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TRENDS, REGIONAL PATTERNS AND SOCIO-ECONOMIC SIGNIFICANCE OF PADDY CULTIVATION IN INDIA WITH SPECIAL REFERENCE TO KARNATAKA

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ABSTRACT--
Agriculture remains the backbone of India's economy, contributing 18.3% to national income and employing nearly 58 per cent of the workforce. Paddy as the staple food for a majority of the population plays a crucial role in ensuring food security and sustaining rural livelihoods. This study analyses long-term trends in area, production, productivity, and the economic importance of paddy farming using secondary data from 2000-01 to 2023-24. The study underscores the socio-economic significance of paddy cultivation as a driver of rural employment, income security and food stability. It also highlights persistent challenges including climate variability, irrigation deficits, and rising input costs. The paper concludes by emphasizing the need for region-specific interventions focused on water-use efficiency, mechanization, hybrid seed adoption, and institutional support to enhance productivity, profitability, and sustainability of paddy farming in Karnataka and across India.
KEYWORDS: *Paddy Cultivation, Karnataka, Productivity Trends, Agricultural Economics, Food Security, Rural Livelihoods.*---

INTRODUCTION

Agriculture, encompassing the cultivation of soil, the growing of crops and the rearing of livestock, remains both an art and a science. It involves the preparation and distribution of plant and animal products for human use and continues to be the cornerstone of India's economy, underpinning livelihood security, food availability and overall economic structure. According to the Ministry of Statistics and Programme Implementation (2022–23), agriculture and allied sectors contribute 18.3 per cent to the national income and employ nearly 58 per cent of the workforce. With strong forward and backward linkages, agriculture drives growth in the secondary and tertiary sectors.

The sector's performance directly influences broader economic development. The World Bank's World Development Report (2008) emphasises that agricultural growth is, on average, twice as effective in reducing poverty as growth in non-agricultural sectors. By increasing farm incomes, generating employment opportunities and stabilising food prices, a vibrant agricultural sector serves as a catalyst for poverty alleviation and rural transformation. India is among the world's leading producers of milk, pulses, jute, wheat, paddy, sugarcane, groundnut, fruits and vegetables (FAO, 2022), highlighting its central role in global agriculture.

Paddy (Oryzasativa) holds special significance as a staple food for more than half of the global population, particularly in Asia. Globally, paddy is cultivated across nearly 160 million hectares, predominantly in irrigated and rainfed lowland areas of tropical and sub-tropical Asia. India, with its vast climatic diversity, ranks among the top producers, cultivating over 43 million hectares and producing about 112 million tonnes annually, with an average productivity of 2.6 tonnes per hectare. Paddy accounts for roughly 40 per cent of India's total food grain output and is a primary source of livelihood for millions. Major producing states include West Bengal, Uttar Pradesh, Punjab, Odisha, Andhra Pradesh and Bihar. While 60 per cent of India's paddy is irrigated, around 40 per cent is rainfed, much of it vulnerable to droughts and floods.

Paddy-Growing Regions in India and Karnataka

Paddy is cultivated across diverse soil and climatic conditions in India, making it highly adaptable. It grows in both alkaline and acidic soils, from low-lying regions like Kerala's Kuttanad to high-altitude areas above 2,000

metres in Jammu & Kashmir, Uttarakhand, Himachal Pradesh and the North-Eastern Hill states. Based on ecological and climatic features, India's rice-growing regions are broadly classified into five major zones.
The North-Eastern Region, including Assam and neighbouring states, receives high rainfall and relies predominantly on rainfed cultivation. The Brahmaputra Valley is a key production area, although yields fluctuate due to frequent floods. The Eastern Region, comprising Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha, Eastern Uttar Pradesh and West Bengal, has the highest rice cultivation intensity. Rainfed lowlands dominate, but productivity is constrained by recurring droughts and floods.

The Northern Region, covering Haryana, Punjab, Western Uttar Pradesh, Uttarakhand, Himachal Pradesh and Jammu & Kashmir, typically follows a single-season cropping pattern due to cold winters and depends heavily on canal irrigation, especially in Punjab and Haryana. The Western Region (Gujarat, Maharashtra and Rajasthan) relies largely on monsoonal rainfall, resulting in relatively lower rice yields. In contrast, the Southern Region (Andhra Pradesh, Karnataka, Kerala and Tamil Nadu) benefits from fertile river deltas such as the Godavari, Krishna and Cauvery systems, supporting both irrigated and rainfed paddy.

Within this national context, Karnataka forms an important part of the Southern Zone. Paddy is cultivated throughout the state, occupying about 28.2 percent of its cultivable land. The Krishna–Tungabhadra Valley (Raichur, Koppal and Ballari) is known as Karnataka's "Rice Bowl," achieving yields often above 3,000 kg/ha, higher than the national average of around 2,700 kg/ha (Directorate of Economics & Statistics, 2023). The Cauvery Basin districts, particularly Mandya and Mysuru, produce high-quality paddy under assured irrigation. Coastal areas like Udupi and Dakshina Kannada practice rainfed cultivation, often growing traditional varieties suited to high rainfall.

While Karnataka's yields are competitive, they are still generally lower than those in heavily irrigated delta regions of Andhra Pradesh and Tamil Nadu. With nearly 40 percent of Karnataka's paddy area being rainfed, productivity remains vulnerable to monsoon variability. Recent improvements in irrigation management and adoption of high-yielding varieties have enhanced stability, but climate-related risks continue to pose challenges. Therefore, region-specific strategies focusing on water-use efficiency, improved seed varieties and climate resilience are essential for sustaining and enhancing paddy production in Karnataka.

Economic Importance of Paddy Production
Paddy occupies a central place in India's agricultural economy. It is grown on approximately 43 million hectares annually, contributing over 40% of the total food grain output. Paddy cultivation provides direct employment to more than 50 million households and supports the country's food buffer stock under the Public Distribution System (PDS). The economic significance of paddy extends beyond food security to include its role in rural employment, income distribution, and poverty reduction.

Karnataka, though not the largest producer, holds a strategic position in southern India's rice economy. The state's paddy output contributes approximately 3-4 per cent of national rice production. With major paddy belts in districts such as Raichur, Mandya, Davanagere, and Mysuru, the crop is cultivated across irrigated and rainfed agro-ecological zones. Paddy cultivation in Karnataka is closely linked with water-intensive irrigation systems, public procurement, and subsidy regimes, thus integrating state-level policy interventions with broader national economic objectives.

THEORETICAL AND EMPIRICAL REVIEW OF LITERATURE
This section reviews theoretical and empirical perspectives relevant to the economics of paddy cultivation, providing a foundation for the study's analytical framework. Classical and modern theories highlight key determinants of agricultural productivity and farmer decision-making. Ricardo's theory of rent underscores land fertility as a major factor influencing yield, while Schultz (1964) emphasises that smallholder farmers are rational decision-makers operating under resource constraints. The production function approach, particularly the Cobb–Douglas model (Heady & Dillon, 1961), is widely used to assess how inputs such as land, labour, fertilisers, irrigation and machinery contribute to output. Empirical evidence, such as Chandrasekaran (2018), indicates that inefficiencies in input use limit achievable productivity, suggesting scope for enhancing resource use efficiency.
Decision-making under risk is central to paddy cultivation due to climatic dependence and price fluctuations. Just and Pope's (1978) stochastic production function explains why farmers may adopt low-risk, low-input strategies to avoid losses. Institutional economics further highlights the role of policies and governance structures. Bardhan's (1989) principal agent framework provides insight into how mechanisms like Minimum Support Price (MSP) influence production decisions, though in Karnataka issues such as delayed procurement reduce effectiveness. Ostrom's (1990) analysis of common-pool resources is particularly relevant for irrigation management,

emphasising community participation and institutional support for sustainable water use.

Empirical Reviews

Empirical literature on paddy cultivation in India and Karnataka highlights regional variations in productivity, influenced by climate, resource availability and farming practices. Mechanization has improved efficiency, yet climate change increases pest risks, requiring adaptive measures. Farmer awareness and extension support play a key role in adopting improved practices, while hybrid seed use remains limited due to cost and information gaps. Overall, integrated, region-specific strategies are needed to enhance productivity, resilience and profitability in paddy cultivation.

The empirical literature on paddy cultivation in India and Karnataka highlights diverse trends in area, production, technology use, climate impacts and farmer practices. Long-term analyses by Netrananda Sahu et al. (2025) show region-specific variations, with area expansion in the northwest, central and western coastal regions, but declines in the northeast and southern peninsular regions. Singh (2021) also observed overall growth in rice productivity despite climatic variability, while Nagaveni et al. (2024) reported recent declines in rice and wheat area and output in Karnataka, alongside moderate gains in maize and mixed trends for millets and pulses.

Mechanization emerges as a key factor improving efficiency. Tabsum et al. (2025) found paddy to have the highest mechanization level in Karnataka, especially in land preparation, irrigation and harvesting. Studies by Pramodh H.S. (2019), Chandrajith et al. (2016) and Visalakshi et al. (2014) show that mechanization and direct seeding significantly reduce labour costs and enhance profitability. Climate change affects pest dynamics and sustainability. BN Balaji (2025) linked yellow stem borer incidence in Mandya to climatic variables, underscoring the need for adaptive practices. Mohamed et al. (2016) cautioned against excessive agrochemical use, and Magma (2019) and Pathak et al. (2019) emphasised sustainable farming and adherence to recommended inputs.

Farmer knowledge plays a crucial role. Sudheendra (2021) found medium-to-high adoption of recommended practices in Shivamogga, stressing the importance of training. Hybrid seed adoption studies (Tripathi, 2022; Jothi Sivananda, 2020) indicate high yield potential but constraints such as cost and limited awareness. Studies also highlight persistent challenges for marginal farmers, including irrigation deficits, labour shortages and weak market infrastructure (Sownnariya, 2022; Miah et al., 2020), underscoring the need for region-specific interventions to enhance productivity and resilience in paddy cultivation.

RESEARCH GAP

Despite extensive research, key gaps remain in understanding paddy cultivation. Existing studies document trends in area, production and mechanization, but lack integration with micro-level farmer decision-making under climatic and market uncertainties. The socio-economic determinants of technology adoption among smallholders remain underexplored. Climate impact studies are often location-specific and lack broader applicability. Hybrid seed adoption research highlights cost and awareness issues, yet interactions between input access, extension services and farmer trust are insufficiently examined. Additionally, structural constraints like irrigation deficits and weak market infrastructure are rarely linked to policy performance, indicating the need for integrated, region-specific research combining economic, institutional and behavioural perspectives.

OBJECTIVES OF THE STUDY

1. To examine the trends and production of paddy cultivation in India
2. To analyse the trends, pattern and production of paddy cultivation in Karnataka

RESEARCH METHODOLOGY

The present study on adopts a systematic methodological framework to analyse both macro- and micro-level dimensions of paddy farming. It integrates secondary data analysis of long-term trends in area, production and productivity into farmer socio-economic conditions, technological adoption and market linkages. Statistical, econometric and spatial analysis tools are employed to identify patterns and determinants.

RESEARCH DESIGN

The research design adopted for the study is descriptive and analytical in nature. It aims to describe the current status of paddy cultivation and analyze its economic aspects, including cost structure, profitability, productivity and constraints faced by farmers.

DATA COLLECTION

- **Secondary Data**: Obtained from government publications, Department of Agriculture, journals, books and research reports.

DISCUSSION AND INTERPRETATION

Paddy cultivation holds a central place in India's agrarian economy, contributing significantly to food security, rural livelihoods, and socio-economic stability. As the staple diet for a majority of the population, rice is grown across diverse agro-climatic zones, from rain-fed uplands to irrigated deltas. Trends in area, production, and productivity reveal dynamic regional patterns influenced by climatic variability, technological adoption, and policy interventions. Karnataka, with its varied geographic and climatic conditions, presents a unique case where paddy is vital in both irrigated command areas and rain-fed tracts. Analysing these trends offers insights into regional disparities, economic importance, and strategies for sustainable cultivation.

Trends in Paddy Production in India and Karnataka

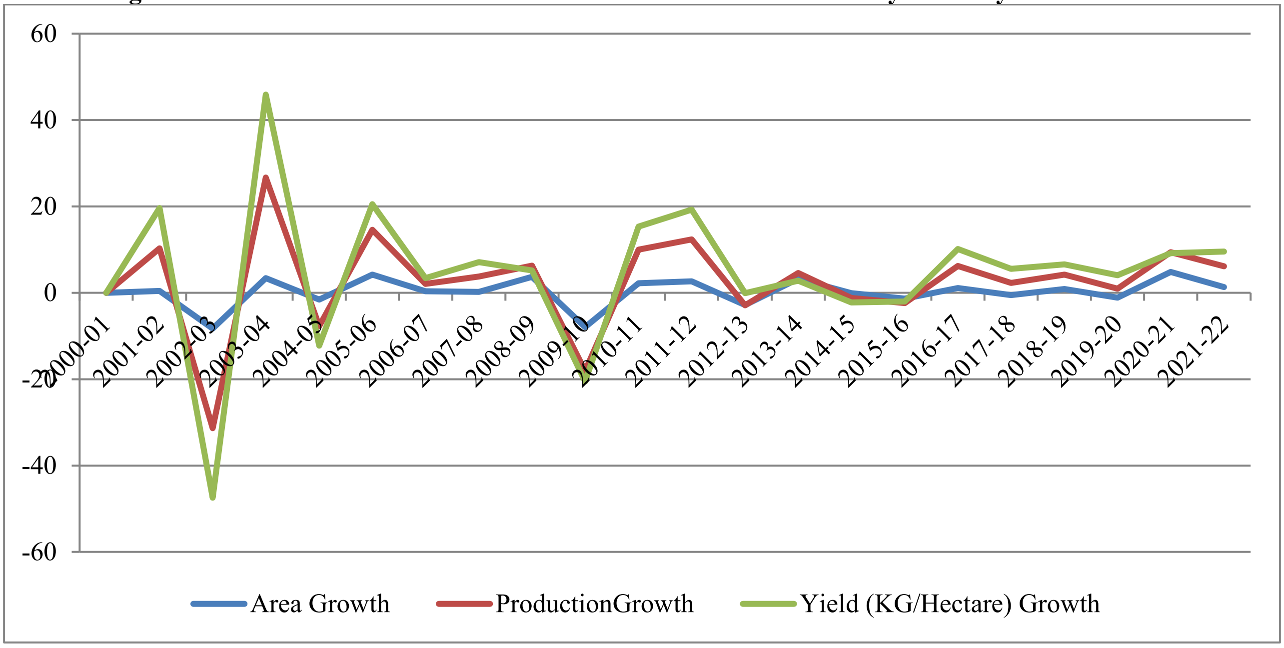
India's paddy production has increased significantly since the Green Revolution, rising from about 40 million tonnes in the 1960s to over 135 million tonnes in 2022–23, driven by irrigation expansion, HYVs, fertilizers and procurement support. However, growth has slowed due to land constraints and productivity stagnation in traditional regions. In Karnataka, paddy area and output fluctuate with rainfall and irrigation availability.

Table - 1: Annual Growth Rate of Area Production and Productivity of Paddy in India

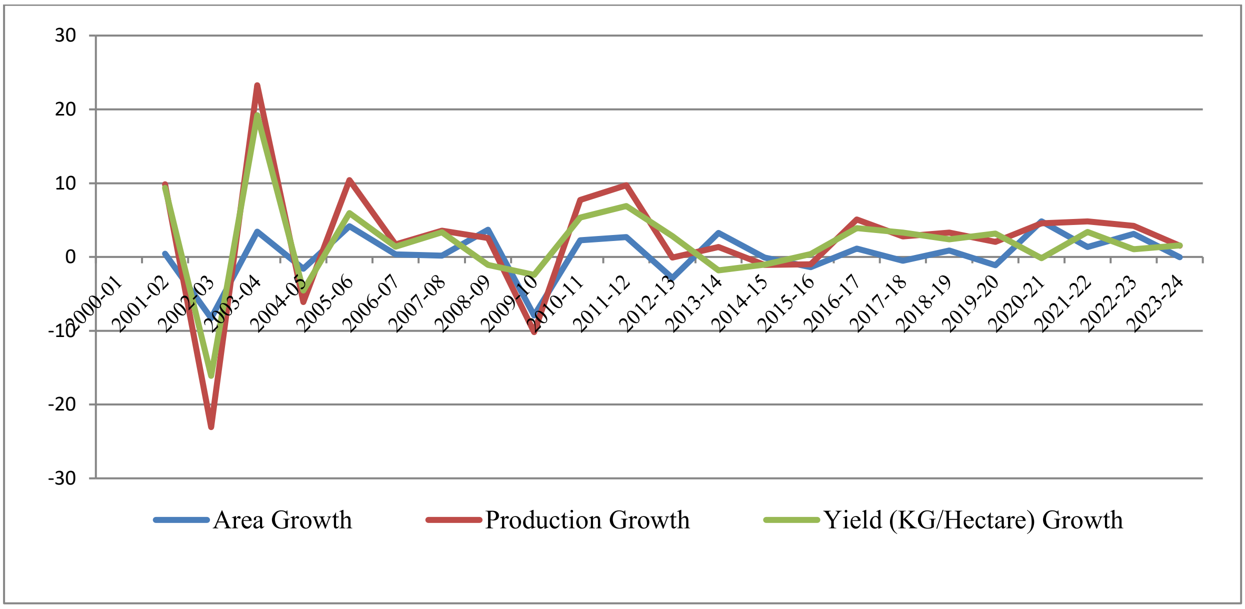
Years	Area (Million Hectares)	Growth Rate (%)	Production (Million Tonnes)	Growth Rate (%)	Yield (KG/Hectare)	Growth Rate (%)
2000-01	44.71	-	84.98	-	1901	-
2001-02	44.9	0.42	93.34	9.84	2079	9.36
2002-03	41.18	-8.29	71.82	-23.06	1744	-16.11
2003-04	42.59	3.42	88.53	23.27	2079	19.21
2004-05	41.91	-1.60	83.13	-6.10	1984	-4.57
2005-06	43.66	4.18	91.79	10.42	2102	5.95
2006-07	43.81	0.34	93.36	1.71	2131	1.38
2007-08	43.91	0.2	96.69	3.57	2202	3.33
2008-09	45.54	3.71	99.18	2.58	2178	-1.09
2009-10	41.92	-7.95	89.09	-10.17	2125	-2.43
2010-11	42.86	2.24	95.98	7.73	2239	5.36
2011-12	44.01	2.68	105.3	9.71	2393	6.88
2012-13	42.75	-2.86	105.23	-0.07	2461	2.84
2013-14	44.14	3.25	106.65	1.35	2416	-1.83
2014-15	44.11	-0.07	105.48	-1.10	2391	-1.03
2015-16	43.5	-1.38	104.41	-1.01	2400	0.38
2016-17	43.99	1.13	109.7	5.07	2494	3.92
2017-18	43.77	-0.50	112.76	2.79	2576	3.29
2018-19	44.16	0.89	116.48	3.30	2638	2.41
2019-20	43.66	-1.13	118.87	2.05	2722	3.18
2020-21	45.77	4.83	124.27	4.54	2717	-0.18
2021-22	46.38	1.33	130.29	4.84	2809	3.39
2022-23	47.83	3.13	135.76	4.20	2838	1.03
2023-24	47.82	-0.02	137.83	1.53	2882	1.55

Source: Ministry of Agriculture and Farmers Welfare, Government of India.

Figure - A: Annual Growth Rate of Area Production and Productivity of Paddy in India



Source: Table – 1



Source: Table -1

Northern canal-irrigated regions have expanded cultivation, while southern areas rely on canal and tank systems. Karnataka's average yield (≈2.9 t/ha) remains lower than states like Punjab and Tamil Nadu. Strengthening water-use efficiency, climate resilience and market access is essential for future sustainability.

The analysis of paddy cultivation in India from 2000–01 to 2021–22 shows distinct trends in area, production and productivity. The cultivated area remained relatively stable, fluctuating between 41 and 46 million hectares. Sharp declines, such as in 2002–03 (-8.29%), were primarily due to drought, while increases like in 2020–21 (4.83%) reflected favourable monsoons and supportive policies. Production showed greater variability than area, indicating the central role of yield performance. A significant drop in production occurred in 2002–03 (-23.06%) due to reduced rainfall and crop damage, followed by strong recovery in 2003–04 (23.27%). After 2010, production consistently improved, reaching 130.29 million tonnes in 2021–22, supported by technological advancements, irrigation expansion and national food security initiatives.

Yield trends closely aligned with production changes. Yield declined in drought years, but the overall trajectory was upward from 1901 kg/ha in 2000–01 to 2809 kg/ha in 2021–22 indicating improved agronomic practices, adoption of high-yielding varieties, increased mechanization and input subsidies.

Between 2022–23 and 2023–24, paddy area largely stabilized, with only minor changes (3.13% increase in 2022–23 and -0.02% in 2023–24). Production continued to rise moderately, reaching 137.83 million tonnes, driven mainly by productivity improvements rather than land expansion. Yield also saw marginal gains, rising to 2882 kg/ha.

Overall, the evidence shows that sustained growth in India’s rice production is primarily driven by improvements in productivity rather than area expansion. Future policy efforts should continue prioritizing technological dissemination, climate resilience, efficient water management, and strengthened extension services to maintain and enhance paddy sector sustainability.

The Status of Paddy Production in Karnataka

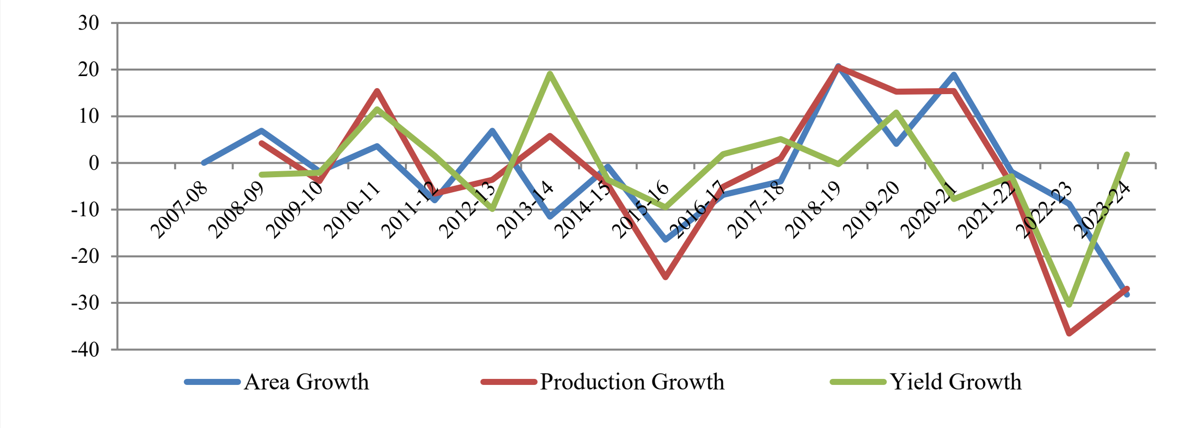
Paddy is one of the most significant food crops in Karnataka, forming a staple part of the state's diet. It is cultivated in about 28.2% of the total cultivable land and is grown across all districts. The major paddy-growing regions include the Krishna-Tungabhadra valley, Cauvery basin, and the coastal districts, which offer favorable agro-climatic conditions. Raichur district leads in rice production, followed closely by Ballari, Koppal, Haveri, Uttar Kannada, Dharwad, Mysore, Hassan and Chitradurga. Notably, Koppal, Ballari, and Raichurcollectively referred to as the “Rice Bowl of Karnataka” fall under the Tungabhadra command area, which benefits from assured irrigation. In the financial year 2021, Karnataka produced over four million metric tons of rice.

Table - 2: Annual Growth Rate of Area Production and Productivity in Karnataka

Year	Area (Lakh Hectares)	Growth Rate (%)	Production (Lakh Tonnes)	Growth Rate (%)	Yield (KG/Hectares)	Growth Rate (%)
2007-08	14.16	-	58		4311	
2008-09	15.14	6.92	60.44	4.21	4202	-2.53
2009-10	14.86	-1.85	58.11	-3.86	4115	-2.07
2010-11	15.39	3.57	67.08	15.44	4588	11.49
2011-12	14.16	-7.99	62.69	-6.54	4660	1.57
2012-13	15.14	6.92	60.44	-3.59	4202	-9.83
2013-14	13.4	-11.49	63.94	5.79	5005	19.11
2014-15	13.29	-0.82	60.94	-4.69	4826	-3.58
2015-16	11.1	-16.48	46.04	-24.45	4366	-9.53
2016-17	10.34	-6.85	43.67	-5.15	4447	1.86
2017-18	9.93	-3.97	44.09	0.96	4674	5.10
2018-19	11.99	20.75	53.14	20.53	4664	-0.21
2019-20	12.48	4.09	61.27	15.30	5167	10.78
2020-21	14.84	18.91	70.73	15.44	4766	-7.76
2021-22	14.56	-1.89	67.45	-4.64	4630	-2.85
2022-23	13.28	-8.79	42.80	-36.56	3223	-30.38
2023-24	9.53	-28.21	31.27	-26.96	3282	1.83

Source: Ministry of Agriculture and Farmers Welfare, Government of India.

Figure - B: Annual Growth Rate of Area Production and Productivity in Karnataka



Source: Table -2

The growth trends of paddy cultivation in Karnataka from 2007–08 to 2021–22 show considerable year-to-year variability influenced by rainfall, irrigation availability, and policy support. The cultivated area fluctuated, peaking at 15.39 lakh hectares in 2010–11 and declining to 9.93 lakh hectares in 2017–18. The steepest reduction occurred in 2015–16 (–16.48%), likely due to drought, while a major rebound in 2018–19 (20.75%) coincided with favorable monsoons and government support. Production patterns generally followed area changes but were also affected by yield shifts. Significant declines were observed in 2015–16 (–24.45%), whereas substantial gains occurred in 2010–11 and 2018–19. The highest production was recorded in 2020–21 at 70.73 lakh tonnes. Yield trends showed high volatility, reflecting weather and input-use sensitivity, though yields increased overall from 4311 kg/ha in 2007–08 to 4630 kg/ha in 2021–22.

Between 2021–22 and 2023–24, Karnataka experienced a sharp downturn, with area falling from 14.56 to 9.53 lakh hectares and production dropping from 67.45 to 31.27 lakh tonnes. Yield declined significantly in 2022–23 but recovered slightly in 2023–24. These trends highlight Karnataka's vulnerability to climatic stress and water scarcity. Strengthening irrigation systems, promoting climate-resilient varieties, and improving agronomic management are essential for stabilizing production and ensuring long-term sustainability.

Table - 3: Comparative Paddy Production Indicators - India and Karnataka (2022–23)

Indicator	India	Karnataka
Area under paddy (million ha)	45.2	1.4
Total production (million tonnes)	135.5	4.2
Average yield (kg/ha)	2,997	2,900
Share in national production (%)	100	~3.1
Major Paddy-Growing Districts	Punjab, West Bengal, Up, Ap	Raichur, Mandya, Mysuru, Davanagere

Source: Directorate of Economics and Statistics, Karnataka & Government of India Agriculture Statistics.

The comparative analysis of paddy production in 2022–23 shows notable differences between India and Karnataka. Nationally, 45.2 million hectares were under paddy cultivation, producing 135.5 million tonnes with an average yield of 2,997 kg/ha. Karnataka cultivated 1.4 million hectares and produced 4.2 million tonnes, contributing about 3.1% to national output, with an average yield of 2,900 kg/ha, slightly below the national average. Karnataka's lower share in production is linked to its diverse cropping patterns, rainfall dependence, and comparatively limited assured irrigation. However, key districts such as Raichur, Mandya, Mysuru and Davanagere achieve stable yields due to canal and borewell irrigation systems. In contrast, major rice-producing states like Punjab and Andhra Pradesh benefit from extensive irrigation and high input use, resulting in higher yields. To enhance Karnataka's performance, expanding irrigation, promoting high-yielding and climate-resilient varieties, strengthening post-harvest systems, and improving extension services are essential for boosting productivity and resilience.

Table -4: Cost of Paddy Cultivation per Hectare (2022–23)

Cost Component	Karnataka (INR)	India Average (INR)
Human Labour	22,500	24,000
Machine Power	4,800	6,000
Seed	1,600	1,800
Fertilizers & Pesticides	5,200	6,500
Irrigation	3,000	3,500
Interest on Working Capital	1,200	1,300
Total Cost (A2+FL)	**38,300**	**43,100**
Gross Return (at MSP)	52,200	58,200
Net Return	**13,900**	**15,100**

Source: Commission for Agricultural Costs and Prices (CACP), 2023.

Note: MSP for common paddy in 2022–23 was ₹2,040 per quintal

The cost analysis of paddy cultivation in 2022–23 shows that Karnataka incurs lower cultivation expenses compared to the national average. The total cost in Karnataka was ₹38,300 per hectare, about 11% less than the national average of ₹43,100, mainly due to lower spending on human labour, machine use, and agrochemicals. Labour costs in Karnataka (₹22,500) were slightly lower than the national average (₹24,000), possibly due to higher mechanization or lower wage rates. However, despite this cost advantage, Karnataka earned a lower gross return at MSP (₹52,200/ha) compared to the national average (₹58,200/ha), resulting in a slightly reduced net return of ₹13,900 per hectare against the national average of ₹15,100. This indicates that while cultivation is relatively cost-efficient, lower yields and price realization limit profitability. Improving productivity through better seed varieties, agronomic practices, irrigation access, and stronger procurement and value chain systems can enhance farm income and overall sustainability in Karnataka.

CONCLUSION

The analysis shows that Karnataka's paddy cultivation is relatively cost-efficient compared to the national average, mainly due to lower expenditure on labour, machinery, and agrochemicals. However, this cost advantage does not fully translate into higher profitability, as the state's gross and net returns remain slightly below national levels due to marginally lower yields and price realization. While certain irrigated districts perform well, expanding irrigation, improving seed quality, and strengthening extension support are essential to enhance productivity. Additionally, better MSP procurement and post-harvest value chain improvements can increase farm income. Overall, region-specific, technology-driven support is key for sustainable paddy growth in Karnataka.

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