International Journal of Research Studies on Environment, Earth, and Allied Sciences (IJRSEAS)
| *Volume-3 Issue-1* | *February-2026* | *ISSN: 3066-0637* | *Website:* https://eesrd.us

Manuscript ID:
IJRSEAS-2026-030131

OPEN ACCESS

Quick Response Code:

Website: https://eesrd.us

DOI: 10.5281/zenodo.21734543

DOI Link:
https://doi.org/10.5281/zenodo.21734543

Volume: 3

Issue: 1

Pp. 145-150

Month: February

Year: 2026

E-ISSN: 3066-0637

Submitted: 17 Jan. 2026

Revised: 29 Jan. 2026

Accepted: 15 Feb. 2026

Published: 28 Feb. 2026

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How to cite this article:
Dalavi, A. V.& Nalawade, L. V. (2026). The Study of Rainfall and Food Grains Landuse in Solapur District. International Journal of Research Studies on Environment, Earth, and Allied Sciences, 3(1), 145–150.
https://doi.org/10.5281/zenodo.21734543

The Study of Rainfall and Food Grains Landuse in Solapur District

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Abstract

Climate is a very important part of the atmosphere, as it controls biodiversity, water availability, and agricultural activities on the earth. India experiences a monsoon type of climate, and this monsoon rainfall is the main source of water for Indian agriculture. Monsoon rainfall has special characteristics such as seasonal, irregular, and uneven distribution, which directly affect both surface water and groundwater availability. Rainfall plays a major role in agricultural production, as farmers plan their cropping pattern and agricultural seasons mainly according to rainfall conditions. The agricultural sector is one of the most important sectors of the Indian economy, where a large population is directly and indirectly dependent on agriculture for their livelihood. Farmers cultivate different crops during the kharif, rabi, and summer seasons, based on rainfall availability. In regions with low and uncertain rainfall, food grains such as jowar, wheat, bajra, and pulses are widely cultivated because they require less water and are suitable for dry farming conditions. These crops are essential for food security and rural economy. Solapur District is located in the south-eastern part of Maharashtra State and lies in the rain-shadow region of the Western Ghats. The district experiences a semi-arid climate with low, irregular, and uncertain rainfall. Due to these climatic conditions, agriculture in Solapur District is largely dependent on monsoon rainfall and limited irrigation facilities. Food grains occupy a dominant position in the agricultural landuse of the district. The present study attempts to analyze the relationship between rainfall days and food grains landuse in Solapur District. Tahsil-wise data on rainfall days and area under food grains cultivation for the year 2024–25 has been used. The Spearman's Rank Order Correlation Method is applied to examine the relationship between rainfall and food grains landuse. The results show a moderate positive correlation (r = +0.66), indicating that higher rainfall days generally support greater food grains cultivation, though other factors such as irrigation, soil type, and farming practices also influence landuse patterns.

Keywords: *Rainfall, Food Grains, Monsoon, Landuse, Solapur District*

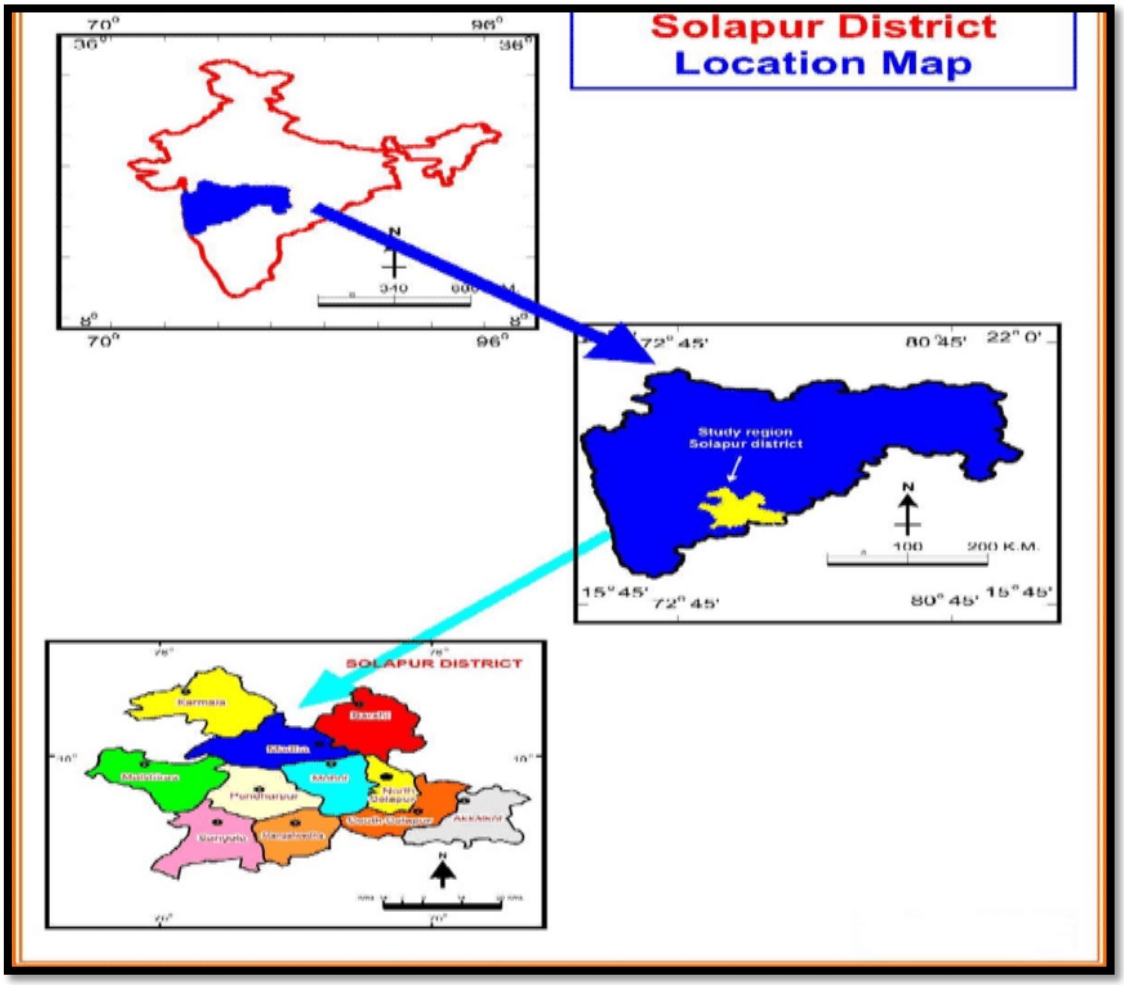
Introduction

Climate is a very important part of the atmosphere because it controls the natural environment and biodiversity of the earth. Climate also plays a major role in deciding agricultural activities. India experiences a monsoon type of climate, and this monsoon climate is the main source of water for Indian agriculture. The agricultural sector is one of the most important sectors of the Indian economy, as a large human population is directly and indirectly engaged in agricultural activities for their livelihood. The monsoon climate of India has distinct characteristics, such as seasonal, irregular, and concentrated rainfall. Rainfall does not occur evenly throughout the year or across all regions. This uneven distribution of rainfall strongly affects both surface water and sub-surface (groundwater) availability, which are the main sources of water for agriculture. Due to variations in rainfall amount and timing, farmers plan their agricultural activities carefully and cultivate different crops during the kharif, rabi, and summer seasons, depending on rainfall conditions. Rainfall plays a crucial role in determining crop patterns, especially in regions with limited irrigation facilities. In many parts of India, crops are grown mainly based on the availability of monsoon rainfall. Food grains such as jowar, wheat, bajra, and pulses are widely cultivated because they require comparatively less water and are suitable for areas with low and uncertain rainfall. These crops are essential for food security and form the backbone of rural economy. Solapur District is located in the south-eastern part of Maharashtra State and lies in the rain-shadow region of the Western Ghats. The district experiences a semi-arid climate, characterized by low, irregular, and uncertain rainfall. Due to frequent drought conditions and limited rainfall days, agriculture in Solapur District is highly dependent on monsoon rainfall and available irrigation sources such as rivers, canals, tanks, and wells. The major rivers in the district include the Bhima and its tributaries, which provide limited water support to agriculture. Because of these climatic and geographical conditions, food grains are the dominant crops cultivated in Solapur District.

Farmers prefer food grains cultivation as these crops can survive under dry farming conditions and uncertain rainfall patterns. The extent and distribution of food grains landuse vary from one tahsil to another depending on rainfall availability, soil type, irrigation facilities, and traditional farming practices.

Study Area

Solapur District is located in the south-eastern part of Maharashtra State. The district lies between 17°10′ to 18°32′ North latitude and 74°42′ to 76°15′ East longitude. It is bounded by Pune District to the north-west, Ahmednagar District to the north, Osmanabad District to the north-east, Kalaburagi District (Karnataka State) to the south-east, and Sangli District to the south-west. Solapur District covers an area of about 14,895 sq. km and is administratively divided into 11 tahsils, namely Karmala, Madha, Barshi, North Solapur, Mohol, Pandharpur, Malshiras, Sangola, Mangalwedha, South Solapur, and Akkalkot.



The district is characterized by a semi-arid climate with low and irregular rainfall, mainly received during the south-west monsoon season. The average annual rainfall is relatively low, and frequent drought conditions affect agricultural activities. The soil is predominantly black cotton soil, which is suitable for dry farming crops such as jowar, bajra, pulses, and other food grains. Agriculture is the main occupation of the people, and landuse is largely influenced by rainfall availability and irrigation facilities. Due to its climatic conditions and dependence on monsoon rainfall, Solapur District provides an important study area to analyze the relationship between rainfall and food grains landuse.

Objectives

The main objectives of this research paper are as under:

1. To study the tahsil-wise distribution of rainfall days in Solapur District.
2. To examine the pattern of food grains landuse in different tahsils of Solapur District.
3. To analyze the relationship between rainfall and food grains landuse in Solapur District.

Database And Methodology

The present study is primarily based on secondary data collected from reliable government sources. Taluka-wise data on rainfall days for the year 2024-25 was obtained from the District Statistical Office, Solapur, and official publications of the Government of Maharashtra, while information related to food grain land use was collected from records of the Department of Agriculture, socio-economic abstracts, and district-level reports. The collected data was carefully classified, tabulated, and analyzed using simple statistical techniques. Spearman's rank order correlation method was used to examine the relationship between rainfall and food grain land use. Tahsils were ranked independently based on rainfall days and area under food grain cultivation, and the difference in ranks was calculated to find the correlation coefficient. Percentage

analysis and comparative methods were also used to highlight spatial variations. This simple and systematic methodology helped in understanding the impact of rainfall on food grain cultivation in Solapur district in a clear and meaningful way. Spearman's rank order method was also used to analyze the correlation between rainfall and the area under sugarcane cultivation.

Formula:
Rank Order Spearman's Method
$$r = 1 - \sigma \Sigma d^2 / n^2 - N$$

Spatial Pattern of Rainfall Days

In the year 2024-25, it rained for avg. rainfall days 36 days across the entire Solapur district. However, the number of rainy days at the taluka level varies from taluka to taluka, ranging from 33 days to 41 days. All 11 tahsils of Solapur district have been divided into the following three categories: (in Table No. 1 and Figure No. 2).

Table No. 1
Rainfall Days in Solapur District (2024-25)

Sr. No.	Name of Tahsils	Avg. Rainfall Days	%
1	Karmala	34	41.89
2	Madha	37	51.84
3	Barshi	41	53.06
4	North Solapur	38	17.48
5	Mohol	34	57.67
6	Pandharpur	33	15.91
7	Malshirus	33	-5.73
8	Sangola	36	23.62
9	Mangalwedha	34	22.9
10	South Solapur	39	9.77
11	Akklkot	41	12.73
Avg.		36.36	29.08

Source: Socio-Economic Abstract of Solapur District (2024-25)

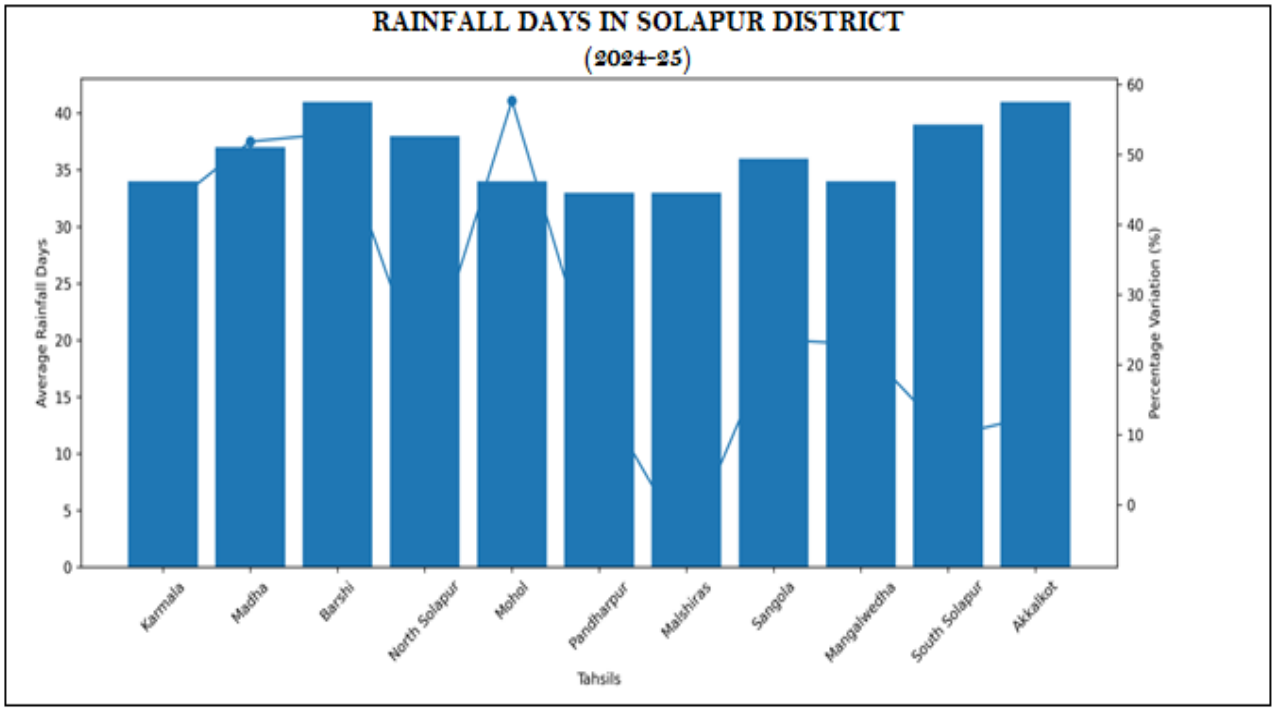


Fig. 2

Table no. 1 and fig. 2 shows the average number of rainy days during the year 2024-25 in various tahsils of Solapur district. The number of rainy days is crucial as it directly impacts agriculture, water resources, groundwater recharge, and the daily lives of the people in the district. The district's overall average number of rainy days is 36.36, indicating that Solapur district receives rainfall for a limited number of days, primarily dependent on the monsoon season. The average percentage of rainfall is 29.08%, which shows that the distribution of rainfall is not uniform across all tahsils. Among all the tahsils, Barshi and Akkalkot recorded the highest average number of rainy days, with 41 days each. Barshi

shows a high percentage value of 53.06%, indicating better rainfall conditions compared to other tahsils. Despite having a high number of rainy days, Akkalkot has a lower percentage value (12.73%), suggesting variations in rainfall intensity and distribution. These tahsils might receive slightly better rainfall due to their geographical location and local climatic conditions.

South Solapur (39 days) and North Solapur (38 days) also have a relatively high number of rainy days. However, their percentage values are lower, especially in North Solapur (17.48%), indicating that the rainfall might be scattered and uneven. Urbanization, changing land-use patterns, and climate change might also be influencing rainfall in these areas. Madha (37 days) and Sangola (36 days) have a number of rainy days close to the district average. Madha has a higher percentage value (51.84%), indicating relatively good rainfall conditions. However, Sangola has a moderate percentage (23.62%), reflecting semi-arid climatic conditions and dependence on the unpredictable monsoon rains. Karmala, Mohol, and Mangalwedha each recorded approximately 34 rainy days, indicating moderate rainfall conditions. Mohol shows a higher percentage value (57.67%), which could be due to short-duration but intense rainfall. Karmala and Mangalwedha have moderate percentage values, suggesting an irregular rainfall pattern. These tahsils largely depend on rain-fed agriculture and face water scarcity during drought periods. Pandharpur and Malshiras recorded the lowest number of rainy days, at 33 each. Pandharpur shows a low percentage (15.91%), indicating low and irregular rainfall. Malshiras recorded a negative percentage (-5.73%), which clearly shows a decrease in the number of rainy days. This situation could be attributed to their location in the rain shadow region of the Western Ghats, frequent drought conditions, and the increasing impacts of climate change.

Spatial Pattern of Sugarcane Landuse

In 2024-25 year, approximately 64,653 hectares of land area is under food grain cultivation. However, the land use for food grains at the taluka level varies from taluka to taluka, ranging from 328 hectares to 27,504 hectares. All 11 tahsils have been classified into the following three groups: (in Table No. 2 and Figure 3)

Table No. 2 Food Grains Landuse in Solapur District (2024-25)

Sr. No.	Name of Tahsils	Food Grains Area (in Hectares)	Percent
1	Karmala	90987	11.82
2	Madha	81181	10.54
3	Barshi	89404	11.61
4	North Solapur	31272	4.06
5	Mohol	48566	6.31
6	Pandharpur	23453	3.05
7	Malshirus	41505	5.39
8	Sangola	80272	10.43
9	Mangalwedha	73477	9.54
10	South Solapur	75835	9.85
11	Akklkot	133983	17.4
TOTAL		769935	67.25

Source: Socio-Economic Abstract of Solapur District (2024-25)

Table no. 2 and Fig. 3 shows the distribution of land under food grain crops in various tahsils of Solapur district during the year 2024-25. Food grains include crops such as sorghum, wheat, millet, and pulses, which are crucial for food security and farmers' livelihoods. The total area under food grain crops in the district is 7,69,935 hectares, which is 67.25% of the total cultivated land. This clearly indicates that agriculture in Solapur district is heavily dependent on food grain crops. Among all the tahsils, Akkalkot taluka has the largest area under food grain crops, covering 1,33,983 hectares, which is 17.40% of the total area. This indicates that Akkalkot is a significant agricultural taluka where food grain cultivation is practiced on a large scale. The availability of cultivable land, suitable soil, and irrigation facilities could be the main reasons for this high proportion. Karmala (90,987 hectares – 11.82%) and Barshi (89,404 hectares – 11.61%) tahsils also have a very high share of land under food grains.

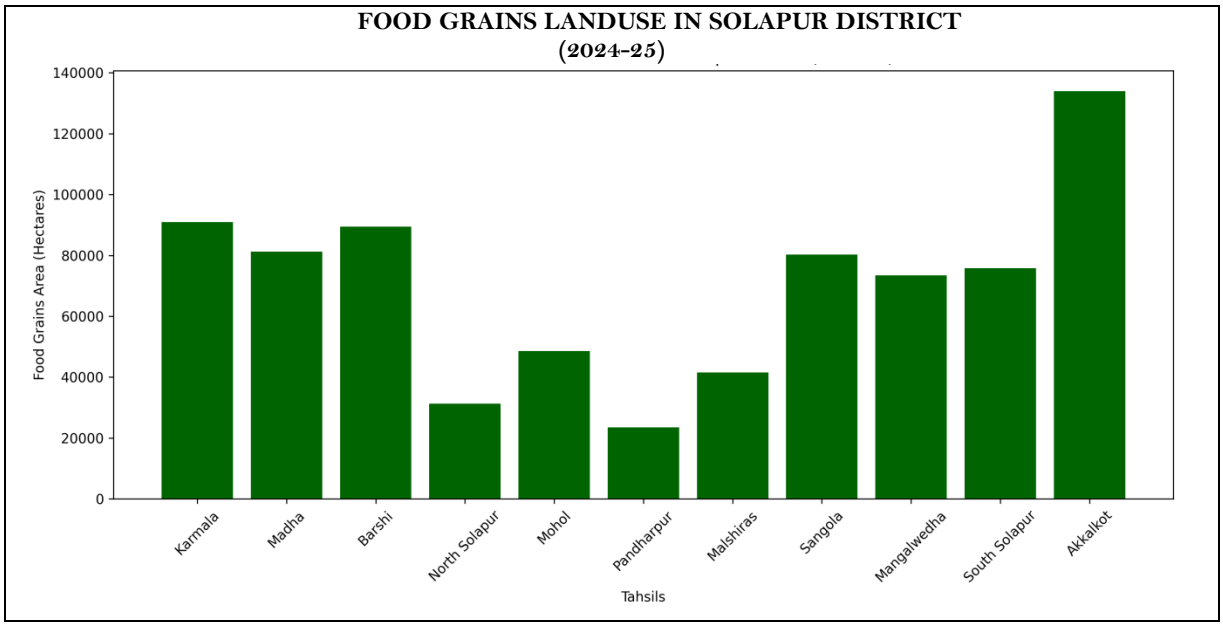


Fig. 3

These tahsils are known for traditional farming practices and primarily depend on food grain crops due to moderate rainfall and suitable climate. Madha (10.54%) and Sangola (10.43%) tahsils also show a significant share, highlighting the importance of food grain cultivation in these semi-arid tahsils.

South Solapur (9.85%) and Mangalwedha (9.54%) tahsils have a moderate area under food grains. These tahsils practice mixed farming, where food grains are cultivated along with other crops. Limited rainfall and increasing irrigation facilities influence the cropping patterns in these areas. The proportion of land under food grain cultivation is relatively low in Mohol (6.31%) and Malshiras (5.39%) tahsils. These tahsils often face irregular rainfall and droughts, which affect agriculture. Farmers in these areas may be prioritizing drought-resistant crops or cash crops. The lowest area under food grain cultivation is found in North Solapur (4.06%) and Pandharpur (3.05%) tahsils. North Solapur has a higher proportion of urban and industrial land use, which reduces the availability of agricultural land. Although Pandharpur is an important religious center, its cultivable land is limited, and it relies more on irrigation and commercial activities, resulting in a smaller area under food grain cultivation.

Correlation Between Rainfall and Food Grains Landuse

To understand the relationship between **rainfall days** and **food grains landuse** in Solapur District, the **Spearman's Rank Order Correlation Method** is used. This method helps to find whether an increase or decrease in rainfall days has any effect on the area under food grains cultivation.

The formula used for calculating correlation is:

$$r = 1-6(\Sigma d^2)/N(N^2-1)$$

Where:

- **r** = Correlation coefficient
- **d** = Difference between ranks
- **N** = Number of tahsils

Table No. 3 Rainfall and Food Grains Landuse in Solapur District

Sr. No.	Name of Tahsil	Rainfall Days	Rank	Food Grains Landuse (Hectares)	Rank	d	d^2
1	Barshi	41	1	89404	3	-2	4
2	Akkalkot	41	1	133983	1	0	0
3	South Solapur	39	3	75835	5	-2	4
4	North Solapur	38	4	31272	10	-6	36
5	Madha	37	5	81181	4	1	1
6	Sangola	36	6	80272	6	0	0
7	Karmala	34	7	90987	2	5	25
8	Mohol	34	7	48566	8	-1	1
9	Mangalwedha	34	7	73477	7	0	0
10	Pandharpur	33	10	23453	11	-1	1
11	Malshiras	33	10	41505	9	1	1
Total							**74**

$r = 1-6(\Sigma d^2)/N(N^2-1)$
Here, r = Correlation, N= Number of Observation, D= deviation
$r = 1-6*74/11\ (11^2-1)$
r = +0.66

The correlation coefficient value (+0.66) indicates a moderate positive correlation between the number of rainy days and the area under food grain cultivation in Solapur district. This means that tahsils with more rainy days generally have a larger area under food grain cultivation. However, this relationship is not perfectly accurate, as agriculture in Solapur district also depends on other factors such as irrigation facilities, soil type, drought conditions, and traditional farming practices.

In some tahsils like Akkalkot and Barshi, despite variations in rainfall, the area under food grain cultivation is higher due to suitable land and farming conditions. On the other hand, in tahsils like Pandharpur and North Solapur, urbanization, limited arable land, and water scarcity result in a smaller area under food grain cultivation.

Conclusion

The research study reveals that rainfall plays a crucial role in controlling agricultural activities in Solapur district, located in the semi-arid and rain-shadow region of Maharashtra. The analysis shows significant variations in rainfall days across the tahsils; Barshi and Akkalkot tahsils receive comparatively higher rainfall, while Pandharpur and Malshiras tahsils experience lower and irregular rainfall. Food grain crops occupy a dominant position in the district's land use pattern, accounting for approximately 67.25% of the total cultivated area. This indicates the agricultural sector's heavy dependence on food grain crops. Tahsils like Akkalkot, Karmala, and Barshi have a higher area under food grains due to better soil conditions, availability of cultivable land, and irrigation facilities, while North Solapur and Pandharpur tahsils show lower land use for food grains due to urbanization, limited agricultural land, and water scarcity. The Spearman's rank correlation value of +0.66 indicates a moderate positive correlation between rainfall days and land use for food grains. This means that higher rainfall generally supports more food grain cultivation; however, other factors such as irrigation, soil type, drought conditions, and traditional farming practices also influence land use patterns. Overall, this study underscores the need for improved water management and sustainable agricultural planning to enhance food grain production in Solapur district.

Acknowledgment

The authors express their sincere gratitude to all those who directly and indirectly contributed to the successful completion of this research paper entitled *"The Study of Rainfall and Food Grains Landuse in Solapur District."*
We are especially thankful to the District Statistical Office, Solapur, the Department of Agriculture, Government of Maharashtra, and other government agencies for providing valuable statistical data and reports required for this study.

Financial support and sponsorship

Nil.

Conflicts of interest

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

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