



CLIMATE-ADAPTIVE CROPPING PATTERNS FOR SUSTAINABLE AGRICULTURE IN DINDIGUL, TAMIL NADU: STRATEGIES FOR RESILIENCE ACROSS DIVERSE CULTIVATION SYSTEMS

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Abstract

This study explores the optimal cropping patterns for the Dindigul district in Tamil Nadu, considering the region's diverse weather conditions and the challenges posed by climate change. The research aims to provide actionable insights for farmers and agricultural planners to enhance crop productivity and sustainability under varying climatic scenarios. The study examines the impact of seasonal variations, including monsoons, dry spells, and temperature fluctuations, on crop selection, planting schedules, and agricultural practices. The research also investigates the traditional and modern cultivation systems prevalent in Dindigul, a region known for its agricultural diversity and productivity. The primary objective is to analyze the evolution of cultivation practices, from traditional methods rooted in indigenous knowledge to modern techniques shaped by technological advancements and market demands. Utilizing historical weather data, soil profiles, and crop performance records, the study identifies the most suitable crops for each weather condition. The findings indicate that a diversified cropping strategy—incorporating millets, pulses, and short-duration cash crops during dry spells, and water-intensive crops like paddy and sugarcane during favorable monsoon seasons—can significantly enhance resilience and productivity. The study suggests three major cultivation areas: command areas under tank-fed irrigation, well-irrigated areas (including bore wells), and rainfed areas. Based on the existing cropping patterns in Dindigul district, specific cropping strategies are recommended for normal rainfall years, moderate drought years, and severe drought years for these three categories. Additionally, the study advocates for integrating agroforestry and mixed cropping systems to reduce vulnerability to extreme weather conditions.

This research provides a comprehensive framework for developing dynamic cropping calendars tailored to the contemporary climatic realities of Dindigul, offering practical solutions for sustainable agriculture in the region.

Key words: Climate Adaptation, Cropping Patterns, Sustainable Agriculture, Drought Resilience, Dindigul district

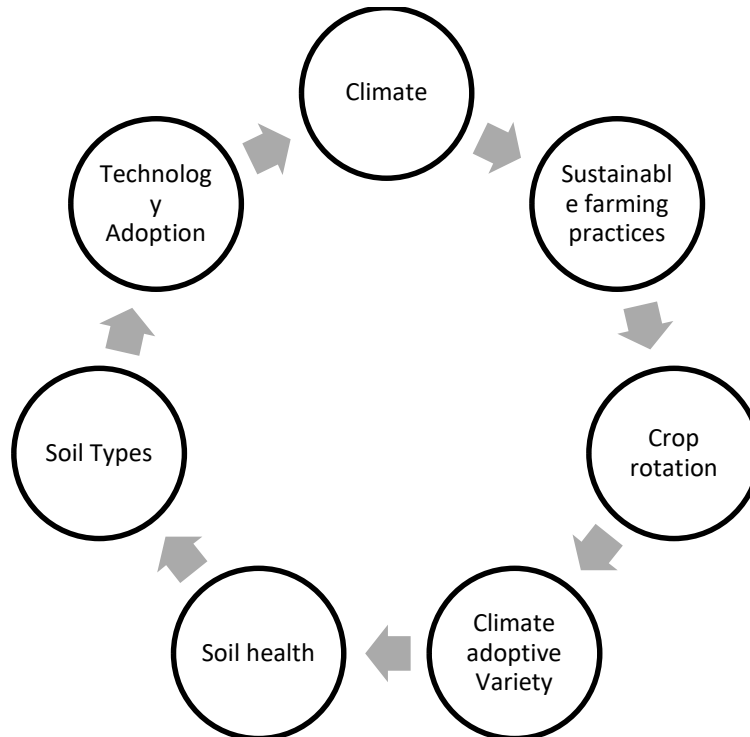
INTRODUCTION

Tamil Nadu is divided into seven agro-climatic zones, each with distinct climatic conditions, soil types, and agricultural practices. These zones are defined based on factors such as rainfall patterns, temperature, altitude, and soil characteristics, which influence the suitability of specific crops and farming systems. Among the agro-climatic zones, Dindigul district is comes under western zone. Dindigul has a semi and tropical monsoon type, which is suitable for various crops. The district receives most of its rainfall from the northeast monsoon, with uneven distribution across the region. The western parts of Dindigul receive more rainfall due to the influence of the Western Ghats. However, the district also experiences variability in rainfall, which can lead to periods of water scarcity. Effective water and crop management practices are crucial to mitigating these challenges. According to the climatic condition, cropping pattern is followed in agriculture. A cropping pattern refers to the sequence and spatial arrangement of crops, or a combination of crop production and fallow (unplanted) periods, on a specific piece of land. Adjusting the cropping pattern can be both desirable and feasible to enhance productivity and increase overall production. In Dindigul district, there are three main cropping seasons, each with its own unique characteristics and major crops (E. Sathyapriya, Rexlin Selvin, 2017). The first season, Chittirai Pattam, typically begins with sowing in April-May and harvesting in August-September. During this season, millets and cotton are the primary crops cultivated. It has been a tradition among farmers in this region to start plowing on the first day of the Tamil month of



Chithirai. The second season, Adipattam starts with sowing in July-August and harvesting in January-February, with paddy and sugarcane being the dominant crops, typically taking more than 145 days to mature. Lastly, Thai pattam which spans from December-January to February-March, focuses on the cultivation of fruits, vegetables, cucumbers, and watermelons. Understanding these cropping seasons is essential for effective agricultural planning and management in Tamil Nadu.

FACTORS INFLUENCING CROPPING PATTERNS



OBJECTIVES OF THE STUDY:

1. To Analyze climate impacts of the Dindigul district.
2. To investigate the traditional and modern cultivation systems prevalent in Dindigul
3. To determine the most suitable cropping patterns for different weather conditions, including normal rainfall years, moderate drought years, and severe drought years, across various cultivation areas such as tank-fed, well-irrigated, and rainfed regions.
4. To create a comprehensive framework for developing dynamic cropping calendars tailored to the contemporary climatic realities of Dindigul

MATERIALS AND METHODS

STUDY AREA

The research was conducted in the Dindigul district of Tamil Nadu, located in the Western Zone, which is characterized by semi-arid and tropical monsoon climates. The district is agriculturally diverse, with significant variations in soil types, rainfall patterns, and temperature. The study focused on three major cultivation areas within the district: tank-fed irrigation areas, well-irrigated areas (including bore wells), and rainfed areas. These regions were selected to assess the impact of different irrigation practices and climatic conditions on cropping patterns. Dindigul district was established on September 15, 1985, after being carved out of the Madurai district in Tamil Nadu, India. Dindigul's diverse landscape



features expansive hilly and rocky areas interspersed with undulating plains. The Palani Hills, an extension of the Western Ghats in the north, dominate the region with elevations ranging from 1,000 to 2,700 meters. The upper plains, averaging 2,500 meters in height, are characterized by valleys and peaks such as Perumal Hill and Vandarvey Hills. The terrain consists of plateaus with rolling downs, covered in coarse grasses and isolated jungles, and is punctuated by peaks ranging from 1,000 to 1,700 meters in height. These peaks, including Thandigudi, Virupatchi, and Palani Hills, are separated by steep and picturesque wooded valleys. On the eastern side, the landscape is marked by the Sirumalai, Alagar Malai, Natham, and Ayyalur hills. Scattered throughout the region are isolated peaks, including the sacred Karumalai, the tapering Kodarangimalai, the iconic rock of Dindigul, and Ranagamalai, each contributing to the region's unique topography.

Dindigul city serves as a vital hub for the wholesale trade of onions and groundnuts, catering to regional demand. Nearby Oddanchatram has established itself as a key market center for vegetables and is also recognized for exporting high-quality butter, produced in local villages using cream separators. Batlagundu has emerged as a significant market center for tomatoes and banana leaves, meeting the needs of both local and regional customers. In the Batlagundu block, Pattiveeranpatti has carved a niche as a center for cardamom and coffee processing enterprises, leveraging the region's rich agricultural produce. Nilakottai Taluk has become a hub for the cultivation and marketing of flowers and grapes, showcasing the region's diverse agricultural capabilities.

DATA COLLECTION

This study examines the cropping pattern in Dindigul district through a comprehensive analysis of secondary data sources. Researcher collected data from a range of sources, government reports, agricultural statistics, and research studies on cropping patterns in Dindigul district, obtained from sources such as the Department of Agriculture, Tamil Nadu Agricultural University, peer-reviewed articles from reputable academic journals such as the Indian Journal of Agricultural Sciences and Journal of Agrometeorology. Additionally, online databases were searched using a systematic strategy to identify relevant and credible sources. This multi-faceted approach ensured a comprehensive and diverse dataset for analysing climate-resilient agricultural practices in the region. The data collection process aimed to capture the diversity of cropping patterns, including crop selection, rotation, and seasonality, to provide a nuanced understanding of agricultural practices in Dindigul district. Dynamic cropping calendars were developed for the three cultivation areas based on the findings from the cropping pattern analysis. These calendars provided detailed guidelines on crop selection, planting schedules, and irrigation practices tailored to the specific climatic conditions of Dindigul.

CLIMATE FACTORS OF DINDIGUL DISTRICT

- Mean annual rainfall (mm) -862.8
- Cold weather period (Jan.-Feb) -38.0
- Summer (March-May) -174.2
- South West monsoon season (June-Sept) -251.4
- North East monsoon season (Oct.-Dec.) -399.2

EXISTING CROPPING PATTERN IN DINDIGUL DISTRICT

Source of Irrigation	Soil Type	Cropping pattern
Command areas	Heavy clay soils	Rice (Oct.-Jan.) - pearl millet/vegetables/sesame/ pulses/groundnut (Feb.-May)
		Sugarcane (Dec.-Nov.) - single crop



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Source of Irrigation	Soil Type	Cropping pattern
		Banana (June-March) - ratoon banana (April-Jan.) – 2 years rotation
Well Water irrigated areas	Red and black soils	Sugarcane (March-Jan.) - single crop
		Sugarcane (Feb.-Dec.) - single crop
		Cotton (Aug.-Dec.) - millets / vegetables (Jan.-April) - groundnut (May-July)
		Rice (Aug.-Jan.) - vegetables / millets / groundnut / pulses (Jan.- April)
Rainfed areas	Red and black soils	Groundnut / maize / millets / pulses (July-Oct.) -pulses (Oct.-Jan.)
		Groundnut (June-Sep.)-maize/pulses (Oct.-Nov.)

The existing cropping pattern in Dindigul district is structured based on three main types of irrigation sources: command areas, well-irrigated areas, and rainfed areas. Each type of area has different soil types and supports various cropping sequences.

1. Command Areas (Heavy Clay Soils):

- *Rice*: Grown from October to January, followed by pearl millet, vegetables, sesame, pulses, or groundnut from February to May.
- *Sugarcane*: Cultivated as a single crop from December to November.
- *Banana*: Grown from June to March, with a rotation of ratoon banana from April to January over a two-year period.

2. Well Irrigated Areas (Red and Black Soils):

- *Sugarcane*: Cultivated as a single crop either from March to January or from February to December.
- *Cotton*: Grown from August to December, followed by millets or vegetables from January to April, and groundnut from May to July.
- *Rice*: Grown from August to January, followed by vegetables, millets, groundnut, or pulses from January to April.

3. Rainfed Areas (Red and Black Soils):

- *Groundnut / Maize / Millets / Pulses*: Grown from July to October, followed by pulses from October to January.
- *Groundnut*: Cultivated from June to September, followed by maize or pulses from October to November.

This pattern shows a diverse use of crops that are grown in rotation based on the available water source and soil type, optimizing agricultural output throughout the year in Dindigul district.



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RECOMMENDED CROPPING PATTERN FOR DINDIGUL DISTRICT

Source of Irrigation	Climatic Year	Cropping pattern
Command Areas	Normal Year	- Rice (Oct.-Jan.) - vegetables / groundnut/ gingelly (Feb.-May) - Banana (June-March) - ratoon banana (April-Jan.) - Sugarcane (Dec.-Nov.) - single crop 2 years rotation
	Moderate Drought Year	- Maize (Aug.-Nov.) - pulses/ gingelly (Dec.-Mar.) - Clusterbean / lab lab / bhendi / sunflower / gingelly (Oct.-Feb.)
	Severe Drought Year	Pulses / gingelly/ fodder sorghum / pearl millet (Aug.-Feb.)
Well water irrigated Areas	Normal Year	- Sugarcane (Feb.-Dec.) - single crop - Cotton (Aug.-Dec.) - millets / vegetables (Jan.-April) - groundnut (May-July) - Rice (Aug.-Jan.) - vegetables / millet / groundnut / pulses (Jan.- April) - Annual moringa (June sowing) - ratoon moringa - (2 years rotation) - Cotton (Aug.-Dec.) - coleus* (Jan.-July) - Cotton (Aug.-Jan.) – sweet sorghum (Feb.-May) – greenmanure (Jun- July) - Groundnut (Jun-Sept.) – sugarbeet* (Sep.-Feb.) – Sweet sorghum* (Feb.-May) - Groundnut (Jun-Sept.) – jatropha* (Sept. sowing)
	Moderate Drought Year	- Maize (Aug.-Dec.) - clusterbean / lab lab / bhendi (Jan.-April) - Pulses (Aug.-Nov.) - wheat (Nov.-Feb.) - Clusterbean / lab lab / bhendi (Oct.-Jan.) - millets / groundnut (Jan.-April)
	Severe Drought Year	- Clusterbean / lab lab / bhendi (Oct.-Feb.) - Minor millets / fodder (Aug.-Dec.)
Rainfed Areas	Normal Year	- Groundnut + pulses / maize / millets / pulses (July-Oct.) - pulses (Oct.-Jan.) - Groundnut (June-Sep.)-maize/pulses/sunflower (Oct.-Nov.) - Castor + pulses (July-Jan.)
	Moderate Drought Year	- Castor + pulses (July-Jan.) - Maize (Sep.-Dec.) - fallow
	Severe Drought Year	- Sorghum / pearl millet / minor millets / pulses / sunflower / fodder (Oct.-Jan.) - fallow - Millet / pulses (July-Aug.) - fallow

The recommended cropping pattern for Dindigul district is designed to optimize agricultural productivity based on varying climatic conditions (normal, moderate drought, and severe drought) and available irrigation sources.



KEY RECOMMENDATIONS:

- The cropping patterns are diversified to handle various climatic scenarios, ensuring sustainability and resilience against drought.
- Normal years encourage a diverse range of crops, including high-value crops like rice, sugarcane, and banana.
- During moderate droughts, patterns shift to include more drought-tolerant crops like maize, pulses, and millets.
- In severe drought conditions, the emphasis is on low water-requirement crops such as pulses, minor millets, and fodder crops.

This strategy aims to maintain productivity and reduce risks associated with variable rainfall and water availability.

CROP MANAGEMENT PLAN

A well-structured Crop Management Plan (CMP) is advocated for optimizing agricultural productivity and sustainability in Dindigul district. This plan addresses various aspects of crop cultivation, including crop selection, soil management, irrigation practices, pest control, and harvesting techniques. Given the district's diverse agricultural landscape, the CMP aims to enhance yields, ensure efficient resource use, and promote sustainable practices. CMP involves selecting the most suitable crops from a range of options, considering factors like available resources, social needs, and environmental constraints. However, traditional crop planning approaches focused on maximizing crop yield per unit of land or water may not be sufficient for optimal decision-making in water-scarce command areas. To allocate water resources effectively, it's crucial to consider the following: Irrigation management, high-yielding varieties, fertilizer and nutrients, along with input costs and market value of farm produce.

A linear programming model helps maximize profits from farming by finding the best combination of crops and management practices. It considers limits on water, land, and crop area to determine the most profitable plan. The model uses data on profits and crop areas to find the optimal solution, taking into account different levels of water and fertilizer use. The goal is to create a practical and profitable farming plan that maximizes return.

A well-planned crop calendar is crucial for maximum production. This includes planting at the right time, rotating crops, and maintaining canals. Planting at the right time increases yields and reduces pests and diseases. It is important to plan the crop calendar from the start to use water efficiently. Soil Testing conduct regular soil tests to assess nutrient levels and soil health. This process is crucial to determine cropping pattern, yield prediction and maintaining proper soil health.

CONCLUSION

This study has provided a comprehensive analysis of optimal cropping patterns for the Dindigul district, taking into account the region's diverse climatic conditions and the growing challenges posed by climate change. By examining the impacts of seasonal variations such as monsoons, dry spells, and temperature fluctuations on crop selection and agricultural practices, the research offers valuable insights for enhancing both crop productivity and sustainability. The investigation into traditional and modern cultivation systems in Dindigul revealed that a diversified cropping strategy is essential for improving resilience and productivity. Incorporating crops like millets, pulses, and short-duration cash crops during dry spells, alongside water-intensive crops such as paddy and sugarcane during favorable monsoon seasons, emerged as effective approaches.

The study's recommendations for specific cropping strategies across the three major cultivation areas tank fed irrigation, well-irrigated areas, and rainfed regions offer tailored solutions for normal, moderate drought, and severe drought years. Furthermore, the integration of agroforestry and mixed cropping systems is advocated to mitigate the risks associated with extreme weather conditions. In conclusion, this research provides a robust framework for developing dynamic cropping calendars that align with the contemporary climatic realities of Dindigul. The findings and recommendations serve as



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practical tools for farmers and agricultural planners, supporting sustainable agricultural practices that can adopt to the challenges of climate variability, ensuring long-term food security and economic stability in the region.

Reference

1. Sathyapriya. E, Rexlin Selvin, (2017), Crop Diversification in Dindigul District – A Temporal Analysis, International Journal of Agricultural Science and Research (IJASR) ISSN (P): 2250-0057; ISSN (E): 2321-0087 Vol. 7, Issue 5, Oct 2017, 375-380
2. Panda S.C., Principles and Practice of Water Management, AGROBIOS (INDIA) Jodhpur, 2018
3. Sebak Kumar Jana, Tank Irrigation of Dry Zones in India, Concept Publishing Company (P) LTD, 2014
4. Sourajit Mustafee, Fundamentals of Agriculture II Edition, Vinod Kumar Jain, Scientific International (Pvt) Ltd, New Delhi, 2018.
5. Jana B.L., Cropping Systems for Sustainable Farming, Pointer Publishers, Jaipur, 2023.
6. https://agritech.tnau.ac.in/agriculture/agri_agrometeorology_croppingpattern_westernzone.html
7. <https://tnau.ac.in/tamil-nadu-agro-climatic-zones/>
8. <http://www.tn.gov.in/sta/a2.pdf>