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Crop-suitability analysis using geospatial techniques for turmeric production under north Easternghat zone of Odisha

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Abstract
The current study used a geographic information system (GIS) technique with rainfall, temperature, soil texture, drainage density, pH, organic carbon, and slope as numerous factors to evaluate the appropriateness of turmeric crops at Kandhamal District, Odisha. The model builder module in ArcGIS 10.8 was used to generate the crop-suitability model. The reclassify tool and weighted overlay analysis were used to superimpose each input parameter once it had been reclassified in accordance with the optimal crop-growth requirement. Similarly, S1 (99.9%) and S2 (0.1%) were projected to be the crop suitability classes for turmeric. The research claims that the area is quite fertile. Consequently, agricultural yield can be raised by cultivating the crop in highly and moderately favorable zones.

Keywords: Crop suitability, geographic information system (GIS), turmeric

Introduction
Turmeric is a major cash crop that propels the state's economic growth, and Kandhamal is the main district for its cultivation. Finding the land suitability classes is crucial to increasing turmeric production since it guarantees that the crops are cultivated in the best locations. For sustainable agricultural production, crop-suitability analysis is therefore essential. In an effort to increase crop yields, reduce environmental effects, and save input material costs, numerous studies have evaluated site suitability using GIS and remote sensing technology. Furthermore, this work offers new insights by (a) providing a practical way for choosing cropping patterns according to agro-ecological suitability, while the majority of previous research uses conventional techniques to accomplish the same objective.

Materials and Methods
Study Area
The study was conducted for Kandhamal District, which is situated at 19 degree 34' to 20 degree 36' north latitude and 83 degree 34' to 84 degree 34' east longitude in Odisha. According to Figure 1, its average elevation is 715 meters (2,346 feet). The state's overall size is 64.09 lakh hectares, or around 4.87% of the nation's total land area. Daily temperatures range from 19 to 39 degrees Celsius in the summer and from 7 to 11 degrees Celsius in the winter. The region is drained by streams that are tributaries of the Bhrutanga River and receives an average of 1336 mm of rainfall annually, most of which occurs between June and October. The state's soil fertility during the last few decades [1] necessitates crop suitability management in this area.

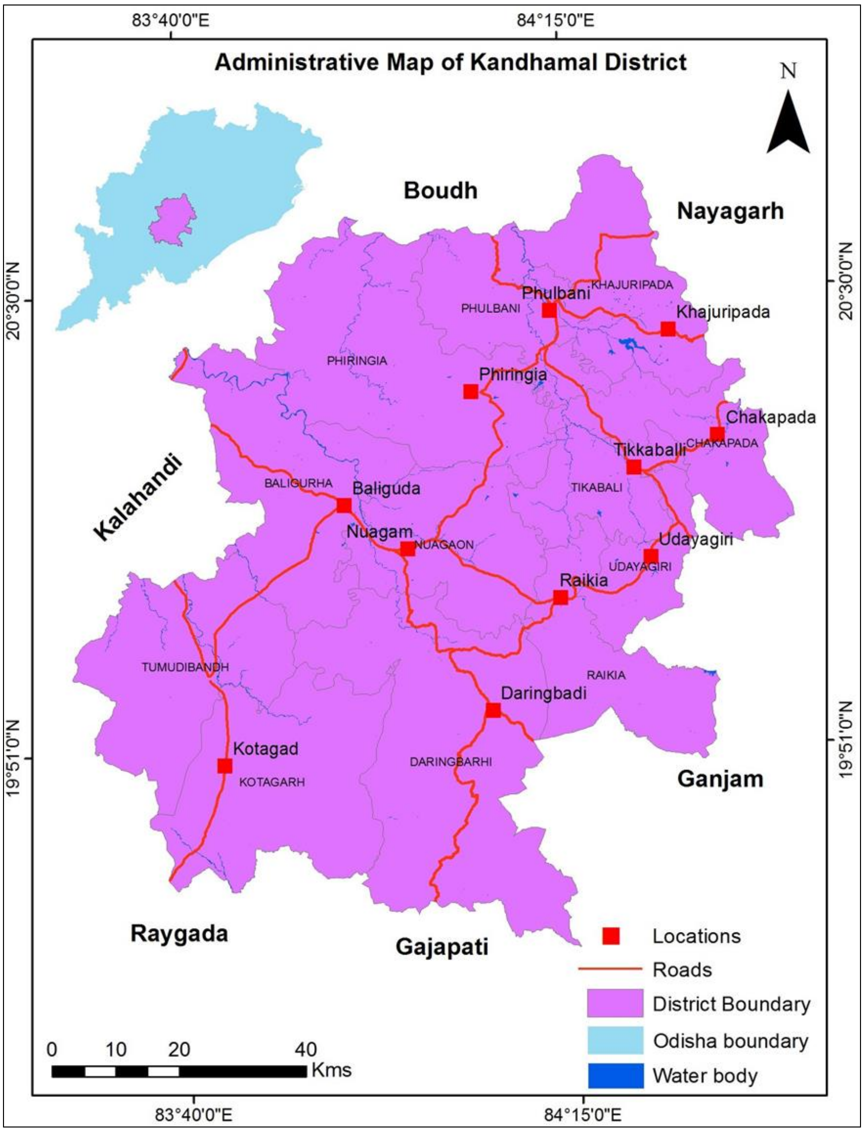

Fig 1: Location Map of Kandhamal District, Odisha

Table 1: List of the data sets used in the present study

Data/Maps	Description	Source
Soil physical parameters	Texture and drainage on 1:500,000 Scale	National Bureau of Soil Survey and Land Use Planning (NBSS&LUP)
Soil chemical parameters	pH, EC, OC	Soilhealthcard(SHC)website https://www.soilhealth.dac.gov.in (accessed on 15 June 2019)
Climatic parameters	Daily temperature and rainfall (from 1985 to 2017)	India Meteorological Department (IMD) and Water Resources Information System (WRIS) websitehttps://indiawris.gov.in (accessed on 15 June 2019)
Digital Elevation Model (DEM)	Slope	Bhuvan (http://bhuvan.nrsc.gov.in/ (accessedon4July2019)
Cropland map	MODIS500m resolution	USGSEarthExplorer https://earthexplorer.usgs.gov/ (accessed on 4 July 2019)

Data Used

Based on a pertinent literature research, the following factors are used to assess the crop's appropriateness for crop production: soil reaction (pH), electrical conductivity (ECe), organic carbon (OC), soil texture, soil drainage, temperature, rainfall, slope, and land use/land cover (Table 1). [2-7].

Generation of Thematic Maps

Using ArcMap10.8's in-verse distance weighted (IDW) interpolation approach, thematic maps of soil chemical and climatic characteristics were produced. ArcMap10.8 software was used to scan, georeference, and digitize the soil map obtained from NBSS&LUP in order to produce maps of soil texture and drainage. Slope map preparation was done using the DEM images that were downloaded from the Bhuvan website. Using photos obtained from the USGS Earth Explorer website (www.earthexplorer.usgs.gov) (accessed on July 4, 2019), the land use/land cover (cropland) map was produced in a GIS environment.

Results

Spatial Variability of Soil and Climatic Parameters

The findings showed that the target area's soil pH ranged from 5.5 to 5.0, with a mean of 5.4. The most acidic location was 55.8%, which was followed by moderately acidic (43.8%). Only 2.9% of the entire OC area was classified as high availability (>0.75%), whereas 43.7% of the region was classified as low availability (<0.4%) and 53.3% as medium availability (0.4-0.75%). Regarding soil texture, the study area contained five different texture classes: sandy (25.95%), sandy loam (32.47%), clay loam (19.03%), sandy clay loam (20.04%), and clayey (0.27%) (Figure 2a).

While, in case of drainage, four classes, namely, moderately well drained (42.39%), well drained (30.95%), excessively drained (26.37%) and imperfectly drained (0.27%), were 2identified (Figure 2b). The average rainfall 1337 mm (Figure 3c).

Slope Map

The study region had a slope that ranged from less than 3.4% to more than 40%. The majority of the research region has a slope of less than or equal to 3.4%, according to the reclassified slope map, as seen in Figure d.

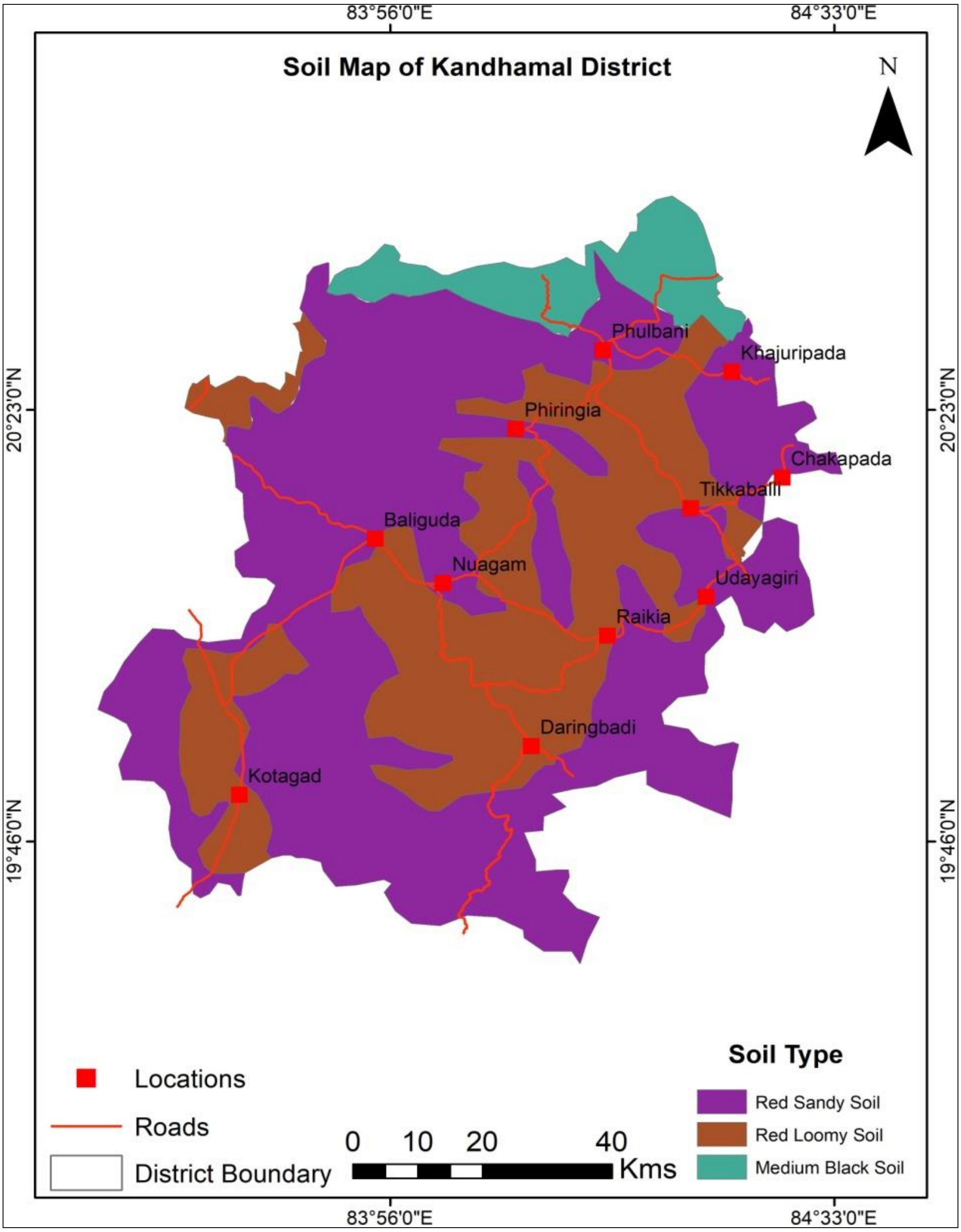

Fig 2a: Soil Texture Map

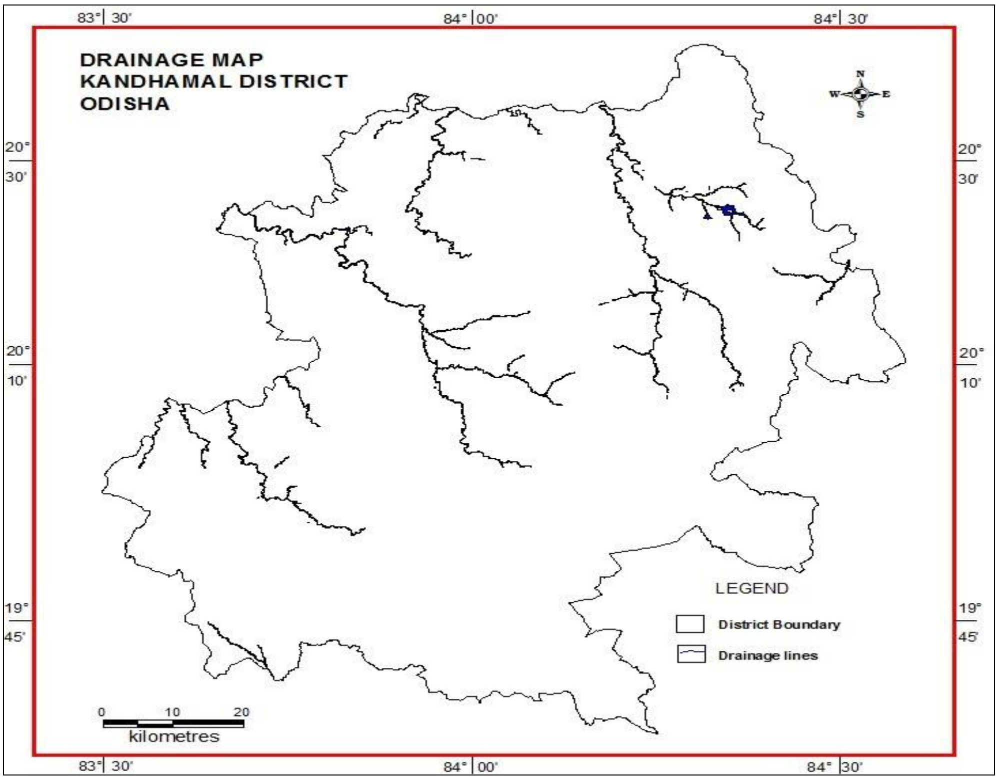

Fig 2b: Soil Drainage Map

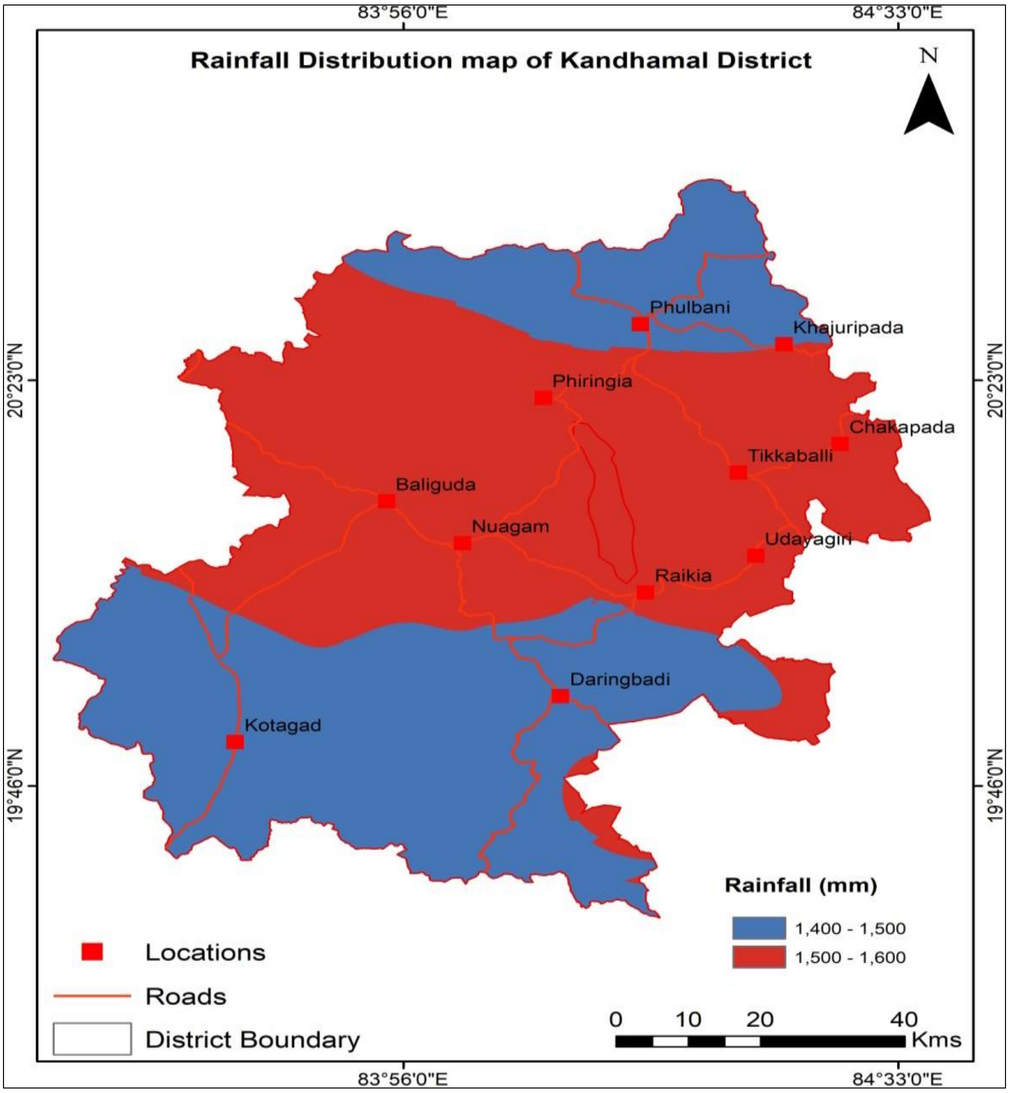

Fig 2c: Rainfall Map

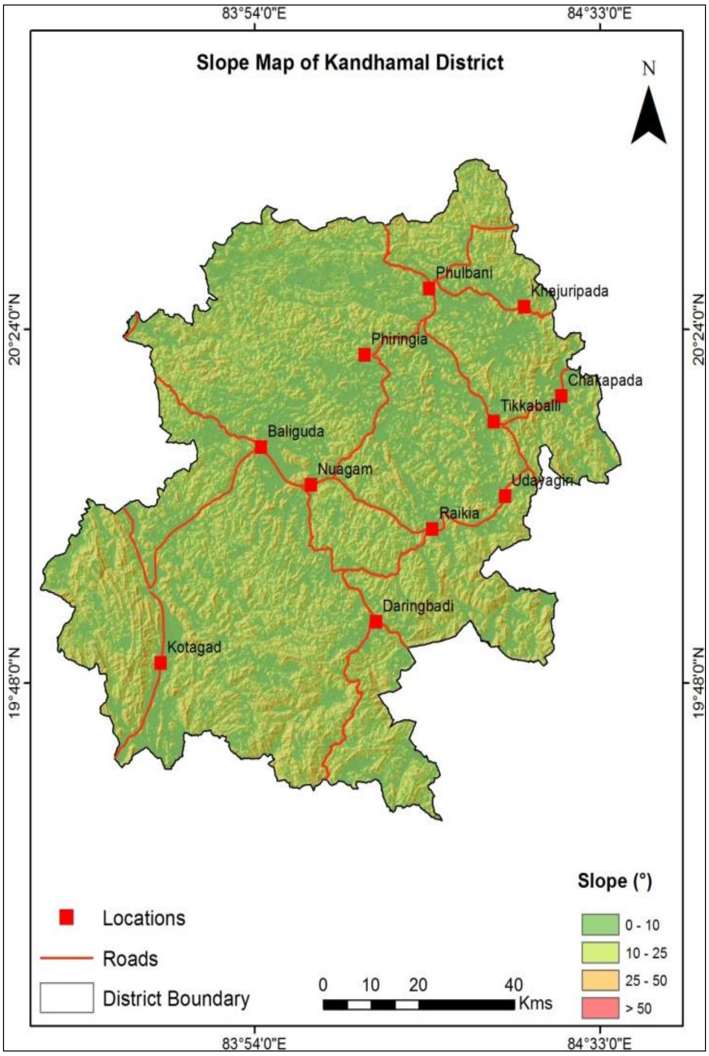

Fig 2d: Slope Map

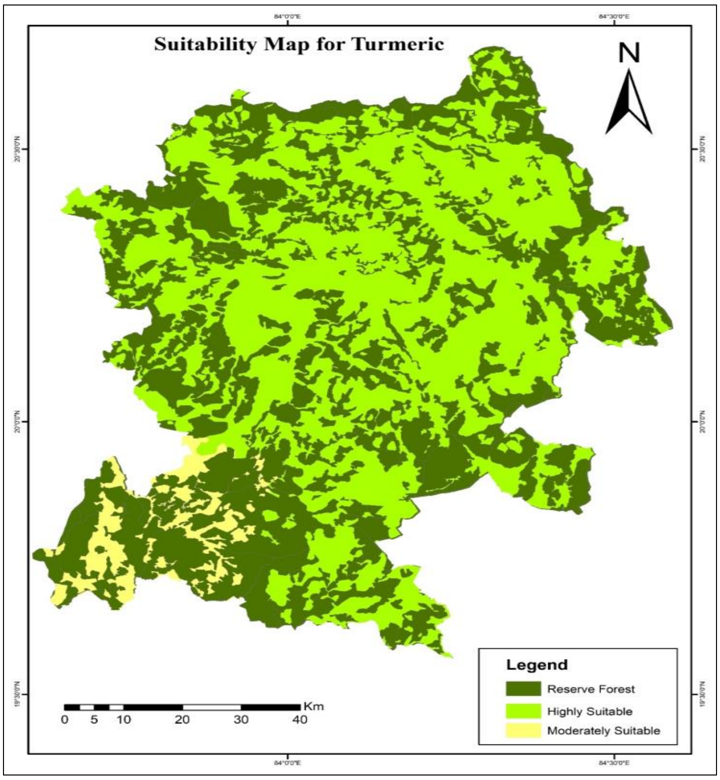

Fig 3: Suitability Map

Turmeric

The findings indicated that several districts in the northeastern zone include 99.9% of the land that is very suited for growing turmeric. The largest percentage, 71.71% of the estimated arable land, is included in the somewhat suitable category, which is primarily located in the southwest and certain areas of the northeastern zone.

Discussion

GIS provides flexibility and precision in managing land use. The analysis of turmeric suitability revealed that 99.9% of the identified arable land was classified as highly suitable. The Kandhamal district was determined to be extremely suitable due to its optimal temperature, organic carbon levels (>0.75%), and soil texture. The main constraints for areas deemed moderately appropriate include excessively draining sandy soil and a restricted supply of organic carbon. Turmeric is often a tropical or subtropical plant that can grow in a range of soil types, climates, and hydrological circumstances. The optimum soils for growing turmeric are heavy soils like clay, clay loam, and loam, which have a pH between 4.5 and 8.0. Expert studies indicated that the field's slope was the least significant aspect in cultivating turmeric.

It was found that most of the state, which comprises 72% of the total arable land and is mostly located in the southwest and some areas of the northeast, is only slightly suitable for growing turmeric. It was estimated that between 1000 and 1600 mm of rain fell in Odisha. A significant portion of the target area is farmland, and based on previous discussions, most of these locations are highly suitable for turmeric and fall under the S1 suitability class.

Conclusion

Turmeric is one of the main commercial crops, and the district is recognized for its turmeric cultivation within the state. This research evaluated the suitability of cropland for growing turmeric using the FAO framework and Remote Sensing-GIS. In order to produce a land suitability map (Fig. 3) for different crops, GIS was essential for processing maps, assessing geographical data, and combining weighted rasters. In order to guarantee enough agricultural output, decision-makers assessing alternative cropland possibilities can benefit greatly from the database and guiding map that GIS can offer. Therefore, the crop can be grown in highly and moderately suitable places to increase food production, while marginally suitable areas can be varied with other more suited crops.

In order to choose cropping patterns based on high, moderate, low, and inappropriate locations, it is expected that the maps will improve agriculturalists' comprehension. The mapping endeavor detects land units linked to suitable crops and suggests substitute methods in cases where the existing land usage is suboptimal. For future crop planning and cereal production decision-making, these findings can be applied to regions with comparable soil and climate circumstances. Future studies will take into account other elements that affect sustainable land use, like infrastructure, irrigation systems, and socioeconomic circumstances. Agricultural productivity in India and the designated area could also be greatly impacted by climate change. Considering this, future studies ought to look at how important crops are affected by climate change.

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Conflicts of Interest: The authors declare no conflict of interest.

References

1. Chauhan AK, Rani J. Land degradation and the extent of soil degradation in Odisha. Int J Res Anal Rev. 2019;6:64-69.
2. Chuong HV. Multicriteria land suitability evaluation for crops using GIS at community level in central Vietnam. In: International Symposium on Geoinformatics for Spatial Infrastructure Development in Earth and Allied Sciences; 2008; Vietnam.
3. Raza SMH, Mahmood AS, Khan AA, Liesenberg V. Delineation of potential sites for turmeric cultivation through multi-criteria evaluation (MCE) using remote sensing and GIS. Int J Plant Prod. 2017;12:1-11.
4. Singh P, Upadhyay RK, Bhatt HP, Oza MP, Vyas SP. Crop suitability analysis for cereal crops of Uttar Pradesh, India. In: ISPRS TC V Mid-term Symposium “Geospatial Technology—Pixel to People”; 2018 Nov 20-23; Dehradun, India. The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences; 2018.
5. Chen Y, Yu J, Khan S. Spatial sensitivity analysis of multi-criteria weights in GIS-based land suitability evaluation. Environ Model Softw. 2010;25:1582-1591.
6. Peter I. Determination of soil-crop suitability for Enugu State using geographic information system (GIS) & multi-criteria evaluation (MCE). Int J Eng Res Technol. 2020;9:274-281.
7. Feizizadeh B, Blaschke T. Land suitability analysis for Tabriz County, Iran: A multi-criteria evaluation approach using GIS. J Environ Plann Manag. 2013;1-23.