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Original Article

The Vulnerability of Rainfall and Temperature on the Jowar Crop in the Solapur District (2010-2024)

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Abstract

Jowar (Sorghum) is a vital cereal crop cultivated extensively in the Solapur district of Maharashtra. The region's semi-arid climate makes jowar cultivation highly vulnerable to changing weather patterns. This paper examines the trends in jowar cultivation, production, and productivity from 2010 to 2024, while analyzing the impacts of climate change on the crop. The study uses rainfall, temperature, and yield data to assess the correlation between climatic variability and jowar productivity. It also explores farmers' adaptive strategies, challenges, and policy interventions. The findings indicate a decline in productivity due to erratic rainfall, rising temperatures, and prolonged dry spells. The study recommends adopting climate-resilient practices, drought-resistant varieties, and improved water management strategies to mitigate the impacts. The effect of rainfall and temperature on the jowar crop in Solapur district has been studied from 2010 to 2024. Since Solapur district is a drought-prone area, the effect of rainfall and temperature on the main crop can be seen. In research paper, the correlation between rainfall and temperature is seen on the jowar crop. Due to this, if the temperature and rainfall change, the crop production is affected. Since the correlation between temperature and crop production is negative, it can be seen that this has an impact on crop production.

Keywords: *Jawar Crop Production, area, production, productivity trends, Climate Variation Trends, Impact of Climate Change on Jowar Cultivation, Correlation analysis, Challenges*

Introduction

Jowar is a principal crop in the dryland agriculture of Maharashtra, particularly in the Solapur district. As a rainfed crop, its cultivation is significantly influenced by monsoon performance. However, in the last decade (2010–2024), climate change effects, such as erratic rainfall, rising temperatures, and prolonged droughts, have adversely impacted jowar production. Importance of Jowar in Solapur District The dough and roti-making characteristics of various sorghum genotypes are significant, as sorghum serves as a fundamental cereal in numerous regions of the country. Despite its nutritional benefits, the consumption of sorghum is declining, largely due to the rising popularity and easy access to highly subsidized fine cereals, which offer convenience in food preparation. Additional factors contributing to this decline include the fading of traditional food practices, particularly in rural areas, the specialized skills required to prepare sorghum *Rotis* (unleavened pancakes), and the lack of readily available sorghum flour and semolina in the market. There is an urgent need to promote sorghum-based foods. With its high fiber content and low starch digestibility, sorghum is particularly suitable for individuals with diabetes and obesity, especially in urban settings. Typically, sorghum varieties with pearly white or yellow bold grains are favored for roti production. The quality of roti is significantly influenced by factors such as pericarp color, endosperm type, and endosperm texture. Generally, corneous grains demonstrate higher density and breaking strength, lower water absorption rates, and superior dough and roti quality (Murthy et al., 1981).

The key crops in Solapur District include Wheat, Jawar, Bajra, Maize, Tur, Gram, Sugarcane, Cotton, and Groundnuts. Notably, Sugarcane and Jawar together represent over 50 percent of the total cultivated land in the area. In Solapur District, Jawar can be cultivated during both the Rabi and Kharif seasons. Jowar is a staple food grain for rural households. It provides fodder for livestock, contributing to the agrarian economy. Solapur district accounts for approximately 2.5 to 3 lakh hectares of jowar cultivation annually, making it a key cereal crop in the region.

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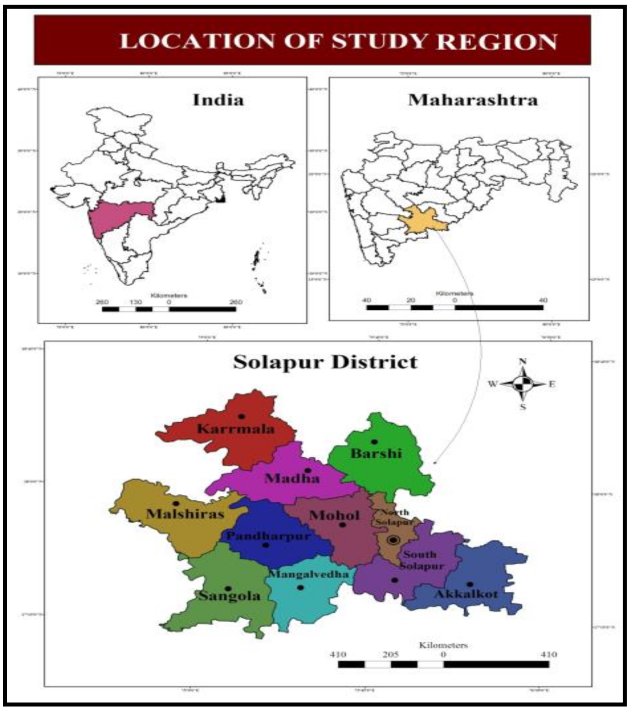
Study Region:

The district of Solapur is located between 17⁰ 10' North and 18⁰ 32' North latitudes and 74⁰ 42' East and 76⁰ 15' East longitudes. The East-West Length of the district is about 200 Km. and North-South width is about 150 Km. The total Geographical area of the Solapur district is about 14878 sq. Km, and population of 43, 15,527 according to 2011 census. (Figure. 1.1) Within the region under study, Karmala is the largest tahsil in area and the lowest is North Solapur tahsil. This tentatively consist 4.88% area and 4.51% population of the Maharashtra State. In other words, the region under study ranks fourth in terms of area and seventh in terms of population among the districts of Maharashtra.

Figure No.1.1



Jawar Crop Production:

Due to the prolonged rains in the entire Solapur district, including Mangalvedha, which has been known as the 'sorghum barn' for centuries, only 73 percent of the sorghum has been sown this year. In Mangalvedha, barely 55 percent has been sown, and that too late. Therefore, this year, along with the sorghum production, there will be very little in the way of sorghum, which is delicious, tasty and juicy. The sorghum produced in Mangalvedha is delicious, crunchy and melts in your mouth as soon as you break the grass. This sorghum, which is in demand across the country, has already received the GI rating. The sorghum produced here in abundance is not only used for bread and sorghum, but has also become famous for other by-products.

In the eastern part of Mangalvedha, a strip of land of about 145 square kilometers is flat, fertile, and completely deep black soil. Sorghum is produced here with little rainfall. The average sowing area of sorghum in the *Rabi* season is 35,457 hectares. But this year, the monsoon rains were prolonged. Due to this, the sowing of sorghum was delayed for many days as the fields did not get ready till late. Only 30 percent was sown till October. After that, farmers planted sorghum, albeit late. Even so, only 55 percent, i.e. 19,573 hectares, could be sown so far.

Objectives:

- To assess the area, production, trends of jowar crops from 2010 to 2024.
- To analyze the impact of climate variability (rainfall, temperature) on jowar yield.

Data Collection:

Secondary Data:

Data from Department of Agriculture, Government of Maharashtra. Rainfall and temperature data from India Meteorological Department (IMD). Jowar area, production, and yield statistics from 2010 to 2024 and collect data High Resolution Gridded rainfall data from CRU website.

Data Analysis:

Trend analysis of area, production, and yield over the years from 2010 to 2024. Correlation analysis between rainfall variability, temperature, and jowar productivity.

Review of Literature:

1. Sivakumar et al. (2005) addressed the topic of climate variability in arid and semi-arid areas globally. Although there has been no significant alteration in the long-term average precipitation, numerous areas have reported a decline in rainfall over the last thirty years. These regions account for approximately 30% of the

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Earth's total land area and house around 20% of the global population.

2. Dash et al. (2007) outlines the rising temperature trends observed over the last twenty-five years. The study also highlights significant climatic variations that occur across different seasons and regions in India. Notably, the increase in minimum temperatures shows considerable variation between the winter and post-monsoon periods. To analyze climatic variability, the country has been categorized into two zones—north and south—divided by the 21° N latitude.
3. In their (2006) study, Kumar et al. employed a high-resolution, limited-area atmosphere and land surface model to illustrate the orographic distribution of summer monsoon rainfall. Analyzing extreme weather events is crucial for evaluating the socio-economic effects of climate change. The findings indicate a rising trend in both precipitation and temperature by the close of the 21st century compared to baseline levels.
4. Kothawale et al., (2010) The climate of India is primarily shaped by the southwest monsoon, which accounts for the majority of the country's rainfall. Approximately 80% of India's annual precipitation occurs between June and September. As a result, farmers in India must schedule their agricultural activities in accordance with the existing weather patterns. Key physiological processes, including photosynthesis, respiration, and grain development, all depend on adequate moisture.
5. Kattimani (2016) The paper outlines several measures to combat global warming and its effects. The combustion of fossil fuels for electricity generation releases substantial amounts of greenhouse gases. Practices such as conserving electricity, minimizing plastic use, halting deforestation, planting more trees, and conserving water can effectively help mitigate global warming. It is our collective responsibility to reduce global warming and protect our environment.

To assess the area, production, and productivity trends of jowar from 2010 to 2024: -

Rabi sorghum sowing usually starts from August as soon as the kharif season ends. Sowing ends from September 15 to October 15 and green, golden sorghum husks are formed in the fields in December-January. Mature sorghum is harvested as soon as the husk season ends.

However, due to the prolonged rains, increased farm labor and increased cultivation costs this year, only half of the sorghum sowing could be done. As a result, only half of the sorghum bread and husks will be available this year.

Table No.1.1

Trends in Jowar Area (ha), Production (MT), Yield (kg/ha), Rainfall (mm) and Average Summer Temp (°C) (2010–2024)

Year	Area (ha)	Production (MT)	Yield (kg/ha)	Rainfall (mm)	Average Summer Temp (°C)
2010-11	280,000	290,000	1035	570	39.5
2012-13	260,000	240,000	923	520	40.2
2014-15	240,000	210,000	875	480	40.8
2016-17	230,000	200,000	870	450	41.0
2018-19	220,000	185,000	840	460	41.5
2020-21	210,000	178,000	848	420	42.0
2022-23	195,000	160,000	820	430	42.3
2023-24	180,000	155,000	810	410	42.8

(**Sources:** Socio-economic Statistical review Solapur District,2024)

Productivity of Jawar Crops in Solapur District. It could be concluded from the table.1.1. That the productivity of most of the crops had decreased over the 2010-11 to 2023-24. The critical observations showed that the productivity of crops mostly decreased during over all period (2010-11 to 2023-24). The major reason for this might be the productivity of *Rabi* jowar was declined from 185000 MT to 155000 MT in 2010-11 to 2023-24. In the total study period but it was drastically decreased in 2018-19. In the research major reasons of Summer temperatures increased by 3.3°C between 2010 and 2024. Winter temperatures rose by 2°C during the same period.

Climate Variation Trends in (2010–2024):

The district experiences high humidity year-round, with oppressive summers followed by significant and well-distributed rainfall during the southwest monsoon season. The cold season lasts from December to February, while summer spans from March to May. The average daily maximum temperature reaches 40°C, and the average daily minimum temperature is 13°C. The highest recorded temperature was 48°C in April 1988. The southwest monsoon occurs from June to September, with October and November marking the post-monsoon period. The district can be broadly divided into three natural zones: the eastern zone, which includes Barshi, North Sholapur, South Sholapur, and Akkalkot talukas, experiences reliable rainfall; the central or traditional zone, consisting of Mohol, Mangalwedha, the eastern part of Pandharpur, and Madha talukas, has unpredictable rainfall; and the western zone, which includes the drought-prone areas of Karmala, Sangola, and Malshiras talukas, along with the western

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sections of Madha and Pandharpur talukas, also faces uncertain rainfall.

Table No.1.2, Rainfall Trends (2010–2024)

Year	Average Rainfall (cm)	Deviation from Average (%)
2010-11	58	+5.4%
2012-13	72	-18.2%
2014-15	65	-21.8%
2016-17	52	-5.4%
2018-19	46	-16.4%
2020-21	74	-10.9%
2022-23	65	-21.8%
2024-25	84	-25.5%

(**Resources:** IMD, Pune)

Graph No.1.1

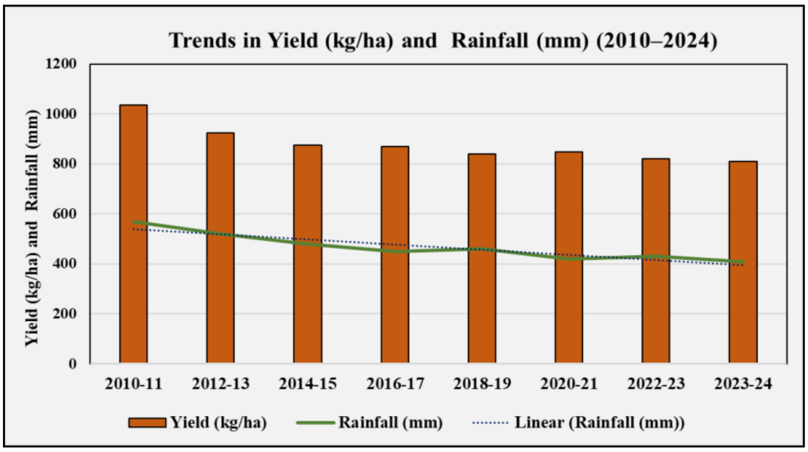


Table No.1.2 shows that, the average rainfall has decreased by approximately 20% over the past decade. Rainfall is concentrated in a few heavy downpours, causing runoff and water wastage. Reduced rainfall has led to recurring droughts in several tehsils, particularly in Sangola, Mangalvedha, and Malshiras.

Figure No.1.2

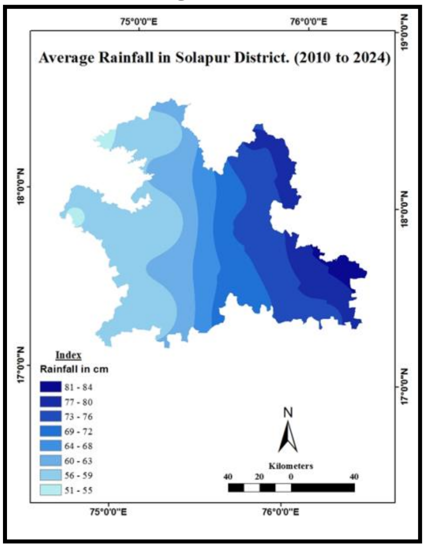
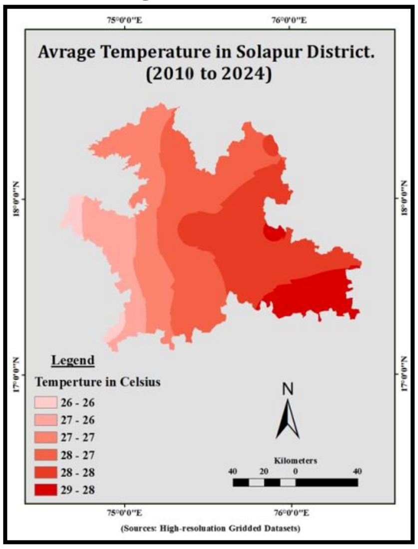


Figure No.1.3



Impact of Climate Change on Jowar:

Delayed or deficient monsoon rainfall reduced germination rates and led to poor crop establishment. Insufficient rain during flowering and grain filling stages resulted in lower yields. Rising temperatures during the flowering stage reduced pollen viability, affecting grain setting. Heat stress during the growing season accelerated crop maturity, reducing grain size. Prolonged droughts led to moisture stress, reducing productivity, especially in rainfed Kharif jowar.

Correlation Analysis:

Declining area and production: From 290,000 ha in 2010-11 to 155,000 ha in 2024, the area under jowar cultivation decreased by 35.7%. The yield declined from 135000 MT 2010 to 2024, indicating a loss of 21.7%. The district experienced reduced and erratic rainfall, impacting productivity.

Table No.1.3

Correlation analysis between temperature, and jowar productivity (2010 to 2024)

Year	Production (MT)	Average Summer Temp (°C)
2010-11	290,000	39.5
2012-13	240,000	40.2
2014-15	210,000	40.8
2016-17	200,000	41
2018-19	185,000	41.5
2020-21	178,000	42
2022-23	160,000	42.3
2023-24	155,000	42.8
	Correlation	**-0.96809**

(**Sources:** Complied by researcher)

The table below analyzes the correlation between temperature and jowar productivity in Solapur district. As per the table, a negative correlation is observed between jowar productivity and average temperature. The main reason for this is that jowar productivity has decreased during the period 2010-11 to 2023-24 due to temperature is increasing. This means that production has decreased and temperature is increasing. The correlation is becoming negative due to the effect of increasing field temperature on jowar productivity.

Challenges:

Dependence on erratic rainfall with limited irrigation facilities. Reduced soil fertility due to frequent droughts and low organic matter. Increasing incidence of grain mold, shoot fly, and stem borer due to changing climatic conditions. Fluctuations in jowar prices due to unpredictable yields.

Conclusion:

Jowar cultivation in Solapur district has witnessed a decline in area and productivity over the period 2010–2024 due to climate variability. Erratic rainfall, temperature rise, and recurring droughts have reduced yields and impacted farmers' income. Implementing climate-resilient agricultural practices, promoting drought-tolerant varieties, and improving water management strategies are essential for sustainable jowar cultivation in the region. Negative correlation is observed between jowar productivity and average temperature. The main reason for this is that jowar productivity has decreased during the period 2010 to 2024 due to temperature is increasing. This means that production has decreased and temperature is increasing. The correlation is becoming negative due to the effect of increasing field temperature on jowar productivity.

Recommendations:

Introduction of high-yielding and drought-tolerant jowar varieties suitable for Solapur's agro-climatic conditions. Adoption of drip and sprinkler irrigation to enhance water-use efficiency. Establishing early warning systems for rainfall patterns and pest outbreaks. Encouraging farmers to enroll in Pradhan Mantri Fasal Bima Yojana (PMFBY) for financial security. Training programs on climate-smart agricultural practices for farmers.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper

References:

1. Sivakumar, Das and O.Brunini (2005).Impact of Present and Future Climate Variability and

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Agriculture and Forestry in the Arid and Semi-Arid Tropics .In Increasing Climate Variability and Change.
2. Dash, Jenamani, S.R.Kalsi and S.K.Panda (2007).Some Evidence of Climate Change in Twentieth-Century India. Springer Science,85,299-321.
3. Kumar,K., Rupa,A.K. Sahai, K.Krishna Kumar, etc.(2006).High Resolution Climate Scenarios for India for the 21stcentury.Current Science, 90,334-345.
4. Kothawale, Revadekar and K.Rupa Kumar (2010). Recent trends in Pre-Monsoon Daily Temperature Extremes over India. Journal of Earth System Science.119,51-65.
5. Kattimani,J .(2016).The Global Warming and its Effect by Mankind in Nature. International Journal of Science and Research.5,1173-1174.
6. Government of Maharashtra, Agriculture Department Reports (2010-2024).
7. India Meteorological Department (IMD) Rainfall Data.
8. Rupa Kumar, K. and Pant, G. B., (1994) Diurnal asymmetry of surface temperature trends over India. Geophys. Res. Lett., 21, 677–680.
9. Singh, R. S., Narain, P. and Sharma, K. D.,(2001) Climate changes in Luni river basin of arid western Rajasthan (India). Vayu Mandal, 31(1–4), 103–106.
10. Season and crop reports of Maharashtra, Department of Economics and Statistics, Government of Maharashtra, 2010–2024.
11. Saravana Kumar, V.,(2015) Impact of climate change on yield of major food crops in Tamil Nadu, India, Working Paper No. 91–1, SANDEE.
12. Kelkar, S. M., Kulkarni, A., & Koteswara Rao, K. (2020). Impact of Climate Variability and Change on Crop Production in Maharashtra, India. Current Science, 118(8), page no.1235.
13. Venkatachalam, H. (2022). Impact of Climate Change on Agriculture and Need to Focus on Agricultural Sustainability and Climate Change Mitigation of Negative Impact. Technoarete Transactions on Climate Change and Disaster Management Research, 1(1), page no.711.
14. Aggarwal P K (ed). (2009). Global Climate Change and Indian Agriculture. Case Studies from the ICAR Network Project. Indian Council of Agricultural Research, India, 148p. New Delhi-110012.