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Climate Variability and Food Security in Satara District, Maharashtra

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Abstract:

Agriculture is main activity in the Satara district. Recent climate change adversely affected food grain production. Rainfall and temperature are main controllers of the food grain production. The variability of rainfall and temperature change the situation of it. More than 89 percent rainfall in the Satara district is received in the southwest monsoon season. The rainfall during the crop growing season is affecting on the crop statistics. In this study, analyse the correlation of rainfall, temperature and food grain in Satara district of Maharashtra. The area under foodgrain is mostly depending on the climatic variability, whereas the foodgrain production is sometimes affected it. In this study the productivity is not affected by any climatic parameter. The decline trend of foodgrain production with association of climatic parameter will be creating the problems of food security in the district.

Key words: Rain, Monsoon, Annual, Agriculture, Foodgrain, Food security, Satara

INTRODUCTION

Agriculture is an important activity in India. More than 70 percent population of country depends on the agriculture. The agriculture sector plays a significant role in the social, economic and industrial development of country. Indian agriculture is the gamble of monsoon. The drought incidence and variability of rainfall and temperature have been historically major causes of low agricultural production in India. In this research paper, the relationships of foodgrain production and climatic parameter of Satara district is discussed. Satara district is located in the western part of Maharashtra. The Geographical location of Satara is 17^0 5' to 18^0 11' North & 73^0 33' to 74^0 54' East. It is bounded by Pune district to the north, Solapur district to the east, Sangli district to the south, Ratnagiri district to the west and Raigad district lies to its north-west direcion. Satara district is situated in the river basins of the Bhima and Krishna. The physical setting of Satara show a contrast of immense dimensions and reveals a variety of landscapes influenced by relief, climate, vegetation and agricultural activity.

Agriculture is the major primary activity of Satara district. It is classified into two main seasons; Kharif and Rabi. The Kharif agriculture season is from June to mid of October during the periods of southwest monsoon season and the Rabi agriculture season is from mid October to February during the post monsoon and cold seasons. Some parts of the district grow crops during summer season. The climatic variability of the district affected the agriculture production. The high frequency of drought is increased in the eastern part of the district (Khandala, Phaltan, Man, Khatav and Koregaon tahsils) during the last few decades. The rainfall distributions during crop sowing period have also become responsible for the reduction of agricultural production. Some historical evidence of the district shows the agriculture production is mainly depending on the

annual rainfall. This study analyzed the climate variability and foodgrain crops (production, area, productivity) of kharif, rabi and annual of the Satara district during 1983-2012.

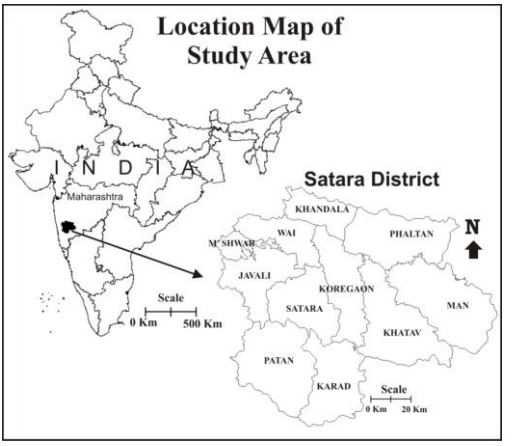


Figure. 1

DATA COLLECTION AND METHODS

The long range monthly data from 1983 to 2012 of rainfall and temperature is collected from Indian Meteorology Department, Pune and Nimbkar Agriculture Research Institute, Phaltan. The seasonal and annual crop statistics have been collected from Agriculture Department, Satara and Maharashtra. The Karl Pearson's method is used for analysis of linear correlation of foodgrain and climatic parameter. A trend analysis technique is used for identification of situation of food grain and climate. The data of climate and food crops is represented by various graphical methods.

RESULT AND DISCUSSION

Climatic variability of district influenced the production and area of food grain. Figure-2 is indicating annual, kharif and rabi production and area of foodgrain in the district

respectively. Annual and kharif foodgrain crops are indicating decline trend of both entity. The production and area is lowest during 2003 and 2005. The average annual area under foodgrain is 473890 hectors and production is 445790 tones. The average area under the kharif foodgrain crop is 263000 hectors and average production is 264010 tonnes. The area under rabi foodgrain rapidly fell down after the 1998 and then slowly down after 2004. Similarly, in this season the production is slowly falling down as compared to the area.

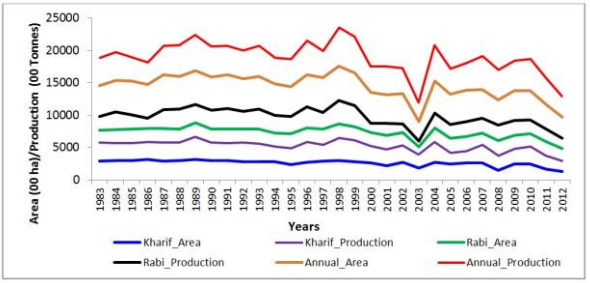


Figure 2

RAINFALL AND FOOD GRAIN PRODUCTION

The rainfall is major controller of agriculture production in the Satara district. The relationship between rainfall versus food grain crops indicated that the rainfall influences the production and area of food grain in most of the years. Figure 3 is showing plot of the total area of foodgrain crops versus rainfall. This plot is showing the specified changing pattern of rainfall and area under crops. The rainfall deficiency has adversely affected the foodgrain area in the Satara district. Figure 4 is depicting the rainfall versus foodgrain production in the district. The production of foodgrain has been influenced by annual and southwest monsoon rainfall. The production is always low, when rainfall is deficient and high during normal rainfall.

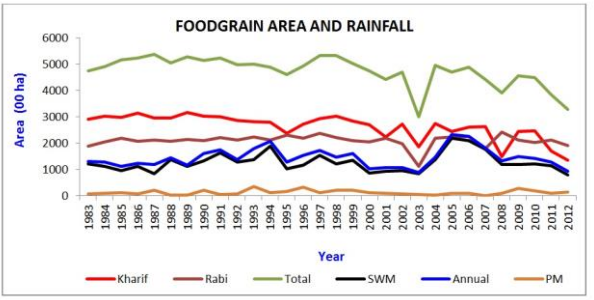


Figure 3

Figure 5 depicts the productivity of foodgrain crops versus rainfall in the district. Productivity is lowest during the excessive and lowest rainfall year. The lowest rainfall years 1990, 2002, 2003, 2011, 2012 and excessive rainfall years 1991, 1993, 1997, 2005, 2006 are showing the lowest productivity of foodgrain crops.

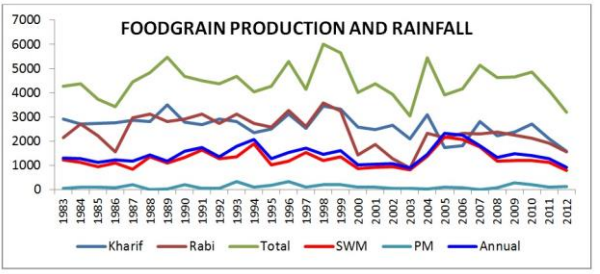


Figure 4

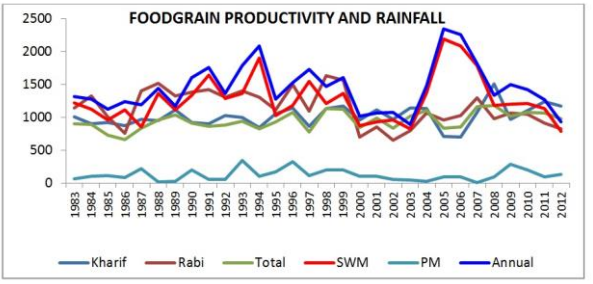


Figure 5

RAINFALL AND FOOD GRAIN PRODUCTION CORRELATION

Table - I shows the correlation of annual, southwest monsoon, post monsoon rainfall and food grain area and production in the district. The relationships between rainfall and area under foodgrain are positive in all seasons, that is if rainfall is increased, the area under foodgrain is increased. The production of foodgrain in kharif season shows negative correlation with rainfall, whereas the annual and Rabi rainfall shows positive correlation with it.

Table I: Satara District - Rainfall and Food Grain Production Correlation (1983-2012)

Season	Total		Kharif		Rabi	
	Area	Production	Area	Production	Area	Production
South West Monsoon	0.28	0.18	0.22	-0.18	0.30	0.32
Post Monsoon	0.15	0.25	-	-	0.27	0.39
Annual	0.35	0.24	0.24	-0.14	0.39	0.44

Source: Compiled by researcher

DROUGHT YEAR AND FOOD GRAIN PRODUCTION

Table -II shows the drought years and deficiency of agriculture production. The effect of annual rainfall deficiency on food grain production varied between 2.7 to 28.7 percent, where area is 2.7 to 36.4 percent. The highest annual deficiency of foodgrain is observed during the drought year 2003. The rainfall during the crop-growing month is main determinant of foodgrain production. The trend of rainfall in June month is sharply decline in the district and it is the most responsible factor for the decline of area and production foodgrain.

Table – II: Satara District - Drought Year and Food Grain Production (1983-2012)

Drought Year	% Decline in Area under food grains over previous year	% Decline in food grains production over previous year
1990	2.9	14.3
1992	4.9	2.7
1994	2.7	14.0
1999	5.4	6.0
2000	5.6	28.7
2003	36.4	22.9
2005	5.2	28.4
2008	11.7	10.1
2011	14.5	15.9
2012	14.5	21.4

Source: Compiled by researcher

TEMPERATURE AND FOOD GRAIN PRODUCTION

Temperature range of annual, kharif and rabi seasons in the district has been increased by 1.12^{o} C, 0.79^{o} C and 1.68^{o} C respectively during study periods (Table III). According to the IPCC the rate of temperature increase has mostly due to the rise and concentration of green house gases in the atmosphere. Annual and seasonal temperature has been showing increasing trend in the district. The increasing trend of temperature has adversely affected area and production of foodgrain in the district. The rate of temperature increase in rabi season is comparatively high. Figure 6 and 7 depicted the temperature versus area, production and productivity of foodgrain respectively.

The Increasing trend of temperature in the district are rapidly decreased the production of foodgrain. All periods have been showing the sharply decline rate of area and production of foodgrain in the district. Rabi season shows lowest decline rate of of area and production of foodgrain. Productivity of foodgrain is all times shows increasing trend; however better crop management, use of advance techniques, fertilizers, irrigation facility and other modern equipments have increased it.

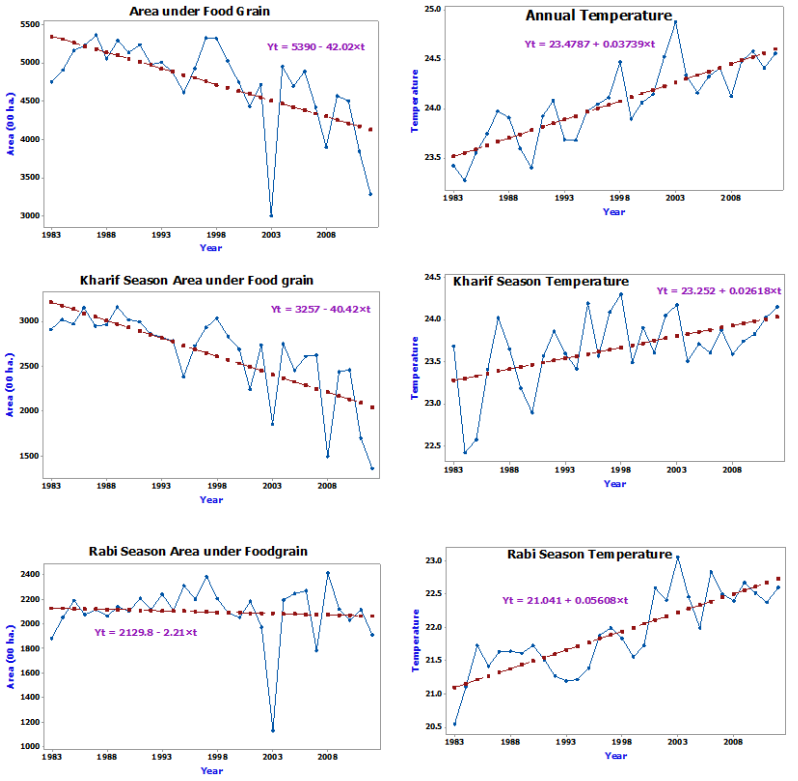
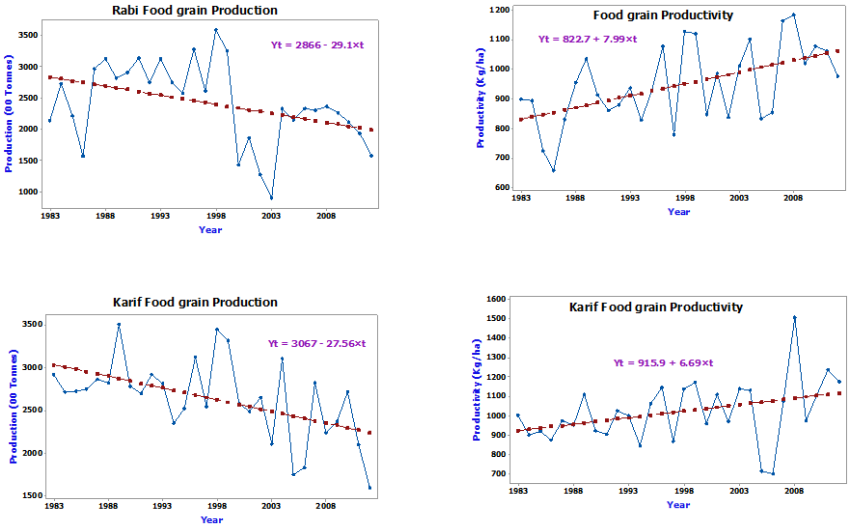

Area under Food Grain
Yt = 5390 - 42.02×t
Area (00 ha.)
Year
Annual Temperature
Yt = 23.4787 + 0.03739×t
Temperature
Year
Kharif Season Area under Food grain
Yt = 3257 - 40.42×t
Area (00 ha.)
Year
Kharif Season Temperature
Yt = 23.252 + 0.02618×t
Temperature
Year
Rabi Season Area under Foodgrain
Yt = 2129.8 - 2.21×t
Area (00 ha.)
Year
Rabi Season Temperature
Yt = 21.041 + 0.05608×t
Temperature
Year

Figure 6


Rabi Food grain Production
Yt = 2866 - 29.1×t
Production (00 Tonnes)
Year
Food grain Productivity
Yt = 822.7 + 7.99×t
Productivity (Kg/ha)
Year
Karif Food grain Production
Yt = 3067 - 27.56×t
Production (00 Tonnes)
Year
Karif Food grain Productivity
Yt = 915.9 + 6.69×t
Productivity (Kg/ha)
Year

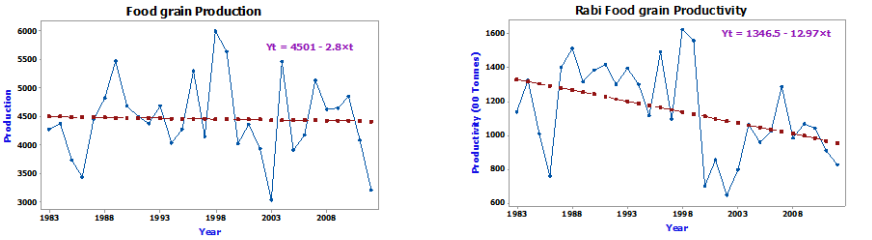


Figure 7

TEMPERATURE TREND AND FOOD GRAIN

Table III shows the trend of temperature and all time foodgrain production in the district. Increasing trend of temperature has declined the annual area up to 90320 hectors and production 10110 tonnes of foodgrain crops during the study period. During the kharif season, area and production of foodgrain has declined 82630 hectors and 60840 tonnes respectively. Rabi season shows lowest decline of area under foodgrain 7360 hectors but production 61000 tonnes, which is highest decline trend during the study period. The maximum increasing trend during the rabi season adversely affected the foodgrain production.

Table – III: Satara District - Temperature Trend and Food Grain (1983-2012)

Decade		**1983-1992**	**1993-2002**	**2003-2012**	**1983 to 2012**
Temperature trend (°C)	**Total**	**0.55**	**0.66**	-0.04	**1.12**
	Kharif	**0.62**	**0.24**	**0.25**	**0.79**
	Rabi	**0.60**	**1.28**	-0.16	**1.68**
Kharif	Area	2999.1	2718.3	2172.8	-
	Changes	-	**-280.8**	**-545.5**	**-826.3**
	Production	2872	2784.7	2263.6	-
	Changes	-	**-87.3**	**-521.1**	**-608.4**
Rabi	Area	2093.4	2173.2	2019.8	-
	Changes	-	+79.8	**-153.4**	**-73.6**
	Production	2637.6	2578.6	2027.6	-
	Changes	-	**-59**	**-551**	**-610**
Total	Area	5110.3	4899.4	4207.1	-
	Changes	-	**-210.9**	**-692.3**	**-903.2**
	Production	4415.6	4643.7	4314.5	-
	Changes	-	+228.1	**-329.2**	**-101.1**

Source: Compiled by researcher (Area- '00' hectors, Production- '00' tonnes.)

The decadal analysis of temperature versus foodgrain in the district shows, that second decade (1993-2002) with lowest variability and the third decade (2003-2012) represents highest variability. The appropriate strategies and planning against the rapid increasing trend of temperature and decline rate of foodgrain production is required. In future, the district will face major problem of foodgrain insecurity.

TEMPERATURE AND FOOD GRAIN CORRELATION

Table -IV is shows the correlation of temperature versus foodgrain production in the district. Temperature of all seasons is negatively correlating with foodgrain production. Area under foodgrain in all season shows strong negative correlation with temperature whereas annual and kharif production is slightly correlated. Production of foodgrain in rabi seasons shows the remarkable negative correlation with temperature.

Table – IV: Satara District - Temperature And Food Grain Production Correlation (1983-2012)

Temperature (°C)	Total		Kharif		Rabi	
	Area	Production	Area	Production	Area	Production
Annual	-0.58	-0.10	-0.59	-0.37	-0.34	-0.44
Kharif	-0.37	-0.08	-	-	-0.19	-0.22
Rabi	-0.59	-0.13	-	-	-0.25	-0.49

Source: Compiled by researcher

CONCLUSION

The rainfall and temperature are main controllers of the foodgrain production in the district. The overall production and area of foodgrain during kharif and rabi seasons is showing decline trend. It will create food deficiency and insecurity in the Satara district. Rainfall of post monsoon season is not remarkable influent over the foodgrain production in the district. Majority of the years during the study periods show adverse impact of annual and southwest monsoon rainfall on

foodgrain production. It is true that rainfall is prime determinant of agriculture production in the study area. During the lowest rainfall year of annual and southwest monsoon, the area of foodgrain is sharply declining, whereas the during the normal rainfall year the area of foodgrain is near average. More than 89 percent rainfall in the district is received in the southwest monsoon season, so it is main determinant of the foodgrain production. The foodgrain crops respond positively to the rainfall of the district. The productivity of foodgrain does not depend on the climatic phenomena, some other manmade factors also important there. The temperature is another controller of area and production of foodgrain. Temperatures of all seasons are showing the negative correlation. If temperature is increased, it adversely affected over the food grain. It is clear that the area and production of foodgrain crops mostly depends upon the temperature situation. The decline trend of foodgrain production will be creating problems of food security in the district. The administration of Satara district takes initiatives and efforts for the growth of foodgrain production.

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