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GIS-Based Spatial Distribution and Production Characteristics of Ginger Cultivation in Hassan District, Karnataka, India

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Abstract

This study examines the spatial distribution, cultivation, intensity and production characteristics of ginger farming in Hassan district using GIS and GPS based field observations. It combines field data, soil suitability, production statistics and spatial analysis to uncover regional differences in cultivation patterns. The study uses spatial interpolation and thematic mapping techniques to assess cultivation intensity, cropping intensity and production variability among the taluks. The results show that ginger farming mainly occurs in the western and central regions especially in Sakleshpur and Arsikere due to favorable environmental conditions. The study also emphasizes how rainfall distribution, soil quality, market access and labor availability affect cultivation patterns. The geospatial information gathered can aid sustainable agricultural planning, resource management and decision making aimed at boosting ginger productivity in Hassan district.

Keywords: GIS, GPS, Ginger cultivation, Spatial distribution, Soil suitability, Hassan district.

1. Introduction

Ginger (*Zingiberofficinale* Roscoe) is a major commercial spice crop cultivated in tropical and subtropical regions. India is the leading producer of ginger with Karnataka making a substantial contribution due to its favorable climate and soil conditions(Ravindran and Babu 2016; Statistics 2022). Hassan district is recognized as a principal ginger producing region in Karnataka, attributed to its diverse agro climatic conditions, adequate rainfall and fertile soils(Sundresha et al. 2020). The spatial distribution of ginger cultivation is influenced by several environmental and socio economic factors including rainfall, soil properties, agricultural practices, market accessibility and labor availability (Li et al. 2018). Understanding these spatial variations is important for sustainable agricultural planning and improving crop productivity.

Geographic Information System (GIS) and Global Positioning System (GPS) techniques provide efficient tools for analyzing agricultural distribution patterns and identifying suitable cultivation zones (Chittora et al. 2022; Mathenge, Sonneveld, and Broerse 2022).Therefore this study integrates GPS-based field observations, GIS analysis, soil suitability assessment and production statistics to examine the spatial distribution and production characteristics of ginger cultivation in Hassan district.

2. Objectives

1. To analyze the spatial distribution of ginger cultivation in Hassan district using GIS techniques.
2. To evaluate taluk wise variations in area under cultivation and production.
3. To assess cropping intensity and soil suitability for ginger cultivation.
4. To identify the major factors influencing ginger cultivation patterns.

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3. Study Area

For this study Hassan district has been choose has study area

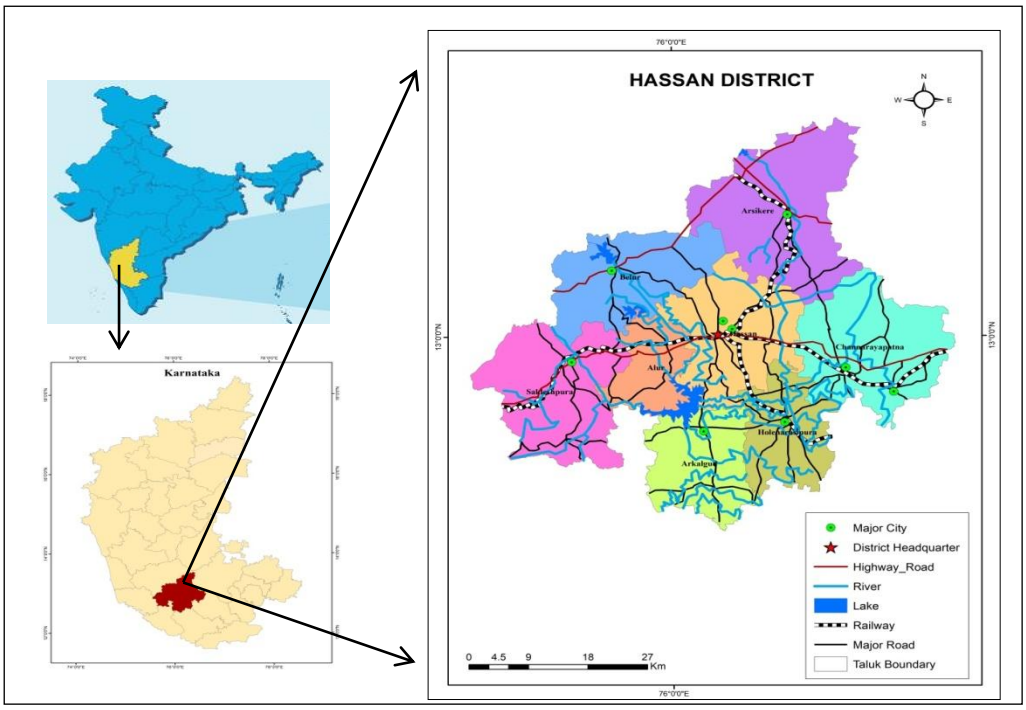

Figure 1: Study area of Hassan district

Hassan district (Figure 1), situated in southern Karnataka, encompasses an area of approximately 6,826 km². The district is administratively divided into eight taluks: Alur, Arkalgud, Arsikere, Belur, Channarayapatna, Hassan, Holenarasipura, and Sakleshpur(FAO 2024 n.d.)(Gazetteer. n.d.).

The district experiences a tropical monsoon climate, with rainfall distribution varying from east to west. Western taluks receive substantially higher rainfall than eastern regions. Hassan district is characterized by fertile agricultural lands, river systems including the Hemavathi and Yagachi and robust transportation connectivity(Gazetteer. n.d.).Agriculture constitutes the primary occupation and ginger is a significant commercial crop cultivated throughout the district.

The variation in topography, rainfall and soil characteristics makes Hassan district an ideal region for studying the spatial distribution of ginger cultivation.

4. Methodology

The study was carried out using GPS based field observations, GIS analysis and agricultural statistics. Approximately 15–20 GPS sample points were collected from each taluk representing ginger cultivation fields. These data were integrated into a GIS environment to generate a spatial database.

Spatial interpolation was performed to identify cultivation intensity patterns across the district. Taluk wise area under cultivation, production statistics and cropping intensity were analyzed. Soil suitability assessment was carried out using nutrient availability information. Finally, all thematic layers were integrated to identify the factors influencing ginger cultivation patterns (Chittora et al. 2022; Mathenge et al. 2022).

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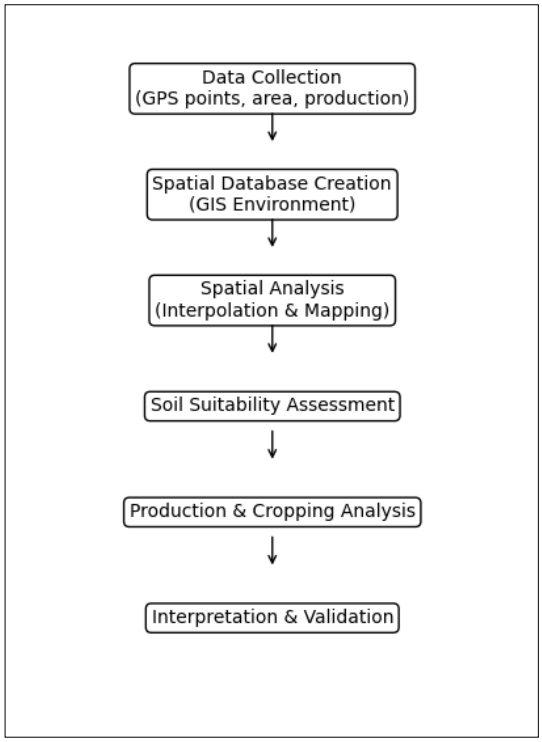

Figure 2: Methodology flow chart

The methodology (Figure 2) adopted in this study involved a systematic integration of field observations and GIS analysis. At the outset, GPS coordinates marking gingergrowing plots were gathered from each of the eight taluks. After collection, the field records were brought into a GIS setting to build a spatial dataset.Spatial interpolation methods were used to produce maps showing cultivation intensity. Area and yield figures for each taluk were assembled and examined. Maps depicting cropping intensity and soil suitability were created to evaluate farming performance and land fitness. In the end, every thematic layer was read together to determine the environmental and socio economic drivers shaping ginger farming across Hassan district.

5. Results and Discussion

Findings from GIS processing combined with on-ground observations show clear spatial differences in ginger cultivation within Hassan district. The prepared maps and plotted graphics supported evaluation of intensity, cultivated extent, output quantity, cropping intensity, and soil suitability. These outcomes assist in pinpointing key ginger-producing zones and the influences shaping cultivation trends inside the district.

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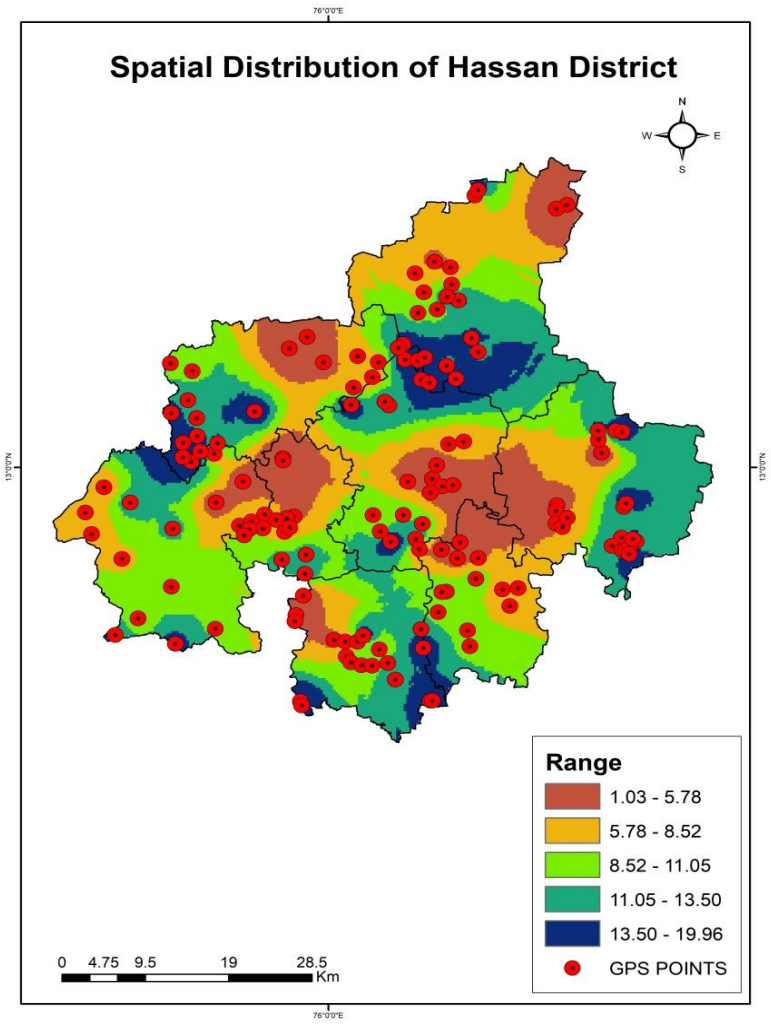

Figure 3: Spatial Distribution of Hassan District

The distribution map(Figure 3) based on GPS field readings shows ginger cultivation is not evenly spread across Hassan district. Interpolation results divided cultivation intensity into five classes, spanning 1.03 to 19.96. The strongest intensity groupings appear mainly in Sakleshpur, Belur and some portions of Hassan taluks while weaker intensities are seen in Channarayapatna and Arkalgud.

This clustered arrangement implies that cultivation is largely dictated by environmental fit. Higher concentrations occur in the western side due to supportive rainfall, productive soilsand appropriate terrain. Earlier research has noted comparable patterns, linking ginger cultivation closely with humid climates and well drained soils(Li et al. 2018; Stirling et al. 2012).

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5.2 Area under Ginger Cultivation

Table 1 :Talukwise Area under Ginger Cultivation Hassan District

Taluk	Area under Ginger Cultivation-2023 to 2024 (hectares)
Arkalgud	420
Alur	360
Holenarasipura	390
Arsikere	450
Belur	340
Sakleshpur	520
Hassan	380
Channarayapatna	310

Source: District statistical report-2023 to 2024

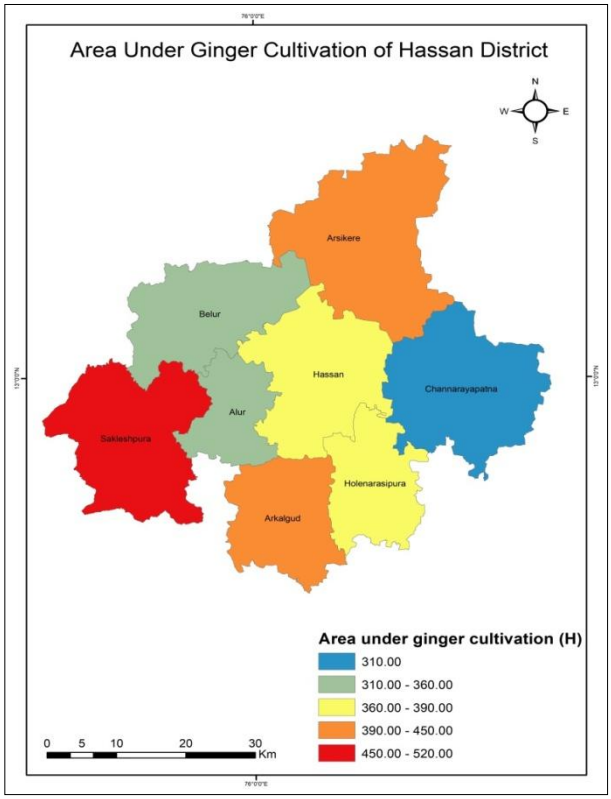

Figure 4: Area Under Ginger Cultivation of Hassan District

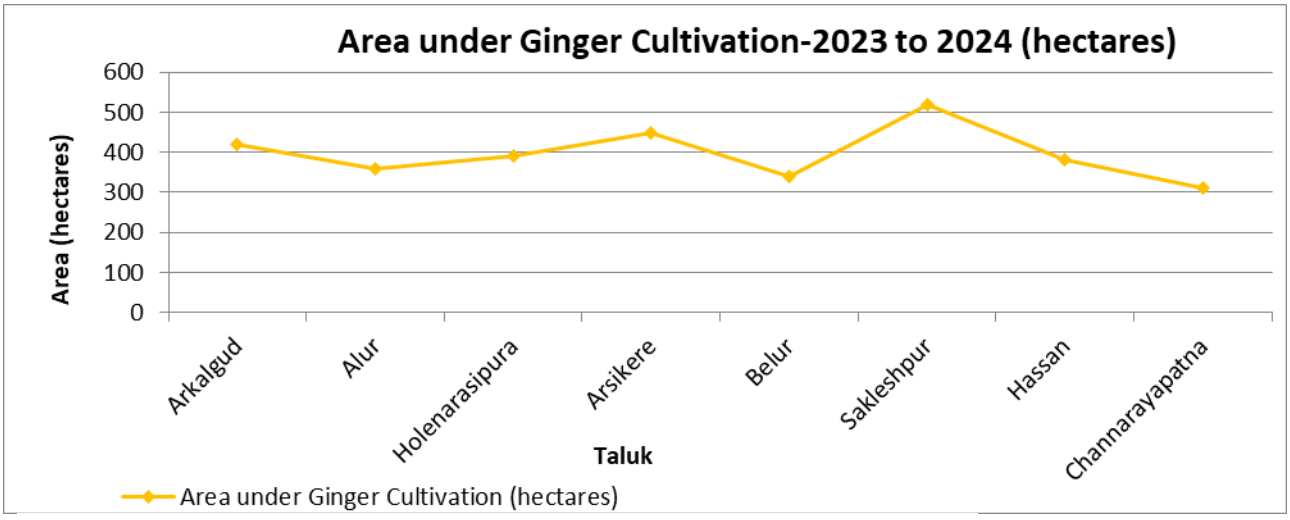

Figure 5: Graph showing Area Under Ginger Cultivation of Hassan District

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The extent of land planted with ginger differs markedly between taluks. Sakleshpur shows the largest cultivated area at 520 ha, with Arsikere next at 450 ha and Arkalgud at 420 ha. Channarayapatna registers the smallest area, at 310 ha.

Sakleshpur's broader cultivation can be explained by suitable agro-climatic settings, greater rainfall, and favorable soil traits. The observed spatial differences suggest that environmental conditions strongly shape cultivation choices across the district.

5.3 Taluk wise Analysis of Cultivated Area

The graph makes the differences in cultivated area among taluks easy to see. From Alur toward Arsikere values rise gradually and Sakleshpur reaches the peak. This pattern points to regional imbalances in how agricultural land is used.

Taluks with better conditions sustain wider cultivation, while places with less rainfall and only moderate soil suitability show a smaller cultivated extant.

5.4 Ginger Production Volume Analysis

Table 2:Taluk-wise Ginger Production Volume

Taluk	Production-2023to 2024 (tons/year)
Arkalgud	7,350
Alur	6,100
Holenarasipura	6,580
Arsikere	8,020
Belur	5,780
Sakleshpur	9,240
Hassan	6,720
Channarayapatna	5,200

Source: District statistical report-2023-2024

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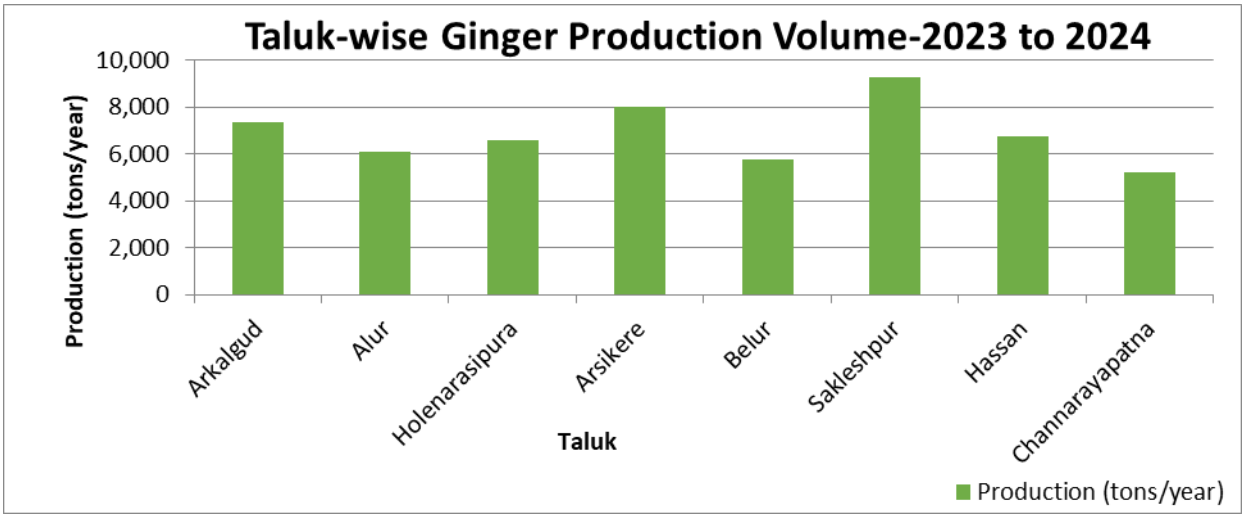

Figure 6: Taluk-wise Ginger Production Volume

P s the greatest output at 9,240 tons/year, followed by Arsikere at 8,020 tons/year. Hassan and Holenarasipura fall in the middle range, whereas Channarayapatna and Belur have relatively lower outputs.

These findings suggest that larger cultivated area corresponds with greater production. Factors like rainfall and soil richness contribute directly to higher yields(Li et al. 2018).

5.5 Cropping Intensity Analysis

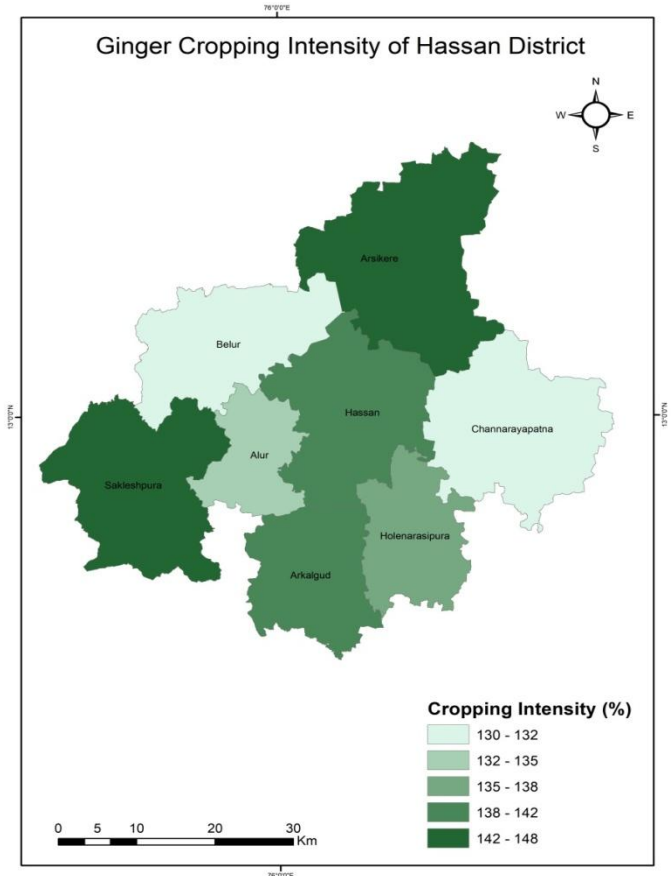

Figure 5: Ginger Cropping Intensity of Hassan District

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Cropping intensity spans from 130% to 148%, showing differences in how efficiently farmland is used across the district. The highest cropping intensity occurs in Sakleshpur and Arsikere, indicating intensive farming activity and effective use of resources.

Hassan and Arkalgud show mid-level intensity, while Belur and Channarayapatna present relatively lower values. Irrigation access along with supportive environmental conditions plays a major role in raising cropping intensity.

5.6 Soil Suitability Analysis

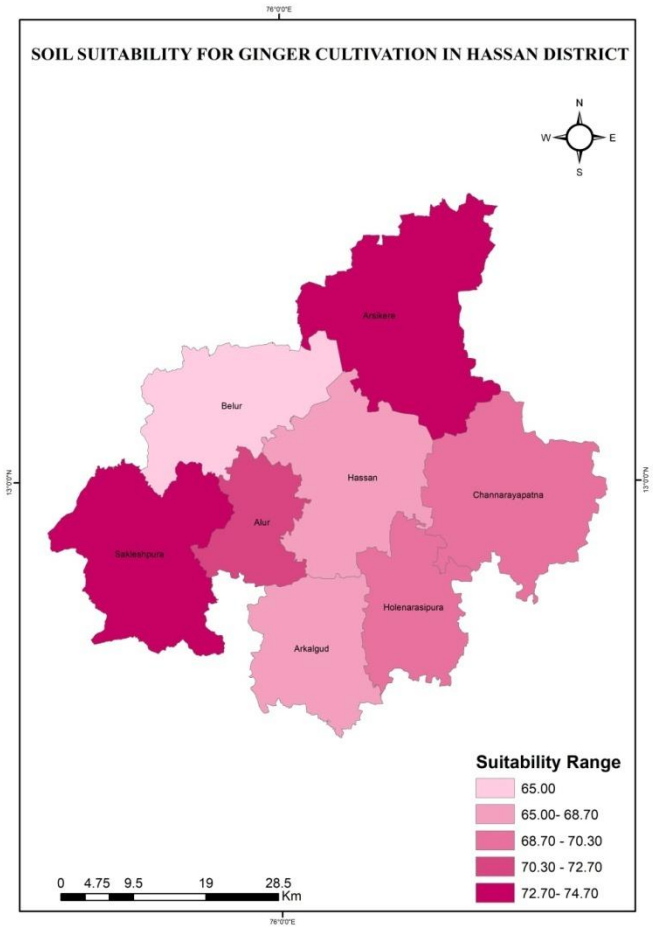

Figure 6: Soil Suitability for Ginger Cultivation

The soil suitability map divides Hassan district into five levels of suitability. Very high suitability is found in Sakleshpur and Arsikere, reflecting favorable nutrients and soil properties for ginger farming.

Hassan, Holenarasipura, and Arkalgud show moderate suitability. Compared with the other taluks, Belur has comparatively lower suitability. The outcomes indicate that soil fertility is a key factor shaping both cultivation intensity and production(Stirling et al. 2012).

5.7 Factors Influencing Ginger Cultivation

Ginger cultivation patterns in Hassan district are shaped by a mix of environmental and socio economic influences. Their combined effects lead to the clustered pattern seen across the district. Multiple drivers shape the spatial pattern of ginger cultivation:

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Rainfall Gradient

Rainfall is a major determinant of ginger farming because the crop needs warm, humid conditions and sufficient moisture through its growing season. Western taluks, especially Sakleshpur and Belur, receive more rainfall and thus show higher cultivation intensity than the drier eastern side(Li et al. 2018).

Soil Suitability

Soil properties have a strong effect on ginger growth and yield. The crop does best in well drained loamy soils with high organic matter and ample nutrients. Where suitability is higher cultivation intensity and production are also higher showing a close link between soil fertility and crop outcomes(Stirling et al. 2012).

Market Accessibility

Access to markets is important for commercial crops like ginger. Locations with stronger roads and nearer markets allow efficient transport, lower post harvest losses and improved returns which in turn supports expansion of cultivated area(FAO 2024 n.d.).

Labor Availability

Growing ginger demands high labor input, with extensive manual tasks for land preparation, planting, weeding, mulching, and harvesting. Areas with sufficient labor can handle operations better, leading to greater productivity and wider cultivation. Together, these influences create the clustered cultivation pattern found in Hassan district(Li et al. 2018)(Münster 2015).

5.Conclusion

This work combined GPS derived field records with GIS methods to study the spatial pattern and production features of ginger cultivation in Hassan district. The findings showed strong spatial variability across the district, with cultivation largely concentrated in the western and central taluks. The pattern was identified as clustered instead of evenly spread indicating a strong role for environmental and socio economic influences.

Across the taluks, Sakleshpur repeatedly showed the top values for cultivated area, production, cropping intensity and soil suitability with Arsikere next. By comparison, Channarayapatna and several eastern areas showed lower figures. The assessment also showed a positive link among cultivated area, production and land suitability, implying that favorable environments support higher output.

Key controls on ginger cultivation were identified as rainfall patterns, soil suitability, market access and labor availability. Western taluks with greater rainfall and fertile well drained soils displayed higher cultivation intensity and stronger production potential.

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