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Effect of weather variations on yield of paddy crop in Gondia district

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Abstract
The study was undertaken in Gondia District entitled "Effect of Weather Variations on Yield of Paddy Crop in Gondia District" to examine the change on Paddy crop with the help of following objectives- To study the changes in temperature and rainfall, To study the impact of climate change on yield of selected crops and To study implication of climate change on farm level adjustment.
The study was undertaken in Gondia District and Paddy crop was selected to study the effect of weather change on yield of the crop for the year 2001-2015.The data for present study was collected from the Publication of Dept. of Agriculture, Govt. of Maharashtra. The data of rainfall and temperature for these districts were taken from the Meteorological Department Dr. P.D.K.V. Akola.
The following conclusions of the study were drawn like Rainfall had inconsistency within weeks over the period of 2001-2015 as revealed by C.V. in Gondia district. The consistency in minimum and maximum temperature was observed within weeks over the period 2001-2015. Gondia's minimum and maximum temperature at flowering stage affected the crop yield of paddy during 2001-2015. In Gondia district paddy is major crop.

Keywords: weather, rainfall, yield

Introduction
Influence of weather is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). It may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions (i.e., more or fewer extreme weather events).
Influence of weather on food production are not limited to crops. It will affect food production and food security via its direct or indirect impact another components of the agricultural production systems, especially livestock production which is closely linked with crop production. The inter annual monsoon rainfall variability in India leads to large-scale droughts and floods, resulting in a major effect on Indian food grain production (Parthasarathy and Pant, 1985, Selvaraju, 2003; Kumar *et al*., 2011) [4, 5, 6, 3] and on the economy of the country (Gadgil *et al*., 1999) [2]. Rice (*Oryza sativa* L.) and sorghum (*Sorghum biocolar* moench.) are two major food crops of India contributing around 42.5 and 34.5 percent, respectively to the total food grain production of the country (DES, 2007). Rice and Sorghum is mostly grown in Kharif (June - October) season. Due to importance of these crops in the national agricultural scenario, it is important to study the influence of weather change on these crops with the help of following objectives: To study the changes in temperature and rainfall, To study the impact of climate change on yield of selected crops and To study implication of climate change on farm level adjustment.

Data & Methodology
The present study was based on secondary data. The data of area and production of these crops was taken from the Publication of Dept. of Agriculture, Govt. of Maharashtra. The data collected on weekly rainfall and temperature for the Gondia district for the years from 2001 to 2015 from the Meteorological Department Dr. P.D.K.V. Akola. The study was based on data for the period 2001-2015.

Changes in Temperature and Rainfall
Mean and CV (%) for weekly rainfall and temperature data is calculated for the behavior of Weekly rainfall and temperature in selected district.

$$CV\ (\%) = \frac{SD}{Mean} X\ 100$$

Where,
CV(%) = Coefficient of Variation
SD = Standard Deviation

Influence of weather change on yield
Yield(Y) are dependent variable, Rainfall and Temperature at three crop stages, Independent variable. The three crop stages of Sorghum is taken such as seedling, flowering and grain filling stage

$$Y=a+b_1X_{1tmin}+b_2X_{2tmax}+b_3X_{3r}+b_4X_{4tmin}+b_5X_{5tmax}+b_6X_{6r}+b_7X_{7tmin}+b_8X_{8tmax}+b_9X_{9r}$$

Where,
Y = Yield per ha.
a = Intercept
X_{1tmin} = Minimum temperature at seedling stage
X_{4tmin} = Minimum temperature at flowering stage
X_{7tmin} = Minimum temperature at grain filling stage
X_{2tmax} = Maximum temperature at seedling stage

X_{5tmax} = Maximum temperature at flowering stage
X_{8tmax} = Maximum temperature at grain filling stage
X_{3r} = Rainfall at seedling stage
X_{6r} = Rainfall at flowering stage
X_{9r} = Rainfall at seedling stage

Implication on farm planning.
The implication on farm planning was studied with help of change in cropping pattern based on previous year rainfall. The year for which rainfall was marked and cropping pattern and changes these in were observed for the next year.

Results and discussion
1. Changes in Rainfall
The average rainfall maximum and minimum rainfall along with CV(%) as a measure of variability for 20 weeks for Gondia district are presented in table 1.The weekly rainfall for 1 to 20 rainfall weeks in Gondia district was analysed for statistic average rainfall. It is Minimum and Maximum rainfall & coefficient of variation in percentage are presented in table. It is revealed from the table that wider variability was observed in all the 20 weeks most of the weeks have zero minimum rainfall while the maximum rainfall over the weeks ranges between 3 to 220.4(mm). The inconsistency within week over the years is revealed by CV (%) ranging between 55.76 to 294.55 % indicating unreliability of average the years.

2. Changes in Maximum Temperature
Consistency in Maximum Temperature observed within week over the period 2001-2015

3. Changes in Minimum Temperature.
Consistency in Minimum Temperature observed within week over the period 2001-2015

4. Contribution of weather parameter in yield of Paddy in Gondia District
Data on minimum, maximum temperature and rainfall at three crop stages was used for regression analysis with yield. In all nine independent and one dependent variable studied. The coefficient along with standard error and coefficient of determination are presented in the following table 4.
It is revealed from the table that constant of the regression line described 70% yield, Irrespective of weather effect the major influence in parameter were the minimum and maximum temperature at flowering stage in paddy which adversely affect crop yield. All nine variable taken together and explain 66.62% contribution in describing the crop yield. The value of coefficient of determination the minimum and maximum temperature at flowering stage is the major contributor.

5. Changes in Cropping Pattern in Gondia District during 2001-2015
Changes in the cropping pattern in Gondia district 2001-2015 are presented in Table5. The District with a single crop domination i.e. Rice with 90.19 per cent of gross cropped area in the year 2015.The cultivation of other pulse crops is second choice of the farmer of the district. There is very little crop diversification in this district. It is typical case of concentrated cultivation with one or two crops.

Table 1: Changes in Weekly Average, Maximum and Minimum Rainfall in Gondia District

Gondia Rainfall				
Weeks	**Mean**	**CV(%)**	**MIN**	**MAX**
22	0.36	265.77	0	3
23	10.01	133.14	0	45.41
24	41.38	143.80	0	186.43
25	33.18	76.85	0	72.61
26	56.80	82.65	0	152.62
27	54.65	73.05	0	136.43
28	63.98	83.09	2.21	169.83
29	62.84	75.62	3.42	179.82
30	112.32	55.76	21.40	220.40
31	84.69	74.90	0	211.40
32	78.95	83.01	16.61	2911
33	67.09	82.08	0	157.81
34	39.07	66.94	0	103.84
35	61.09	96.65	0	184
36	49.81	115.19	0	218.80
37	32.69	156.48	0	150
38	25.31	112.28	0	100.63
39	10.31	172.52	0	64.21
40	15.26	125.58	0	53.61
41	4.16	294.55	0	45.64

Table 2: Changes in Maximum Temperature in Gondia District

Gondia Max Temp.				
Weeks	**Mean**	**CV(%)**	**MIN**	**MAX**
22	41.42	3.28	37.16	43.21
23	39.20	5.51	34.83	42.87
24	37.81	7.35	30.84	41.56
25	35.63	8.30	32.14	40.80
26	33.46	8.04	28.67	37.73
27	32.24	6.47	29.91	35.93
28	31.64	5.10	29.70	35.31
29	31.37	7.43	26.94	34.64
30	29.66	5.64	26.21	32.83
31	29.80	5.53	26.30	32.17
32	29.10	6.07	26.26	32.09
33	30.62	4.45	28.17	33.11
34	30.80	6.74	24.63	33.33
35	30.35	4.99	28.01	34.04
36	30.37	4.24	28.29	32.36
37	31.28	4.78	29.41	33.79
38	31.32	5.84	29.19	35.24
39	32.51	3.70	30.70	34.30
40	33.40	4.97	29.76	36.01
41	34.12	4.40	31.03	36.53

Table 3: Changes in Minimum Temperature in Gondia District

Gondia Min Temp.				
Weeks	**Mean**	**CV (%)**	**MIN**	**MAX**
22	26.8	14.01	18.77	29.99
23	27.5	5.03	25.17	29.20
24	26.8	6.22	24.30	28.93
25	25.9	5.47	23.99	28.10
26	24.6	2.90	23.50	25.71
27	24.3	1.65	23.50	24.73
28	24.5	2.75	23.59	26.13
29	24.2	3.75	23.34	26.13
30	23.5	1.45	22.77	24.03
31	23.4	1.94	22.79	24.03
32	23.4	2.03	22.74	24.06
33	23.6	2.97	22.53	24.91
34	23.2	2.18	22.50	24.03
35	23.2	1.82	22.34	23.74
36	23.1	1.60	22.37	23.54
37	23.0	1.28	22.41	23.51
38	22.8	2.68	21.56	23.66
39	22.4	4.95	20.81	24.46
40	21.2	8.28	17.09	23.69
41	19.4	8.59	15.24	21.76

Table 4: Contribution of weather parameter on yield of Paddy in Gondia District

Gondia		
Variable	**Coefficient**	**S. Error**
Intercept	-51978.807	27095.71
X_{1tmin}	4.14741383	100.5417
X_{2tmax}	123.107262	88.66759
X_{3r}	8.27864749	5.989939
X_{4tmin}	1148.70*	574.4391
X_{5tmax}	229.77**	99.13896
X_{6r}	5.66916789	3.420147
X_{7tmin}	436.142238	556.256
X_{8tmax}	130.187112	132.4781
X_{9r}	0.73632281	2.540686
	R^2	0.6662**

Table 5: Changes in Cropping Pattern in Gondia District during 2001-2015 (in "00" ha)

	YEARS			
CROP	**2001**	**2005**	**2009**	**2015**
Paddy	1818	1625	1819	1747
	(94.20)	(94.09)	(92.38)	(90.19)
Tur	40	45	54	65
	(2.07)	(2.61)	(2.74)	(3.36)
Other Pulses	46	40	61	73
	(2.38)	(2.32)	(3.10)	(3.77)
Gram	26	17	35	52
	(1.35)	(0.98)	(1.78)	(2.68)

(Figures in parenthesis are percentages over gross crop area)

Conclusions

1. In Gondia district, rainfall had inconsistency within weeks over the period 2001-2015 as revealed by C.V. ranging between 55.76 to 294.55 per cent.
2. In Gondia districts the consistency in minimum and maximum temperature observed within weeks over the period 2001-2015.
3. In Gondia district, minimum and maximum temperature at flowering stage affected the crop yield of paddy during 2001-2015.
4. In Gondia district, with a single crop domination i.e. Rice with 90.19 per cent of gross cropped area in the year 2015. There is very little crop diversification in Gondia district.

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