

THE GEOGRAPHICAL STUDY OF RAINFALL PATTERN AND GEOGRAPHICAL LANDUSE IN SOLAPUR DISTRICT

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Article Info	ABSTRACT
<p>Article History: Received: 18th Sep 2025 Accepted: 02nd Oct 2025 Published: 17th Oct 2025</p> <hr/> <p>Keywords: Rainfall Pattern, Geographical Land Use, Semi-Arid Climate, Cropping Pattern, Net Sown Area, Fallow Land, Irrigation, Spearman's Rank Correlation, Agricultural Development,</p>	<p>A geographical study of rainfall pattern and land use in Solapur district highlights the interdependence of climate variability and resource use in a semi-arid environment. Located in the rain shadow region of the Western Ghats, Solapur receives low, erratic and unevenly distributed rainfall which significantly impacts agricultural practices and land use dynamics. Analysis based on secondary data for 2022-24 shows that the average rainfall in the district is 562.53 mm, with three tehsils (Akkalkot, South Solapur, North Solapur) falling in the high rainfall category, while drought-prone talukas like Sangola, Malshiras and Madha are under severe water stress. Land use data for 2023-24 shows that agriculture dominates with 76.5% net sown area, but challenges such as expanding fallow land, minimal forest cover and increasing non-agricultural land reflect the stress of water scarcity and soil degradation. Correlation analysis using Spearman's rank order method reveals a moderate positive correlation ($r = 0.31$) between rainfall distribution and land use, indicating that rainfall variability, along with geological, soil and irrigation factors, partially determines crop intensity and land use. These findings highlight the need for region-specific water resources planning, sustainable land use practices and integrated management strategies to address disparities between high-rainfall and drought-prone tehsils. This study helps in understanding the spatial imbalance in rainfall and its impact on land use, providing insights for policy formulation, agricultural planning and sustainable development in Solapur district.</p>

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INTRODUCTION

Rainfall and geographical land use are the most crucial factors in determining the agricultural and socio-economic development of any region. Rainfall not only controls the availability of water resources but also the cropping patterns, irrigation intensity and sustainability of agriculture. In Solapur district, situated in the rain shadow region of the Western Ghats, rainfall is low, irregular and unevenly distributed across its eleven tehsils, creating sharp regional disparities. Areas with high rainfall support double cropping and water-intensive crops, while drought-prone tehsils rely on irrigation projects and drought-resistant varieties.

Similarly, geographical land use reflects the interaction between natural conditions and human activities. In Solapur, agriculture dominates land use, covering more than three-fourths of the geographical area, but challenges such as soil degradation, water scarcity and climate stress have resulted in large areas of fallow land, minimal forest cover and increasing non-agricultural uses. The difference between the heavily cultivated tehsils like Barshi, Akkalkot and Karmala and the drought-prone tehsils like Sangola, Malshiras and Mangalwedha highlights the impact of rainfall on land use. Therefore, a geographical study of rainfall patterns and land use in Solapur is required to assess these disparities, identify correlations and provide insights for sustainable land and water management in the district.

NEED FOR STUDY

Rainfall and Geographical land use are two fundamental factors shaping the agricultural and socio-economic development of Solapur district. Being in the rain shadow region of the Western Ghats, the district faces persistent problems of low, irregular and uneven rainfall, which directly impacts cropping intensity, irrigation demand and agricultural sustainability. At the same time, land use in Solapur is dependent on agriculture, yet there is a large variation across tehsils in terms of net sown area, fallow land, forest area and non-agricultural use. This variation reflects the impact of climatic conditions, soil fertility, availability of irrigation and socio-economic pressures on land use structure.

Therefore, a systematic geographical study is required:

1. To assess the spatio-temporal variations in rainfall across eleven talukas of Solapur district.
2. To examine how rainfall distribution affects the agricultural land use pattern including net sown area, fallow land, forest area and non-agricultural land.
3. Identify drought-prone and water-stressed areas where agricultural sustainability is at risk.
4. Establish correlations between rainfall variability and land use distribution through scientific methods such as Spearman's rank correlation.
5. Provide insights for sustainable land and water resource management, which can support policy-making, agricultural planning and long-term development strategies.

- Thus, this study is essential not only for understanding natural and human interactions in Solapur district but also for guiding future agricultural development, resource use and environmental management in semi-arid regions.

STUDY AREA

Solapur district, which is the selected study area, is located in the southeastern part of the state of Maharashtra between 17°10' North to 18°32' North latitude and 74°42' East to 76°15' East longitude. Its total geographical area is about 14.89 lakh hectares and is administratively divided into 11 tehsils namely Akkalkot, Barshi, Karmala, Madha, Malshiras, Mangalvedha, Mohol, Pandharpur, Sangola, North Solapur and South Solapur. Solapur city serves as the district headquarters. Geographically, the district lies in the rain shadow region of the Western Ghats and is characterized by a semi-arid plateau at an altitude of about 450-650 m above sea level. It has gently undulating plains and scattered mountain ranges. The climate is hot and dry, with an average rainfall of 562.53 mm in 2022-23, resulting in low, erratic and unevenly distributed rainfall. This variability in rainfall divides the district into low, medium and high rainfall zones.

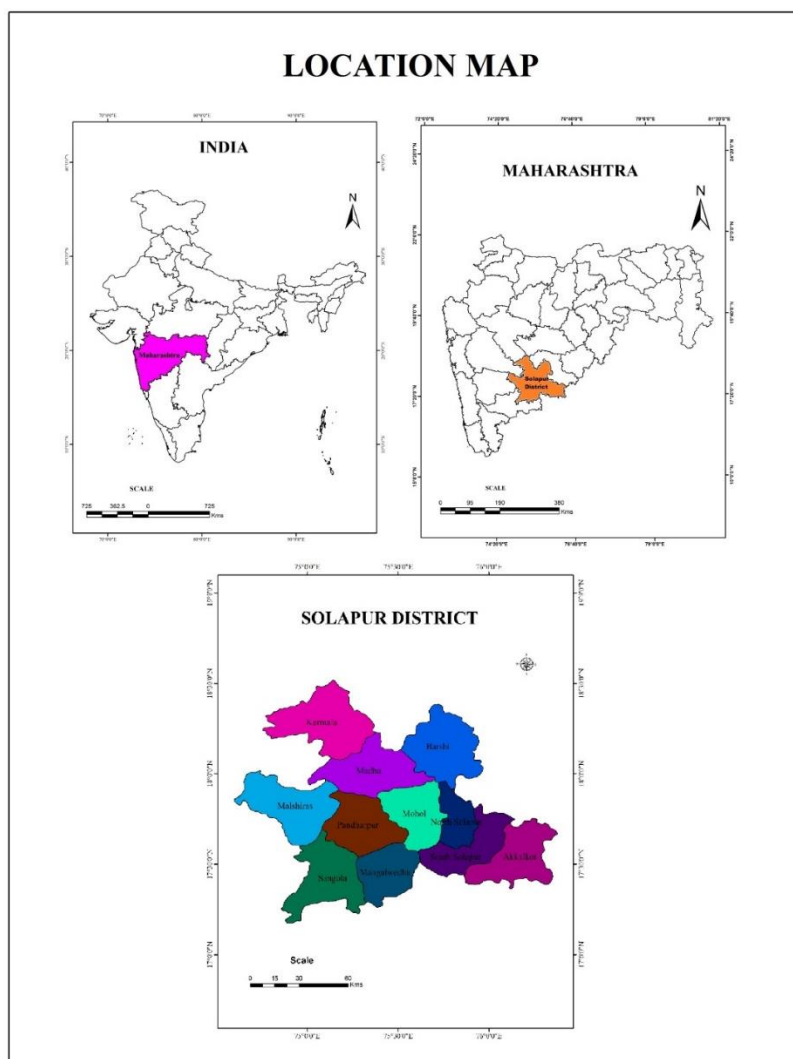


Fig. No.1

The soil is predominantly black cotton soil (regur), fertile and moisture-retaining, although shallow and less productive soils are found in drought-prone talukas such as Sangola, Malshiras and Mangalwedha. The land is used for agriculture, which covers more than three-quarters of the total geographical area, with about 76.5% of the land being net sown area. Forest cover is low, while fallow land and non-agricultural uses are increasing due to soil degradation, water scarcity and urbanisation. Agricultural practices depend heavily on rainfall availability: high rainfall talukas such as Akkalkot, South Solapur and North Solapur support double cropping and high water-demanding crops, while drought-prone talukas such as Sangola, Malshiras, Madha and Mangalwedha rely more on dry farming, drought-tolerant crops and irrigation projects. Thus, geology, climate, soil, precipitation and land use structure together make Solapur district an important point for the geographical study of precipitation patterns and land use dynamics.

DATABASE AND METHODOLOGY

The present study is based on secondary data obtained from the Socio-Economic Review and District Statistical Abstract of Solapur District (2022–23, 2023–24), along with records from the Revenue and Forest Department, Irrigation Department, IMD, Census of India and Survey of India maps. Rainfall was classified into low, moderate and high zones, while land use was grouped into net sown area, forest land, non-agricultural land and fallow land. To measure the relationship between rainfall and land use, Spearman's Rank Order Correlation Method was applied using the formula:

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

where r = correlation coefficient, N = number of observations, and d = difference in ranks.

OBJECTIVES OF THE STUDY

1. To analyze the spatio-temporal distribution of rainfall in Solapur district and classify the tahsils into low, moderate, and high rainfall zones.
2. To examine the geographical land use structure of Solapur district with special reference to net sown area, fallow land, forest cover, and non-agricultural land.
3. To study the correlation between rainfall variability and land use pattern at the tahsil level.

RAINFALL PATTERN

One of the most decisive climatic factors affecting the geographical landscape, land use and agricultural development of Solapur district is rainfall. Solapur, located in the semi-arid region of Maharashtra, experiences irregular, uncertain and highly variable rainfall. The district lies in the rain shadow region of the Western Ghats, which restricts the flow of southwest

monsoon winds, leading to low and uneven distribution of rainfall across its tehsils. This variability directly shapes the agricultural practices, cropping intensity and land use systems of the region. These variations in rainfall have a major impact on land use patterns. Areas with high rainfall encourage double cropping and water-intensive crops, while areas with low rainfall rely on dry farming, drought-resistant varieties and irrigation. Thus, rainfall distribution acts as a major determinant of the agricultural and socio-economic conditions of Solapur district.

Table No. I
SOLAPUR DISTRICT: RAINFALL PATTERN
(2022-23)

Sr. No.	Tahsil	Rainfall(mm.)	Trend/Grade of Rainfall
1.	N. Solapur	621.49	High
2.	Barshi	586.65	Moderate
3.	Akkalkot	666.44	High
4.	Mohol	542.07	Moderate
5.	Mangalwedha	576.95	Low
6.	Pandharpur	513.82	Moderate
7.	Sangola	484.73	Low
8.	Malshiras	453.57	Low
9.	Karmala	592.14	Low
10.	Madha	514.56	Low
11.	S. Solapur	635.42	High
Solapur District		562.53	Moderate

Source: Socio-Economic Review and District Statistical Abstract, Solapur District, 2022-23. Trend: Low: Below 550 mm, Moderate: Between 550 mm and 600 mm, High: Above 600 mm

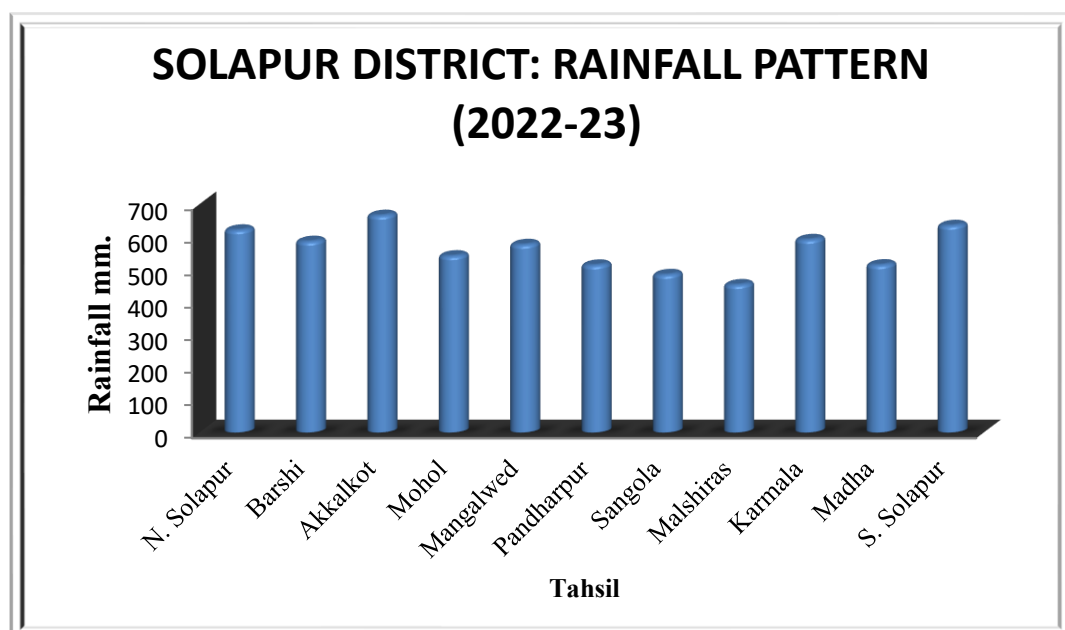


Fig. No.2

The rainfall data of Solapur district in 2022-23 shows a highly uneven distribution across its tehsils, reflecting the semi-arid nature of the region (in Table No. I and Fig. no.2).. The district average was 562.53 mm, which falls in the moderate range. Out of the eleven tehsils, three tehsils - Akkalkot (666.44 mm), South Solapur (635.42 mm) and North Solapur (621.49 mm) - received more rainfall, indicating relatively favourable conditions for agriculture and water availability. A group of tehsils recorded moderate rainfall between 550 and 600 mm, including Barshi (586.65 mm), Mohol (542.07 mm) and Pandharpur (513.82 mm). These areas, although not abundant, receive sufficient rainfall to sustain seasonal crops with supplementary irrigation. On the other hand, five tehsils - Mangalwedha (576.95 mm), Sangola (484.73 mm), Malshiras (453.57 mm), Karmala (592.14 mm) and Madha (514.56 mm) - fall under the low rainfall category. These regions face significant water stress, making them more dependent on irrigation projects, tank storage and drought-tolerant crops. The low rainfall areas, especially Sangola and Malshiras, are most vulnerable to drought and agricultural instability. Overall, the table highlights a clear rainfall imbalance in the district, where the eastern and southern tehsils receive more rainfall, while the western and central parts are relatively dry. This uneven distribution strongly impacts cropping patterns, irrigation demand and land use patterns in Solapur.

LAND USE PATTERN

Land use is an important indicator of the relationship between human activities, natural resources and the geographical environment. Solapur district, located in the rain shadow area of the Western Ghats, is characterized by a semi-arid climate, variability in rainfall, soil characteristics and socio-economic conditions. The dominance of agriculture supported by black cotton soils, irrigation projects and traditional methods is shaping the land use structure of the district. At the same time, non-agricultural uses, forest areas and fallow lands highlight the challenge of resource management and environmental sustainability.

The land use pattern of Solapur district during 2023-24 shows that out of the total geographical area of 14.89 lakh hectares, a large share (about 93%) is under cultivation and of this area, about 76.5% is used as net sown area, which establishes the agricultural dominance of the district, indicating that land is not being used from time to time due to soil degradation, water scarcity and climate stress.

Table No. II

LAND USE PATTERN : SOLAPUR DISTRICT (2023-24)

Sr. No.	Tahsil Name		Total Geographical Area	Cultivable Land	Net Sown Area	Land Under Forest	Area Not Available for Agriculture	Total Fallow Land
1	North Solapur	In No.	74630	65262.9	55708	3562.9	8338.71	11328.7
		%	5.01	4.72	4.89	9.95	5.21	5.08
2	Barshi	In No.	148310.5	152537.6	136987	1866	16417.21	16845.41
		%	9.96	11.03	12.02	5.21	10.26	7.55
3	Akkalkot	In No.	139030	126737.6	120017	375.88	11916.56	14280.81
		%	9.33	9.16	10.53	1.05	7.45	6.4
4	Mohol	In No.	140840	150110.5	115323.9	224.89	34786.6	34786.6
		%	9.46	10.85	10.12	0.63	21.74	15.6
5	Mangalwedha	In No.	114090	101612	70798	680	3876	32088
		%	7.66	7.35	6.21	1.9	2.42	14.39
6	Pandharpur	In No.	130360	115053.1	103482.2	1000.1	10437.3	7492.69
		%	8.75	8.32	9.08	2.79	6.52	3.36
7	Sangola	In No.	155070	137330.6	91317.89	7085.77	2015.66	36221.28
		%	10.41	9.93	8.01	19.79	1.26	16.24
8	Malshiras	In No.	152220	124426.8	100308.6	6602.59	27475.62	25255.12
		%	10.22	8.99	8.8	18.44	17.17	11.33
9	Karmala	In No.	160970	131362.2	121094.8	11173.32	18434.47	6659.6
		%	10.81	9.5	10.62	31.21	11.52	2.99
10	Madha	In No.	154490.5	139604	114622	2584	5138	29566
		%	10.37	10.09	10.06	7.22	3.21	13.26
11	South Solapur	In No.	119530	139265.8	110225.7	647.35	21149.54	8471.19
		%	8.02	10.07	9.67	1.81	13.22	3.8
Total			1489541	1383303	1139885	35802.8	159986	222995

Source: Socio-Economic Review and District Statistical Abstract of Solapur District (2023-24)

The land use pattern of Solapur district in 2023-24 shows significant variation among tehsils, reflecting differences in geographical conditions, rainfall availability and farming

practices. Out of the total geographical area of 14.89 lakh hectares, the largest share is under cultivation (1383303 hectares), with North Solapur, Barshi, Akkalkot, Mohol and Karmala having a large share. The net sown area is highest in tehsils like Barshi (136987 hectares), Karmala (121094 hectares) and Akkalkot (120017 hectares), indicating their strong agricultural base, while Sangola (91318 hectares) and Mangalwedha (70798 hectares) are comparatively less due to semi-arid conditions and drought-prone nature (in Table No. II).

The forest area in the district is generally low, with Karmala (11173 ha) and Sangola (7086 ha) being relatively high, while most other tehsils have negligible forest land. Non-agricultural land use is significant in Mohol (34787 ha) and Malshiras (27476 ha), which reflects urban sprawl, wasteland and land under settlements or infrastructure. A notable feature is the extent of wasteland, which is very high in Sangola (36221 ha), Mohol (34787 ha) and Madha (29566 ha), which reflects the problems of water scarcity, soil degradation and untimely use of cultivable land (in Table No. II)..

Overall, this table shows that although agriculture dominates the land use pattern of Solapur, regional disparities exist: the eastern and central tehsils (Barshi, Akkalkot, Karmala) show more cultivation, while the southern and western tehsils (Sangola, Mohol, Malshiras) have more fallow land and non-agricultural areas. The low forest cover in all tehsils adds to the district's environmental stress, making sustainable land and water management a critical need.

CORRELATION BETWEEN RAINFALL PATTERN AND GEOGRAPHICAL LANDUSE

The Spearman's Rank Order method is used for the calculation of the correlation of Rainfall Pattern and Geographical Landuse in Solapur District. The formula are-

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

It is observed that there is moderate positive or direct correlation i.e. $p = 0.31$ between the rainfall pattern and geographical landuse in Solapur district. There are the some reasons- especially physiography, slope, plain area, fertile soil, climate and irrigation system for moderate positive or direct correlation in Solapur district.

Table No. III
RAINFALL PATTERN AND GEOGRAPHICAL LANDUSE IN SOLAPUR DISTRICT

Sr. No.	Tahsil	Rainfall(mm.)	Ran k	Net Sown Area	Ran k	Total Geograp hical Area	Cultiva ble Land	Land Under Forest	Area Not Availabl e for Agricult ure	Total Follow Land	D ²
1	Akkalkot	666.44	1	120017	3	139030	126737 .6	375.88	11916. 56	14280. 81	4
2	Barshi	586.65	5	136987	1	148310. 5	152537 .6	1866	16417. 21	16845. 41	16
3	Karmala	592.14	4	121094 .8	2	160970	131362 .2	11173.3 2	18434. 47	6659.6	4
4	Madha	514.56	8	114622	5	154490. 5	139604	2584	5138	29566	9
5	Malshiras	453.57	11	100308 .6	8	152220	124426 .8	6602.59	27475. 62	25255. 12	9
6	Mangalw ed	576.95	6	70798	10	114090	101612	680	3876	32088	16
7	Mohol	542.07	7	115323 .9	4	140840	150110 .5	224.89	34786. 6	34786. 6	9
8	N. Solapur	621.49	3	55708	11	74630	65262. 9	3562.9	8338.7 1	11328. 7	64
9	Pandhar pur	513.82	9	103482 .2	7	130360	115053 .1	1000.1	10437. 3	7492.6 9	4
10	S. Solapur	635.42	2	110225 .7	6	119530	139265 .8	647.35	21149. 54	8471.1 9	16
11	Sangola	484.73	10	91317. 89	9	155070	137330 .6	7085.77	2015.6 6	36221. 28	1

Source : Compiled by Researcher, 2025

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

Here, r = Correlation, N= Number of Observation, D= deviation

$$r = 1 - 6 * 152 / 11 (11^2 - 1)$$

$$r = 0.31$$

CONCLUSION

The geographical study of rainfall and land use in Solapur district highlights the deep interrelationship between variability in natural rainfall and human use of land. Situated in the rain shadow of the Western Ghats, the district receives low, irregular and uneven rainfall, which significantly impacts agricultural practices and land use. Analysis of rainfall data for 2022-23 shows clear disparities, with some talukas like Akkalkot, North Solapur and South Solapur receiving relatively high rainfall, while drought-affected talukas like Sangola, Malshiras and Mangalwedha experienced severe water stress. These disparities are further reflected in the land

use pattern of 2023-24, where the share of net sown area is higher in talukas with good rainfall and irrigation (Barshi, Akkalkot, Karmala), while fallow and fallow land is more in drought-affected regions (Sangola, Mohol, Malshiras). The district has low forest cover and non-agricultural land use, pointing to environmental stress and sustainable management challenges. Correlation analysis using Spearman's rank order method reveals a moderate positive correlation ($r = 0.31$) between rainfall distribution and geographical land use. This implies that rainfall is an important but not the only determinant of land use – other factors such as geology, soil fertility, irrigation facilities and socio-economic conditions also play an important role. Finally, the rainfall-land use relationship of Solapur district reflects both opportunities and constraints. Regions with favourable rainfall and irrigation resources sustain intensive agriculture, while drought-prone tehsils frequently face stress and instability. Therefore, sustainable land and water management, expansion of irrigation, adoption of drought-resistant crops and ecological conservation measures are essential to reduce disparities and ensure balanced development in the district.

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