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(RESEARCH ARTICLE)

PROPOSING SUITABLE CROPS FOR MICRO PHYSIO-AGRO CLIMATIC ZONES OF CHAMARAJANAGARA DISTRICT USING GEOMORPHOLOGICAL APPROACH

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ABSTRACT

Agriculture is the major source of livelihood in Chamarajanagara District, Karnataka. However, variations in landforms, climate, rainfall, vegetation, and water resources influence crop growth and agricultural productivity across the district. Therefore, identifying suitable crops based on the physical and agro-climatic characteristics of each region is essential for sustainable agricultural development. This study aims to identify suitable crops for the Micro Physio-Agro Climatic Zones of Chamarajanagara District using a geomorphological approach.

Keywords: Suitable Crops; Physio agro Climatic Zones; Geomorphology

1 INTRODUCTION

Agriculture is the primary source of livelihood for the majority of the population in Chamarajanagara District, Karnataka. However, the district is considered one of the economically and socially backward districts of the state, with a large proportion of the population depending directly on agriculture for their income. In recent years, agricultural production has been affected by irregular rainfall, increasing temperatures, limited water availability, and changing climatic conditions. These environmental changes have led to frequent crop failures, declining agricultural productivity, and reduced farm income.

The district has also experienced increasing land degradation and desertification, particularly in its eastern and semi-arid regions. Continuous drought, uncertain rainfall, depletion of groundwater resources, and unsuitable cropping practices have accelerated the conversion of productive agricultural land into dry and degraded land. As a result, many farmers face financial difficulties, lower agricultural returns, and increasing uncertainty in farming. These challenges have also contributed to rural poverty and out-migration in search of better employment opportunities.

Crop selection based on the physical and climatic characteristics of a region is one of the most effective ways to improve agricultural productivity and ensure sustainable land use. Since the terrain, rainfall, temperature, vegetation, and drainage conditions vary considerably across Chamarajanagara District, the suitability of crops also differs from one

location to another. Therefore, it is necessary to identify suitable crops according to the Micro Physio-Agro Climatic Zones of the district.

2 REVIEW OF LITERATURE

Singha and Swain (2016) explained that land suitability evaluation is an effective method for selecting appropriate crops based on land capability, soil characteristics, topography, and climatic conditions. Their review emphasized that scientific land evaluation helps improve crop production, supports sustainable agriculture, and assists policymakers in agricultural planning.

Shaloo et al. (2022) reviewed different methods used in cropland suitability assessment and found that GIS integrated with Multi-Criteria Evaluation (MCE), particularly the Analytical Hierarchy Process (AHP), is one of the most widely used approaches. Their study showed that topography, climate, and soil are the most important parameters used for crop suitability mapping, while remote sensing and GIS improve the accuracy of agricultural decision-making.

AbdelRahman et al. (2016) demonstrated the application of GIS and Remote Sensing for land suitability assessment in Chamarajanagar District, Karnataka. The study integrated terrain, soil, and land capability information to identify suitable agricultural land. The research highlighted the usefulness of geospatial technology for regional agricultural planning but focused mainly on land suitability rather than crop recommendations based on micro agro-climatic conditions.

Bose and Halder (2023) applied GIS and the Analytical Hierarchy Process (AHP) to identify suitable land for major crops in West Bengal. Their study used parameters such as slope, elevation, rainfall, land use, and transportation networks to prepare crop suitability maps. The research demonstrated that integrating spatial datasets with GIS provides reliable results for agricultural planning and efficient land resource management.

Studies on Agro-Ecological Zoning (AEZ) have shown that combining topography, climate, soil, and land use characteristics is an effective method for identifying suitable agricultural regions. GIS-based agro-ecological zoning enables researchers to classify land according to its agricultural potential and supports sustainable crop planning under different environmental conditions.

Objective

- Identification and Delineation of Micro Physio-Agro-Climatic Zones in Chamarajanagara District.
- Identification and Recommendation of Suitable Crops for Each Micro Physio-Agro-Climatic Zone of Chamarajanagara District.

2.1 About the study area

Chamarajanagara District is located in the southern part of Karnataka, India, and was formed in 1997 by separating it from the erstwhile Mysuru District. The district headquarters is Chamarajanagara town. It lies between 11°40′58″ and 12°06′32″ North latitude and 76°24′14″ and 77°46′55″ East longitude, covering a geographical area of about 5,101 km^2. The district is bordered by Mysuru District to the north and northwest, Tamil Nadu to the east and south, and Kerala to the southwest. Owing to its strategic location at the junction of three states, the district possesses diverse physical and environmental characteristics.

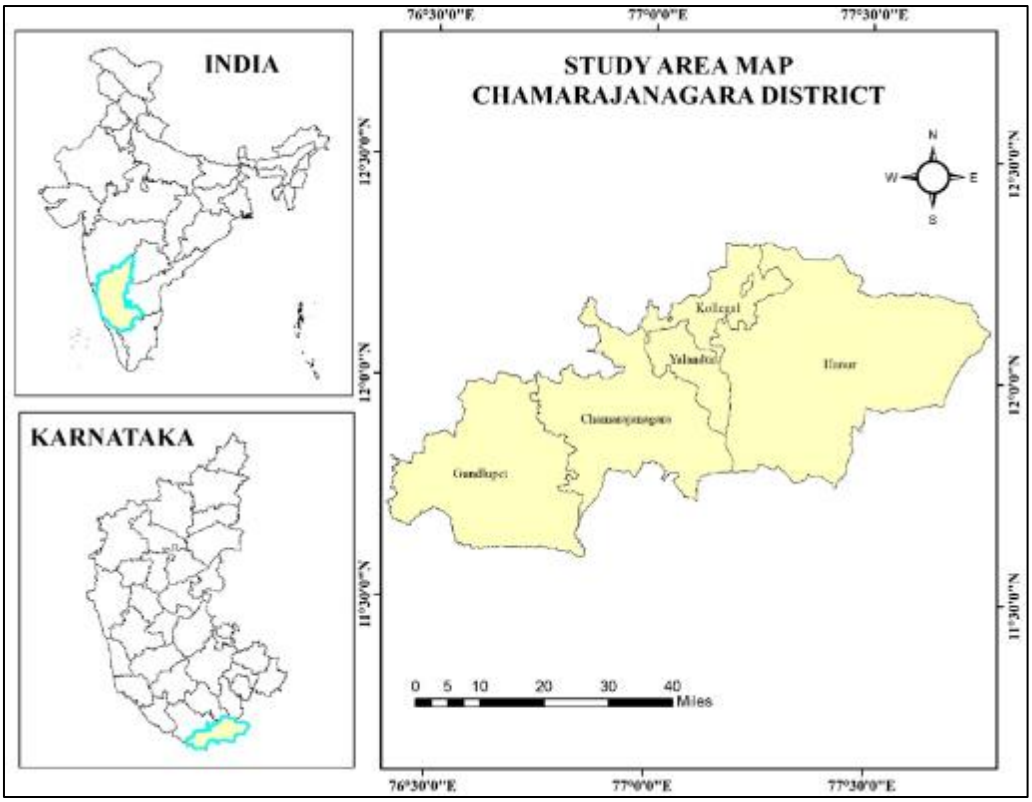

Figure 1: Study Area Map Chamarajanagara District

Administratively, Chamarajanagara District comprises five taluks: Chamarajanagara, Gundlupet, Kollegala, Hanur, and Yelandur. The district has a predominantly rural population, with agriculture serving as the principal occupation. Farming, livestock rearing, and allied agricultural activities provide the main source of livelihood for the majority of the population.

The physiography of the district is highly diverse, consisting of hills, plateaus, valleys, gently undulating plains, and forested landscapes. The major hill ranges include the Biligirirangana (BR) Hills, Male Mahadeshwara (MM) Hills, and Himavad Gopalaswamy Hills, which significantly influence the district's climate, drainage pattern, and vegetation. Elevation ranges from low-lying plains in the eastern region to high mountainous areas in the western and southern parts, resulting in considerable variations in topography.

3 METHODOLOGY

The study employs Geographic Information System (GIS) and remote sensing techniques to prepare Micro Physio-Agro Climatic Zone maps. Five major thematic layers—Digital Elevation Model (DEM), rainfall, temperature, Normalized Difference Vegetation Index (NDVI), and drainage density—were integrated using a weighted overlay analysis to delineate the Micro Physio-Agro Climatic Zones. The methodology used for preparing these thematic maps and identifying the zones is explained in detail in the methodology section.

Based on the final Micro Physio-Agro Climatic Zone map, suitable crops were identified for each zone by considering their environmental conditions, agro-climatic requirements, and existing agricultural practices. The results indicate that each micro zone has distinct characteristics that support different crop types. The proposed crop recommendations can help improve agricultural productivity, optimize the use of land and water resources, strengthen climate-resilient farming practices, and reduce the impacts of land degradation.

3.1 Physio–Agroclimatic Zones of Chamarajanagara District

The physio–agroclimatic zones of the study area were delineated through a weighted overlay analysis performed in the GIS environment. This analysis integrated multiple geomorphological and climatic parameters, including the Digital Elevation Model (DEM), Normalized Difference Vegetation Index (NDVI), rainfall, temperature, and drainage density. Each parameter was assigned a specific weight based on its relative importance, and the final composite map was generated by overlaying all standardized thematic layers.

The final output provides a spatially explicit classification of physio–agroclimatic zones, which can be used to identify suitable cropping regions, recommend appropriate farming practices, optimize resource allocation, and support long-term agricultural planning. The methodology ensures that all influencing factors—both physical and climatic—are systematically evaluated to produce scientifically reliable and practical results.

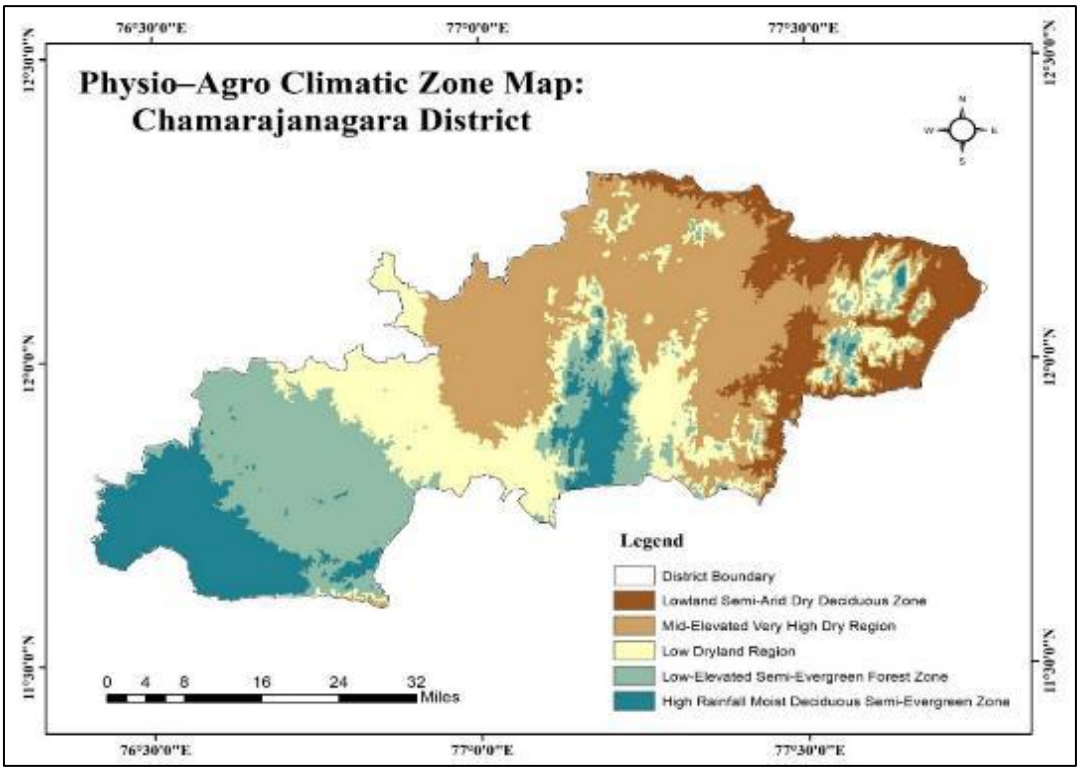

Figure 2: Physio-Agro Climatic Map Chamarajanagara District

4 RESULT AND SUGGESATION OF SUITABLE CROPS FOR VARIOUS MICRO CLIIMATIC ZONES OF THE DISTRICT

4.1 Lowland Semi-Arid Dry Deciduous Zone

The Lowland Semi-Arid Dry Deciduous Zone is characterized by low elevation, limited rainfall, high temperatures, sparse vegetation cover, and low drainage density. Water availability is a major constraint in this zone, making agriculture highly dependent on drought-resistant crops. The predominance of dry deciduous vegetation indicates moisture stress during most parts of the year. Millets such as ragi, foxtail millet, and little millet are highly suitable because of their low water requirements and adaptability to dry conditions. Sorghum and groundnut also perform well under these environmental conditions. Pulses such as red gram, green gram, and black gram can be cultivated as supplementary crops due to their ability to withstand moisture stress and improve soil fertility through nitrogen fixation. Agroforestry, fodder cultivation, and drought-tolerant vegetable production are recommended to enhance livelihood security and improve land productivity.

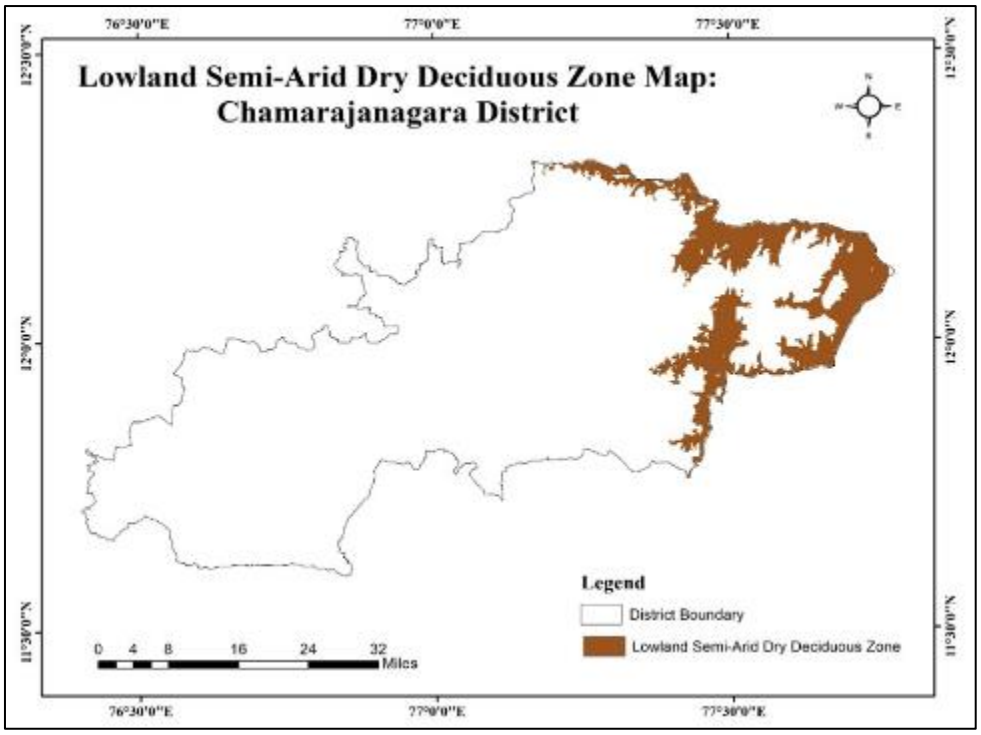

Figure 3: Lowland Semi-Arid Dry Deciduous Zone Map Chamarajanagara District

4.2 Mid-Elevated Very High Dry Region

The Mid-Elevated Very High Dry Region represents one of the most drought-prone areas of the district. It is characterized by moderate elevation, extremely low vegetation cover, poor rainfall, and high evapotranspiration rates. These environmental conditions create severe moisture stress, limiting the cultivation of water-intensive crops. Therefore, drought-resistant crops such as pearl millet, horse gram, cowpea, and castor are highly suitable for this zone. Oilseed crops including sunflower and niger can also be cultivated successfully due to their tolerance to dry conditions. Sustainable land management practices such as soil moisture conservation, rainwater harvesting, dryland horticulture, and Silvi-pastoral systems are essential for maintaining agricultural productivity and preventing further land degradation and desertification.

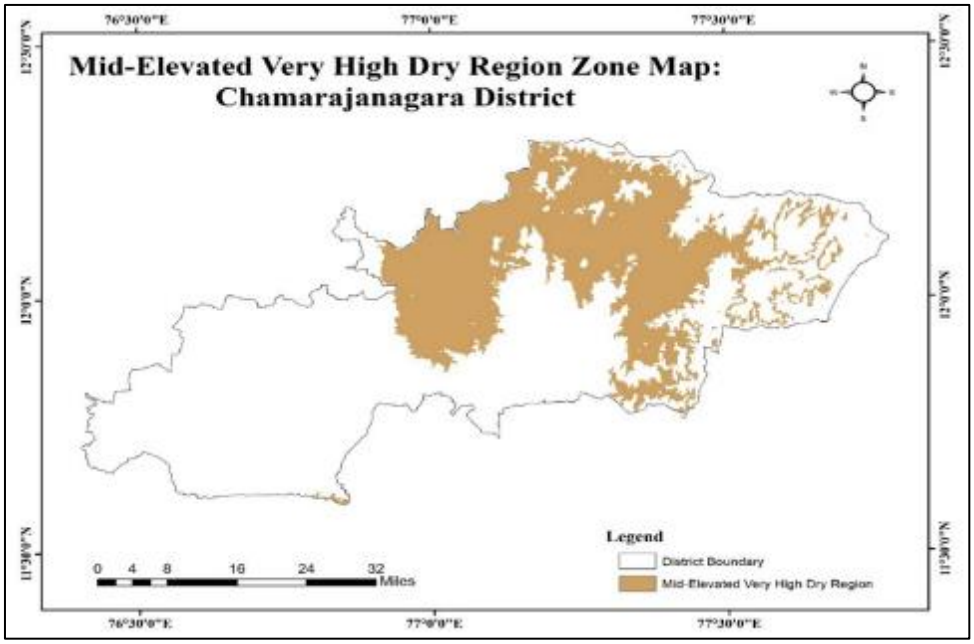

Figure 4: Mid-Elevated Very High Dry Region Zone Map Chamarajanagara District

4.3 Low Dryland Region

The Low Dryland Region is characterized by low elevation, moderate vegetation cover, and comparatively better rainfall than the highly dry zones. Although moisture availability remains limited, the zone offers more favorable conditions for agricultural activities. Ragi, maize, horse gram, and red gram are highly suitable crops because they can efficiently utilize available soil moisture while providing stable yields. Groundnut, sunflower, and sorghum are moderately suitable due to their adaptability to semi-arid environments. The relatively better resource base of this zone also supports vegetable cultivation, fodder production, and agro-horticultural practices involving crops such as guava and pomegranate. These diversified farming systems contribute to income generation and agricultural sustainability.

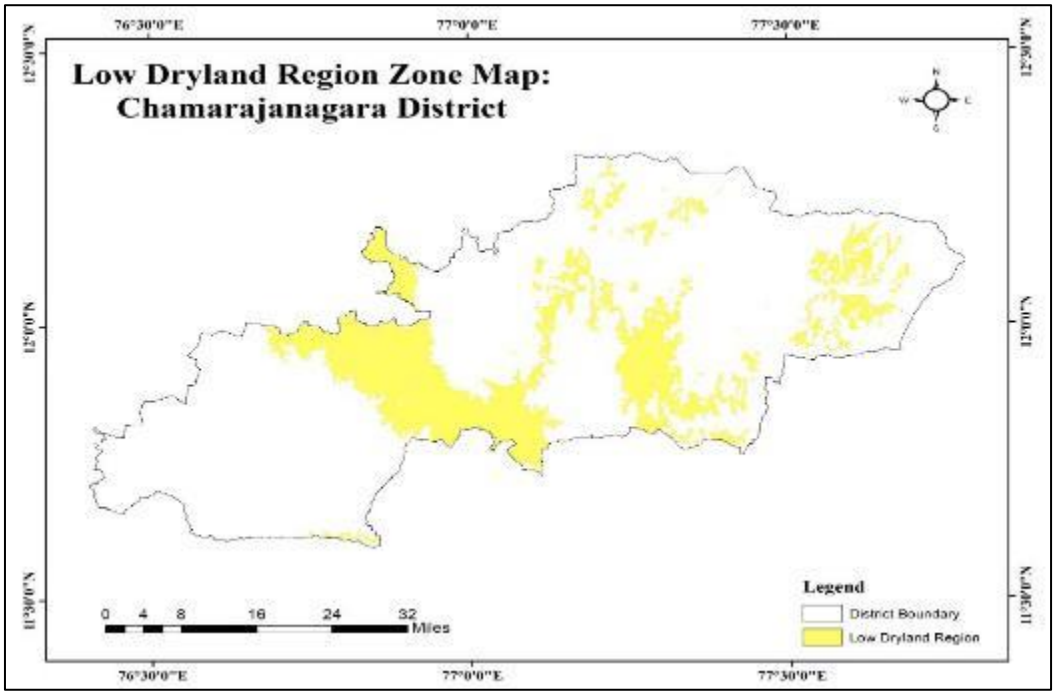

Figure 5: Low Dryland Region Zone Map Chamarajanagara District

4.4 Low-Elevated Semi-Evergreen Forest Zone

The Low-Elevated Semi-Evergreen Forest Zone experiences relatively higher rainfall, moderate temperatures, and dense vegetation cover compared to the dry regions. The favourable climatic conditions and improved soil moisture availability support a wider range of agricultural activities. Paddy cultivation is highly suitable due to the adequate water supply, while banana, turmeric, and ginger thrive under the humid conditions of the zone. Sugarcane and arecanut can be cultivated in suitable locations where irrigation and soil conditions are favorable. The presence of semi-evergreen vegetation also provides opportunities for agroforestry, mixed cropping, floriculture, and spice cultivation. These diversified agricultural systems help in maximizing land productivity while conserving ecological resources.

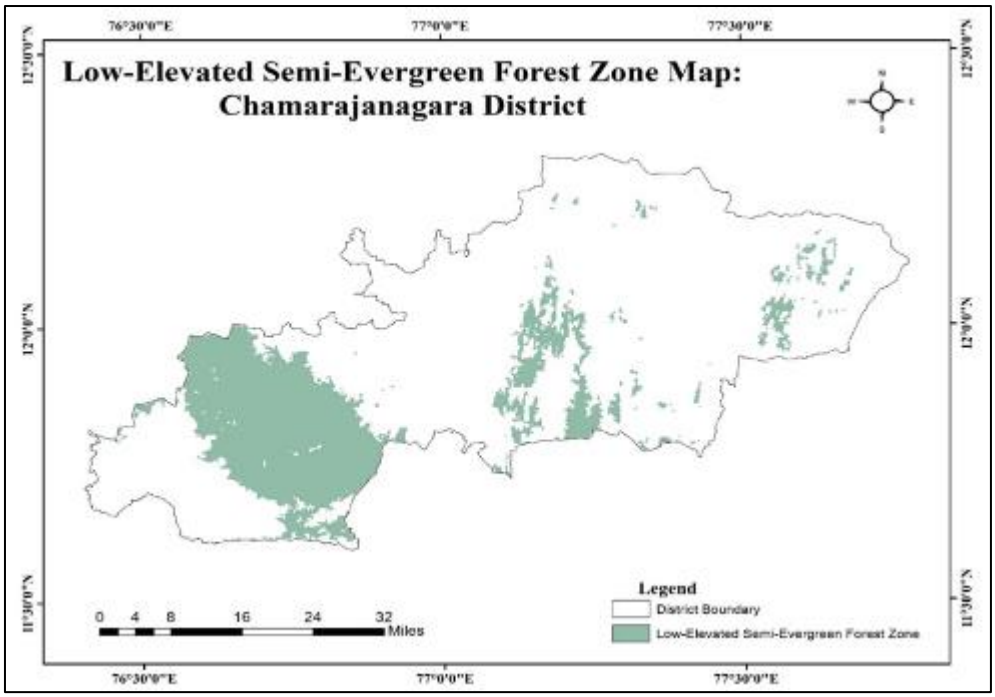

Figure 6: Low-Elevated Semi-Evergreen Forest Zone Map Chamarajanagara District

4.5 High Rainfall Moist Deciduous Semi-Evergreen Zone

The High Rainfall Moist Deciduous Semi-Evergreen Zone is characterized by abundant rainfall, dense vegetation cover, moderate temperatures, and well-developed drainage systems. These environmental conditions create a highly favourable setting for plantation crops, spices, and intensive agriculture. Paddy is the dominant crop because of the ample moisture availability throughout the growing season. Coffee, pepper, and cardamom are particularly suitable due to the humid climate and forest-like ecological conditions. Banana, tapioca, and rubber can also be cultivated in suitable areas. The zone possesses significant potential for horticulture, agroforestry, spice cultivation, and sericulture, which can contribute to sustainable economic development while maintaining environmental stability.

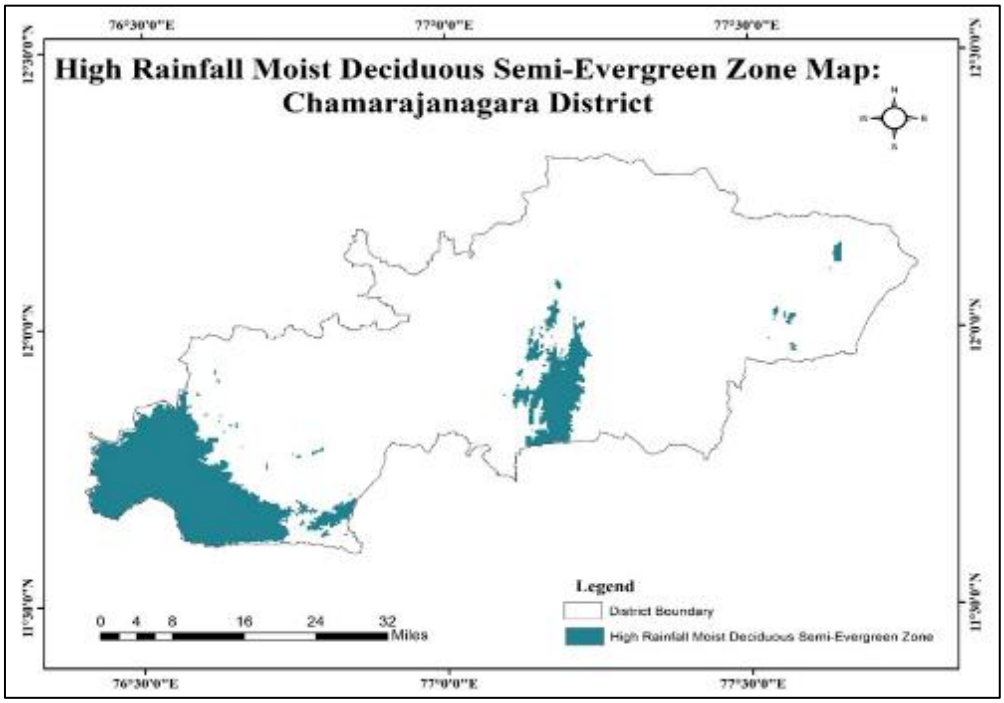

Figure 7: High Rainfall Moist Deciduous Semi-Evergreen Zone Map Chamarajanagara District

5 CONCLUSION

Agriculture in Chamarajanagara District is highly dependent on climatic and geomorphological conditions. Therefore, farmers should select and cultivate crops that are suitable for the local climate and physical characteristics of their region. Cultivating crops according to the environmental conditions of each area can improve crop productivity, reduce the risk of crop failure, and increase farmers' income. In this study, Micro Physio-Agro Climatic Zones were identified using a geomorphological and GIS-based approach by integrating key environmental parameters such as elevation, rainfall, temperature, vegetation, and drainage density. Based on these identified zones, suitable crops were recommended according to the agro-climatic characteristics of each zone. The proposed crop recommendations provide a scientific basis for location-specific agricultural planning and can help farmers make informed decisions about crop selection. Adopting these recommendations is expected to improve agricultural productivity, promote efficient use of land and water resources, enhance climate-resilient farming, and reduce the effects of land degradation and desertification.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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- District at a Glance, Chamarajanagar (1995–96 to 2024–25) – crop and agricultural statistics.
- ArcGIS and QGIS – spatial analysis, map preparation, and weighted overlay.

Disclosure of conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this research paper. All four authors have contributed to the research and preparation of the manuscript and have no financial, personal, or professional interests that could influence the study or its findings.

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