5 shows the comparison for probability of occurrence of rainfall for Anjar taluka with that of Kutch district.
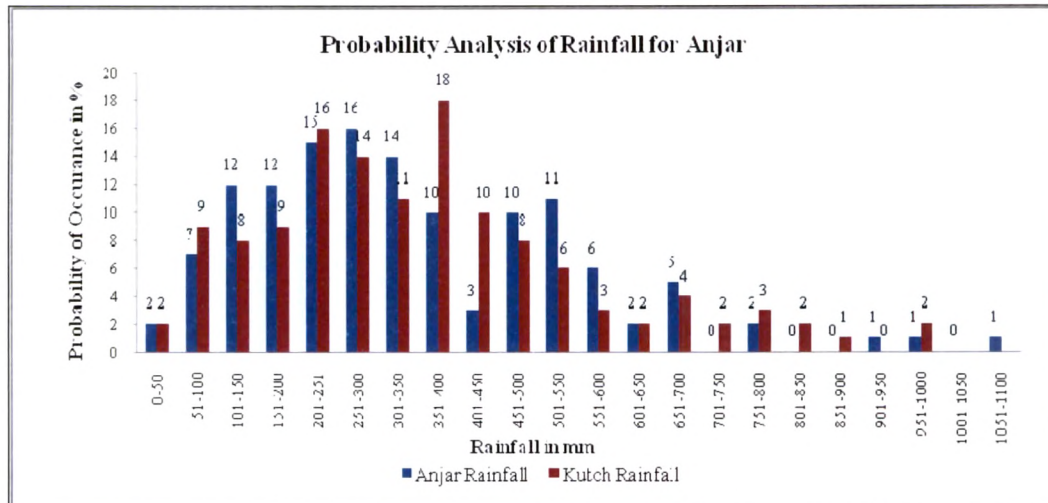
Graph 3.5 Probability of Occurrence of Rainfall for Anjar Taluka
and Kutch District

Table 3.5 Probability of Occurrence of Rainfall For Anjar Taluka

Rainfall in mm	Number of events	% Probability of Occurrence
0-50	2	1.54
51-100	7	5.38
101-150	12	9.23
151-200	12	9.23
201-251	15	11.54
251-300	16	12.31
301-350	14	10.77
351-400	10	7.69
401-450	3	2.31
451-500	10	7.69
501-550	11	8.46
551-600	6	4.62
601-650	2	1.54
651-700	5	3.85
701-750	0	0.00
751-800	2	1.54
801-850	0	0.00
851-900	0	0.00
901-950	1	0.77
951-1000	1	0.77
1001-1050	0	0.00
1051-1100	1	0.77
Total	130	100.00

3.2.2.2 Distribution of Rainfall for Anjar

During the study period of 130 years, the Anjar taluka has experienced 21 drought years, 45 rainfall deficit years, 22 years having normal rainfall, 13 years having above average rainfall and 29 years having surplus rainfall. The results for the analysis have been tabulated in Table 3.6. Graph 3.6 shows the distribution of rainfall pattern over a period of 130 years for Anjar Taluka.
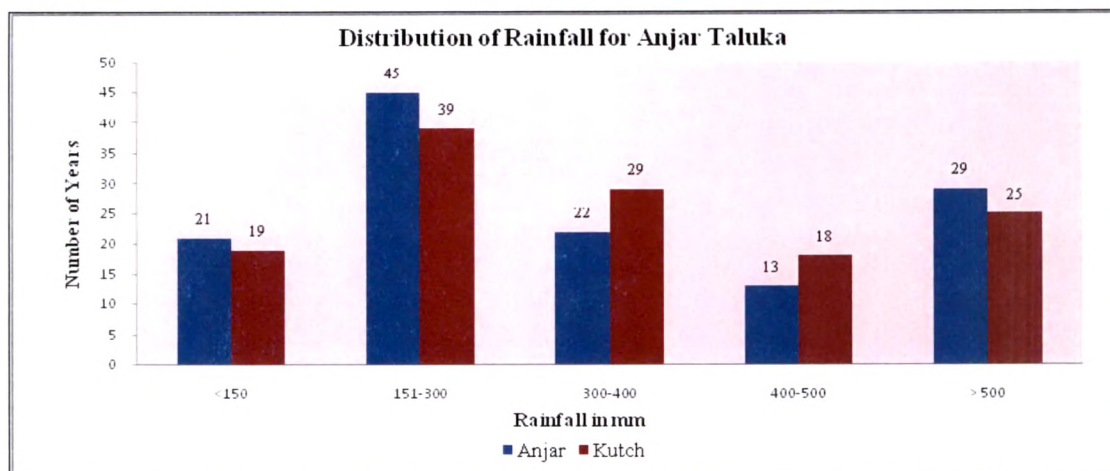
Graph 3.6 Comparison of Distribution of Rainfall for Anjar Taluka with Kutch District

Table 3.6 Distribution of Rainfall for Anjar Taluka

Drought years	Rainfall deficit years	Normal Rainfall years	Above average rainfall years	Surplus rainfall years
<150	151-300	300-400	400-500	> 500
1899, 1901 1904, 1911 1918, 1923 1931, 1939 1948, 1951 1960, 1963 1964, 1969 1972, 1974 1982, 1987 1991, 1999 2002	1879, 1885, 1887, 1888, 1890, 1891 1892, 1895, 1902, 1905, 1908, 1915 1919, 1922, 1924, 1925, 1928, 1930 1933, 1936, 1937, 1938, 1940, 1942 1946, 1955, 1943, 1961, 1962, 1966 1968, 1970, 1971, 1973, 1984, 1985 1986, 1990, 1993, 1995, 1996, 1998 2000, 2001, 2004	1880,1889 1893,1898 1900,1907 1909,1910 1914,1929 1932,1935 1947,1952 1957,1958 1965,1976 1977,1978 1983,2005	1886,1903 1927,1941 1944,1953 1954,1956 1975,1980 1988,1992 2006	1878,1881 1882,1883 1884,1894 1896,1897 1906,1912 1913,1916 1917,1920 1921,1926 1934,1949 1950,1945 1959,1967 1979,1981 1989,1994 1997,2003 2007
Total 21 years	Total 45 years	Total 22 years	Total 13 years	Total 29 years

The analysis shows that of the total study period of 130 years, there have been 21 (16.15 %) drought years, 45 (34.62 %) rainfall deficit years, 22 (16.92 %) years having normal rainfall, 13 (10.00 %) years having above average rainfall and 29 (22.31 %) years having surplus rainfall.

3.2.3 Analysis for Bhachau Taluka

Results for analysis for Bhachau taluka are as follows:
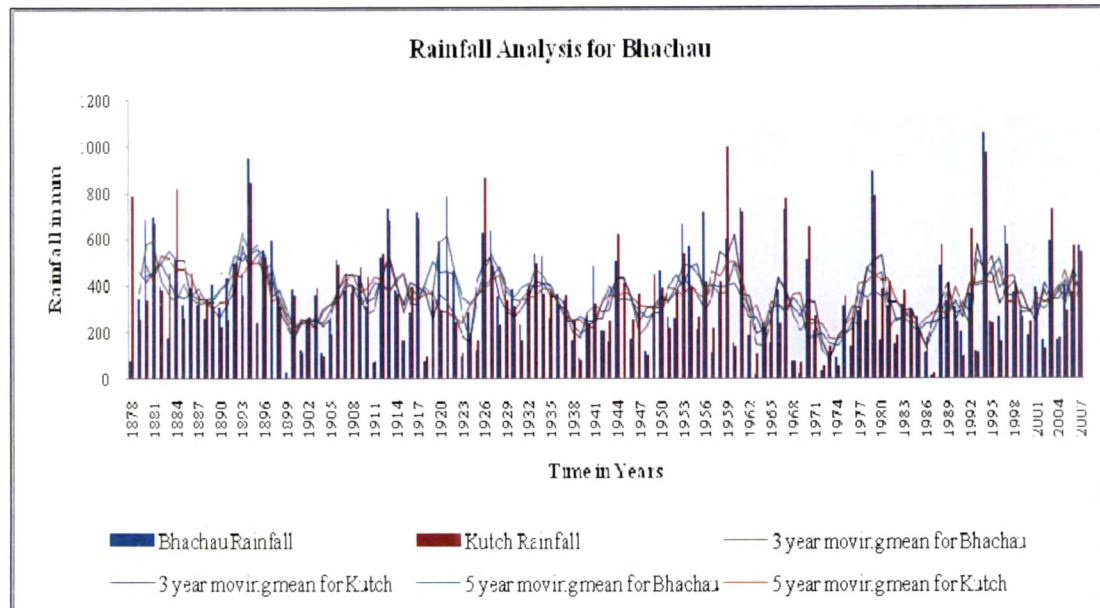
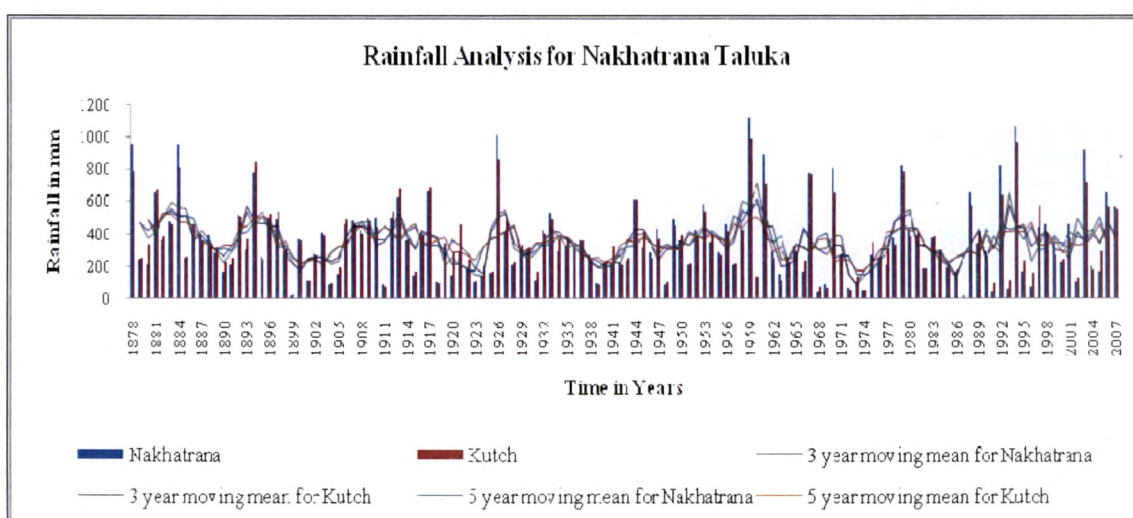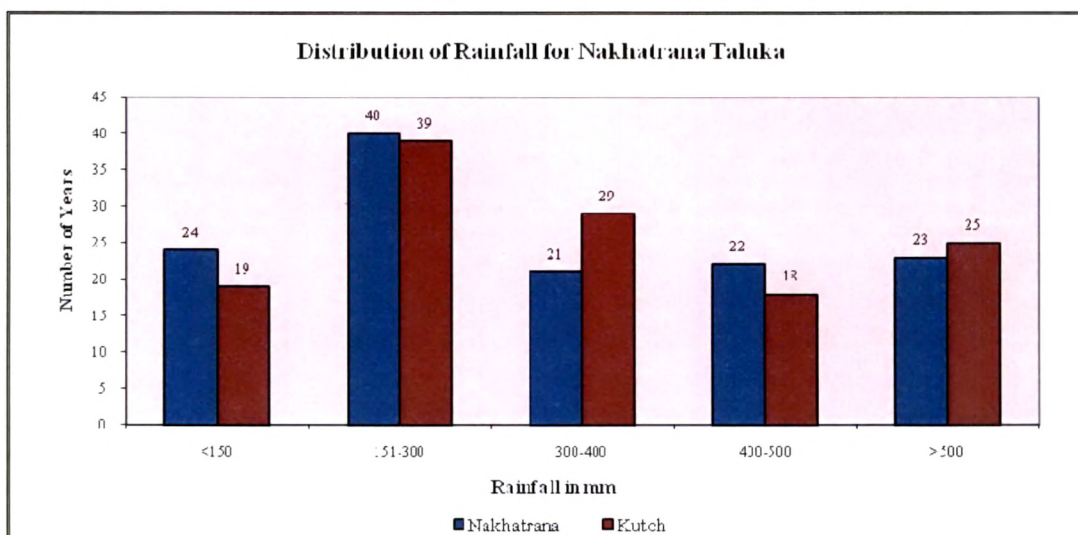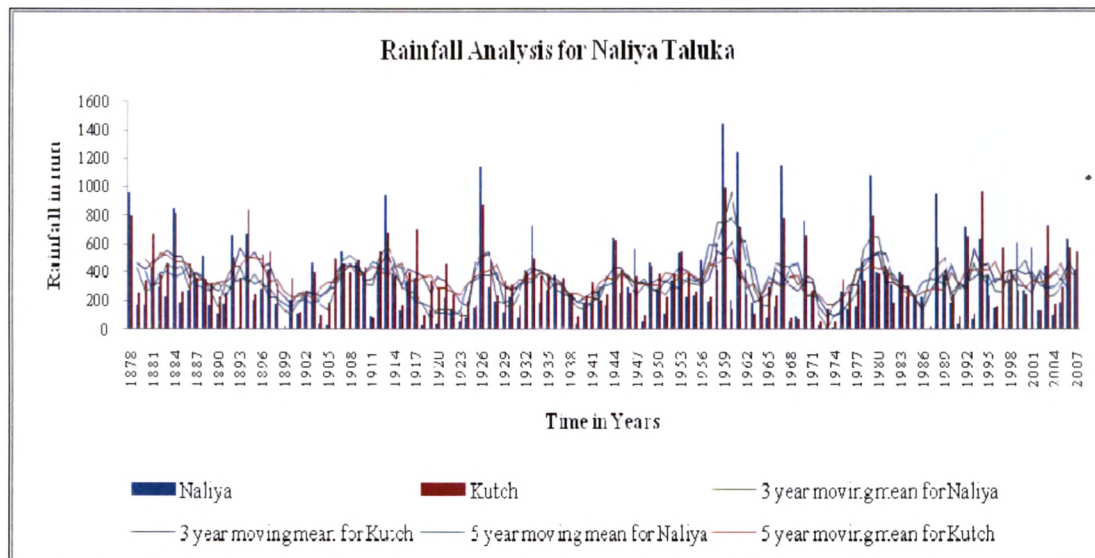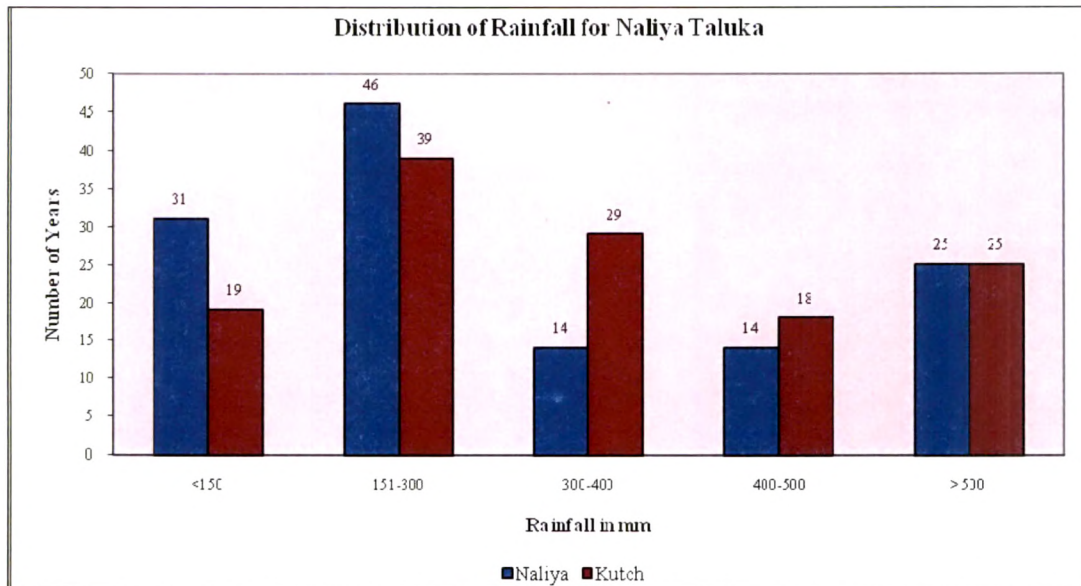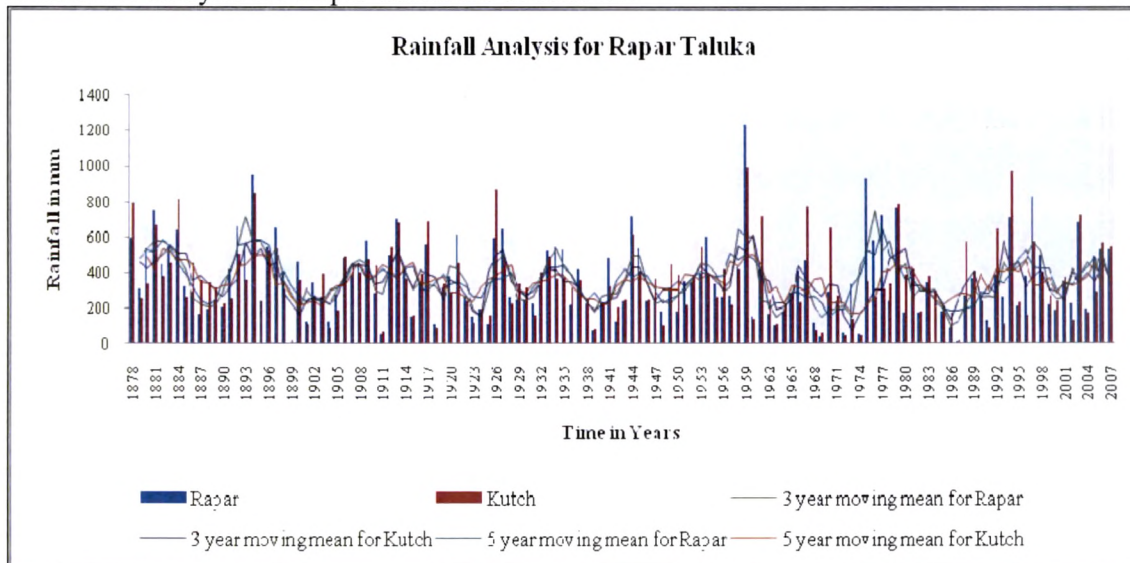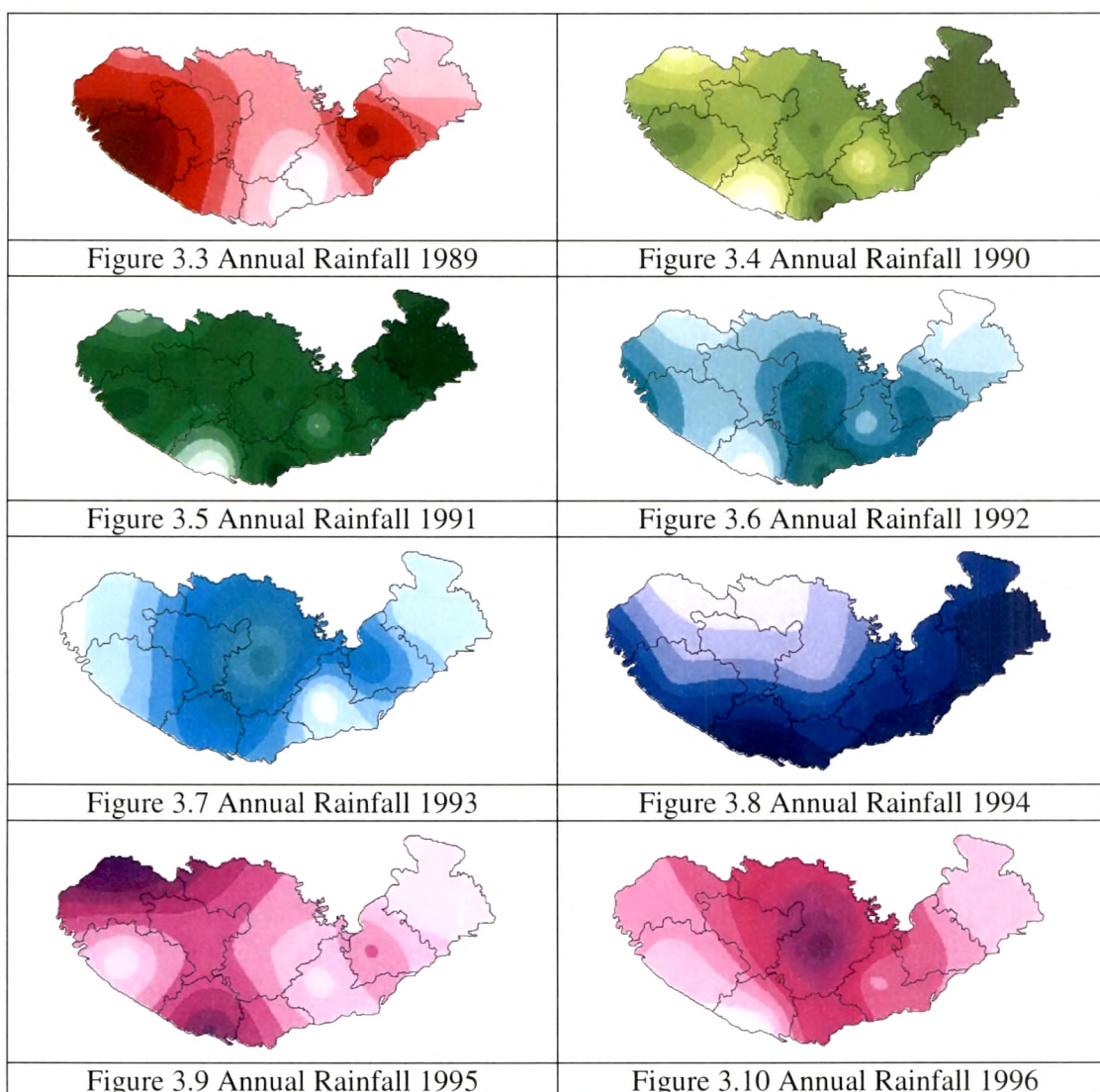Graph 3.7 Rainfall analysis for Bhachau taluka and Comparison with Kutch District
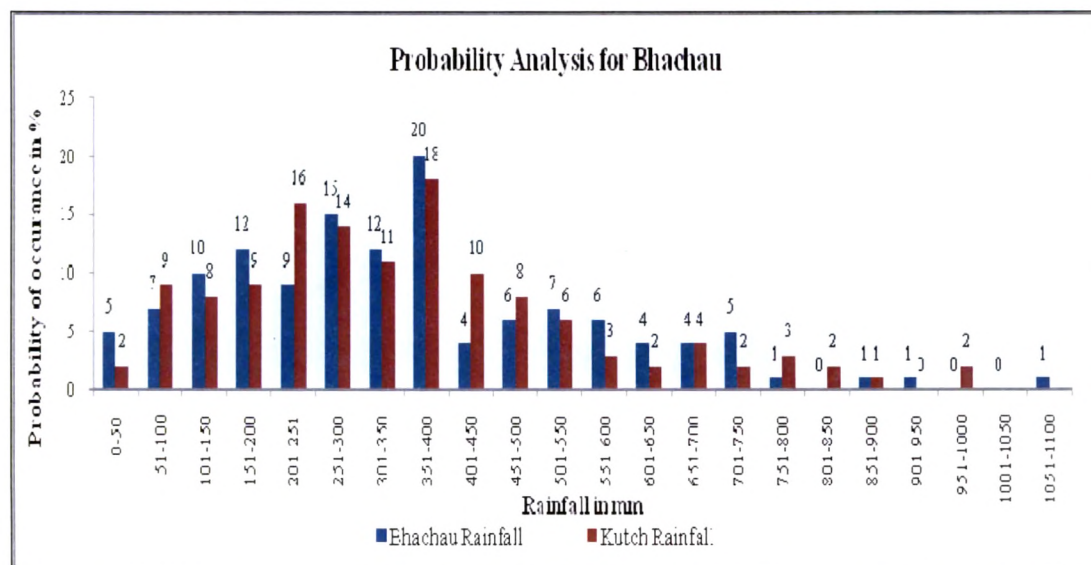
Graph 3.8 Probability of Occurrence of Rainfall for Bhachau Taluka and Kutch District
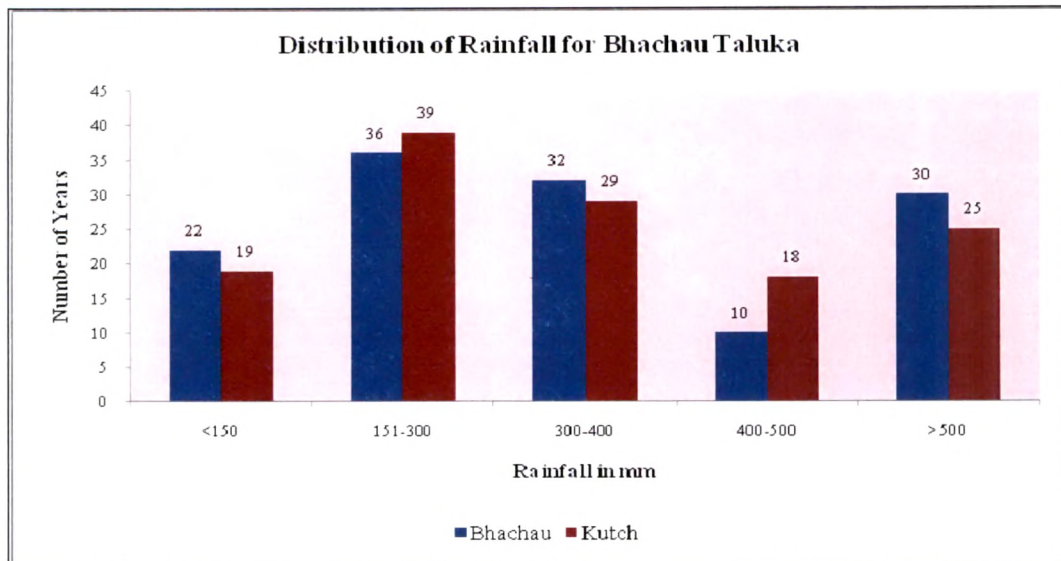
Graph 3.9 Comparison of Distribution of Rainfall for Bhachau Taluka with Kutch District

3.2.4 Analysis for Bhuj Taluka

Results for analysis for Bhuj taluka are as follows:
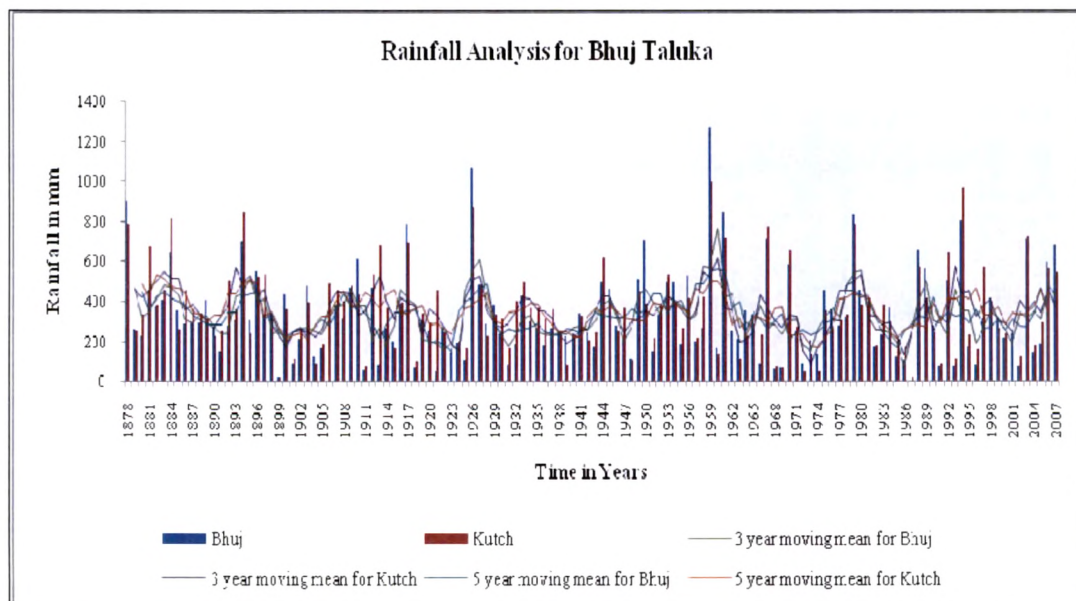
Graph 3.10 Rainfall Analysis for Bhuj taluka and Comparison with Kutch District
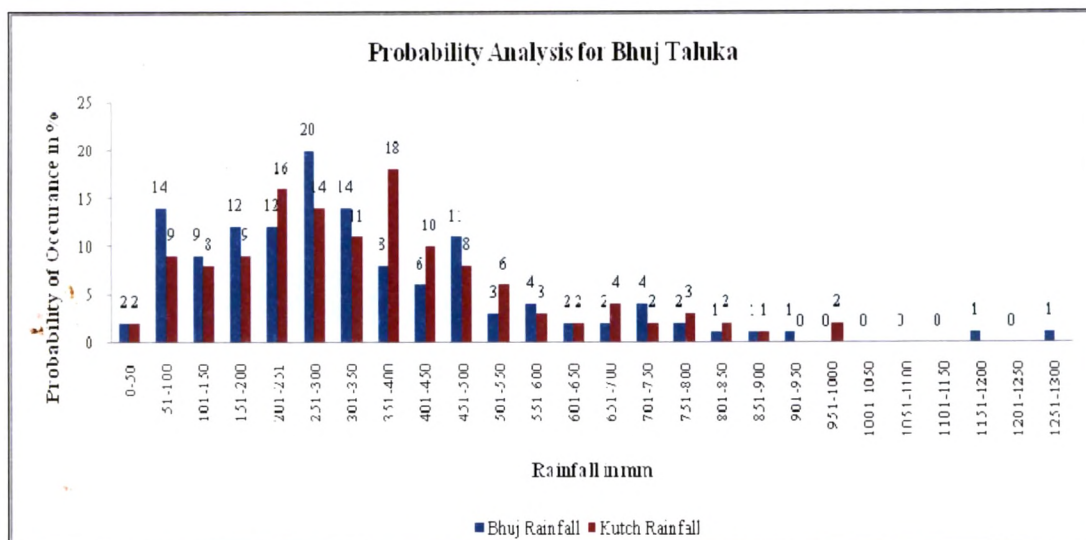
Graph 3.11 Probability of Occurrence of Rainfall for Bhuj Taluka and Kutch District
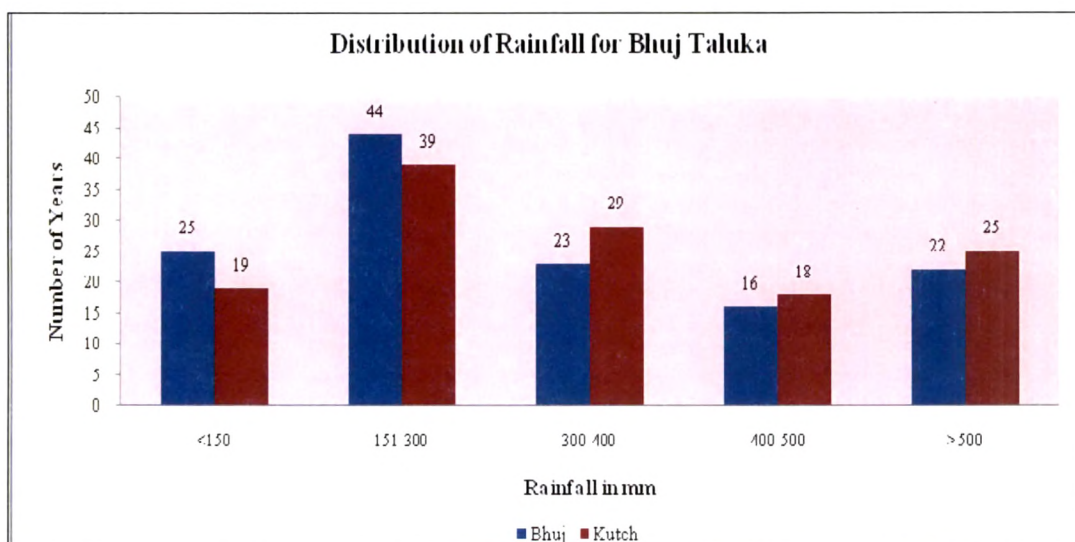
Graph 3.12 Comparison of Distribution of Rainfall for Bhuj Taluka with Kutch District

3.2.5 Analysis for Lakhpat Taluka

Results for analysis for Lakhpat taluka are as follows:
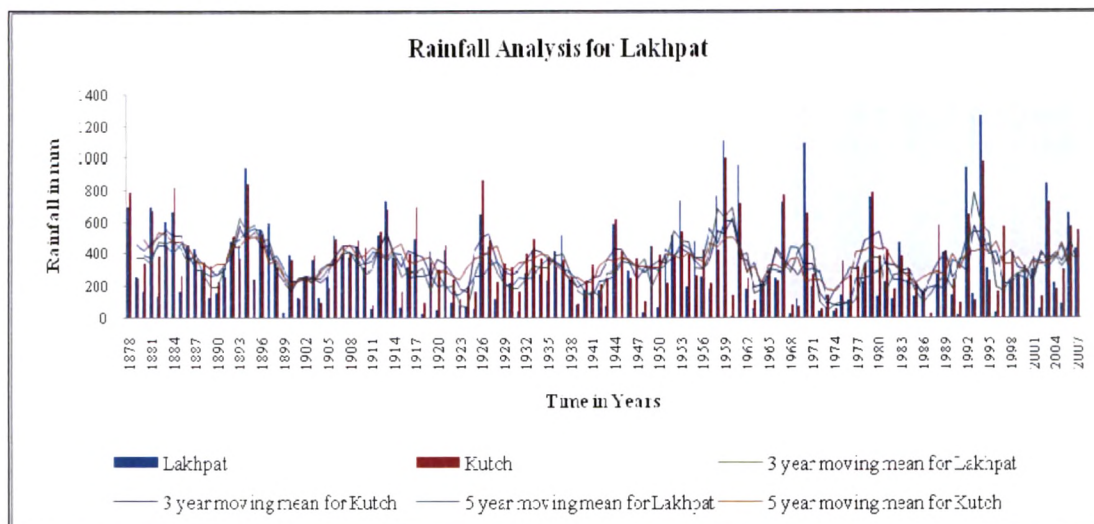
Graph 3.13 Rainfall Analysis for Lakhpat taluka and Comparison with Kutch District
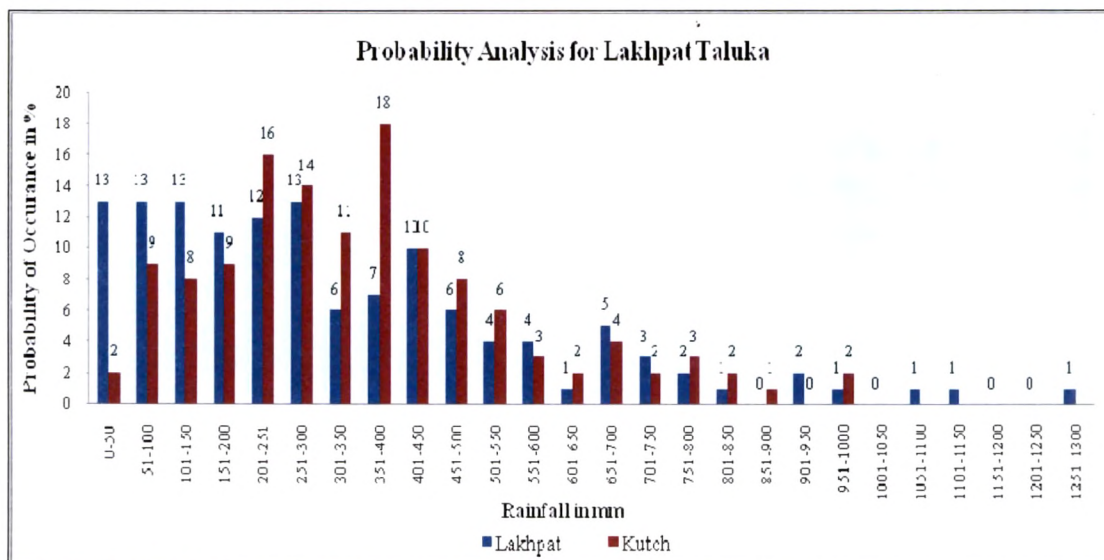
Graph 3.14 Probability of Occurrence of Rainfall for Lakhpat Taluka and Kutch District
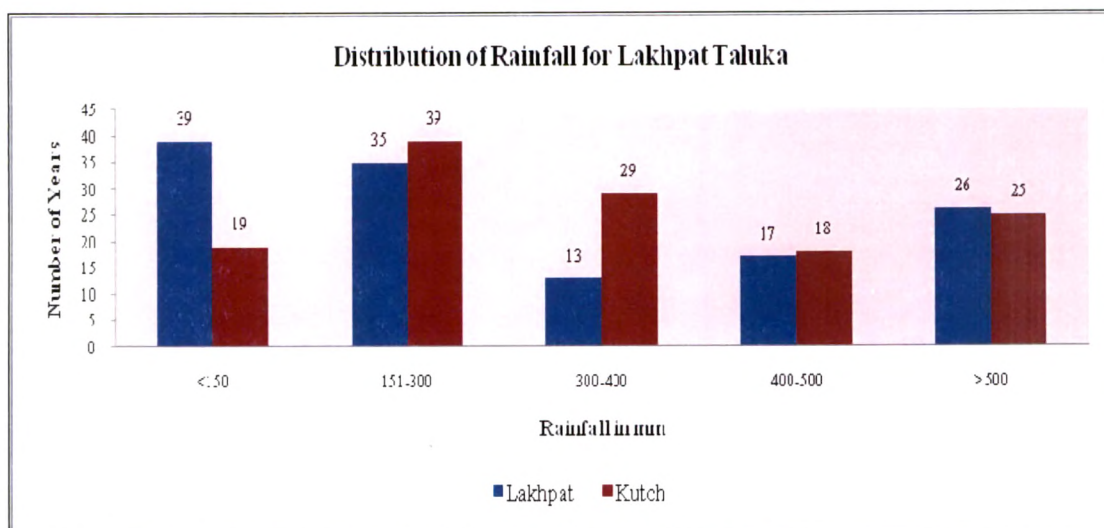
Graph 3.15 Comparison of Distribution of Rainfall for Lakhpat Taluka with
Kutch District

3.2.6 Analysis for Mandvi Taluka

Results for analysis for Mandvi taluka are as follows:
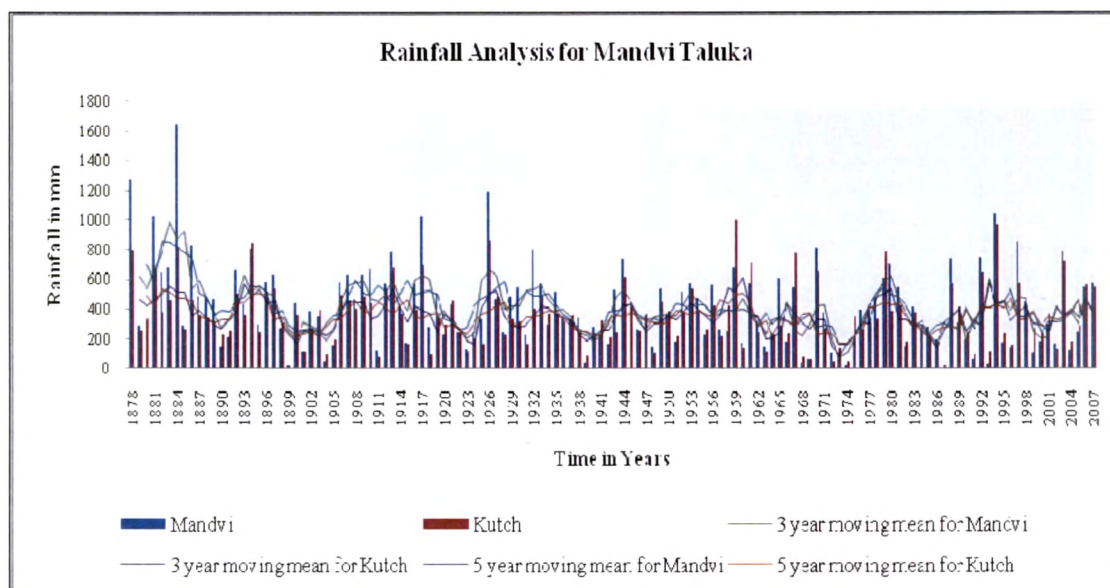
Graph 3.16 Rainfall Analysis for Mandvi taluka and Comparison with Kutch District
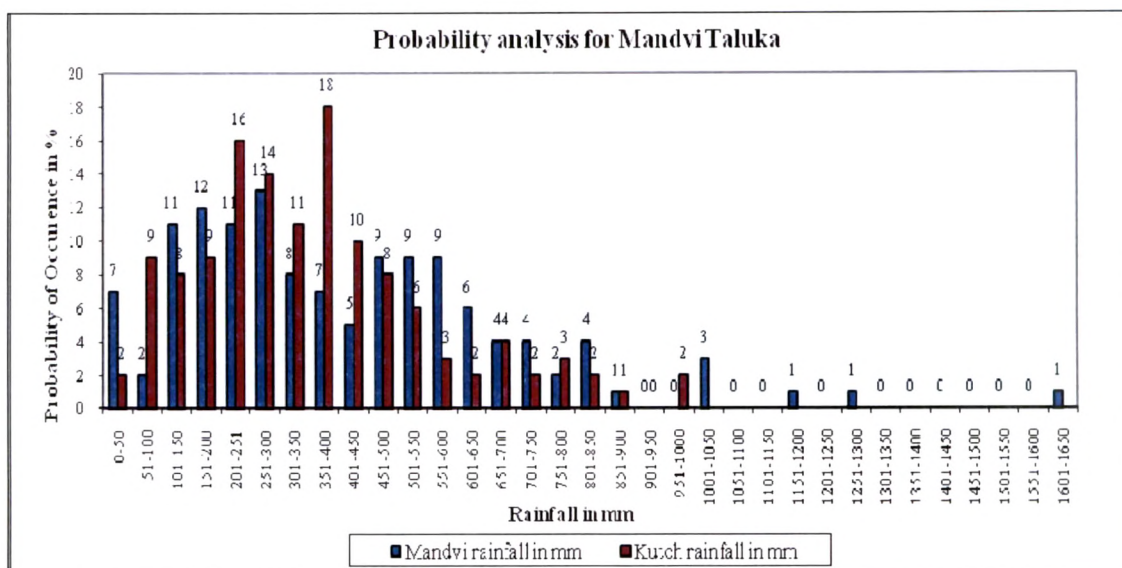
Graph 3.17 Probability of Occurrence of Rainfall for Mandvi Taluka and Kutch District
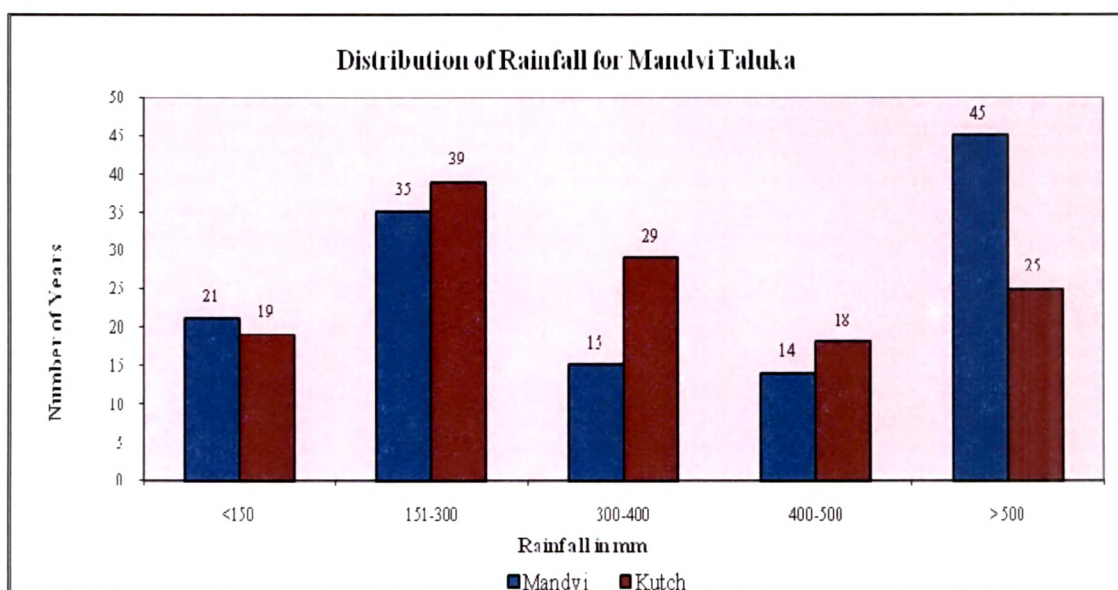
Graph 3.18 Comparison of Distribution of Rainfall for Mandvi Taluka with
Kutch District

3.2.7 Analysis for Mundra Taluka

Results for analysis for Mundra taluka are as follows:
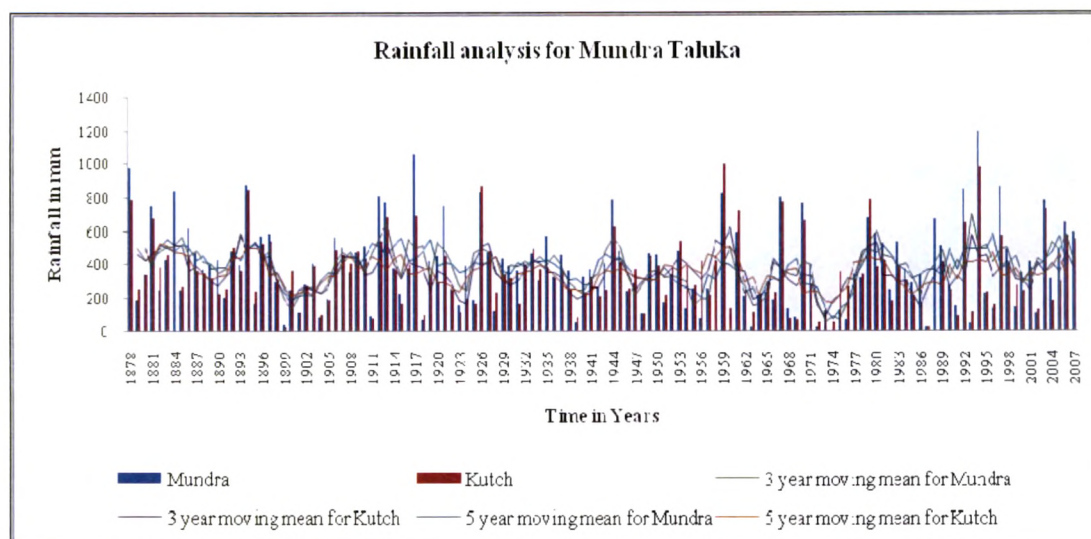
Graph 3.19 Rainfall Analysis for Mundra taluka and Comparison with Kutch District
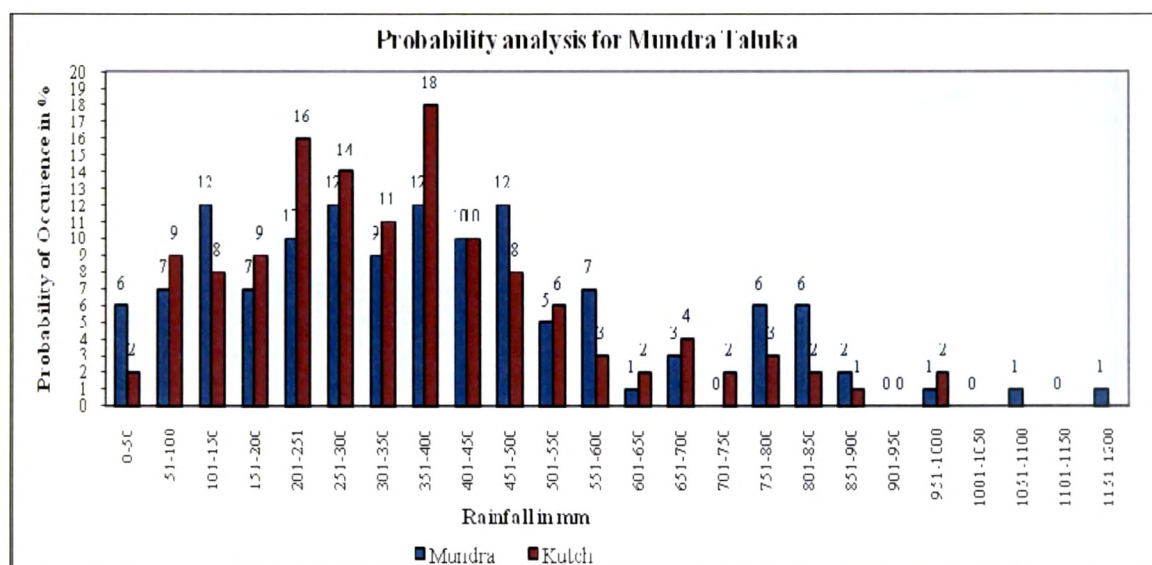
Graph 3.20 Probability of Occurrence of Rainfall for Mundra Taluka and Kutch District
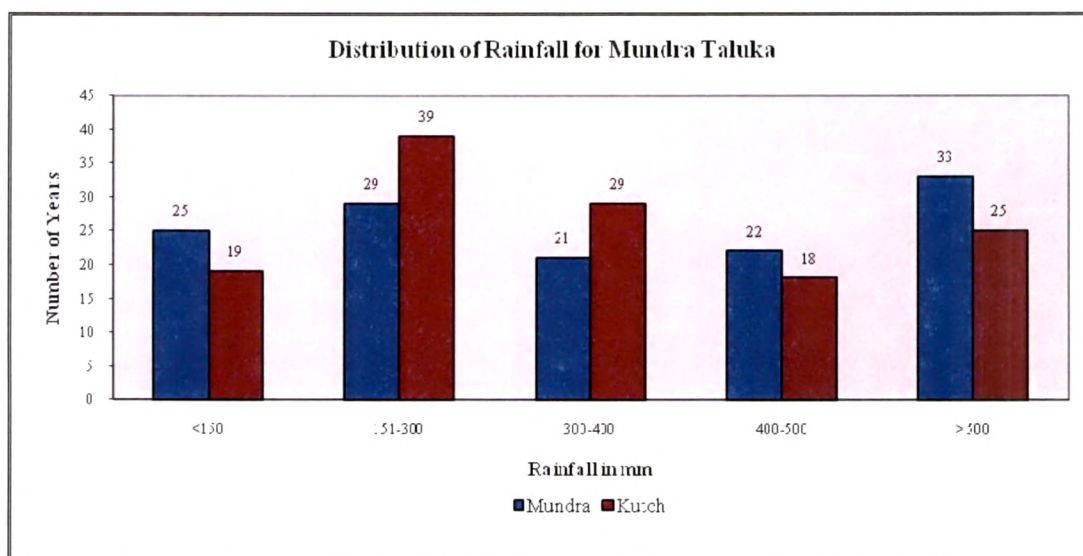
Graph 3.21 Comparison of Distribution of Rainfall for Mundra Taluka with
Kutch District

3.2.8 Analysis for Nakhatrana Taluka

Results for analysis for Nakhatrana taluka are as follows:

Graph 3.22 Rainfall Analysis for Nakhatrana taluka and Comparison with
Kutch District
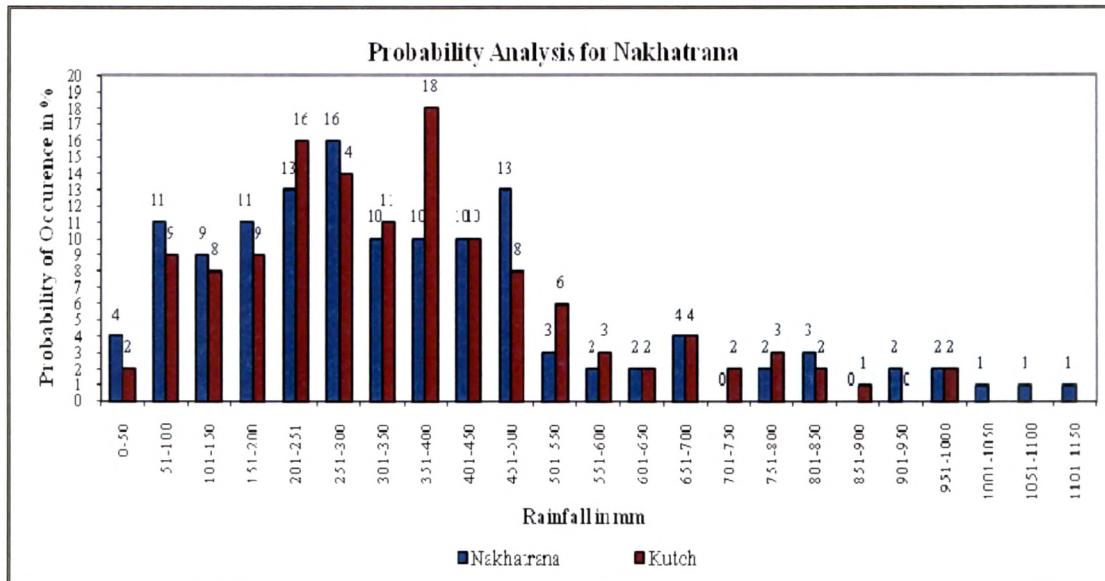
Graph 3.23 Probability of Occurrence of Rainfall for Nakhatrana Taluka
and Kutch District

Graph 3.24 Comparison of Distribution of Rainfall for Nakhatrana Taluka
with Kutch District

3.2.9 Analysis for Naliya Taluka

Results for analysis for Naliya taluka are as follows:

Graph 3.25 Rainfall Analysis for Naliya taluka and Comparison with Kutch District
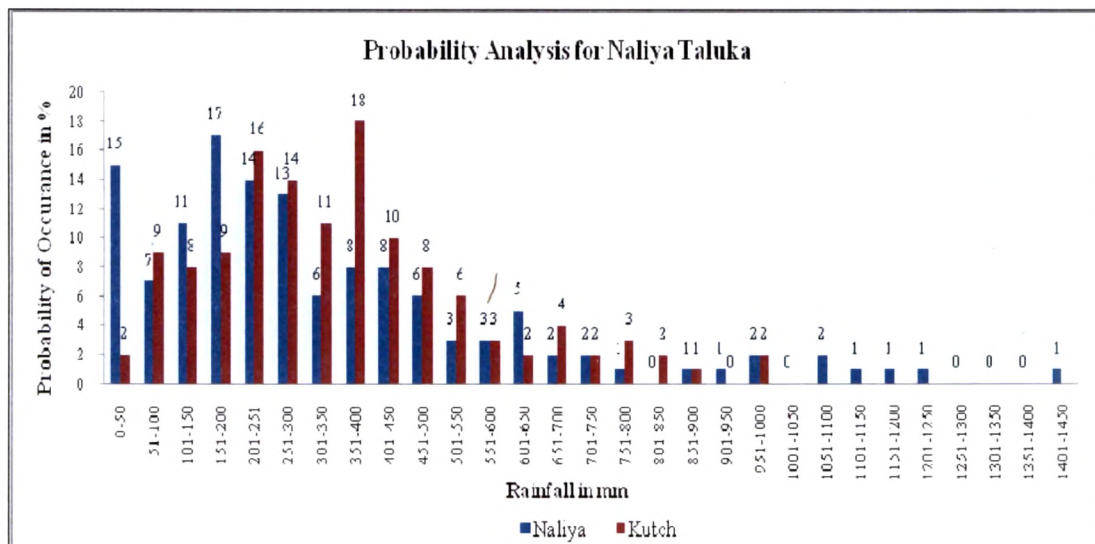
Graph 3.26 Probability of Occurrence of Rainfall for Naliya Taluka and Kutch District

Graph 3.27 Comparison of Distribution of Rainfall for Naliya Taluka with Kutch District

3.2.10 Analysis for Rapar Taluka
Results for analysis for Rapar taluka are as follows:

Graph 3.28 Rainfall Analysis for Rapar taluka and Comparison with Kutch District
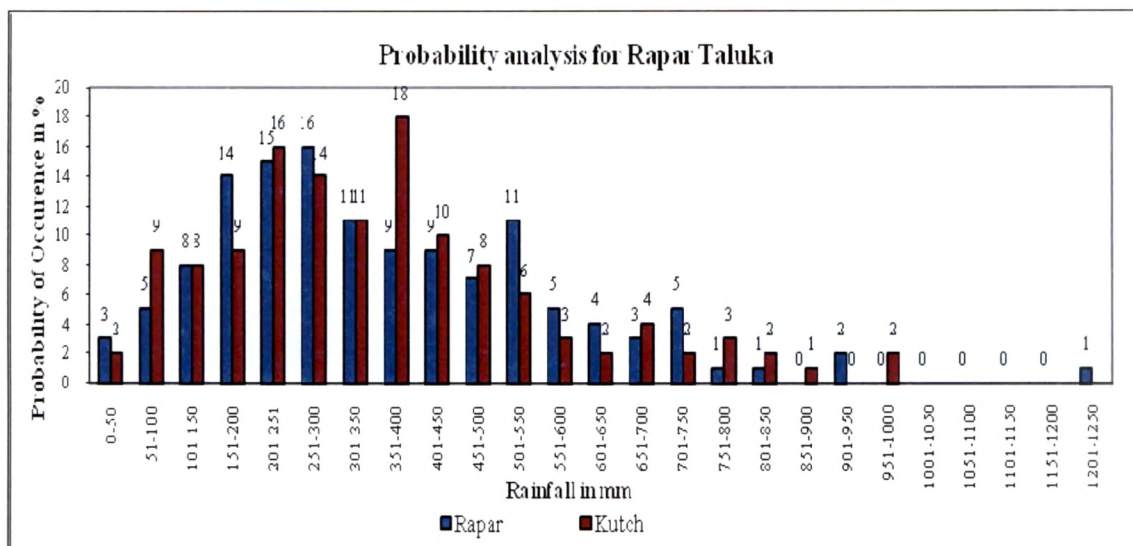
Graph 3.29 Probability of Occurrence of Rainfall for Rapar Taluka and Kutch District
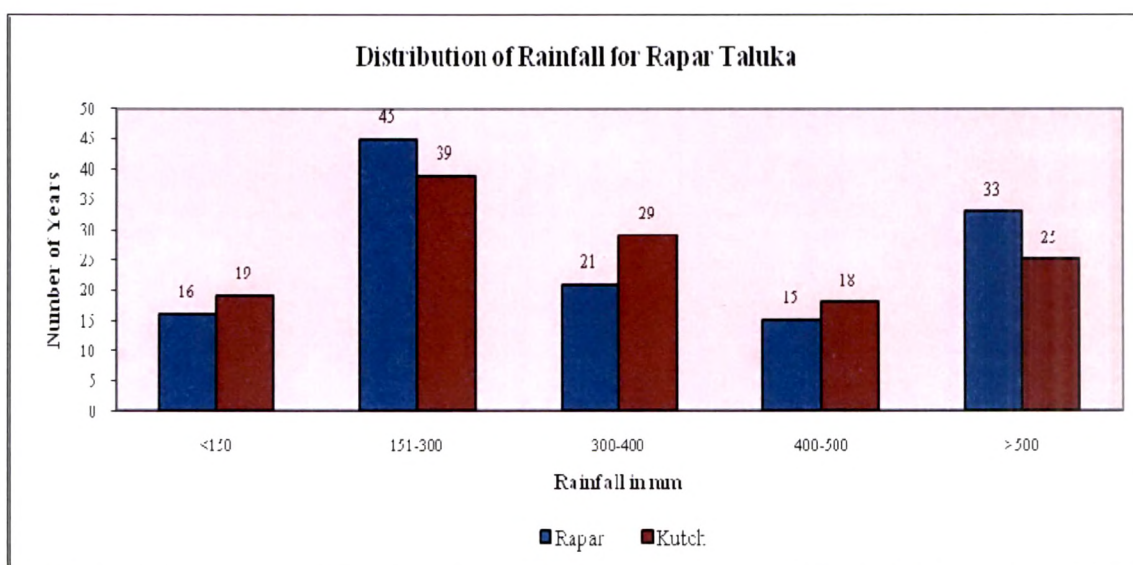
Graph 3.30 Comparison of Distribution of Rainfall for Rapar Taluka with Kutch District

3.3 ANALYSIS OF 19 YEAR ANNUAL RAINFALL DATA

Out of the 130 year annual rainfall data, 19 year rainfall data from 1989 to 2007 has been utilized for developing relationship between rainfall and runoff as well as rainfall and groundwater recharge. Therefore, separate analysis has been done for the 19 year data. Figures 3.3 to 3.21 show the distribution pattern of the rainfall over the study area for the years 1989 to 2007 along with the taluka boundaries. The darker shades indicate higher values of rainfall and lighter shades indicate lower values of rainfall. A common legend system for plotting of annual rainfall has not been adopted due to the wide variation in the values of annual rainfall but values have been tabulated for reference. Table 3.7 shows the annual rainfall values for all the talukas and the average rainfall values for Kutch district for the study period of 1989 to 2007.

Figure 3.3 Annual Rainfall 1989	Figure 3.4 Annual Rainfall 1990
Figure 3.5 Annual Rainfall 1991	Figure 3.6 Annual Rainfall 1992
Figure 3.7 Annual Rainfall 1993	Figure 3.8 Annual Rainfall 1994
Figure 3.9 Annual Rainfall 1995	Figure 3.10 Annual Rainfall 1996

Figure 3.11 Annual Rainfall 1997

Figure 3.12 Annual Rainfall 1998

Figure 3.13 Annual Rainfall 1999

Figure 3.14 Annual Rainfall 2000

Figure 3.15 Annual Rainfall 2001

Figure 3.16 Annual Rainfall 2002

Figure 3.17 Annual Rainfall 2003

Figure 3.18 Annual Rainfall 2004

Figure 3.19 Annual Rainfall 2005

Figure 3.20 Annual Rainfall 2006

Figure 3.21 Annual Rainfall 2007

Table 3.7 Annual Rainfall in mm for 1989 to 2007

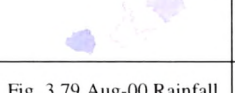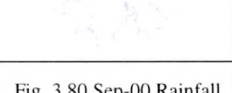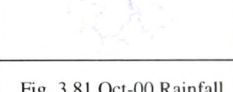| Year	Anjar	Bhachau	Bhuj	Lakhpat	Mandvi	Mundra	Nakha-trana	Naliya	Rapar	Kutch (Avg)
1989	428	189	284	332	186	122	1122	970	317	439
1990	240	149	227	138	244	76	655	710	129	285
1991	115	378	87	267	126	419	418	397	383	288
1992	478	44	596	943	336	630	813	30	491	485
1993	149	281	74	108	471	238	64	415	208	223
1994	979	496	45	360	978	504	119	136	1091	523
1995	217	176	109	1317	764	274	170	638	376	449
1996	191	599	53	656	126	961	217	141	231	353
1997	728	107	186	233	521	31	497	22	532	317
1998	294	289	369	110	468	106	174	220	635	296
1999	107	642	242	58	189	411	147	34	416	250
2000	236	184	672	650	37	619	56	895	319	407
2001	302	416	806	98	115	494	81	165	167	294
2002	144	403	137	58	307	403	55	160	220	210
2003	901	283	359	4	210	120	161	443	845	369
2004	315	506	456	642	751	137	100	529	699	459
2005	386	262	212	88	547	721	35	187	472	323
2006	470	788	684	656	485	1133	489	579	244	614
2007	614	157	1371	458	29	618	1002	167	180	511
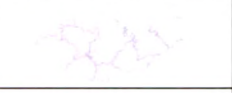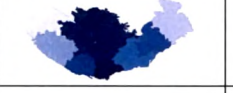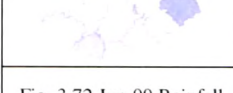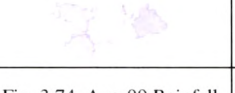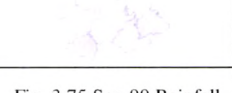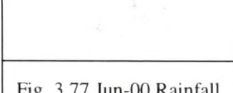
(Source: State Water Data Centre)
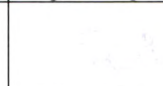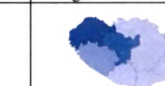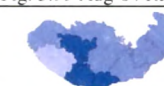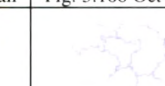
3.4 ANALYSIS OF MONTHLY RAINFALL DATA

The analysis for the monthly rainfall data has been done for the study period of 1989 to 2007. The monthly rainfall values for all talukas for the study period have been plotted and shown in Figures 3.22 to 3.116. The figures for monthly rainfall plots show the boundaries of all the talukas and the rainfall distribution. The darker shades indicate higher values of rainfall and lighter shades indicate lower values of rainfall. Table 3.8 shows the legends for the monthly rainfall values in mm. Annexure 2 shows the values of monthly rainfall for 19 years.

<2.5 mm	2.5-10 mm	10-25 mm	25-50 mm	50-100 mm	100-150 mm	150-300 mm	300-450 mm	> 450 mm

Table 3.8 Legends for Monthly Rainfall Values in mm

Fig. 3.22 Jun-89 Rainfall	Fig. 3.23 Jul-89 Rainfall	Fig. 3.24 Aug-89 Rainfall	Fig. 3.25 Sep-89 Rainfall	Fig. 3.26 Oct-89 Rainfall
Fig. 3.27 Jun-90 Rainfall	Fig. 3.28 Jul-90 Rainfall	Fig. 3.29 Aug-90 Rainfall	Fig. 3.30 Sep-90 Rainfall	Fig. 3.31 Oct-90 Rainfall
Fig. 3.32 Jun-91 Rainfall	Fig. 3.33 Jul-91 Rainfall	Fig. 3.34 Aug-91 Rainfall	Fig. 3.35 Sep-91 Rainfall	Fig. 3.36 Oct-91 Rainfall
Fig. 3.37 Jun-92 Rainfall	Fig. 3.38Jul-92 Rainfall	Fig. 3.39 Aug-92 Rainfall	Fig. 3.40 Sep-92 Rainfall	Fig. 3.41 Oct-92 Rainfall
Fig. 3.42 Jun-93 Rainfall	Fig. 3.43 Jul-93 Rainfall	Fig 3.44 Aug-93 Rainfall	Fig. 3.45 Sep-93 Rainfall	Fig 3.46 Oct-93 Rainfall
Fig. 3.47 Jun-94 Rainfall	Fig. 3.48 Jul-94 Rainfall	Fig. 3.49Aug-94 Rainfall	Fig. 3.50 Sep-94 Rainfall	Fig. 3.51 Oct-94 Rainfall
Fig. 3.52 Jun-95 Rainfall	Fig. 3.53 Jul-95 Rainfall	Fig. 3.54 Aug-95 Rainfall	Fig. 3.55 Sep-95 Rainfall	Fig. 3.56 Oct-95 Rainfall
Fig. 3.57 Jun-96 Rainfall	Fig. 3.58 Jul-96 Rainfall	Fig. 3.59 Aug-96 Rainfall	Fig. 3.60 Sep-96 Rainfall	Fig. 3.61 Oct-96 Rainfall
Fig. 3.62 Jun-97 Rainfall	Fig. 3.63 Jul-97 Rainfall	Fig. 3.64 Aug-97 Rainfall	Fig. 3.65 Sep-97 Rainfall	Fig. 3.66 Oct-97 Rainfall
Fig. 3.67 Jun-98 Rainfall	Fig. 3.68 Jul-98 Rainfall	Fig. 3.69 Aug-98 Rainfall	Fig. 3.70 Sep-98 Rainfall	Fig. 3.71 Oct-98 Rainfall
Fig. 3.72 Jun-99 Rainfall	Fig. 3.73 Jul-99 Rainfall	Fig. 3.74 Aug-99 Rainfall	Fig. 3.75 Sep-99 Rainfall	Fig. 3.76 Oct-99 Rainfall
Fig. 3.77 Jun-00 Rainfall	Fig. 3.78 Jul-00 Rainfall	Fig. 3.79 Aug-00 Rainfall	Fig. 3.80 Sep-00 Rainfall	Fig. 3.81 Oct-00 Rainfall

Fig. 3.82 Jun-01 Rainfall	Fig. 3.83 Jul-01 Rainfall	Fig. 3.84 Aug-01 Rainfall	Fig. 3.85 Sep-01 Rainfall	Fig. 3.86 Oct-01 Rainfall
Fig. 3.87 Jun-02 Rainfall	Fig. 3.88 Jul-02 Rainfall	Fig. 3.89 Aug-02 Rainfall	Fig. 3.90 Sep-02 Rainfall	Fig. 3.91 Oct-02 Rainfall
Fig. 3.92 Jun-03 Rainfall	Fig. 3.93 Jul-03 Rainfall	Fig. 3.94 Aug-03 Rainfall	Fig. 3.95 Sep-03 Rainfall	Fig. 3.96 Oct-03 Rainfall
Fig. 3.97 Jun-04 Rainfall	Fig. 3.98 Jul-04 Rainfall	Fig. 3.99 Aug-04 Rainfall	Fig. 3.100 Sep-04 Rainfall	Fig. 3.101 Oct-04 Rainfall
Fig. 3.102 Jun-05 Rainfall	Fig. 3.103 Jul-05 Rainfall	Fig. 3.104 Aug-05 Rainfall	Fig. 3.105 Sep-05 Rainfall	Fig. 3.106 Oct-05 Rainfall
Fig. 3.107 Jun-06 Rainfall	Fig. 3.108 Jul-06 Rainfall	Fig. 3.109 Aug-06 Rainfall	Fig. 3.110 Sep-06 Rainfall	Fig. 3.111 Oct-06 Rainfall
Fig. 3.112 Jun-07 Rainfall	Fig. 3.113 Jul-07 Rainfall	Fig. 3.114 Aug-07 Rainfall	Fig. 3.115 Sep-07 Rainfall	Fig. 3.116 Oct-07 Rainfall

3.5 SUMMARY OF RAINFALL ANALYSIS

The analysis for obtaining the mean values, minimum values, maximum values, variance, standard deviation and the standard error of estimation was done using the software STATISTICA for Windows version 5.0.

3.5.1 Summary for 130 Year Annual Rainfall Data

The study for the period of 130 years for all the talukas as well as the Kutch district shows that the average annual rainfall for all the talukas ranges between 300 to 400mm except for Mandvi taluka. The district average value is 356 mm. The summary for the analysis of 130 year annual rainfall data from 1878 to 2007 has been tabulated in Table 3.9.

Table 3.9 Summary of Analysis for Annual Rainfall (mm) for study period of 1878 to 2007

Taluka	Mean	Median	Minimum	Maximum	Variance	Std.Dev.	Standard Error
Anjar	345.83	303.00	25.00	1060.00	41137.85	202.82	17.79
Bhachau	344.58	314.50	0.00	947.00	43124.73	207.66	18.21
Bhuj	338.97	283.00	5.00	1371.00	56995.29	238.74	20.94
Lakhpat	308.52	252.50	0.00	1317.00	68634.75	261.98	22.98
Mandvi	412.89	366.00	3.00	1646.00	75073.91	274.00	24.03

Taluka	Mean	Median	Minimum	Maximum	Variance	Std.Dev.	Standard Error
Mundra	381.67	365.00	0.00	1133.00	59378.05	243.68	21.37
Nakhatrana	346.30	290.00	0.00	1126.00	60670.75	246.31	21.60
Naliya	330.35	234.50	0.00	1445.00	83119.64	288.30	25.29
Rapar	368.20	321.50	2.00	1235.00	49246.97	221.92	19.46

The summary for the analysis to find out the number of drought years, number of years with rainfall deficit, the number of years with normal rainfall, the number of years with above average rainfall and the number of years with surplus rainfall have been tabulated in Table 3.10.

Table 3.10 Results of Rainfall (mm) Distribution Analysis for 1878 to 2007

Sr. No.	Taluka	Drought years	Rainfall deficit years	Normal Rainfall years	Above average rainfall years	Surplus rainfall years
	Rainfall in mm	<150	151-300	300-400	400-500	> 500
1	Bhuj	25	44	23	16	22
2	Mandvi	21	35	15	14	45
3	Anjar	21	45	22	13	29
4	Rapar	16	45	21	15	33
5	Naliya	31	46	14	14	25
6	Lakhpat	39	35	13	17	26
7	Bhachau	22	36	32	10	30
8	Mundra	25	29	21	22	33
9	Nakhatrana	24	40	21	22	23
10	Kutch	19	39	29	18	25

3.5.2 Summary for 19 Year Annual Rainfall Data

The study for the period of 19 years for all the talukas as well as the Kutch district shows that the average annual rainfall for all the talukas ranges between 250 to 450 mm. The district average value is 356 mm. The summary for the analysis of 19 year annual rainfall data from 1989 to 2007 has been tabulated in Table 3.11.

Table 3.11 Summary of Analysis for Annual Rainfall (mm) for study period of 1989 to 2007

	Mean	Median	Minimum	Maximum	Variance	Std.Dev.	Standard Error
Anjar	383.89	302.00	107.00	979.00	66666.65	258.20	59.23
Bhachau	324.47	283.00	0.00	788.00	45004.26	212.14	48.67
Bhuj	366.79	242.00	45.00	1371.00	113309.62	336.61	77.22
Lakhpat	269.37	108.00	0.00	1317.00	121213.91	348.16	79.87
Mandvi	362.63	307.00	29.00	978.00	71148.58	266.74	61.19
Mundra	421.95	411.00	31.00	1133.00	94942.94	308.13	70.69
Nakhatrana	323.21	161.00	0.00	1122.00	121772.40	348.96	80.06
Naliya	336.58	187.00	0.00	970.00	91697.92	302.82	69.47
Rapar	418.68	376.00	129.00	1091.00	64291.67	253.56	58.17

The analysis of the monthly rainfall shows that July is the rainiest month in most of the years for the study period of 1989 to 2007 while October is the month which receives the minimum rainfall for most of the years. July 2003 is the rainiest year of the study period of 1989 to 2007. The summary for the analysis of 19 year monthly rainfall data from 1989 to 2007 have been tabulated in Table 3.12. The minimum monthly rainfall values being zero have not been tabulated here.

Table 3.12 Summary of Analysis for Monthly Rainfall (mm) for study period of 1989 to 2007

Taluka	Mean	Median	Minimum	Maximum	Variance	Std.Dev.	Standard Error
Anjar	31.99	0.00	0.00	636.20	6780.95	82.35	5.45
Bhachau	27.04	0.00	0.00	455.00	4871.74	69.80	4.62
Bhuj	30.56	0.00	0.00	1087.00	9797.77	98.98	6.56
Lakhpat	22.45	0.00	0.00	1141.00	9890.99	99.45	6.59
Mandvi	30.77	0.00	0.00	602.00	7843.60	88.56	5.87
Mundra	35.31	0.00	0.00	755.00	10056.07	100.28	6.66
Nakhatrana	27.17	0.00	0.00	837.00	9343.71	96.66	6.43
Naliya	27.99	0.00	0.00	890.00	10294.51	101.46	6.72
Rapar	34.89	0.00	0.00	717.00	7182.48	84.75	5.61