

## Influence of Weather on Yield of Sorghum in Washim District

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### ABSTRACT

The study was undertaken in Washim Districts entitled “Influence of weather on yield of sorghum in Washim district” to examine the influence of weather change on Sorghum. The Sorghum crop was selected to study the influence of weather change on yield of the Sorghum 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 in Washim District. Rainfall had inconsistency within weeks over the period of 2001-2015 as revealed by C.V. The consistency in minimum and maximum temperature was observed within weeks over the period 2001-2015. The rainfall at seedling stage, minimum temperature and rainfall at grain filling stage affected the crop yield of sorghum during 2001-2015. The crop cotton and other pulses were major crops of the district during 2000-2001, constituting 66 per cent of total cropped area. But now area under cotton and kharif Jowar is reduced and soybean emerged as a major crop occupying 66.24 per cent of gross cropped of region.

**Key words:** Weather, Rainfall, Yield, *Oryza sativa*

### 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).

Influences 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<sup>4,6,3</sup> and on the economy of the country<sup>2</sup>.

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Rice (*Oryza sativa* L.) and sorghum (*Sorghum bicolor* 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. 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.

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

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

## MATERIAL AND METHODS

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 Washim 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.

variable. The three crop stages of Sorghum is taken such as seedling, flowering and grain filling stage.

$$Y = a + b_1 X_{1tmin} + b_2 X_{2tmax} + b_3 X_{3r} + b_4 X_{4tmin} + b_5 X_{5tmax} + b_6 X_{6r} + b_7 X_{7tmin} + b_8 X_{8tmax} + b_9 X_{9r}$$

Where,

Y = Yield per ha.

a = Intercept

X<sub>1tmin</sub> = Minimum temperature at seedling stage

X<sub>4tmin</sub> = Minimum temperature at flowering stage

X<sub>7tmin</sub> = Minimum temperature at grain filling stage

X<sub>2tmax</sub> = Maximum temperature at seedling stage

X<sub>5tmax</sub> = Maximum temperature at flowering stage

X<sub>8tmax</sub> = Maximum temperature at grain filling stage

X<sub>3r</sub> = Rainfall at seedling stage

X<sub>6r</sub> = Rainfall at flowering stage

X<sub>9r</sub> = 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 minimum rainfall along with CV(%) as a measure of variability for 20 weeks for Washim district are presented in table 1. The weekly rainfall for 1 to 20 rainfall weeks in Washim 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 1 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 26.5 to 391(mm). The inconsistency within week over the years is revealed by CV (%) ranging between 59.21 to 239.14 % indicating unreliability of average the years.

## 2. Changes in Maximum Temperature in Washim District

The changes in maximum temperature was shown in Table 2. Consistency in Maximum Temperature observed within week over the period 2001-2015

## 3. Changes in Minimum Temperature in Washim District

The changes in minimum temperature was shown in Table 3 Consistency in Minimum Temperature observed within week over the period 2001-2015

## 4. Contribution of weather parameter in yield of Sorghum in Washim 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 rainfall at seedling stage in sorghum which adversely affect crop yield ,while the minimum temperature and rainfall at crop stage 3<sup>rd</sup> or at grain filling stage found to be major yield contributor. All nine variable taken together and explain 81.37% contribution in describing the crop yield. The value of coefficient of determination the rainfall at seedling stage, minimum temperature and rainfall at grain filling stage are the major contributor.

## 5. Changes in Cropping Pattern in Washim District during 2001-2015.

Changes in the cropping pattern in Washim district 2001-2015 are presented in Table 5. Cotton and Other pulses were major crops of the District during 2000-2001 constituting 66 per cent of total cropped area. The proportion of area under Tur over gross cropped area is found to be constant for the period 2001-2005 and maintained a level in the neighbourhoods of ten per cent. The area of kh Jowar and cotton drastically decreases. Soybean crop is emerging as one of the major crops of the region occupying 66.24 per cent of gross cropped area of the region.

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

| Washim Rainfall |        |        |     |        |
|-----------------|--------|--------|-----|--------|
| Weeks           | Mean   | CV (%) | MIN | MAX    |
| 22              | 4.59   | 206.66 | 0   | 26.50  |
| 23              | 24.07  | 127.10 | 0   | 92.21  |
| 24              | 84.07  | 107.98 | 0   | 284.23 |
| 25              | 37.79  | 83.88  | 0   | 76.84  |
| 26              | 81.89  | 108.65 | 0   | 296    |
| 27              | 62.98  | 101.15 | 0   | 225    |
| 28              | 47.17  | 91.31  | 0   | 106    |
| 29              | 66.41  | 84.76  | 12  | 226.50 |
| 30              | 84.85  | 86.66  | 0   | 182    |
| 31              | 105.29 | 81.88  | 0   | 256.58 |
| 32              | 67.87  | 142.64 | 0   | 391    |
| 33              | 26.19  | 91.69  | 0   | 65     |
| 34              | 60.31  | 131.87 | 0   | 203    |

|    |       |        |   |        |
|----|-------|--------|---|--------|
| 35 | 62.33 | 101.28 | 0 | 204.94 |
| 36 | 51.63 | 59.21  | 0 | 102.62 |
| 37 | 26.82 | 153.44 | 0 | 155.23 |
| 38 | 43.39 | 104.86 | 0 | 127    |
| 39 | 18.91 | 139.30 | 0 | 55     |
| 40 | 30.10 | 175.40 | 0 | 191.21 |
| 41 | 11.57 | 239.14 | 0 | 106.32 |

**Table 2: Changes in Maximum Temperature in Washim District**

| Washim Max Temp. |       |        |       |       |
|------------------|-------|--------|-------|-------|
| Weeks            | Mean  | CV (%) | MIN   | MAX   |
| 22               | 36.60 | 4.39   | 36.66 | 43.21 |
| 23               | 35.01 | 6.20   | 34.83 | 42.53 |
| 24               | 32.96 | 9.84   | 30.60 | 41.06 |
| 25               | 31.32 | 8.85   | 31.56 | 40.30 |
| 26               | 29.86 | 10.31  | 28.53 | 37.73 |
| 27               | 29.04 | 7.26   | 29.41 | 35.93 |
| 28               | 28.88 | 7.33   | 29.57 | 35.49 |
| 29               | 27.78 | 7.80   | 26.94 | 34.14 |
| 30               | 26.33 | 6.19   | 26.21 | 32.33 |
| 31               | 26.63 | 6.24   | 26.30 | 31.73 |
| 32               | 25.83 | 5.95   | 25.76 | 31.73 |
| 33               | 26.78 | 5.75   | 27.30 | 33.11 |
| 34               | 26.81 | 8.67   | 24.63 | 33.33 |
| 35               | 26.97 | 5.74   | 27.79 | 33.54 |
| 36               | 27.02 | 6.61   | 26.43 | 32.89 |
| 37               | 27.97 | 5.35   | 29.41 | 33.79 |
| 38               | 27.98 | 6.07   | 29.04 | 34.74 |
| 39               | 29.02 | 5.69   | 29.61 | 35.01 |
| 40               | 29.65 | 6.89   | 29.26 | 36.81 |
| 41               | 30.16 | 5.42   | 31.03 | 36.53 |

**Table 3: Changes in Minimum Temperature in Washim District**

| Washim Min Temp. |       |         |       |       |
|------------------|-------|---------|-------|-------|
| Weeks            | Mean  | C V (%) | MIN   | MAX   |
| 22               | 28.43 | 4.40    | 24.94 | 29.99 |
| 23               | 27.06 | 6.71    | 23.77 | 29.36 |
| 24               | 25.59 | 6.87    | 23.09 | 28.73 |
| 25               | 25.36 | 5.35    | 23.40 | 27.90 |

|    |       |      |       |       |
|----|-------|------|-------|-------|
| 26 | 24.71 | 4.45 | 22.46 | 26.56 |
| 27 | 24.27 | 2.96 | 23.30 | 26.09 |
| 28 | 24.33 | 2.95 | 23.29 | 26.01 |
| 29 | 23.91 | 3.64 | 22.67 | 25.93 |
| 30 | 23.17 | 1.83 | 22.45 | 23.73 |
| 31 | 23.22 | 2.54 | 22.06 | 23.99 |
| 32 | 23.05 | 2.35 | 21.96 | 24.06 |
| 33 | 23.19 | 2.85 | 21.83 | 24.71 |
| 34 | 22.86 | 2.54 | 21.60 | 23.83 |
| 35 | 22.77 | 2.67 | 21.23 | 23.54 |
| 36 | 22.69 | 2.65 | 20.96 | 23.34 |
| 37 | 22.62 | 2.95 | 20.43 | 23.31 |
| 38 | 22.60 | 2.52 | 21.60 | 23.66 |
| 39 | 22.30 | 4.26 | 20.51 | 24.26 |
| 40 | 21.51 | 5.16 | 19.17 | 23.49 |
| 41 | 20.17 | 7.48 | 16.89 | 22.47 |

**Table 4: Contribution of weather parameter in yield of Sorghum in Washim District**

| Washim             |             |          |
|--------------------|-------------|----------|
| Variable           | Coefficient | S. Error |
| Intercept          | 1164.62     | 8398.06  |
| X <sub>1tmin</sub> | -50.17      | 95.74    |
| X <sub>2tmax</sub> | -14.00      | 34.81    |
| X <sub>3r</sub>    | 2.60*       | 1.18     |
| X <sub>4tmin</sub> | -104.30     | 290.25   |
| X <sub>5tmax</sub> | 35.97       | 107.06   |
| X <sub>6r</sub>    | -0.94       | 2.42     |
| X <sub>7tmin</sub> | 158.57**    | 57.84    |
| X <sub>8tmax</sub> | -8.25       | 59.95    |
| X <sub>9r</sub>    | 5.88**      | 2.38     |

\*Significant at 10%

\*\* Significant at 5%

R<sup>2</sup> 0.8137\*\***Table 5: Changes in Cropping Pattern in Washim District during 2001-2015 (in “00” ha)**

| CROP     | YEARS          |                 |                 |                 |
|----------|----------------|-----------------|-----------------|-----------------|
|          | 2001           | 2005            | 2009            | 2015            |
| Cotton   | 882<br>(20.35) | 678<br>(13.88)  | 524<br>(11.09)  | 202<br>(4.51)   |
| Kh.Jowar | 663<br>(15.30) | 525<br>(10.74)  | 299<br>(6.33)   | 100<br>(2.23)   |
| Tur      | 401<br>(9.25)  | 474<br>(9.70)   | 494<br>(10.45)  | 523<br>(11.68)  |
| soybean  | 833<br>(19.22) | 1851<br>(37.88) | 2264<br>(47.91) | 2965<br>(66.24) |

|              |                 |                 |                 |                |
|--------------|-----------------|-----------------|-----------------|----------------|
| Other Pulses | 1555<br>(35.88) | 1358<br>(27.79) | 1145<br>(24.23) | 686<br>(15.33) |
|--------------|-----------------|-----------------|-----------------|----------------|

(Figures in parenthesis are percentages over gross crop area)

### CONCLUSIONS

1. The rainfall had inconsistency within weeks over the period 2001-2015 as revealed by C.V. ranging between 59.21 to 239.14 per cent.
2. The consistency in minimum and maximum temperature observed within weeks over the period 2001-2015.
3. The rainfall at seedling stage, minimum temperature and rainfall at grain filling stage affected the crop yield of sorghum during 2001-2015.
4. The crop cotton and other pulses were major crops of the District during 2000-2001 constituting 66 per cent of total cropped area. but during span of 15 years the area under cotton and kh. jowar is reduced by 15.84 and 13.07 per cent respectively and soybean emerged as of major crop occupying 66.24 per cent of

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