

An Economic Analysis of Paddy Cultivation with Special Reference to Tamil Nadu

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Abstract

The expenses, returns, profitability, and difficulties faced by farmers are the main topics of this study's economic analysis of paddy production in Tamil Nadu's Madurai District. As a main food crop, paddy is essential to the region's agricultural economy. By analyzing several aspects of the cultivation process, such as the expenses of inputs like seeds, fertilizers, labor, and irrigation, as well as the income from crop yields, the study assesses the economic feasibility of paddy farming. A standardized questionnaire was used to survey 100 paddy farmers, and secondary data from government agricultural departments was added. The results show that although paddy farming is typically lucrative, the net returns are frequently marginal because of shifting market prices and rising input costs. The report highlights several major issues, such as a lack of access to institutional credit, high labor costs, and water shortages. The investigation reveals notable variances in farmers' profitability, which can be linked to changes in farm size, the use of contemporary agricultural methods, and the availability of water resources. Policymakers and agricultural extension services can use this research's insightful findings to develop measures that will improve the region's paddy cultivation's economic sustainability, such as encouraging water-efficient technology and offering improved price support systems.

Keywords: Paddy Cultivation, Economic Analysis, Madurai District, Farm Profitability, Agricultural Economics, Tamil Nadu

Introduction

Rice (paddy) is paramount to India's food security, establishing the country as one of the world's primary producers of both white and brown rice. India's contribution constitutes approximately 20 percent of the total global rice production. Furthermore, India has historically been a strong net exporter, shipping substantial quantities of both Basmati and Non-Basmati varieties worldwide, with imports remaining negligible during the period from 2009-10 to January 2017.

Within the national context, Tamil Nadu plays a significant role, contributing seven percent to India's overall rice output. The state dedicates 19 lakh hectares of land to paddy cultivation. A notable achievement for Tamil Nadu is its per hectare productivity, which stands highest among all Indian states at an impressive 3900 kg. This superior efficiency allows the state to secure the fifth position nationally in terms of total production, despite cultivating a smaller land area than some other states. In 2016, Tamil Nadu's total rice production reached 75.85 lakh tonnes.

Production is fundamentally defined as the process by which various inputs (goods and services) are converted or transformed into desired outputs (goods and services). This comprehensive process involves several steps, including changes in the product's form, location, and time of use, all of which require the application of resources. The resulting quantity of farm output is directly dependent upon the level and combination of inputs employed in the process.

This critical input-output relationship is scientifically characterized by a production function. A production function provides a framework for predicting the expected quantity of output when specific inputs are combined in a particular manner, with the outcome being determined by the chemical, physical, and biological properties inherent in the production system.

While the Madurai district has been the subject of numerous agricultural research projects, studies specifically focusing on paddy cultivation are noticeably limited. The current study is therefore designed to empirically investigate the resource use efficiency of input factors in paddy cultivation. Given the importance of farming to the regional economy, assessing the efficiency of input utilization in paddy farming is significant for the rural development trajectory of the Madurai District in Tamil Nadu. This research attempts to evaluate this resource use efficiency across the entire sampled population of farms within the district.

Review of Literature

Several seminal studies have employed production function analysis to explore resource utilization and efficiency in Indian agriculture:

Rajkrishna (1964) estimated a Cobb-Douglas production function using farm management data collected from two districts in Punjab between 1954–55 and 1956–57. His analysis employed a simple linear regression model to investigate the relationship between output and labor. Rajkrishna concluded that farmers in Punjab were optimally utilizing their available resources, a finding based on the marginal product of each input factor equaling its respective acquisition cost.

Hanumantha Rao (1965) utilized the production function approach as an analytical tool for agricultural data. Specifically, he applied the Cobb-Douglas function to establish the relationship between agricultural output and the key inputs of land and labor.

Junakar (1999) conducted a study to test the combined assumption of profit-maximizing behavior and competitive market participation among Indian farmers. The research relied on cross-sectional data collected from paddy growers in the Thanjavur district of Tamil Nadu during the 1969–70 agricultural year.

More recently, Kalirajan (2020) examined the economic efficiency of various farmer groups. His methodology involved the use of a profit function, alongside four separate variable input demand equations that related to the usage of labor, chemical fertilizers, pesticides, and bullock pair units.

Statement of the Problem

Paddy cultivation occupies a central and critical position in India's agricultural sector, serving as the bedrock of national food security and a vital source of income for millions of rural families. In Tamil Nadu, the Madurai district is a crucial contributor to the state's rice production, with paddy farming being deeply integrated into the regional economy.

Despite this vital role, the farmers engaged in paddy production in Madurai are currently confronting numerous and complex economic obstacles that threaten the long-term viability and profitability of their operations. Initial findings from the literature and on-the-ground observations suggest that while farming output has experienced modest gains, the overall socio-economic well-being of paddy farmers remains highly vulnerable.

The key challenges identified include the sharp escalation of input costs—such as seeds, fertilizers, and labor—combined with volatile, frequently low-yielding market prices for the

final harvest. Furthermore, the region's vulnerability to erratic weather patterns, including unpredictable monsoons and recurrent droughts, presents a significant risk to crop yields and income stability. The combined impact of these pressures often culminates in reduced net returns, growing farmer debt, and generalized agrarian distress among the farming populace.

Objectives of the Study

1. To analyze the trends in area, production, and yield of paddy in India over the period 1993–94 to 2023–24.
2. To examine the crop-wise and district-wise patterns of agricultural production, with special reference to paddy cultivation in Tamil Nadu.

Methodology

The present study is based entirely on secondary data and adopts a descriptive and analytical research design to examine trends in paddy cultivation and agricultural production in India with special reference to Tamil Nadu. Secondary data were collected from reliable and authentic published sources, including the Directorate of Economics and Statistics (DES), Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare, Government of India, Agricultural Statistics at a Glance, Economic Survey of India, FAOSTAT publications, Reserve Bank of India reports, and Season and Crop Reports published by the Department of Economics and Statistics, Government of Tamil Nadu. These sources provide comprehensive time-series and cross-sectional data on area, production, yield, and crop-wise and district-wise agricultural performance. The period of the study covers thirty years from 1993–94 to 2023–24, enabling a long-term assessment of changes in paddy area, production, and productivity in India, along with inter-crop and inter-district comparisons. The tools of analysis employed in the study include simple statistical techniques such as averages, percentages, ratios, minimum and maximum values, standard deviation, coefficient of variation, compound annual growth rate (CAGR), and derived yield calculations, which help in measuring central tendency, variability, growth, and productivity trends. Tabular analysis is extensively used to present data in a systematic and comparative manner for clearer interpretation. The nature of the study is descriptive, as it explains existing patterns and trends, and analytical, as it interprets variations, growth rates, and regional disparities in agricultural performance. The study does not involve primary data collection or econometric modeling, but relies on quantitative analysis of secondary data to draw meaningful inferences regarding

productivity, stability, and regional concentration of paddy cultivation. This methodological approach is suitable for understanding long-term agricultural trends and policy implications in the Indian context.

Result and Discussion

Yield, calculated as the ratio of Production to Area is a key measure of agricultural productivity.

Table 1 Year Wise Area and Production of Paddy in India during 1993-94 to 2023-24

Sl. No.	Year	Area (A, Million ha)	Production (P, Million Tons)	Derived Yield (Y = P/A, Tons/ha)
1.	1993-94	42.65	74.68	1.751
2.	1994-95	41.78	72.86	1.744
3.	1995-96	42.54	80.30	1.888
4.	1996-97	42.81	81.81	1.911
5.	1997-98	42.84	76.98	1.797
6.	1998-99	43.43	81.73	1.882
7.	1999-00	43.45	82.54	1.900
8.	2000-01	44.08	86.08	1.953
9.	2001-02	45.16	89.68	1.986
10.	2002-03	44.71	84.98	1.901
11.	2003-04	44.90	93.34	2.079
12.	2004-05	41.18	71.82	1.744
13.	2005-06	42.59	88.53	2.080
14.	2006-07	41.91	83.13	1.984
15.	2007-08	43.66	91.79	2.102
16.	2008-09	43.81	93.36	2.131
17.	2009-10	45.91	96.69	2.106
18.	2010-11	45.54	99.18	2.178
19.	2011-12	41.92	89.09	2.125
20.	2012-13	42.86	95.09	2.219
21.	2013-14	44.01	105.30	2.393
22.	2014-15	42.75	105.23	2.462
23.	2015-16	44.14	106.65	2.416
24.	2016-17	44.11	105.48	2.391
25.	2023-24	43.39	104.32	2.404

Source: Directorate of Economics & Statistics, DAC&FW, 2024

Result

This table summarizes the central tendency and dispersion for each variable over the 25 observed years.

Table 1(a) Central Tendency and Dispersion

Statistic	Area (Million ha)	Production (Million Tons)	Yield (Tons/ha)
Total Observations (N)	25	25	25
Mean (Average)	43.26	89.26	2.062
Median (Middle Value)	42.86	89.09	2.080
Minimum Value	41.18 (2004-05)	71.82 (2004-05)	1.744 (1994- 95/2004-05)
Maximum Value	45.91 (2009-10)	106.65 (2015-16)	2.462 (2014-15)
Standard Deviation	1.25	11.96	0.252
Coefficient of Variation (CV)	2.89%	13.40%	12.22%
CAGR	+0.07%	+1.38%	+1.27

The above table provides a comprehensive overview of the year-wise area, production, and derived yield of paddy in India from 1993–94 to 2023–24, highlighting long-term trends in agricultural performance and productivity. Over the 25 observed years, the area under paddy cultivation remained relatively stable, fluctuating within a narrow range, with a mean of 43.26 million hectares and a low coefficient of variation of 2.89 per cent, indicating that land allocation to paddy has not changed significantly over time. The minimum area of 41.18 million hectares was recorded in 2004–05, while the maximum of 45.91 million hectares occurred in 2009–10, reflecting short-term adjustments due to monsoon conditions and policy incentives rather than structural expansion. In contrast, production shows a clear upward trend, rising from 74.68 million tonnes in 1993–94 to over 104 million tonnes in 2023–24, with an average production of 89.26 million tonnes and a higher variability as indicated by a coefficient of variation of 13.40 per cent. The lowest production of 71.82 million tonnes was recorded in 2004–05, a year associated with adverse climatic conditions, while the peak production of

106.65 million tonnes in 2015–16 reflects favorable rainfall, improved irrigation, and technological progress. Yield, derived as the ratio of production to area, emerges as the most critical indicator of productivity improvement, increasing steadily from around 1.75 tons per hectare in the mid-1990s to above 2.4 tons per hectare in recent years. The mean yield of 2.062 tons per hectare and a median of 2.080 suggest consistent productivity gains over time, while the maximum yield of 2.462 tons per hectare in 2014–15 highlights the impact of high-yielding varieties, better input use, and improved agronomic practices. The relatively moderate coefficient of variation in yield (12.22 per cent) indicates that productivity growth has been steady rather than erratic. The compound annual growth rate further reinforces these trends, showing marginal growth in area at 0.07 per cent, but much stronger growth in production (1.38 per cent) and yield (1.27 per cent), clearly demonstrating that increases in paddy output have been driven primarily by productivity improvements rather than expansion of cultivated area. Overall, the table underscores India’s transition from area-led to yield-led growth in paddy cultivation, emphasizing the crucial role of technological advancement, irrigation development, and policy support in enhancing food grain security over the long run.

Figure 1 Year wise Area and Production of Paddy in India

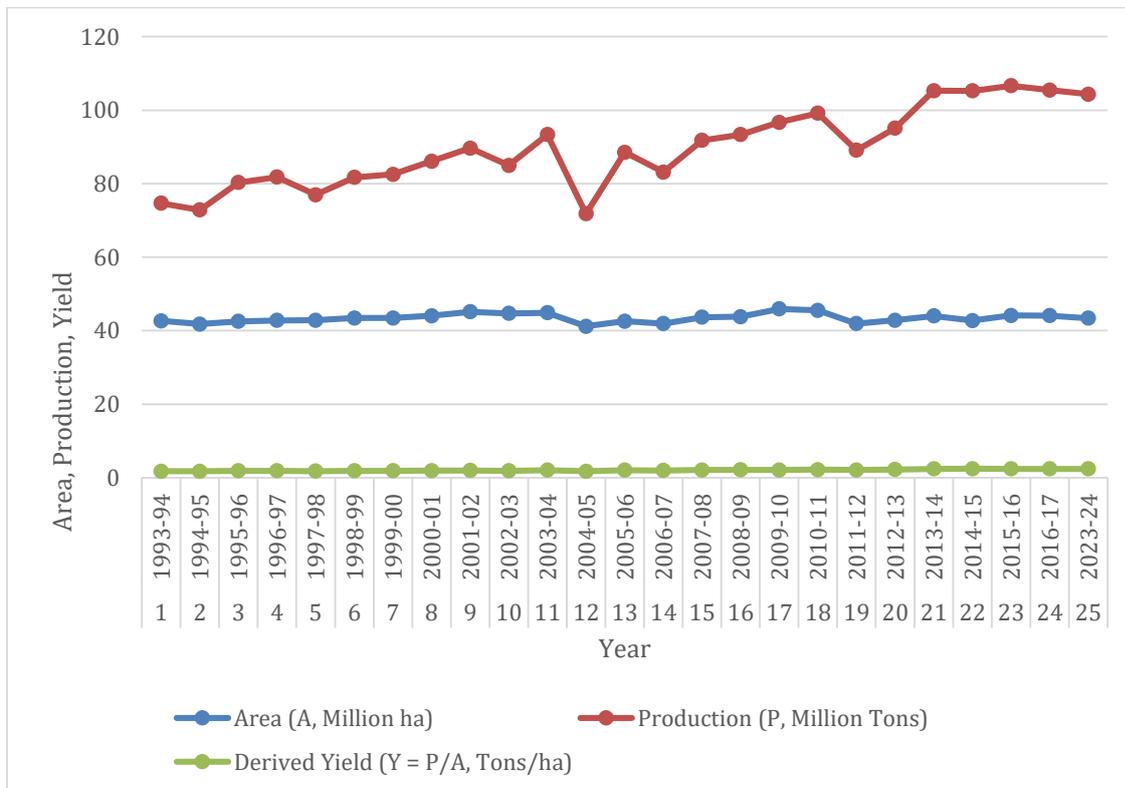


Table 2 India's Production of Major crops in Million Tonnes

Name of Crop	2013-14	2014-15	2015-16	2016-17	2023-24
Rice	136.8	140.2	138.2	144.2	133.5
Wheat	73.5	77.5	70.2	72.2	71.6
Coarse Cereals	30.5	31.1	32.5	34.4	26.5
Pulses	15.1	13.6	11.8	14.5	12.3
Total Food Grains	204.0	208.2	198.5	213.0	185.9
Oil seeds	241.2	21.2	19.3	21.3	15.3
Sugarcane	286.2	298.5	297.3	300.9	279.6
Cotton*	12.5	11.2	9.8	11.7	8.9
Jute and Mesta**	9.9	11.2	10.9	11.9	12.0

Source: Ministry of Agriculture, Government of India, 2018.

* In million bales of 170kg each

** In bales of 180kg each

Table 2 (a) India's Production of Major crops in Million Tonnes Result

CROP	Mean Production	Std. Deviation	Minimum	Maximum
Rice	138.58	3.56	133.50	144.20
Wheat	73.00	2.49	70.20	77.50
Coarse Cereals	31.00	2.62	26.50	34.40
Pulses	13.46	1.26	11.80	15.10
Total Food Grains	201.92	9.33	185.90	213.00
Oil seeds	63.66	88.80	15.30	241.20
Sugarcane	292.50	8.19	279.60	300.90
Cotton*	10.82	1.30	8.90	12.50
Jute and Mesta**	11.18	0.76	9.90	12.00

Source: Primary Data

The above table presents a comparative picture of India's production of major crops over selected years from 2013–14 to 2023–24, along with key descriptive statistics such as mean, standard deviation, minimum, and maximum production levels. Rice emerges as the most stable and dominant food crop, with a mean production of 138.58 million tonnes and a relatively low standard deviation of 3.56, indicating limited year-to-year fluctuation; its production peaked at 144.2 million tonnes in 2016–17 but declined to 133.5 million tonnes by 2023–24, suggesting recent pressures such as climatic variability or shifts in cropping patterns. Wheat shows moderate stability with an average production of 73 million tonnes and a standard

deviation of 2.49, reflecting comparatively consistent output, though it never exceeded 77.5 million tonnes and fell to a minimum of 70.2 million tonnes, indicating constraints related to water availability and rising input costs. Coarse cereals, with a mean of 31 million tonnes and higher variability (SD 2.62), demonstrate a noticeable decline by 2023–24 to 26.5 million tonnes, highlighting reduced emphasis on these crops despite their nutritional importance. Pulses display relatively lower production levels, averaging 13.46 million tonnes, with fluctuations reflecting sensitivity to monsoon conditions; although pulses peaked at 15.1 million tonnes, the decline to 12.3 million tonnes in 2023–24 points to persistent supply challenges. Total food grains show an overall mean of 201.92 million tonnes with a standard deviation of 9.33, indicating broader volatility driven by changes across cereals and pulses; the sharp fall to 185.9 million tonnes in 2023–24 compared to a maximum of 213 million tonnes underscores concerns about food security sustainability. Oilseeds production is highly erratic, as evidenced by an exceptionally high standard deviation of 88.8, mainly due to the unusually high value reported in 2013–14 (241.2 million tonnes) compared to much lower outputs in subsequent years, indicating structural inconsistencies or shifts in reporting and cultivation. Sugarcane remains a strong commercial crop with a high and stable mean production of 292.5 million tonnes and limited variation, reflecting assured pricing and industrial demand. Cotton production, measured in bales, averages 10.82 million bales but shows a declining trend, reaching a minimum of 8.9 million bales, possibly due to pest issues and rising costs. Jute and mesta exhibit the least variability, with a mean of 11.18 million bales and a low standard deviation of 0.76, indicating relative stability. Overall, the table highlights both the strengths and vulnerabilities of India’s agricultural production structure, emphasizing the need for policy support, technological adoption, and climate-resilient practices to ensure balanced and sustainable crop growth.

Figure 2- India’s Production of Major crops in Million Tonnes

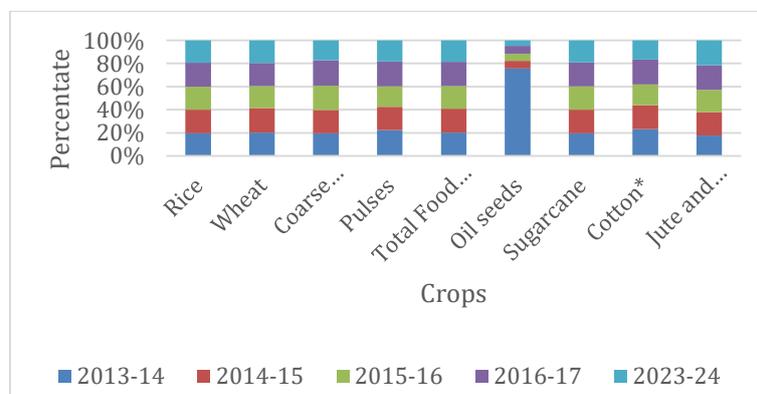


Table 3 Tamil Nadu district wise paddy cultivation

Sl. No.	District	Area under Paddy in Hectares	% yield in percentage	Gross Cropped area	% of yield area to Gross Cropped Area
1.	Chennai	--	--	--	--
2.	Kancheepuram	90874	4.70	131622	69.00
3.	Thiruvallur	82240	4.30	131053	62.80
4.	Cuddalore	107817	5.60	284998	37.80
5.	Villupuram	146641	7.60	371216	39.50
6.	Vellore	47417	2.50	211986	22.40
7.	Thiruvannamalai	101886	5.30	267650	38.10
8.	Salem	29929	1.50	259401	11.50
9.	Namakkal	13909	0.70	183089	7.60
10.	Dharmapuri	20368	1.10	172725	11.80
11.	Krishnagiri	14621	0.80	182146	8.00
12.	Coimbatore	2573	0.10	191146	1.30
13.	Thiruppur	11060	0.60	201924	5.50
14.	Erode	38053	2.00	238872	15.90
15.	Thiruchirapalli	72530	3.80	193581	37.50
16.	Karur	15628	0.80	99051	15.80
17.	Peramballur	12399	0.60	101259	12.20
18.	Ariyalur	24574	1.30	115862	21.20
19.	Pudukkottai	96386	5.00	154248	62.50
20.	Thanjavur	177094	9.20	272612	65.00
21.	Thiruvarur	178040	9.20	262873	67.70
22.	Nagapattinam	170840	8.80	299084	57.10
23.	Madurai	66699	3.50	150521	44.30
24.	Theni	15579	0.80	126147	12.30
25.	Dindugul	19638	1.00	234856	8.40
26.	Ramanathapuram	128795	6.70	188568	68.30
27.	Virudhunagar	32497	1.70	139990	23.20
28.	Sivaganga	80833	4.20	112810	71.70
29.	Tirunelveli	91320	4.70	193902	47.10
30.	Thoothukudi	22401	1.20	184742	12.10
31.	The Nilgiris	775	0.00	77522	1.00
32.	Kanniyakumari	18187	0.90	88792	20.50
	State	1931603	100.00	5824248	33.20

Source: Season and Crop Report of Tamil Nadu, 2023, p.21. Department of Economics and Statistics, Chennai.

Table 3 presents a detailed district-wise analysis of paddy cultivation in Tamil Nadu, highlighting the spatial distribution of paddy area, its share in total yield, gross cropped area, and the proportion of paddy area to gross cropped area, thereby revealing significant regional disparities in agricultural specialization. Chennai records no paddy cultivation, reflecting its urban character. Among the districts, the Cauvery delta region clearly dominates paddy cultivation, with Thanjavur and Thiruvarur emerging as the leading districts, accounting for 9.2 per cent each of the state's paddy area and exhibiting high ratios of paddy area to gross cropped area at 65.0 per cent and 67.7 per cent respectively, underscoring their strong dependence on paddy-based agriculture. Nagapattinam also shows substantial paddy cultivation with 8.8 per cent of total area and 57.1 per cent of its gross cropped area under paddy, reaffirming the delta's role as the rice bowl of Tamil Nadu. Districts such as Villupuram (7.6 per cent), Ramanathapuram (6.7 per cent), Cuddalore (5.6 per cent), Pudukkottai (5.0 per cent), and Thiruvannamalai (5.3 per cent) further contribute significantly, though their paddy area constitutes a comparatively smaller share of gross cropped area, indicating more diversified cropping patterns. Sivaganga stands out with the highest proportion of paddy area to gross cropped area at 71.7 per cent, suggesting heavy reliance on paddy cultivation despite its moderate share in overall production. In contrast, western and north-western districts such as Coimbatore, Nilgiris, Namakkal, Krishnagiri, Dharmapuri, Salem, and Thiruppur exhibit minimal paddy cultivation, with paddy accounting for less than 15 per cent of their gross cropped area, reflecting agro-climatic constraints, water scarcity, and a shift towards commercial and horticultural crops. Southern districts like Madurai, Tirunelveli, and Virudhunagar show moderate levels of paddy cultivation, indicating mixed farming systems. At the state level, Tamil Nadu records a total paddy area of 19.31 lakh hectares, constituting 33.2 per cent of the gross cropped area, signifying that while paddy remains a major crop, a substantial portion of agricultural land is allocated to other crops. Overall, the table highlights the dominance of irrigated delta districts in paddy cultivation and the pronounced regional imbalance shaped by water availability, river systems, and cropping diversification across Tamil Nadu.

Central Government Programs

- Pradhan Mantri Fasal Bima Yojana (PMFBY)
- National Food Security Mission (NFSM)
- Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

- Sub-Mission on Agricultural Mechanization (SMAM)

Tamil Nadu Government Programs

- Agricultural Mechanisation Programme
- Special Package for Paddy Growers
- Tamil Nadu Irrigated Agriculture Modernization and Water bodies Restoration and Management (TN-IAMWARM) Project
- Chief Minister's Farmers Service Centres
- Paddy Procurement Incentive

Finding of the study

1. During 1993–94 to 2023–24, the area under paddy in India remained almost constant with a mean of 43.26 million ha, while production increased from 74.68 to 104.32 million tonnes due to yield growth from 1.75 to 2.40 tons/ha.
2. Rice production in India shows high stability with a mean output of 138.58 million tonnes and a low standard deviation of 3.56, though it declined from a peak of 144.2 million tonnes (2016–17) to 133.5 million tonnes (2023–24).
3. Total food grain production averaged 201.92 million tonnes, but declined sharply from 213.0 million tonnes (2016–17) to 185.9 million tonnes (2023–24), indicating recent volatility in food grain output.
4. Oilseeds production shows extreme fluctuation with a very high standard deviation of 88.80, ranging from a maximum of 241.2 million tonnes to a minimum of 15.3 million tonnes, reflecting high instability.
5. In Tamil Nadu, paddy cultivation is highly concentrated in delta districts, with Thiruvarur (178,040 ha), Thanjavur (177,094 ha) and Nagapattinam (170,840 ha) together accounting for a major share of the state's total paddy area.
6. Paddy occupies 33.2% of Tamil Nadu's gross cropped area, but district-wise variation is wide, ranging from 71.7% in Sivaganga to just 1.0% in the Nilgiris, highlighting strong regional disparity.

Suggestions for Improving Rice Cultivation

- ❖ Promote high-yielding and climate-resilient paddy varieties to sustain yield growth beyond 2.40 tons/ha.

- ❖ Strengthen irrigation infrastructure to prevent declines in food grain output observed after 2016–17.
- ❖ Encourage water-saving technologies like SRI and drip irrigation in paddy-dominant regions.
- ❖ Provide targeted policy and price support to stabilize highly volatile oilseeds production.
- ❖ Ensure timely input supply and MSP support in Cauvery delta districts with over 60% paddy area.
- ❖ Promote crop diversification in low-paddy districts such as the Nilgiris and Coimbatore.
- ❖ Improve soil health management to enhance productivity without expanding cultivated area.
- ❖ Expand extension services to disseminate modern cultivation practices among small farmers.
- ❖ Encourage balanced crop planning since paddy occupies only 33.2% of Tamil Nadu's gross cropped area.
- ❖ Strengthen climate-risk management measures to reduce production variability across years.

Conclusion

The study concludes that paddy cultivation in India has experienced sustained growth in production primarily due to improvements in yield rather than expansion of cultivated area, reflecting a clear shift towards productivity-led agricultural growth. Despite the relative stability of rice production compared to other crops, recent declines in total food grain output highlight emerging challenges from climatic variability and resource constraints. The analysis of major crops reveals significant disparities in production stability, with oilseeds and coarse cereals showing high volatility, while sugarcane and rice remain comparatively stable. District-wise evidence from Tamil Nadu further underscores pronounced regional imbalances, as paddy cultivation is heavily concentrated in the Cauvery delta districts, whereas western and hilly regions exhibit minimal paddy coverage due to water scarcity and diversification. Overall, the findings emphasize the need for region-specific policies, efficient water management, technological adoption, and balanced crop planning to ensure sustainable paddy production and long-term food security in India.

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