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Assessment of land suitability for blackgram cultivation in Keonjhar district, Odisha employing GIS techniques

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Abstract

The article examines the land suitability in the Keonjhar district for blackgram cultivation. The study uses a land suitability model based on the guidelines of the 'National Bureau of Soil Survey and Land Use Planning' applying 'GIS' techniques [1, 2]. The researchers consider several factors, such as soil properties, climate, and topography, to assess land suitability for blackgram cultivation. The district occupying an area of 8,303 km², is divided into different suitability classes for analysis. Rainfall, temperature, and elevation help determine these classes. This paper presents the findings of the study.

Keywords: Land suitability, blackgram, Keonjhar district etc.

Introduction

Geographic Information Systems (GIS) plays an important role in crop suitability analysis. GIS helps researchers to combine and study spatial data related to land, climate, and other important factors. This method also helps to identify areas that are suitable for specific crops. It also helps farmers choose suitable crops and improve agricultural productivity [3]. Blackgram is an important food crop. It ranks next to rice, wheat, and maize in importance. Farmers mainly grow this pulse in India as a dryland crop. Blackgram grows well in sub-humid climates. It can grow at elevations up to 533 m above the 'MSL'. Farmers cultivate it in both rainfed and irrigated conditions. The crop grows best in moist environments. It is commonly grown in regions that receive up to 100 cm rainfall. It is also transplanted in regions with higher rainfall or irrigation facilities. Local communities consume blackgram as a staple food. The plant has an erect and tufted growth form with many slender and fibrous roots that effectively absorb soil moisture. Blackgram is usually self-fertilizing and photo-insensitive. Farmers can cultivate it throughout the year (NBSS, 2006).

Objective

The paper mainly aimed to characterize the climatic and physico-chemical factors that affect blackgram cultivation in the study area. Another aim is to classify the study area according to the suitability for blackgram cultivation.

Methodology

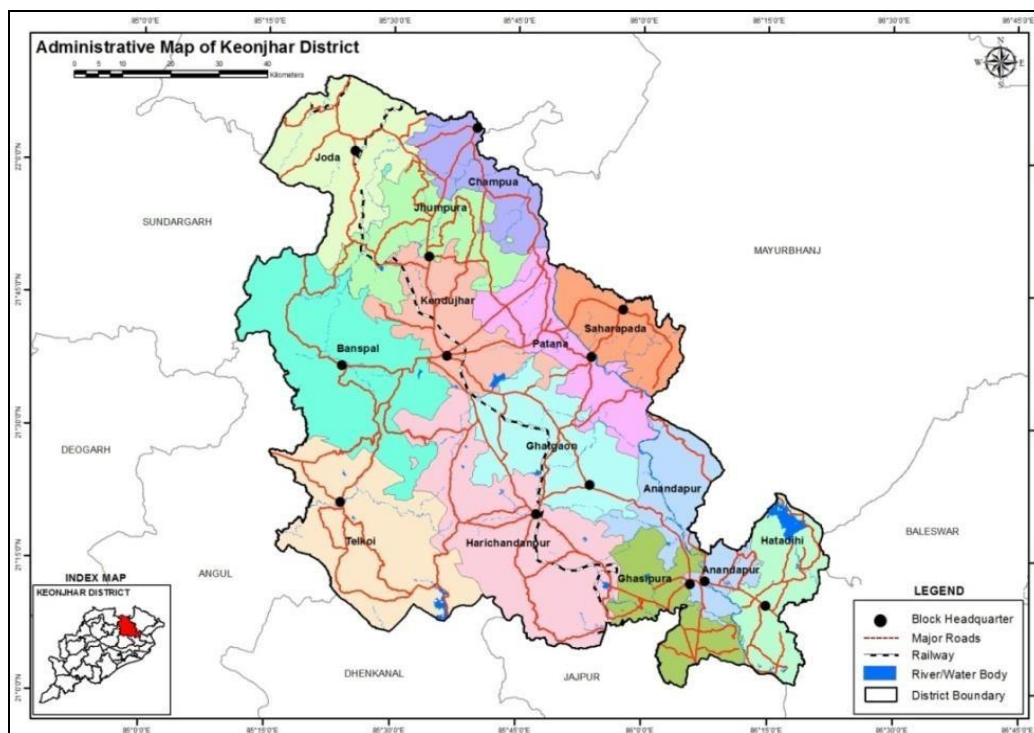
The Food and Agriculture Organization has developed a land suitability classification scheme. The guidelines of 'National Bureau of Soil Survey and Land Use Planning' (1990) [4] provide the basis for the land suitability model. This research uses the guidelines of both organizations. A number of criteria are taken into account by the land suitability model. Climate, soil characteristics, soil drainage, soil depth, soil texture, and slope are some of these variables. Based on temperature, elevation, and rainfall, the study classifies the Keonjhar district into three suitability classes [5]. After assessing each parameter, the study assigns the grades as S1, S2, S3, and N.

Study Area

The district lies between 21° 1' N to 22° 10' N latitude and 85° 11' E to 86° 22' E longitude (Fig.1).

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‘Fig 1: Location map of Keonjhar district’

Suitability Analysis

Table 1: Type of Land suitability in Keonjhar district for blackgram crop-2024

Order	Area (ha) (%TGA)
S1	4261 (66.05)
S2	1741 (26.99)
S3	449 (6.96)

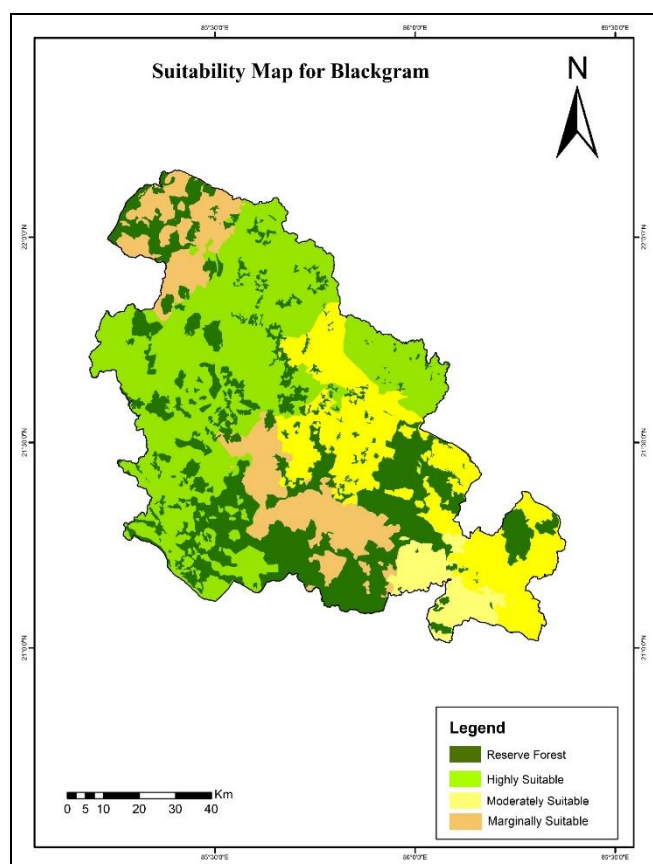


Fig 2: Land suitability for blackgram crop in Keonjhar district

Highly Suitable (S1)

As blackgram thrives in warm climates, it can be grown all year round. Blackgram prefers temperatures between 25 °C and 33 °C. The ideal temperature range for growth is between 28 °C and 32 °C. The distribution of rainfall during the growth season is more significant than the total amount of rainfall. The ideal annual rainfall range for blackgram growth is between 900 and 1250 mm. Well-drained and moderately well-drained soils are ideal for blackgram growth. It is not able to withstand wet condition. Blackgram can be grown in a variety of soil types such as loamy, silty loam, sandy loam, clayey, silty clay, and sandy clay soils. The pH ranging from 6.0 to 7.8 is ideal. There should be less than 2.0 dS/m of electrical conductivity. Soil depth more than 100 cm is suitable for cultivating blackgram (Fig. 2). The ideal slope for blackgram cultivation is less than 3%. Table 1 shows that 66.05% of the study area (4261 ha) is highly suitable for growing blackgram.

Moderately suitable (S2)

The mean temperature ranging from 21 °C to 24 °C and 34 °C to 36 °C is moderately suitable for blackgram cultivation. These regions receive an annual rainfall between 800 and 1200 mm. Soil is poorly drained that makes the region moderately suited for growing blackgram. The pH values of the soil ranges from 5.5 to 5.9 and 7.9 to 8.4. The electrical conductivity of soil is between 2 and 4 dS/m. These conditions also suggest a moderate level of suitability. For blackgram cultivation, a soil depth of 75 to 100 cm is moderately suitable. Additionally, a slope of 3 to 5% is moderately suitable. These results were also noted by researchers in these particular areas. Table 1 shows that 26.99% of the total land (1741 ha) is moderately suitable for blackgram cultivation (Fig. 2).

Marginally Suitable (S3)

The mean temperature ranging from 18 °C to 20 °C and 37 °C to 39 °C are marginally suitable for growing blackgram.

These regions receive an annual rainfall between 600 and 750 mm. The poorly drained soil makes the region marginally suitable. The pH values of the soil ranges from 8.5 to 8.9 and 5.0 to 5.4. The electrical conductivity of soil varies between 4.0 and 8.0 dS/m. Marginal suitability is also indicated by these conditions. For blackgram growing, a soil depth of 50 to 75 cm is marginally suitable. Additionally, a slope of 5 to 10% is marginally suitable. Similar results were also found by researchers in particular areas. Table 1 shows that 6.96% of the total land (449 ha) is marginally suitable for blackgram cultivation (Fig. 2).

Conclusion

Blackgram cultivation is confined to the S1 region which includes taluks such as Banspal, Saharpada, Keonjhar, Jhumpura, Champua, and Telkoi. These areas provide the best conditions for blackgram growth. The suitability rate in these regions is 66.05%^[6].

Some areas are unsuitable for blackgram cultivation because of forest cover and heavy rainfall. Geographic Information Systems-based modelling provides useful analytical information for decision-making in many scientific fields, including agriculture. Researchers can also apply this method in different climatic conditions^[7, 8, 9].

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Appendix No 1: Soil-Site suitability criteria (crop requirements) for Blackgram

Soil-Site Characteristics	Unit	Highly Suitable S1	Moderately Suitable S2	Marginally Suitable S3	Not Suitable N
Mean temperature in growing season	°C	25-28 31-33	34-36 21-24	37-39 18-20	>40 <20
Total rainfall	mm	900-1000 1000-1250	750-900 1250-1500	600-750	<600
Soil drainage	Class	Well drained to moderately well drained	Imperfectly drained	Poorly drained	
Texture	Class	l, sil, cl, sicl, scl	sic, sc	Ls, sl, c	
pH	1:2.5	6.0-6.5 6.6-7.8	5.5-5.9; 7.9-8.4	5.0-5.4; 8.5-8.9	<5.0
Effective soil depth	cm	>100	75 to 100	50 to 75	<50
Salinity (EC saturation extract)	ds/m	<2.0	2.0-4.0	4.0-8.0	
Slope	%	0-3	3-5	5-10	>10

Source: NBSS & LUP