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Original Research Article

Agroclimatic Characterization of Cotton Crop under Parbhani District of Marathwada Region

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A B S T R A C T

In the present study, the agroclimatic characterization of cotton crop under Parbhani district analysed to detect the degree of characterization of Parbhani location from 1985-2014 year during 23rd MW – 5th MW of each year. The result revealed that temperature is variable and maximum temperature range 26.2 - 31.3 ^{0}C, minimum temperature range 13.7 - 21 ^{0}C showed decreasing trend, morning relative humidity and afternoon relative humidity showed continuous fluctuation, yearly total rainfall is most variable during 30 years only 8 year rainfall observed above normal and remaining years below the normal, mean bright sunshine hours 7.6 hrs, mean evaporation rate 5.1 mm and mean wind speed 5.6 kmph. However, overall Area, production and productivity of cotton crop analysed and result showed that increasing trend up to 1998 then after reduced up to 2007 and after increase continuous in area and production except last two years but last five years productivity of cotton decreasing trend is noticed in Parbhani district. This will give an insight to the planners to go further for micro-level analysis regarding sustainability and profitability of a particular crop and cropping system.

Keywords

Weather parameters, Area, Production, Productivity

Introduction

Cotton (*Gossypium spp.*) is one of the important cash crops of India which is subtropical crop grown in an area with rainfall of 600 mm to 2500 mm. At least 500 mm (20 in.) of water (rainfall/ irrigation) is required to produce a cotton crop during the season in a constant and regular pattern (Doorenbos and Pruitt, 1984). An agroclimatic characterization of a region has been aim with determining homogeneous areas. Characterisation of the agroclimatic environment involves two types of inventories. The first contains long term historic records of climatic elements. This set assist extrapolation to comparable areas.

The second set contains the elements which vary during trial periods, also called real time variables. This set helps to interpret result of particular trials and compare actual weather observations to long term historic records (Oldeman, 1990). The characterization part of this study includes descriptions of the characteristics and graphing of the patterns of precipitation, temperature, evaporation, humidity, bright sunshine, wind speed, climatic productivity indicators, phenology of cotton crop. A special section is dedicated to the use of a method of climatic analyses to detect the degree of characterisation a location.

Climate characterization is very useful for understanding the current occurrence of the climate in the area for agricultural planning.

Materials and Methods

Parbhani district is situated in the Godawari drainage basin in the central part of the India. The area is lying on the central part of Marathwada region in Maharashtra. Climatologically it comes under semi-arid, sub-tropical region and agro climatologically is identified as plain zone of Maharashtra. The geographic location of the VNMKV, Parbhani was 19^{o} 16' N latitude; 76^{o} 47' E Longitude; 409 meters above mean sea level (MSL) in Marathwada division of Maharashtra state. Agroclimatically Parbhani comes under assured rainfall zone. It has an average rainfall of 963 mm. The soil comes under order vertisol clay in texture medium to deep black (Inceptisol-75% / Vertisol-25). The major soils of the district are derived from "Deccan trap" rock (basalt) which is rich in iron, lime and magnesium (Gajbe *et al.,* 1976). Weather Data and crop data were collected during 1985-2014 from state department of agriculture, statistical department, Agricultural related websites, Department of Agricultural Meteorology, V.N.M.K.V. Parbhani etc. Processing of data were worked out here on the basis of standard date of sowing recommended for given crop by VNMKV, Parbhani and the standard average duration of cotton crop was 23^{th} MW- 5^{th} MW.

Results and Discussion

Parbhani district weather data during 1985-2014 of cotton crop

The weather data in the Parbhani has been classified into different years of the widely grown cotton crops during 1985-2014 (23^{th} MW – 5^{th} MW). This yearly data can help in planning the expansion of thrust crops implementing projects to expand areas under the crops currently grown or to introduce new crops or their cultivars into the new area in the suitable farming situations of Parbhani.

The relevant weather parameters data is presented in Table 1 during 1985-2014 (23^{th} MW – 5^{th} MW)) since last 30 years at Parbhani district as given below.

Temperature

The maximum and minimum temperature is a basic and indispensable weather factor for crop production. Its quality largely determines the variety and magnitude of agriculture production. The data revealed that the maximum temperature was less to normal during pre-monsoon season and fluctuated in monsoon season in Parbhani district. During *kharif* season, maximum and minimum temperature was below the normal. During *rabi* season, maximum temperature was normal and minimum temperature was more fluctuation in Parbhani district. The maximum and minimum temperature was fluctuating.

During the years 1985 to 2014 highest and lowest maximum temperature was recorded in 1987 and 1998, respectively. Whereas, the highest and lowest minimum temperature recorded in 1985 and 2000, respectively and the average mean maximum temperature estimated (31.3 ^{0}C) and average mean minimum temperature (17.6 ^{0}C).

Relative humidity

The relative humidity was most important weather parameter of crop production. The mean yearly morning and afternoon relative

humidity recorded is presented in Table 1 that both the morning and afternoon relative humidity showed continuous fluctuation during 1985 to 2014. During 2011 to 2014 mean morning and afternoon relative humidity showed increasing trend to above normal and rest of period it was less than normal in Parbhani district. Afternoon relative humidity during 1988 to 1993 showed continuously decreasing trend and after 2007 it increased in Parbhani.

The highest and lowest morning relative humidity was recorded in 2013 and 1991, respectively. Whereas, the highest and lowest afternoon relative humidity was recorded in 2008 and 1993, respectively. The average mean morning relative humidity estimated (60 %) and mean afternoon relative humidity (38%) in Parbhani.

Rainfall

Rainfall weather factor was most important for crop growth, development and crop production. Information on the yearly total rainfall for a location is helpful for crop planning, cultivar selection, run off estimation, determining crop water needs, and for designing watersheds and ultimately irrigation system. The rainfall distribution was on yearly basis with the association variability for the Parbhani district during 1985 to 2014 (23^{th} MW – 5^{th} MW) data presented in Table 1. The normal rainfall of Parbhani district is 963 mm. Total rainfall was most variable in Parbhani district during 30 years only 8 year rainfall observed above normal and remaining years below the normal.

The highest total rainfall and lowest total rainfall recorded in 1990 and during 2014, respectively while mean total rainfall was recorded 891 mm in Parbhani district.

Doorenbos *et al.*, (1984) reported that at least 500 mm of water is required to produce a cotton crop. For water not to be limiting factor to yield, cotton needs between 550 mm to 950 mm during season in consistent and regular pattern.

BSS

The bright sunshine hours is a basic and indispensable weather factor for crop production its quality largely determine the variety and magnitude of agriculture production. The mean BSS corresponding yearly are presented in Table 1. The data revealed that the Bright sunshine hours was fluctuating observed during 1985 to 2014.

During 1985 to 2014 (23^{th} MW – 5^{th} MW) years, the highest and lowest bright sunshine hour was recorded in 1986 and 2013, respectively. However, the average bright sunshine hours estimated (7.6 hrs) in Parbhani district.

Evaporation

The evaporation is a most affected weather factor for crop production. The mean evaporation corresponding yearly was presented in Table 1. The data revealed that the evaporation was fluctuated monsoon season in Parbhani district. The evaporation rate was decreasing in trend during 1985 to 2014.

During the year 1985 to 2014, the highest and lowest evaporation was recorded in 1986 and 1998 respectively. The average evaporation estimated (5.1 mm) in Parbhani district.

Wind speed

The wind speed is a most affected weather factor for crop production.

Fig.1 Yearly average maximum and minimum temperature recorded in different meteorological week at Parbhani district during 1985-2014

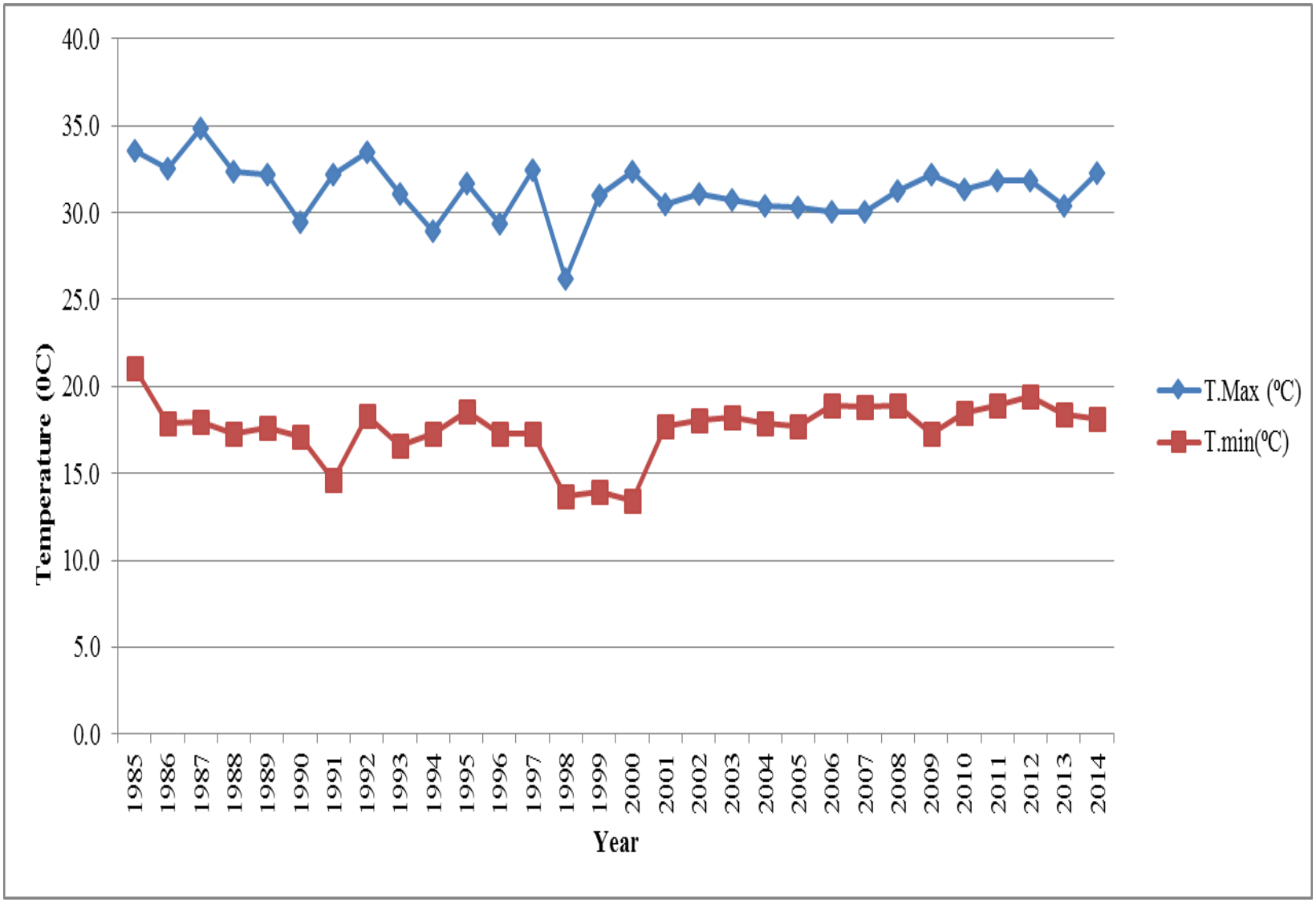

Fig.2 Yearly average RH-I and RH-II recorded in different meteorological week at Parbhani district during 1985-2014

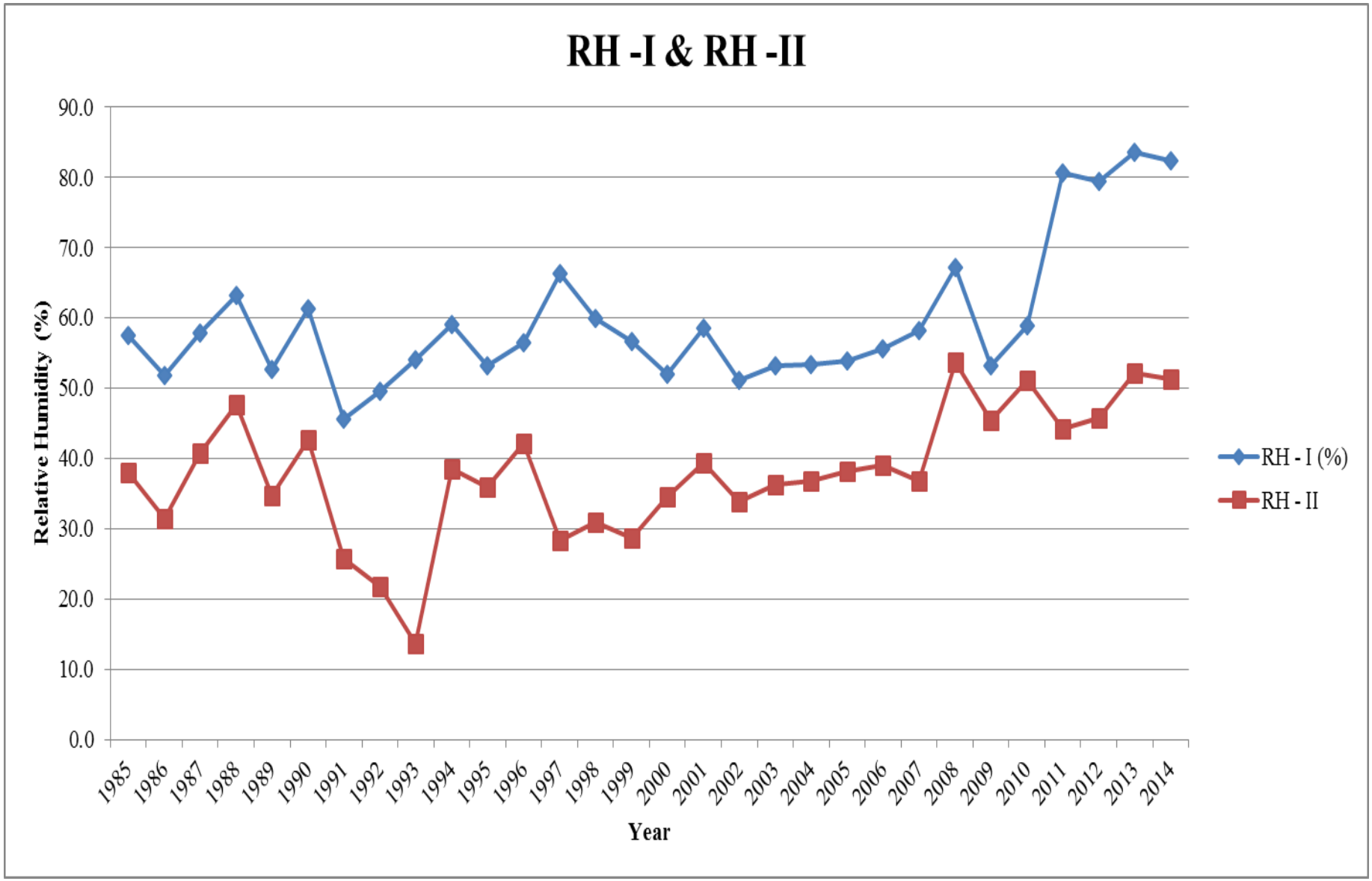

Fig.3 Yearly average rainfall (mm) recorded in (23MW-5MW) of Parbhani district during 1985-2014

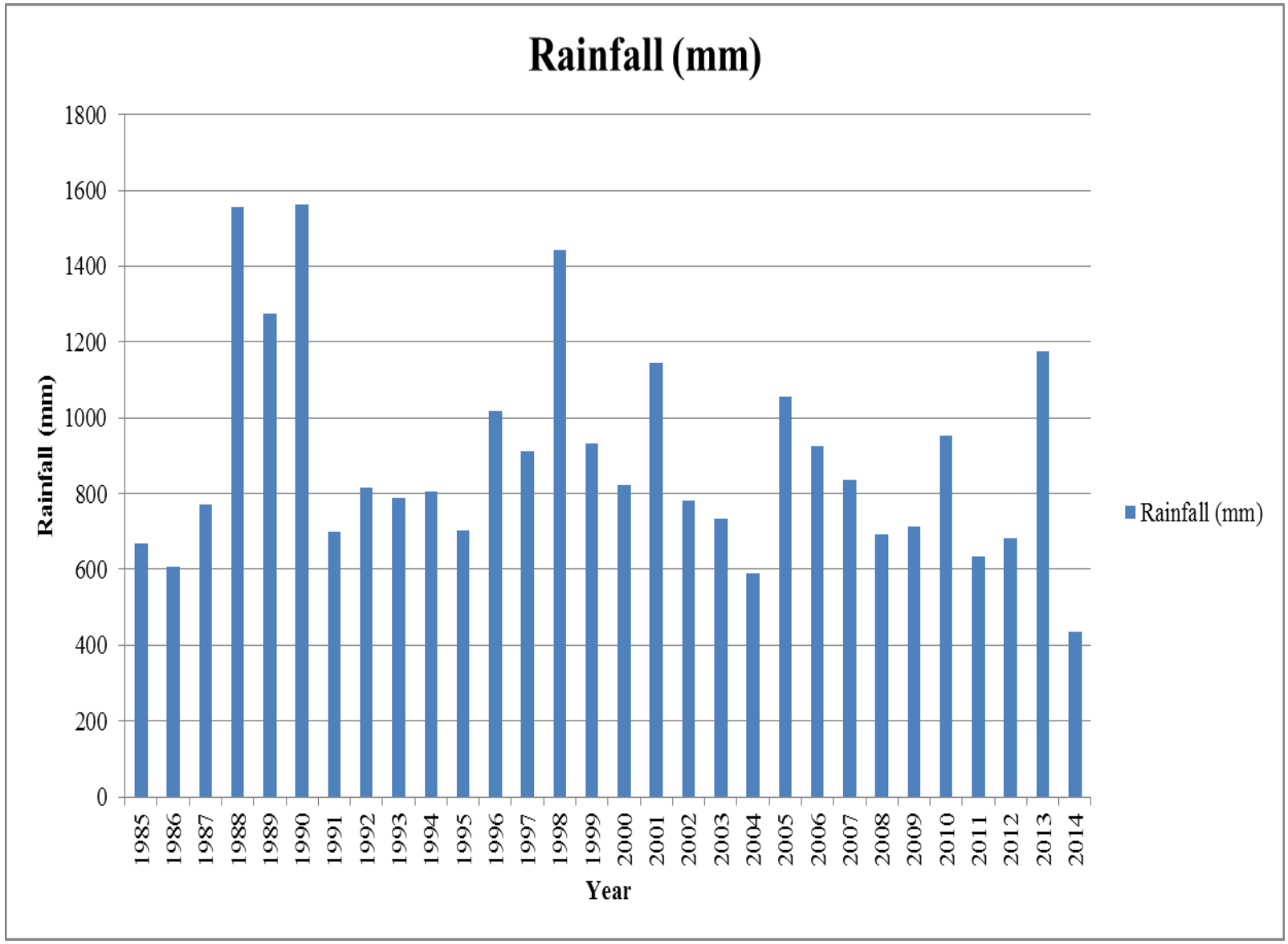

Fig.4 Yearly average bright sunshine recorded in (23MW-5MW) of Parbhani district during 1985-2014

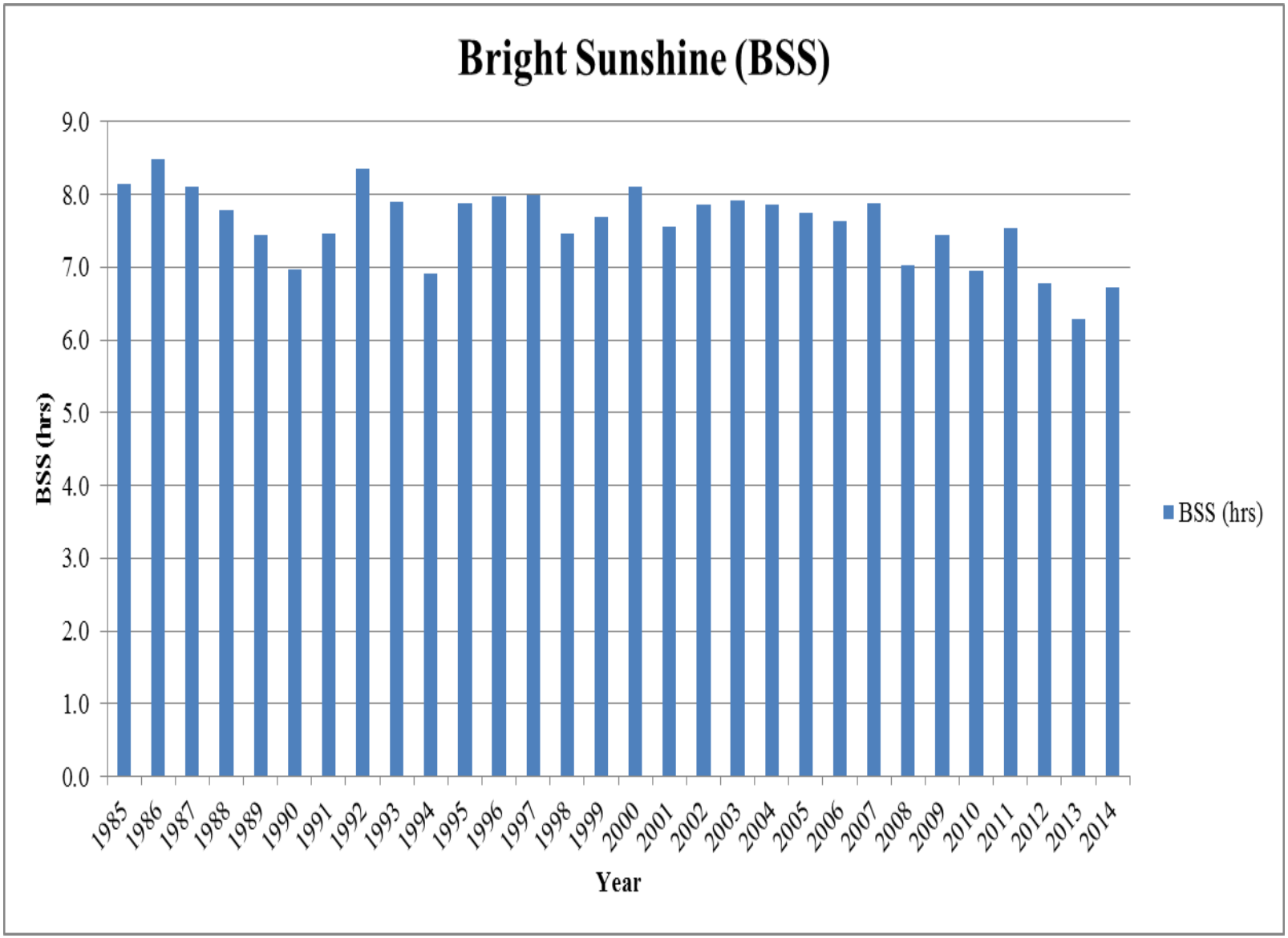

Fig.5 Yearly average evaporation recorded in different meteorological week at Parbhani district during 1985-2014

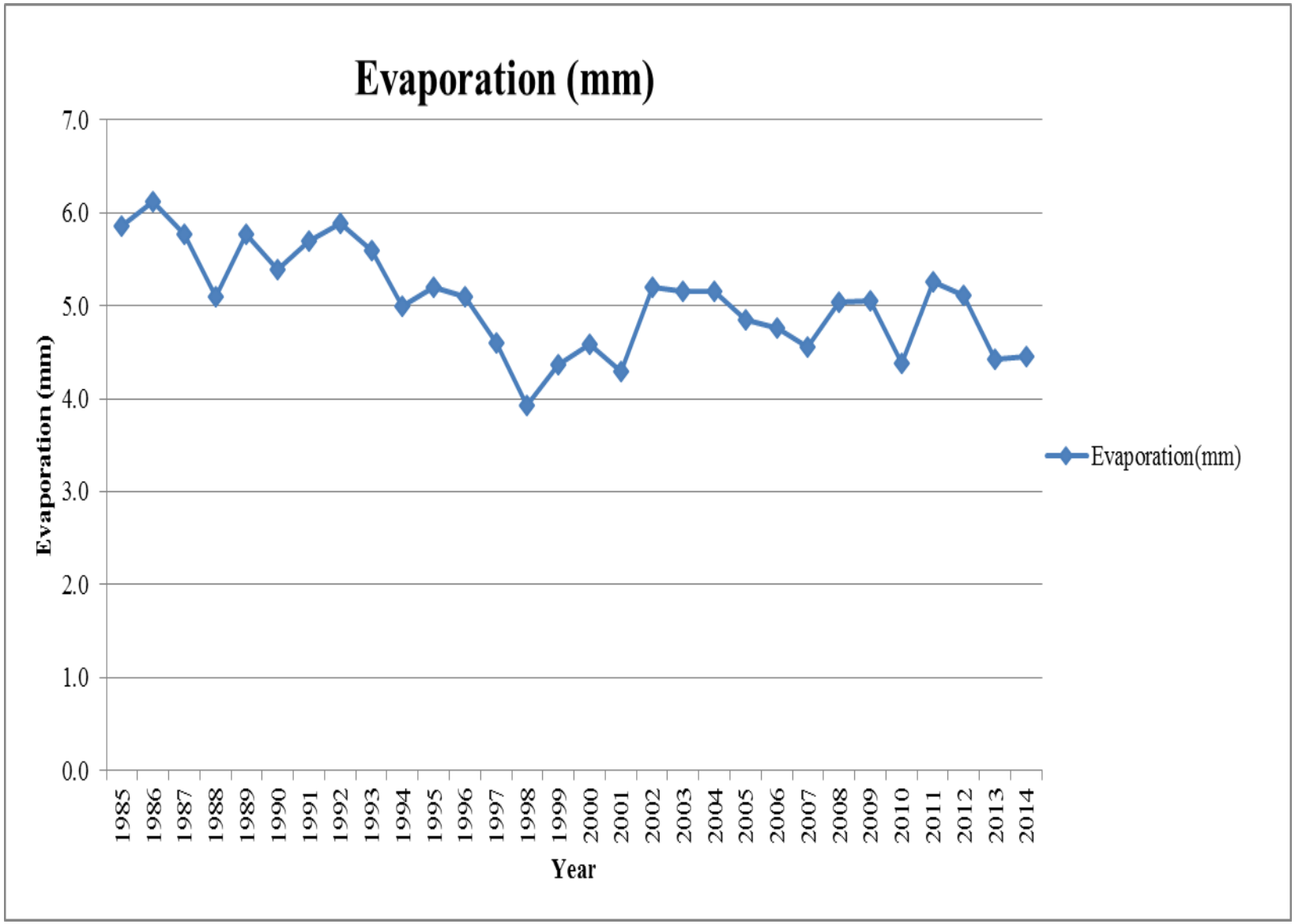

Fig.6 Yearly average wind speed recorded in different meteorological week at Parbhani district during 1985-2014

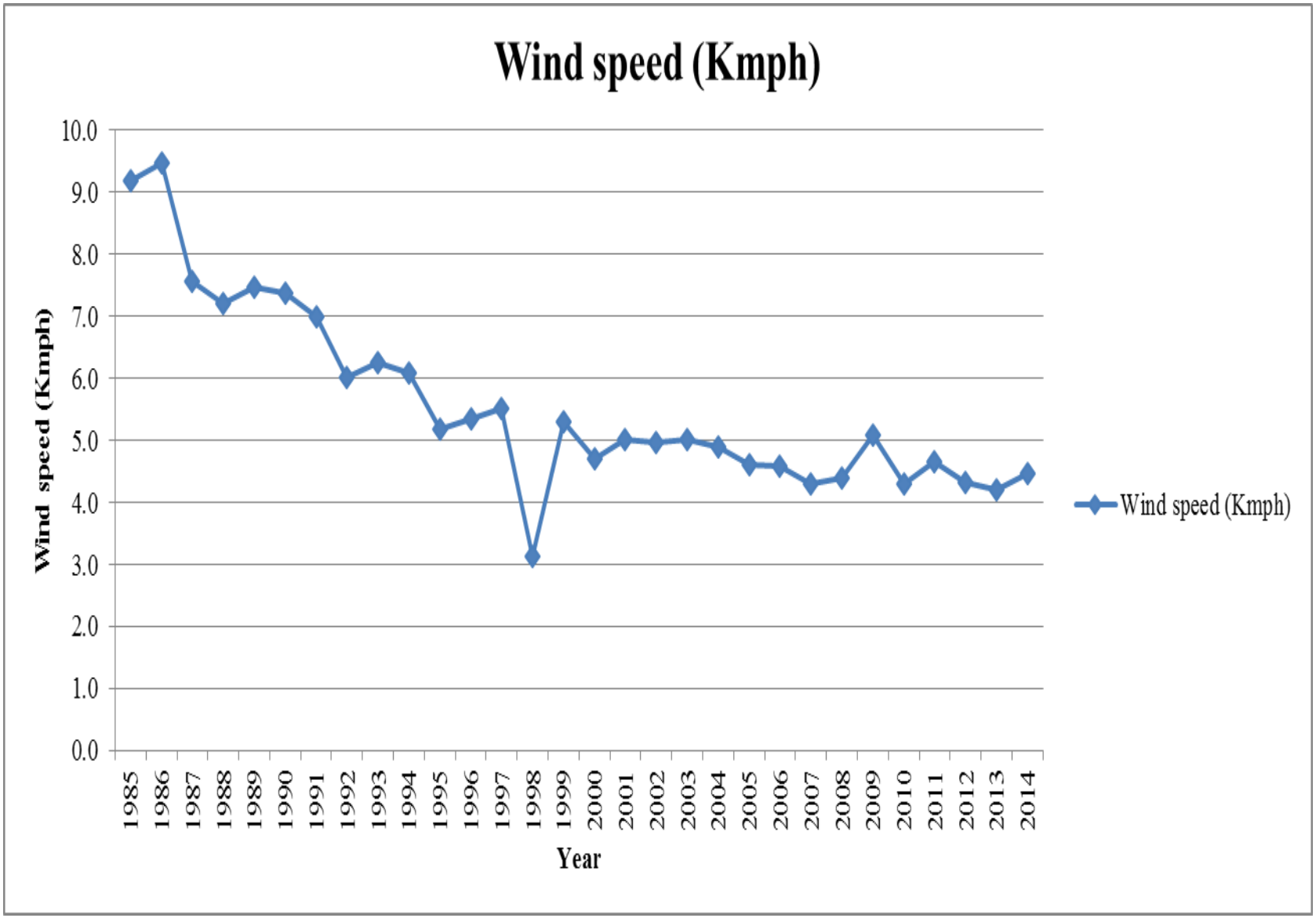

Fig.7 Trends in area, production and productivity of cotton crop in Parbhani district of Marathwada region during 1985-2014

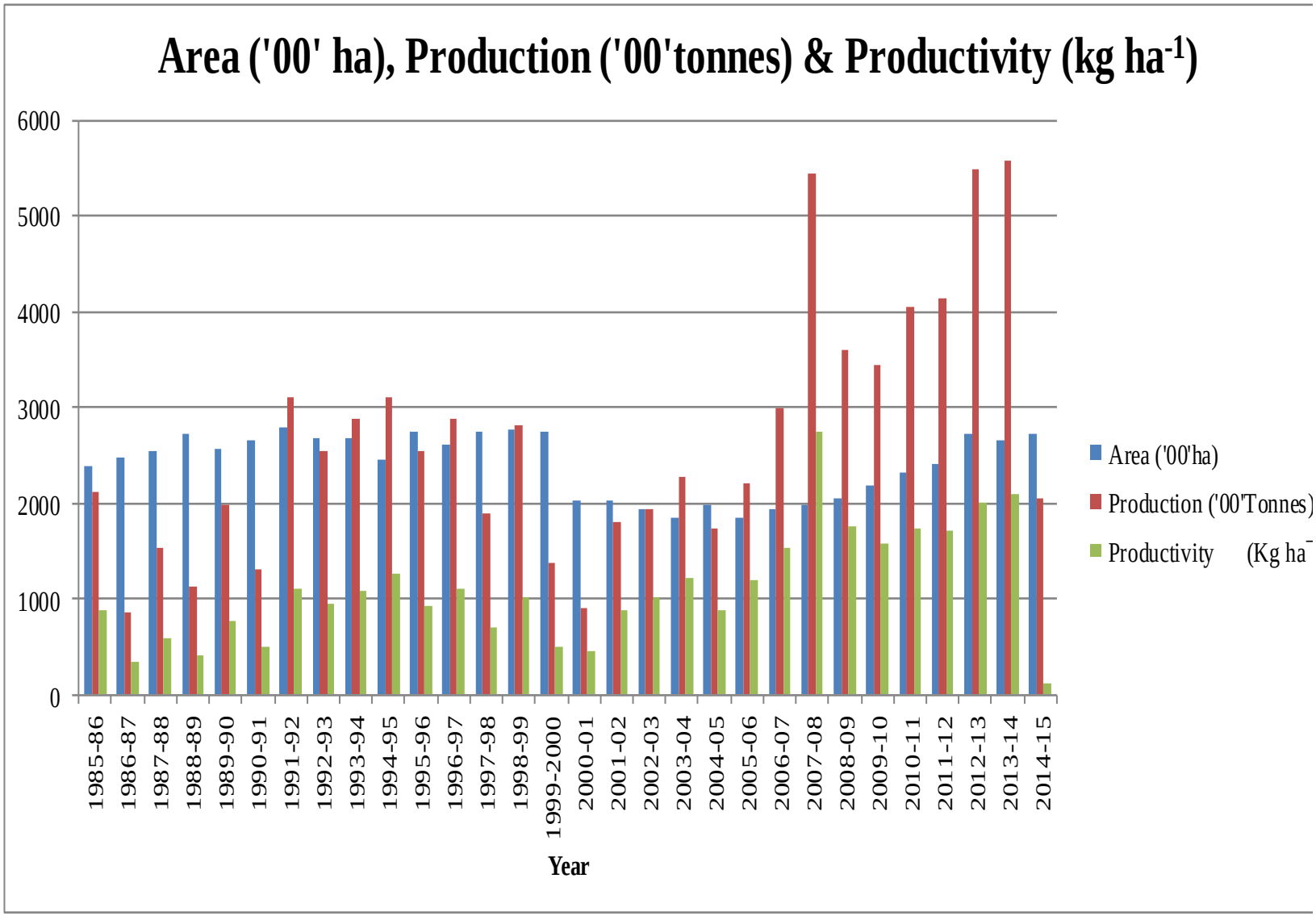

Table.1 Recorded Parbhani district weather data during 1985-2014 (23MW-5MW) of cotton crop

Year	T.Max (^{0}C)	T.Min (^{0}C)	RH-I (%)	RH-II (%)	RF (mm)	Bright Sunshine (hrs)	Evaporation (mm)	Wind Speed (Km hr^{-1})
1985-86	33.5	21.0	58	38	667.6	8.1	5.9	9.2
1986-87	32.6	17.8	52	31	607.8	8.5	6.1	9.5
1987-88	34.8	18.0	58	41	770.3	8.1	5.8	7.6
1988-89	32.4	17.3	63	48	1554.5	7.8	5.1	7.2
1989-90	32.2	17.6	53	35	1274.2	7.4	5.8	7.5
1990-91	29.5	17.1	61	43	1562.2	7.0	5.4	7.4
1991-92	32.2	14.6	46	26	700.7	7.5	5.7	7.0
1992-93	33.4	18.3	50	22	815.5	8.3	5.9	6.0
1993-94	31.1	16.6	54	14	786.9	7.9	5.6	6.2
1994-95	28.9	17.3	59	39	805	6.9	5.0	6.1
1995-96	31.7	18.6	53	36	703.8	7.9	5.2	5.2
1996-97	29.4	17.3	57	42	1018.2	8.0	5.1	5.4
1997-98	32.4	17.3	66	28	912.2	8.0	4.6	5.5
1998-99	26.2	13.7	60	31	1441.4	7.5	3.9	3.1
1999-2000	31.0	14.0	57	29	931.4	7.7	4.4	5.3
2000-01	32.4	13.4	52	35	822.5	8.1	4.6	4.7
2001-02	30.5	17.7	59	39	1143.1	7.5	4.3	5.0
2002-03	31.1	18.0	51	34	782.3	7.9	5.2	5.0
2003-04	30.8	18.2	53	36	734.8	7.9	5.2	5.0
2004-05	30.4	17.9	53	37	590.1	7.9	5.2	4.9
2005-06	30.3	17.7	54	38	1055.5	7.7	4.8	4.6
2006-07	30.0	18.9	56	39	925.4	7.6	4.8	4.6
2007-08	30.1	18.9	58	37	837.9	7.9	4.6	4.3
2008-09	31.3	18.9	67	54	692.5	7.0	5.0	4.4
2009-10	32.2	17.3	53	46	712.8	7.4	5.1	5.1
2010-11	31.4	18.5	59	51	953.7	7.0	4.4	4.3
2011-12	31.8	18.9	81	44	633	7.5	5.3	4.7
2012-13	31.9	19.4	79	46	683.2	6.8	5.1	4.3
2013-14	30.4	18.4	84	52	1175	6.3	4.4	4.2
2014-15	32.3	18.1	82	51	436.9	6.7	4.5	4.5
Mean	31.3	17.6	60	38	891.0	7.6	5.1	5.6

(Source: I.M.D., NDC, Pune and Dept. of Agril. Meteorology, VNMKV, Parbhani)

Table.2 Trends in Parbhani district Area, Production and Productivity of cotton (lints) crop during 1985-2014

Year	Area ('00'ha)	Production ('00'tonnes)	Productivity (kg ha^{-1})
1985-86	2386	2121	888.9
1986-87	2475	858	346.7
1987-88	2536	1525	601.3
1988-89	2731	1128	413.0
1989-90	2564	1977	771.1
1990-91	2660	1307	491.4
1991-92	2801	3116	1112.5
1992-93	2687	2546	947.5
1993-94	2680	2890	1078.4
1994-95	2458	3116	1267.7
1995-96	2747	2546	926.8
1996-97	2624	2890	1101.4
1997-98	2752	1905	692.2
1998-99	2781	2818	1013.3
1999-2000	2743	1371	499.8
2000-01	2024	905	447.1
2001-02	2034	1797	883.5
2002-03	1935	1949	1007.2
2003-04	1847	2268	1227.9
2004-05	1980	1727	872.2
2005-06	1850	2216	1197.8
2006-07	1947	2988	1534.7
2007-08	1981	5445	2748.6
2008-09	2044	3610	1766.1
2009-10	2177	3437	1578.8
2010-11	2324	4048	296.0
2011-12	2405	4134	292.0
2012-13	2736	5480	341.0
2013-14	2659	705	361.0
2014-15	2736	2048	127.0
Average	2410.1	2495.7	894.4

(Divisional office (stat) Latur, Govt.of Maharashtra)

The mean wind speed corresponding yearly was presented in Table 1. The data revealed that the wind speed was normal during pre-monsoon season and fluctuated in monsoon season in Parbhani district. The wind speed was continuously decreasing in trend during 1985 to 2014. Highest and lowest wind speed recorded in 1986 and 1998 into Parbhani district, respectively. During crop growing environment weather parameter was fluctuate year wise. The average wind speed 5.6 kmph.

Area, production and productivity of cotton crop in Parbhani district during 1985-2014

Cotton is the principal commercial crop of the Parbhani district. It is cultivated in more than 2.0 lakh ha. Though productivity trends of the crop show large variability there has been a constant increase in its area and production chiefly due to the introduction of Bt cotton, market forces and partly due to vagaries in the temporal distribution of monsoon rains. In early dry spells of the rainy season more area sown for cotton showed relative drought tolerance.

The area earmarked to other crops which are moisture sensitive, are brought under cotton. Apart from the spatial and temporal distribution of rainfall, insect pest damage is another important parameter that affects cotton productivity in Parbhani district.

Abundance resource of poor farmers whom cotton cultivation was dependent on the vagaries of monsoon. The unpredictability of rainfall and high element of risk leads to low input usage. Cotton is mainly grown on shallow and medium deep soils, which have low available water holding capacity and are highly erosion prone. Most of the rainfall is received during July and August in short and heavy spells resulting in high runoff and soil loss, 40-80% of the rain water goes unutilized in the absence of proper soil and water conservation measures. Abiotic adversities like cloudy weather, water logging during initial stages and moisture stress at later stages aggravate physiological shedding of buds and bolls. Jassids and bollworms are the major pests of cotton. Unfavourable weather conditions affect the timely pest control in the early stages of the crop. Infection by powdery mildew and bacterial blight diseases cause premature crop cessation and reduction of yield. There is ultimate target of increasing the productivity of cotton field crops in Parbhani. Overall area, production and productivity trends are shown in table 2 for the cotton field crops. Cotton crop continuous increasing trend up to the 1998 then after decrease up to 2007 and after increase continuous in area and production but last four years productivity of cotton decreasing trend is noticed in Parbhani district. This will give an insight to the planners to go further for micro-level analysis regarding sustainability and profitability of a particular crop and cropping system.

Area

The net sown area of different years of the widely grown crops over 30 year data can help in planning and expansion of thrust crops implementing projects to expand areas under the crops currently grown or to introduce new crops or their cultivars into the new area in the suitable farming situations of Parbhani.

Crop sown area data presented in table 2. Area under Cotton crop continuous increasing in trend up to the 1998 than after decrease up to 2007 and again increase continuous area up to 2014 in Parbhani district.

The highest and lowest sown area of cotton crop recorded in 1991 and 2003, respectively. The average area estimated during 1985-2014 was (241010 ha) in Parbhani district.

Production

The production of cotton crop in the Parbhani district was recorded into different years of the widely crop production during

1985-2014. Crop production data is presented in table 2. The highest and lowest mean production of cotton crop recorded in 2012 and 2013, respectively. Whereas average production estimated during 1985-2014 is (249570 tonnes) in Parbhani district.

Productivity

The Productivity of cotton crop in the Parbhani district was recorded into different years of the widely crop Productivity during 1985-2014 total 30 years data. Crop Productivity data presented in table 2. Productivity of Cotton crop continuous more fluctuated trend during 1985 to 2014 in Parbhani district. Last five year (2010-2014) lowest productivity of cotton crop was recorded in Parbhani district and also during 1986 to 1990 comparatively low productivity observed due to inadequate rainfall into flowering to boll development stage. The highest and lowest mean productivity of cotton crop recorded in 2008 and 2014, respectively. The total average productivity (894.4kg/ha) was estimated during 1985-2014 in Parbhani district.

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