

# Inter-Cropping: An Empirical Study in Warangal District of Telangana State

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**Abstract:** Agriculture is the backbone of every developing economy in the same way in the case of Warangal district. The main economic activity of Warangal district consists of agricultural use of 60-65% of the total land area which amounts to 770,000 to 835,000 hectares. The availability of irrigation facility reaches only 25-30% of this agricultural land therefore most farmers solely depend on rain for crop cultivation. The dependence on erratic monsoons produces substantial problems for farmers' productivity while resulting in multiple agricultural disasters along with soil erosion and production volatility. Intercropping presents itself as a sustainable farming system that surpasses mono-cropping benefits by integrating two or more crops simultaneously. This research paper examines different intercrop patterns used in the Warangal district which contribute to water conservation alongside improving soil fertility, pest management and increased climate adaptability. The practice of intercropping provides farmers with improved water management across their farms particularly for conditions of unreliable rainfall. Intercropping brings two key advantages: it enhances biodiversity in agricultural systems while minimizing production expenses which generate increased incomes from diverse yield offerings. The research recommends appropriate intercropping systems for Warangal's weather characteristics that include Cotton and Red Gram as well as Maize with Cowpea, Groundnut with Sunflower, and Chili with Onion and Coriander which benefit the soil health and resource management. Inter-planting establishes itself as an economical production method benefiting both the environment and the economy to help farmers in Warangal address their agricultural issues. The implementation of intercropping leads farmers to greater productivity alongside better climate resistance and sustainable agricultural advancement which ensures permanent food security throughout the entire region.

**Index Terms:** Agriculture, Intercropping, Irrigation, Production, Rain-fall, Food security

## 1. INTRODUCTION

The Indian economy relies on agriculture as its principal support while most people derive their existence from agricultural activities. The district of Warangal in Telangana heavily relies on agriculture as its main sector to support rural people and provide food security to citizens. Traditional farming practices including mono-cropping have caused multiple problems for farmers through their impact on soil quality decline, resource management issues, and environmental sensitivity. The local farming community now evaluates various alternative farming approaches because they aim to boost yield rates and develop sustainable practices.

The agricultural practice of intercropping has become more important because farmers deliberately plant multiple crops in their fields without separate cultivation areas. The intercropping method achieves efficient land utilization as well as soil fertility improvement increases biodiversity and protects against climate change volatility. The practice of intercropping holds great importance in Warangal because its agricultural region encompasses 60-65% of total land but only 25-30% of this area has irrigation systems. Rain-fed farming dominates the majority of the agricultural land so intercropping stands out as a sustainable strategy to strengthen crops and lower water requirements.

In the Warangal District of Telangana, the main occupation supports a large segment of residents through agriculture. The practice of regular monoculture has generated several problems because it leads to soil fertility decline and intensified pest problems together with ineffective resource usage and climate-sensitive systems. The development of intercropping has emerged as an effective approach that simultaneously raises agricultural output while strengthening soil conditions and preserving farming sustainability.

Intercropping adoption faces challenges from the combination of labor demands and difficulties with equipment usage together with variable financial returns.

## 2. OBJECTIVE

- To evaluate the effectiveness of intercropping practices compared to other cropping patterns.
- To assess the significance and socio-economic impacts of intercropping patterns in agriculture.
- To study the challenges faced by farmers of Intercropping in Erstwhile Warangal District.
- To analyze the existing intercropping pattern in the Warangal district and recommend optimized models that enhance farmers' income and agriculture sustainability.

## 3. METHODOLOGY

The primary data has been collected from 100 intercropping farmers in erstwhile Warangal district of Telangana state through a structured questionnaire. Meetings with agriculture officers were also conducted to gain further insights. The relevant secondary data is collected from the reports of State and Central Governments, the Socio-Economic Outlook of Telangana, Journals, and other independent published sources.

## 4. REVIEW OF LITERATURE

Two or more crop plants grown together in one field through intercropping helps maximize resource usage for improved agricultural production. Food security together with sustainability remains key focal points according to Andrews & Kassam (1976) when studying this practice. Intercropping increases the land equivalent ratio (LER) of available land resources according to Willey (1979). The process of intercropping improves nitrogen fixation especially when legumes are included according to the findings of Rao & Willey (1980). The practice of intercropping promotes better soil fertility in Telangana's semi-arid climate as concluded by Shankar et al. (2018). Intercropping serves as an economic method to keep farm income consistent according to studies. Decertified cropping methods identified by Yadav & Chauhan (2019) act as risk mitigation tools that produce financial advantages for farmers. Intercropping systems create management obstacles that lead to rising workforce demands along with issues in equipment operation (Maitra et al., 2021). The limited availability of

irrigation systems coupled with weak market accessibility in Warangal District prevents farmers from adopting this practice (Reddy & Kumar, 2017). Rain-fed farming is common in Warangal District so intercropping serves as an appealing approach for protecting resources among local farmers. Intercropping cotton with legumes according to research helps to control pests and improve soil quality (Narayanaswamy et al., 2016). The implementation of technical innovations remains restricted due to small farm sizes alongside financial difficulties for farmers (Telangana Agricultural University Report, 2022).

## 5. SIGNIFICANCE OF INTERCROPPING PATTERN IN WARANGAL DISTRICT

Warangal district, located in the Telangana region of India, is predominantly an agrarian economy where nearly 60-65% of the total land is devoted to agriculture. This translates to approximately 770,000 to 835,000 hectares of farmland. However, a major challenge faced by farmers in this region is the limited availability of irrigation facilities, with only 25-30% of the agricultural land having access to assured water supply. The remaining farmland, which constitutes the majority, is rain-fed and highly dependent on the seasonal monsoon. This makes farming vulnerable to droughts, erratic rainfall patterns, and climate change effects.

## 6. DATA ANALYSIS

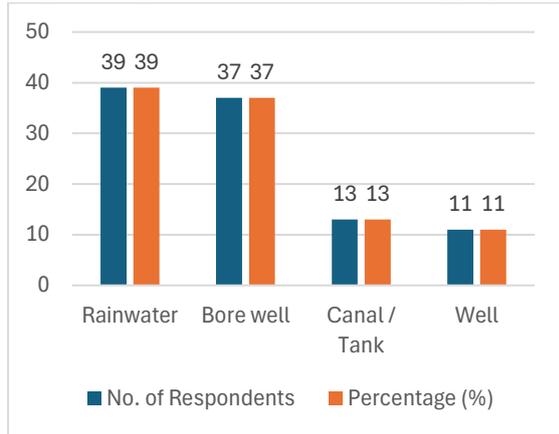
The data collected through structured schedule is analysed using with different tools. The irrigation facilities, water requirement, duration practice, cost of production and profitability of intercropping are analysed below.

Table 1: Irrigation Facilities for Intercropping

S. No.	Source of water	No. of Respondents	Percentage (%)
1	Rainwater	39	39
2	Bore well	37	37
3	Canal / Tank	13	13
4	Well	11	11
Total		100	100

(Source: Field Data)

Graph 1: Irrigation Facilities for Intercropping



(Source: Field Data)

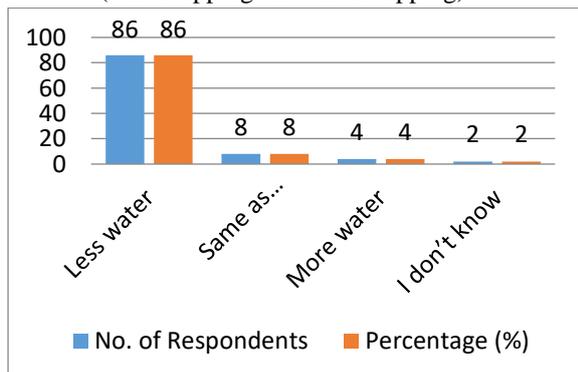
The above table 1 and bar diagram 1 show that 39% of respondents depend on rainwater as their primary water source. Only 37% use bore wells, and 13% rely on wells. The low reliance on canal/tank irrigation (11%) suggests limited access to government irrigation schemes, making farmers highly dependent on seasonal rainfall, which makes their agricultural productivity climate-sensitive. Still, a large section of farmers depends on monsoon rains especially for crops like cotton, pulses, and millet.

Table 2: Water Requirement Comparison (Intercropping vs. Monocropping)

S. No.	Water Requirement	No. of Respondents	Percentage (%)
1	Less water	86	86
2	Same as monocropping	08	08
3	More water	04	04
4	I don't know	02	02
Total		100	100

(Source: Field Data)

Graph 2: Water Requirement Comparison (Intercropping vs. Monocropping)



(Source: Field Data)

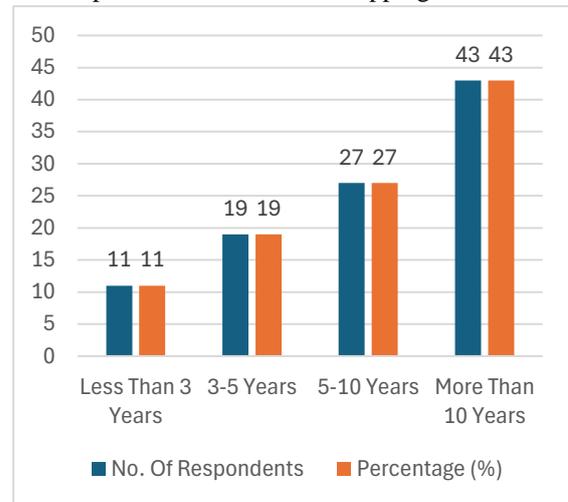
The above table 2 clearly shows that 86% of respondents believe intercropping requires less water than monocropping, making it a water-efficient farming practice. 8 % respondents said it requires as same as monocropping. Only 4% reported that intercropping needs more water, indicating its suitability for areas with water scarcity. The same data is shown in graph 2. A significant majority (86%) percentage intercropping as water saving practice, suggesting it may be a more sustainable agricultural method with uses less water.

Table 3: Duration of Intercropping Practice

Sl. No.	Duration	No. Of Respondents	Percentage (%)
1.	Less Than 3 Years	11	11
2.	3-5 Years	19	19
3.	5-10 Years	27	27
4.	More Than 10 Years	43	43
Total		100	100

(Source: Field Data)

Graph 3: Duration of Intercropping Practice



(Source: Field Data)

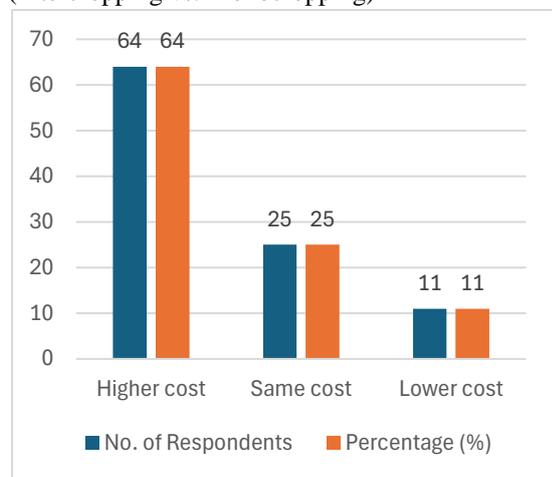
The table 3 indicates that 43% of respondents have been practicing intercropping for more than 10 years, and 27% for 5–10 years. 19 % and 11% of respondents are practicing the intercropping for 3-5 years and less than 3 years respectively. This demonstrates that intercropping is a well-established practice among farmers in the region. It reflects the long-term adoption and reliance on intercropping as a sustainable agriculture practice in the Warangal district.

Table 4: Cost of Production Comparison (Intercropping vs. Monocropping)

S. No.	Cost of production of Monocropping	No. of Respondents	Percentage (%)
1.	Higher cost	64	64
2.	Same cost	25	25
3.	Lower cost	11	11
	Total	100	100

(Source: Field Data)

Graph 4: Cost of Production Comparison (Intercropping vs. Monocropping)



(Source: Field Data)

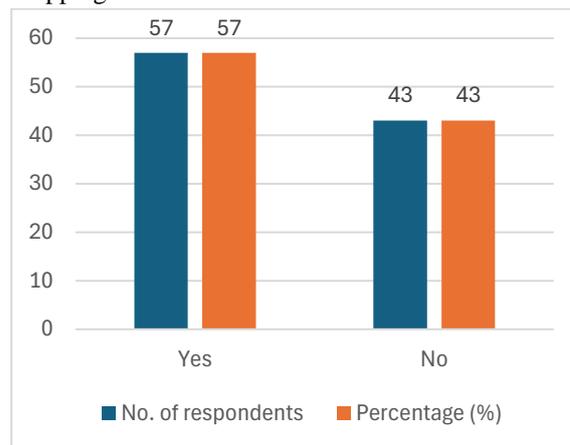
The above table 4 shows that 64% of respondents reported higher costs in intercropping compared to monocropping. But 25% of respondents opined same cost. Only 11% found intercropping to be cheaper. This suggests that while intercropping has benefits, its higher input costs may be a concern for many farmers. While intercropping is a widely adopted practice in Warangal, this table suggests the cost remains a major concern. Farmers may be requiring financial support subsidies, cost cost-effective techniques to make intercropping more reliable.

Table 5: Profitability of Intercropping vs. Monocropping

S.No.	Respondents option	No. of respondents	Percentage (%)
1.	Yes	57	57
2.	No	43	43
	Total	100	100

(Source: Field Data)

Graph 5: Profitability of Intercropping vs. Monocropping



(Source: Field Data)

In the table 5 the details of profitability of intercropping vs. Monocropping is shown. It indicates that 57% of respondents perceive intercropping to be more profitable compared to monocropping, while 43% do not share this view. This suggests that a slight majority of farmers find financial benefits in intercropping, potentially due to better resource use or diversification of income. However, the substantial proportion of farmers who do not find it more profitable indicates that profitability can vary based on factors like crop choices, market access, and individual farming conditions.

## 7. MAJOR FINDINGS

According to the study, findings are as follows.

- Intercropping presents a potential solution for Warangal farmers who operate smaller land plots because their average size stands at 1.6 acres based on existing research. The traditional crops such as cotton and maize in addition to pulses which have always grown in this region are consistent with these findings.
- Warangal observed a transition from sorghum and pulses cultivation in the 1960s to commercial crops such as cotton and chilies during the 1980s leading to a requirement for sustained yield stability. The agricultural system of intercropping functions to safeguard farmers by decreasing vulnerability to market instability and pest-like entities such as the cotton bollworm.
- The fertility of black cotton soils in Warangal remains threatened by intensive monocropping of cotton but legume intercropping can help preserve soil health because these farmers

depend solely on natural fertility.

- The major cotton cultivation area in Warangal since 1990 is highly vulnerable to insect infestations and weed growth. Intercropping serves as an economical pest management solution particularly vital for the cotton-growing small-scale farmers who took up commercial agriculture after the arrival of Guntur settlers.
- Rainfed agricultural land which occupies an area larger than 50% of Warangal remains exposed to unpredictable monsoon conditions. The practice of intercropping matches traditional methods for crop diversification that have been observed in the district since the 1960s and helps stabilize yield production.
- The Warangal area faces obstacles to farmer adoption because its small landholders lack access to market infrastructure for pulses and agricultural machinery. The previous practice of combining crops demonstrated local farmers are prone to accept new agricultural methods.

#### 8. SUGGESTION

- The program to be implemented which offers payment discounts for seeds along with organic fertilizers and irrigation tools built solely for intercropping practices.
- The agricultural extension services must receive funding to provide training for farmers about optimal intercropping plans along with best production methods.
- Research and development of affordable farming machines specifically designed for intercropped operations should be established to sow seed and weed and harvest fields.
- Low-interest credit facilities through credit schemes should become available to farmers interested in implementing intercropping.
- The increased crop insurance protection of intercropping systems may ensure farmers receive financial support when climate conditions lead to crop failures.
- Soil Health Monitoring should include the establishment of testing laboratories that will help farmers manage their nutrients according to intercrop selection.
- Agroforestry integration through tree-based intercropping of fruits with legumes allows land productivity enhancement while expanding biodiversity.
- A direct market connection between farmers

and food processing industries and supermarkets should be developed to establish fair prices for farmers.

#### 9. CONCLUSION

Intercropping faces several obstacles that reduce its adoption by farmers. The practice of intercropping involves high labour requirements while also having increased setup expenses and minimal machine use capabilities and restricted marketing possibilities for the cultivated plants. The majority of farmers demonstrate insufficient understanding about suitable intercropping methods and effective management techniques. Strategic policy backing along with economic motivators must be coupled with agricultural teaching programs and scientific research solutions to boost Warangal's intercropping adoption rates. Better adoption of intercropping will result from improved extension services combined with mechanical solutions for farming and enhanced market networks. The implementation of drought-tolerant agricultural mixes together with soil preservation techniques will improve intercropping success in Warangal's arid environment. Inter-conceptual farming stands as a proven solution for sustainable farming success in Warangal District. The combination of resolving existing limitations with supportive environmental measures makes intercropping serve as an effective strategy to achieve sustainable food security and enhanced farmer incomes across the region.

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