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ANALYTICAL SURVEY AND STUDY OF GEOGRAPHICAL CONDITIONS FOR SOYBEAN CULTIVATION IN SHAJAPUR DISTRICT, MADHYA PRADESH

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Abstract:

Shajapur district, located in the western part of Madhya Pradesh, is geographically positioned at 23.4226° N and 76.2871° E, and forms part of the agriculturally significant Malwa Plateau. The district's terrain is shaped by undulating plains, low hills, and basaltic formations of the Deccan Trap, with elevations ranging from 335 to 608 meters above sea level. This diverse topography supports a primarily agrarian economy, with nearly 71% of the district's 619,600-hectare area under cultivation. Shajapur's soil profile is predominantly composed of dark black cotton soil and alluvial deposits, both of which are highly suitable for rainfed crops like soybean. The region is drained by rivers such as the Parvati and Nevaj, and receives an average annual rainfall between 100 and 112 centimetres, mostly during the southwest monsoon season. Shajapur's subtropical climate—with hot summers, mild winters, and concentrated monsoon rains—creates favourable conditions for seasonal agriculture. Soybean, the principal kharif (monsoon) crop, thrives due to the district's well-suited soil, topography, and rainfall pattern. This abstract presents a geographic overview of Shajapur with a focus on factors contributing to its suitability for soybean cultivation, providing a basis for further agro-environmental and productivity assessments

1. INTRODUCTION:

Madhya Pradesh is the centre point of India, where the Shajapur district is located in the western part of Madhya Pradesh. If we look geographically, Shajapur is located at 23.4226° N, 76.2871° E coordinates.Shajapur's landscape is shaped by the rolling topography of the Malwa Plateau, which features a mix of plains, low hills, and scattered elevations of Deccan Trap basaltic rocks. The region's elevation ranges from approximately 335 to 608 meters above sea level, with a general slope that descends from south to north [1][2]. Major rivers, including the Parvati and Nevaj, flow through the area, while the predominant soil types found here are dark black soil and alluvial soil. The total geographical area of Shajapur is 619,600 hectares. Approximately 445,000 hectares of land are under cultivation, accounting for 71% of the total land area [3][4]. Shajapur is primarily adjacent to Rajasthan, resulting in a subtropical climate characterized by hot, dry summers, pleasant winters, and rainfall during the southwest monsoon season. Annual rainfall in this region ranges from 100 to 112 centimetres. Agriculture is the primary economic activity in Shajapur district, primarily due to the availability of rainfall [5]. The main crop cultivated here during the rainy season is soybeans [6]. On average, 4,00,000 metric tonnes of soybeans are produced every year in Shajapur district.

2. RELATED WORK

Soybean cultivation is a major kharif season activity in Shajapur district of Madhya Pradesh, and agricultural researchers and government sources have studied several geographical, climatic, and soil factors that affect its productivity. This section reviews the known information and highlights relevant gaps for a more analytical survey in Shajapur.

Sharma et al. mapped districts of Madhya Pradesh on the basis of soybean cultivation area versus yield. It shows that Shajapur is one of the districts where the soybean area is high, but the yield is low to very low[7].

Mishra et al. conducted a study of 32 years (1988-89 to 2019-20) in several districts, including Shajapur and Agar Malwa. They investigated the growth rate and volatility of area, production, and productivity of soybean and related cropping systems[8].

Rao et al. explored the feasibility of soybean-based cropping systems in different climatic zones of Madhya Pradesh based on assessment of climate change, water management, supplementary irrigation, etc. [9].

Walikar et al. used crop modelling to assess how future climate projections will affect soybean yield in Madhya Pradesh, and it helps in understanding the spatial and temporal climate impacts on yield[10].

Kumar et al, Geospatial Approaches in Assessing Agro-Climatic Suitability of Soybean in Rainfed Agro-Ecosystems, reported that climate databases, soil data, and remote sensing were used to map and assess the suitability of rainfed agro-ecosystems for soybean in Madhya Pradesh. This includes water-limited yield potential, length of growing period, etc. [11].

Dupare et al.'s work identifies constraints faced by farmers - availability of quality seed, pests and diseases, fertilizer inputs, marketing/infrastructure, etc. Non-geographical but useful for understanding management and input-related issues [12].

Rajan et al. compare the level of knowledge among beneficiary vs non-beneficiary farmers for soybean production technologies. Although it is more detail/knowledge-based, it provides insights into adoption challenges in geographical and socio-economic contexts [13].

3. GEOGRAPHICAL CONDITION

Shajapur is a district rich in natural resources, featuring the Vindhyachal mountain range and the Kali Sindh River. It is characterized by various types of fertile soil. The district experiences distinct weather patterns across different seasons: it has a unique climate during the rainy season, winter, and summer. The Geographical condition of Shajapur is as follows.

3.1 Location and Boundaries: Shajapur district is situated in the northwestern part of Madhya Pradesh, India. It is located between 23°06′ and 24°19′ north latitudes and 75°41′ and 77°02′ east longitudes. The district is bordered by Ujjain and Agar-Malwa to the west, Dewas and Sehore to the south, Rajgarh to the north, and Sehore district to the east.

3.2 Physical Features and Topography: Shajapur district is part of the central Madhya Pradesh plateau, specifically the Ratlam plateau micro-region. The terrain is characterized by uplands and river valleys, with significant variations in elevation and soil type [14].

3.4 Shajapur Forested Highlands: Located in the center, this area features a continuous range of hills with elevations ranging from 450 to 530 meters above sea level. It is part of the Malwa Plateau and is drained by seasonal rivers like the Lakundar and Aahu.

3.5 Kali Sindh Basin: This region is defined by the presence of the Kali Sindh River, which influences the local topography and soil fertility.

3.6 Soil Types: The district primarily consists of deep black and shallow black-brown soils, which are particularly suitable for soybean cultivation. These soils are rich in nutrients and possess good moisture-retaining properties, essential for the growth of soybean crops[15].

3.7 Climate and Rainfall: Shajapur district experiences a tropical climate with distinct seasons: summer, monsoon, and winter. The average annual rainfall is about 1,100 mm, occurring mainly during the monsoon months from June to September. However, recent statistics indicate a rainfall deficit in the region, with Shajapur recording a 40% reduction in rainfall compared to normal levels by July 2024 [16].

3.8 Water Resources: The district is drained by several rivers, including the Kali Sindh and Parvati rivers, which provide essential water resources for irrigation and other agricultural activities. These water bodies play a crucial role in soybean cultivation, particularly during dry periods.

4. BENEFITS AND BARRIERS

Shajapur district is endowed with several geographical features that significantly bolster the cultivation of soybean:

Favourable Soil Types: The region is characterized by deep black and medium black soils that excel in water retention, creating an ideal environment for healthy soybean growth. These nutrient-rich soils, when managed effectively, can lead to impressive yields, enabling farmers to maximize their productivity.

Monsoon-Based Rainfall Pattern: The district experiences an average annual rainfall ranging between 1,000 to 1,100 mm, with a majority of this precipitation occurring during the monsoon months from June to September. This naturally aligns with the kharif growing season for soybeans, providing the crops with essential moisture during their critical growth phases.

Plateau and Upland Topography: The Malwa plateau and the upland regions of Shajapur feature a landscape that promotes natural drainage. This is particularly beneficial for soybean farming, as it minimizes the risk of waterlogging, which can severely hinder crop health.

River Basins for Irrigation: The presence of rivers such as the Kali Sindh and Parbati offers invaluable opportunities for supplemental irrigation. This is particularly advantageous during periods of insufficient rainfall, ensuring that crops have an adequate water supply and thus enhancing agricultural security.

Agro-climatic Suitability: Falling within the Central Plateau Zone of Madhya Pradesh, Shajapur is recognized as one of the most favourable regions for rainfed soybean cultivation in India, a fact supported by research from the Indian Council of Agricultural Research (ICAR) and state agricultural institutions.

Despite its many advantages, several geographical limitations pose challenges to maximizing soybean production in Shajapur:

Rainfall Variability and Drought Risk: Recent patterns indicate a troubling trend of increasingly erratic monsoons, characterized by late arrivals and extended dry spells. For instance, a considerable 40% deficit in rainfall was recorded during the 2024 season, creating significant risk for unirrigated soybean fields and jeopardizing harvests.

Soil Erosion in Uplands: While the upland areas provide excellent drainage, they are also susceptible to soil erosion, particularly on hilly terrains during heavy rainfall events. This erosion can strip away topsoil, depleting the land's fertility and negatively impacting crop growth.

Limited Groundwater Availability: In several tehsils, declining groundwater levels and inadequate irrigation systems hinder farmers' efforts to save their crops during dry seasons. This limitation is especially pronounced in regions that do not benefit from river basins, making droughts particularly difficult for farmers to navigate.

Fragmented Land Holdings: The prevalence of small and fragmented land holdings restricts the scalability of mechanized farming, which is vital for efficient and cost-effective soybean production. This challenge is exacerbated in the plateau landscape, where accessing these smaller fields can be labor-intensive and less economically viable.

Inadequate Infrastructure in Remote Areas: Certain forested and upland areas within the district suffer from poor infrastructure, including a lack of quality roads, storage facilities, and weather stations. This inadequacy complicates access for farmers who require timely advisories and post-harvest assistance, ultimately hindering their productivity and profitability.

5. RECOMMENDATION

To promote soybean cultivation in Shajapur district, it is essential to adopt region-specific agricultural practices to suit the diverse topography and soil types of the region. Farmers should be encouraged to use high-yielding and climate-resistant soybean varieties, such as JS 93-05, JS 335, and Ahilya series, which are suitable for the local agro-climatic conditions. Regular soil testing and use of organic inputs, along with crop rotation strategies, can significantly improve soil fertility and productivity. Given the district's dependence on monsoon rainfall, it is imperative to promote drought-resistant varieties and water conservation methods such as mulching and rainwater

harvesting. Use of GIS-based crop suitability mapping and remote sensing techniques can help monitor crop health and take timely interventions. Strengthening agricultural extension services through training programmes and better access to quality seeds will ensure better adoption of modern practices. Additionally, infrastructural support in the form of improved storage, market linkages, and access to crop insurance will enhance farmers' resilience. Continued research on climate impacts, soil-crop interactions, and precision farming is recommended to ensure long-term sustainability and yield improvement in soybean cultivation across the district.

6. CONCLUSION

The analytical survey of the geographical conditions for soybean cultivation in Shajapur District reveals several natural advantages that support this type of agriculture. The district's location on the Malwa Plateau features fertile black cotton soils, moderate elevation, and sloping terrain, creating a strong foundation for rainfed farming. The subtropical climate, with seasonal rainfall ranging from 100 to 112 cm, is particularly beneficial for the kharif cropping pattern, making soybean the dominant crop during the monsoon season. However, the study also identifies certain geographical and climatic challenges, such as rainfall variability, soil erosion in upland areas, and a lack of irrigation infrastructure. These issues can negatively impact crop yields and farmer incomes, especially during years of irregular monsoon rainfall. Despite these obstacles, Shajapur's extensive cultivated area, favourable soil composition, and river systems offer significant potential for sustainable soybean production if supported by region-specific agricultural planning. To improve productivity and resilience, it is crucial to implement soil conservation practices, use drought-tolerant seed varieties, and enhance water management techniques. Overall, the geographical conditions of Shajapur District position it as a key region for soybean cultivation in Madhya Pradesh, with considerable opportunities for agricultural development through targeted interventions and informed policy planning.

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