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Millet Production in India: Long-Term Trends, Regional Concentration and Productivity Dynamics (1975–76 to 2025–26)

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Abstract

Millets have played an important role in India's nutritional security for a long time due to its climate-resilient and sustainable farming practices. The current environment, health and ecological understand has renewed our interest in the millets and coarse grains. The study is undertaken to understand the long term patterns in production of millets in India. This paper examines the production trends, regional distribution and productivity changes of four major millets in India - Jowar (Sorghum), Bajra (Pearl Millet), Ragi (Finger Millet), and Small Millets, The study is based on the state level cross-sectional data for Indian states for the period 1975–76 to 2025–26, data for which is taken from unified portal for agricultural statistics (UPAg). For the purpose of analysis, we computed CAGR, HHI, CV and CDVI. We decomposed the changes in production into 'yield effect', 'area effect' and 'interaction effect'. We used β-convergence analysis to know whether gaps in productivity levels across different states are narrowing or widening. The data shows that for all the four millets studied, the area under cultivation was declining significantly but the yield (productivity) was increasing in all the millet crops under study. The decomposition analysis showed that the negative impact on production due to area effect was more than the positive impact due to yield effect in case of Jowar, Ragi, and Small Millets. This resulted in decline in the production for these three millet crops. Bajra was the crop where larger yield effect led to an increase in production. Ragi exhibited the highest geographical concentration, followed by Jowar and Bajra, whereas Small Millets showed comparatively low concentration. We found a significant inter-state difference in productivity in all the millet crops though convergence analysis showed that this gap has been narrowing. The results indicated that the policy thrust of the government should be two pronged, that is, expand the cultivated area under a particular crop and improve the productivity. Sufficient encouragement to the farmers must be given to achieve these both objectives.

Keywords: Millet; Production trends; Regional distribution; Decomposition analysis; Convergence analysis.

Introduction

Millets have been an integral component of India's rain-fed agricultural, contributing to food and nutritional security and same time supporting climate-resilient farming, especially in semi-arid regions. Crops such as Sorghum (Jowar), Pearl Millet (Bajra), Finger Millet (Ragi), and Small Millets require relatively less water and have shorter growing periods than rice. The millet crops have traditionally formed an important part of local food systems, especially in resource-constrained rural areas. Millets are gaining renewed attention due to their high nutritional value[1], climate resilience[2], low water and carbon footprints[3,4], adaptability to diverse soils and climates, and their role in ensuring food, nutrition, and livelihood security for resource-poor populations[5]. Their high nutritional value, resilience to climatic conditions, and contribution to sustainable agriculture have renewed research interest in recent years. The importance of millets for food and nutritional security, climate resilience, and the achievement of the Sustainable Development Goals (SDGs) is emphasied[6].

Finger millet contains 344 mg of calcium per 100g—the highest among all cereals—while millets in general provide 7-12% protein, 11-20% dietary fiber, and significant amounts of iron, zinc, and magnesium[1]. The study also reported that millets are rich in phytochemicals (phenolic acids, flavonoids, tannins) that function as antioxidants, immune modulators, and detoxifying agents.

Despite these advantages, millet cultivation has declined considerably over the past decades. Anbukkani et al. (2017) documented a significant reduction in the area under millets is observed[7], while another study reported compound annual declines of −3.60 percent for Small Millets, −1.86 percent for Jowar, −1.27 percent for Ragi, and −0.60 percent for Bajra during 1950–2021[8]. This decline is due to policy preferences favouring rice and wheat, expansion of commercial crops, subsidised foodgrain distribution through the Public Distribution System (PDS), changing consumer preferences, and insufficient market incentives[7,8].

Consequently, concerns have grown regarding the sustainability of rain-fed agriculture, farmer livelihoods, and the resilience of India's food system under changing climatic conditions. Recent initiatives, including state millet missions, MSP support, and the inclusion of millets in PDS, ICDS, and Mid-Day Meal schemes, have begun to improve production incentives and market opportunities[9].

The long-term decline in millet cultivation is directly associated with the structural transformation of Indian agriculture following the Green Revolution. Expansion of irrigation, input subsidies, and assured procurement under the Minimum Support Price (MSP) system increased the profitability of rice and wheat, encouraging farmers to shift land away from traditional coarse cereals. The main factor behind reduction in area under cultivation for Ragi, Jowar and Bajra is rise in productivity and profitability from rice-wheat production patterns[2].

The improvement in productivity due to better farm practices and use of improved and hybrid varieties of seeds were not sufficient to offset the large contraction in the area cultivated under millet crops. This paper has focus on analyzing the interstate differences in production, area and yield and the changes taken place in the last five decades in India. The paper is based on the state level cross-sectional data for Indian states for the period 1975–76 to 2025–26, data for which is taken from unified portal for agricultural statistics (UPAg). For the purpose of analysis, we computed CAGR, HHI, CV and CDVI. We decomposed the changes in production into 'yield effect', 'area effect' and 'interaction effect'. We used β-convergence analysis to know whether gaps in productivity levels across different states are narrowing or widening.

The rest of the paper is organised as under. The review of literature is presented in section 2 and the objectives and hypotheses are presented in section 3. Section 4 discusses data and methodology. The results obtained from data are presented in Section 5 and Section 6 and 7 pertains to discussion and conclusion.

Review of literature

The studies on millets in India can be grouped into various categories depending upon the main theme studied in these studies. The studies using decomposition of production in area effect and production effect showed a transition with earlier studies showing area effect leading to the production growth[10,11] . The method developed by Minhas and Vaidyanathan which separates output into area and yield part is mostly used for decomposition. But the recent studies observed a contraction in the area cultivated and large negative area effect led to the fall in the production. But here also large area effect dominated the comparatively smaller yield effect[2,8,12,13] for most of the millet crops. The studies pertaining to Bajra revealed the opposite where larger yield effect dominating the weaker area effect[12,14,15] contrary to other millet crops.

The literature has linked decline in millet cultivation to the changes in the Indian agriculture scenario. The changes in technology, prices, and institutional incentives have impacted the cropping choices[16]. They further observed that after green revolution factors such as irrigation, fertilizer use, procurement systems, and minimum support prices have favoured rice and wheat production thereby reducing relative attractiveness of millets. Structural break approach is used to examine area and yield trends in minor millets and finger millet[6]. They identified significant breaks around 1998 and the early 2000s.An improvement in pearl millet production and yield between 2015–16 and 2021–22is observed and this is attributed to government promotional measures[17]. The study pointed to two initiatives as key supports: the recognition of millets as Nutri-Cereals, and higher minimum support prices.

Among the studies focusing on productivity, instability, and technological change, it is found that a large productivity gap between actual and potential yields for sorghum and pearl millet in India[18]. The likely factors behind this are: improved varieties, hybrid seeds, nutrient management, and better agronomic practices to bridge the yield gap and increase productivity. Though Rajasthan and Maharashtra account for a large share of millet production in India, but the yield in these states is very low[17]. Several studies found that fluctuations in area, production, and yield remain almost same in rain fed agriculture[6,12,14,19]. But millets showed higher stability than other crops because of their adaptability to drylandconditions[12,20].

The increased awareness of the nutritional value of millets and health benefits associated with their use has led to a rise in consumer interest and then demand for millets[15,21]. Yet crops such as Jowar and Ragi still provide lower returns than paddy, maize, cotton, and groundnut which encourages farmers to shift area under cultivation to away from millets[17]. This suggests that improvements in productivity alone are insufficient to increase area under millet cultivation without market support, efficient procurement systems, value addition and processing facilities[3, 6]. Weak procurement and limited market infrastructure are part of the problem. Insufficient variety development and persistent yield gaps are other factors in limiting millet crops production. Together, these factors constrict millet cultivation[6,9].

From the above, we notice a gap in the surveyed literature that few studies have analyzed convergence or divergence in productivity across states. To fill this gap, the present study offers a comprehensive analysis of five decades of state-level data (1975–76 to 2025–26), examining long-term growth, regional concentration, instability, decomposition, and productivity convergence for four major millet crops in India.

Objectives and Hypothesis

Although the studies have documented the decline in millet cultivation and its determinants, several gaps remain. This study addresses the gaps by employing comprehensive state-level data

for the period 75–76 to 25–26 to analyse long-term trends in area, production and yield. The specific objectives of the study are to: i. analyze the trends in area, production, and yield of major millet crops in India; ii. examine the geographical distribution, concentration, and productivity patterns of millets using production shares, productivity, and the Herfindahl–Hirschman Index; iii. assess the extent of production instability and variations in area, production, and yield; iv. examine state-wise productivity differentials and evaluate the convergence of productivity across major millet-producing states; and v. quantify the relative contributions of area and yield changes to production growth using decomposition analysis.

The study is guided by the following null hypotheses (research questions): H_{01}: There is no significant difference between the effects of cultivated area and yield on millet production. H_{02}: Millet production is uniformly distributed across states (i.e., no significant concentration exists). H_{03}: There is no significant difference in production instability among states. H_{04}**:** There is no significant difference in yield among states. H_{05}**:** There is no significant convergence in state-wise yields over the time.

Methodology

The study employed a multi-stage approach for analysis. The paper first examined growth and descriptive trends, and then regional concentration and instability were investigated. Finally, decomposition of production and convergence analysis was performed.

Data Source and Study Framework: The data for the study is extracted from the Unified Portal for Agricultural Statistics (UPAg), Department of Agriculture and Farmers' Welfare. Data on area sown (A, in lakh hectares), production (P, in lakh tonnes), and yield (Y, in kg/ha) for four millet crops (Jowar, Bajra, Ragi, and Small Millets) were first extracted for the period 1975–76 to 2025–26. The raw data were then scrutinized, and the entries corresponding to the states that did not cultivate a given millet in a particular year or had missing information on either area or production were removed. As a result, the final sample size is different for each crop. Thus, the final dataset is unbalanced, with 870 observations for Jowar, 997 for Bajra, 871 for Ragi, and 1,032 for Small Millets.

Analytical Framework: The analytical framework applied to examine the trends in growth, distribution, productivity dynamics, and structural transformation of millet cultivation in India is explained below.

Trend and Descriptive Analysis: The trend growth rates (CAGR) are estimated using the standard semi logarithmic function of the form $Y=ab^t$. The descriptive statistics, production shares, and ranking were used to understand the distribution of millet production and to identify the leading producing states.

Spatial Analysis: Regional concentration was measured using the Herfindahl–Hirschman Index (HHI): $HHI = \sum_{i=0}^{n} {s_i}^2$ where s_i represents the share of the i^{th} state in total national production.

Besides annual HHI estimates, Production-weighted long-run HHI for the entire period was estimated. For this, aggregate production for each state was first computed as: $P_i = \sum_{t=i}^{T} P_{it}$ where P_{it} is the production of state i in year t. Long-run production shares (S_i) were then calculated as: $S_i = \frac{P_i}{\sum P_i}$ and the corresponding aggregate concentration index was obtained as: $HHI = \sum_{i=1}^{n} {S_i}^2$. Unlike the annual HHI the Production-weighted long-run HHI measures the long-term geographical concentration of millet production over the entire study period.

State-wise yield rankings were used to identify leading and lagging states in terms of productivity. Pearson's correlation coefficients were also computed to examine the relationships among cultivated area, production, and yield.

Dynamic Analysis: The dynamics of millet production are examined through instability, productivity convergence, and decomposition analyses. Instability in area, production, and yield was measured using the Cuddy–Della Valle Instability Index (CDVI)**,** which adjusts the coefficient of variation for long-term trends: $CDVI = CV x \sqrt{1 - R^2}$ where R^2 is the coefficient of determination from the trend regression.

To examine whether interstate productivity differences narrowed over time, β-convergence analysis was performed, wherein state-wise convergence in millet productivity was examined using the below model, estimated separately for each millet crop:

$\frac{1}{T} ln\left(\frac{Y_{i,T}}{Y_{i,0}}\right) = \alpha + \beta \ln(Y_{i,0}) + \varepsilon_i$ Where $Y_{i,0}$ denotes the initial yield of state *i*; $Y_{i,T}$ denotes the final yield ; T represents the length of the period ; α is the intercept; β is the convergence coefficient, and ε_i is the random error term. The model was estimated using OLS. A negative and statistically significant value of (β) indicates absolute β-convergence, implying that states with lower initial productivity experienced faster yield growth.

To quantify the separate contributions of changes in cultivated area, yield improvement and their interaction to the total change in production, the model developed by Minhas and Vaidyanathan was employed. The change in production (ΔP) between a base year (0) and current year (n) is decomposed as follows:

$\Delta P = (Y_0 \times \Delta A) + (A_0 \times \Delta Y) + (\Delta A \times \Delta Y)$ Where the three components represent the Area Effect ($Y_0 \times \Delta A$), Yield Effect ($A_0 \times \Delta Y$) and Interaction Effect($\Delta A \times \Delta Y$), respectively.

Table-1: Theme-wise Summary of Major Studies on Millet Cultivation in India.

Theme	Key Findings
Growth and Decomposition	Earlier production growth was largely area-driven, whereas recent evidence attributes changes mainly to area contraction and productivity improvement in selected millet crops.
Crop-wise and Regional Variation	Growth patterns differ across millet crops and states. Bajra has shown better productivity growth, while Jowar, Ragi, and Small Millets have experienced slower growth. Millet cultivation remains concentrated in a few regions.
Structural Transformation and Policy Bias	Green Revolution policies favoured rice and wheat, reducing incentives for millet cultivation. Recent policy initiatives have improved millet performance in some regions.
Productivity and Technological Change	Improved varieties and better crop management increased productivity, but yield gaps and declining cultivated area continue to limit production growth.
Instability and Climate Resilience	Millets show relatively stable performance under rain fed conditions despite fluctuations in area, production, and yield.
Markets, Profitability and Institutional Support	Consumer demand has increased, but weak procurement, limited market infrastructure, and lower profitability continue to discourage millet cultivation.
Policy Implications	Sustainable millet development requires coordinated policy, technology, market support, and state-specific strategies.

Results and Discussion

Aggregate Trends across Millet Crops: India's major millet crops followed divergent growth path during 1975–76 to 2025–26 (Table-2). During the study period the cultivated area has declined in case of Jowar, Ragi, and Small Millets. Productivity has increased considerably in all the millet crops but it was not sufficient to compensate the reduction in production loss due to dwindling cultivated area. Consequently the net result was the decline in the production of these three millets. As evident from the table, cultivate area in case of Jowar has reduced by 78% and production has reduced by 54%. The reduction in case of small millets was more severe with cultivated area declining by 91 % and production by 81%. Ragi registered moderate reductions in both area and production. The case of Bajra was different where cultivated area has reduced by 29 percent but production increased significantly from from 57.36 to 108.48 lakh tonnes. In this case we found that loss in cultivated area was offset by the more than threefold increase in productivity during the study period. Thus, changes in cultivated area constituted the dominant component of the observed long-term change in millet production.

In Table-3, the decadal average on cultivated area, production and yield for each of the decade is presented. The decadal averages also show the same pattern when we compared first and last year's values. In case of Jowar the decline in area for first two decade was not significant and increase in productivity has helped its cause. But in last three decade the cultivated area has declined at an accelerated rate but enhanced productivity arrested the decline in the production. This is also evident from the CAGR shown in Table-4 where Jowar experience rapid acreage decline (−5.25%) in last decade 2015-16 to 2025-26 but productivity growth had ensured that production fell only by 0.27 percent.

In case of Bajra we found that the cultivated area has not declined has fast as in case of other three millets. It had a moderate reduction in cultivated area but found sustained gains in both production and productivity. From the mid-1990s, Bajra production has increased significantly owing to a productivity-led expansion which made its production profitable and consequently cultivated area decline was not that sharp. But in case of Jowar we found continuous reduction in area despite moderate yield gains. During 2015–26, Bajra recorded strong positive growth in both area (11.78%) and production (8.09%), although yield growth moderated.

Ragi also experienced declines in area and production and productivity improved till 2015. Small millets have lost nearly 88% of its cultivated area between first and last decades. Small millets recorded continuous and significant decline in the cultivated area reducing at a CAGR of 4.71 percent per annum.

Table-2: All-India Trends and Growth Rates.

Crop	Area (lakh ha)			Production (lakh ton)			Yield(kg/ha)		
	1975-76	2025-26	CAGR (%)	1975-76	2025-26	CAGR (%)	1975-76	2025-26	CAGR (%)
Jowar	160.92	35.48	-2.98	95.04	43.56	-1.55	590.6	1227.5	1.47
Bajra	115.71	69.63	-1.01	57.36	108.48	1.28	495.7	1557.9	2.31
Ragi	26.30	13.46	-1.33	27.97	20.00	-0.67	1063.6	1486.0	0.67
Small Millets	46.73	4.15	-4.71	19.24	3.80	-3.19	411.8	915.2	1.61

Table-3: Decadal Average Area, Production and Yield of Major Millets in India.

Period	Jowar			Bajra			Ragi			Small Millets		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1975-76 to 1984-85	162.2	111.7	6.9	112.2	55.7	5.0	25.5	26.6	10.4	40.2	16.2	4.0
1985-86 to 1994-95	141.5	107.6	7.7	104.8	58.5	5.5	21.6	25.1	11.7	24.6	10.7	4.4
1995-96 to 2004-05	101.0	80.9	8.0	94.3	73.4	7.7	16.6	22.6	13.5	13.8	6.0	4.4
2005-06 to 2014–15	72.0	65.9	9.2	82.3	85.6	11.2	12.4	19.6	15.9	8.3	4.4	5.4
2015-16 to 2025–26	44.5	44.3	10.2	76.4	114.7	15.4	11.1	17.4	15.7	4.9	3.9	8.2

Note: A denotes total cropped area under each millet (lakh ha); P denotes total output (lakh tonnes); Y denotes Yield (quintals/ha).

While all four crops experienced productivity improvements, shrinking cultivated area continued to reduce the production in Jowar, Ragi, and Small Millets, with Bajra being the only exception. These results presented in table 3 and 4 indicate that cultivated area wielded a stronger influence on long-term millet production than productivity improvements for most crops, thereby supporting Hypothesis H_1.

Regional Patterns and State-wise Concentration of Production: Regional distribution of millet production has undergone changes during 1975–76 to 2025–26 (Table-5). In case of Jowar Maharashtra was the top producer in all the five decades with its share increasing in first three decades and the state produced more than half (52.4% share) of the total output in India. The share of Maharashtra declined in last two decade and it average share was 36.3% in the last decade 2015-16 to 2025-26. The second top producer Karnataka also held its position throughout the period under study. Rajasthan had moved up to occupy the third position in the last decade by replacing Madhya Pradesh in the last decade. In 2025-26, the top four producing states had contributed 74.2% of the total production in the country.

Rajasthan was the top Bajra Producing state in last four decades of the period though its share had shown a decline in last decade with its average share decreasing from 34.8 percent in 2005-06 to 2014-15 to 28.4 percent in 2015-16 to 2025-26. Gujarat moved from first position in first decade (1975-85) to second position in the decades of 1985-95 & 1995-2005 and in last decade its position was fourth with 12.9 percent share in total production. Haryana has continuously moved up the ladder from fifth position in first three decades of the study period to second position in the last decade with 15.5 percent share. There was little change in the regional distribution of Ragi production at during the the study period with Karnataka and Tamil Nadu occupying first and second position respectively. The distribution of the Ragi is top heavy with top four states contributing 91.9 percent of the total Ragi production in the country. Uttarakhand's share has increased since its inception in 2000. Unlike the other millet crops, the distribution of Small Millets was less skewed with top four states contributing only 57.4 percent of the total production. Madhya Pradesh remained the largest producer, while Uttarakhand accounted for a growing share of production after 2005–06.

The degree of regional concentration also differed substantially across crops (Figure-1 and Table-6). The HHI index clearly shows that the most concentrated millet crop is Ragi and the concentration has increased over time. The top four states contributed more than 90 percent of national production after 2005–06. Small Millets has low concentrated area as it continued to be cultivated in a wider range of states and it maintained its low concentration throughout the study period.

The HHI index of the Jowar has continuously increased in first three decades and BajraHHI Index has increased in first four decades. Jowar remained highly concentrated despite moderation after the mid-1990s and value of production-weighted long-run HHI being 0.263 during the period. In the last period, this concentration declined slightly as share of other states has increased. The production-weighted long-run HHI values of Bajra were 0.164. Rajasthan share increased in Bajra production during the 2000s, leading to a higher HHI during the period. Ragi constantly has the highest HHI values among the crops primarily due to a dominant share of Karnataka in its production. The production-weighted long-run HHI values provide support for these benchmark changes, indicating very high concentration for Ragi (0.371), high concentration for Jowar (0.263), moderate concentration for Bajra (0.164), and low concentration for Small Millets (0.116). The above discussion support Hypothesis H_2, which assumes that millet production in general remains concentrated in a limited number of states, though the degree of concentration differed among crops.

Yield Ranking and Regional Patterns: The productivity is an important indicator of the production dynamics indicating efficiency in the resource utilization and technical progress. Benchmark-year rankings in yield (Table-7) reveal a marked interstate difference in productivity.

The regional distribution of states ranking in terms of productivity shows that the Southern states was consistently have higher productivity in case of Jowar and Ragi. Within the region, however, the relative position of states moved up and down over time. Improvements in Jowar productivity were seen in Andhra Pradesh after 2005–06 increasing from 1,324 kilogram per hectare to 3,656 kilogram per hectare in 2025–26, which was highest among the major producing states. For Ragi, Tamil Nadu continued to lead in productivity during the whole study period recording a significant increase from the decade of 2005-06 (1838 kilogram per hectare) to 2015-16 (3013 kilogram per hectare).In case of Bajra, we observed a different pattern. During the earlier decades, Punjab and Tamil Nadu has the highest productivity but in later years Madhya Pradesh, Gujarat, and Haryana progressed as the leading states in terms of productivity. Small Millets had a more dispersed productivity pattern, with Gujarat, Uttarakhand, and Tamil Nadu being the leading states during the later years. The discussion and the data presented above, reveals that a higher share of production did not always keep up a correspondence with higher yields.

The interstate yield-gap estimates for the last year of the period (Table-8) further highlight the magnitude of productivity differences among states. Ragi exhibited the largest disparity and the ratio of state with highest productivity to the state with the lowest productivity is more than ten times. Similarly gaps were observed in Jowar and Bajra, where productivity differed by nearly seven times. Small Millets displayed a comparatively smaller difference (five-fold). If the lagging states are able to bridge the gap in productivity through the dissemination of better technologies and management practices then the national millet production could be increased manifold.

Table-4: Decade-wise CAGR of Different Millets (%).

Period	Jowar			Bajra			Ragi			Small Millets		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1975-76 to 1984-85	0.02	0.71	0.71	-0.82	-4.38	-3.59	-0.91	-1.04	-0.14	-3.86	-4.45	-0.61
1985-86 to 1994-95	-3.45	-0.89	2.66	-1.33	3.92	5.32	-3.05	-0.07	3.08	-6.14	-4.31	1.96
1995-96 to 2004-05	-2.64	-1.99	0.67	0.28	3.63	3.34	-1.37	-0.61	0.77	-4.59	-5.14	-0.58
2005-06 to 2014–15	-3.49	-5.71	-2.3	-11.93	-0.98	11.3	-3.9	-2.53	1.42	-4.65	-1.67	3.13
2015-16 to 2025–26	-5.25	0.27	5.82	11.78	8.09	-3.3	2.46	0.77	-1.65	-4.78	-0.78	4.19
1975-76 to 2025-26	-2.98	-1.55	1.47	-1.01	1.28	2.31	-1.33	-0.67	0.67	-4.71	-3.19	1.61

Note: A denotes total cropped area under each millet (lakh ha); P denotes total output (lakh tonnes); Y denotes Yield (kg/ha).

Table-5: Decade-wise Ranking of Major Millet Producing States (Average Shares).

Millet	Rank	1975-76 to 84-85	85-86 to 94-95	95-96 to 2004-05	05-06 to 14–15	15-16 to 25–26
Jowar	1	MAH (42.1)	MAH (46.9)	MAH (52.4)	MAH (47.5)	MAH (36.3)
	2	KTK (14.8)	KTK (15.6)	KTK (18.1)	KTK (21.6)	KTK (19.6)
	3	MP (13.5)	MP (13.4)	MP (8.5)	MP (8.4)	RAJ (10.0)
	4	AP (11.5)	AP (8.1)	AP (7.4)	AP (6.1)	AP (7.1)
	5	TN (5.4)	TN (5.3)	UP (3.9)	RAJ (5.4)	UP (6.6)
Bajra	1	GJ (24.4)	RAJ (28.7)	RAJ (34.2)	RAJ (34.8)	RAJ (28.4)
	2	RAJ (21.8)	GJ (17.7)	GJ (15.9)	UP (13.8)	HAR (15.5)
	3	UP (12.8)	MAH (17.1)	MAH (15.8)	HAR (11.7)	UP (13.1)
	4	MAH (11.7)	UP (14.1)	UP (15.2)	TN (10.3)	GJ (12.9)
	5	HAR (8.3)	HAR (8.2)	HAR (9.3)	GUJ (10.0)	TN (9.9)
Ragi	1	KTK (47.4)	KTK (53.7)	KTK (64.1)	KTK (66.6)	KTK (66.1)
	2	TN (13.1)	TN (12.4)	TN (9.6)	TN (10.4)	TN (13.6)
	3	AP (10.8)	MAH (8.1)	MAH (6.8)	UK (8.8)	UK (7.0)
	4	MAH (7.9)	AP (7.1)	AP (4.9)	MAH (6.5)	MAH (5.6)
	5	ODS (7.8)	UP (6.9)	UP (4.1)	AP (2.7)	AP (2.2)
Small Millet	1	MP (20.3)	MP (27.2)	MP (27.7)	MP (20.1)	MP (25.2)
	2	AP (16.1)	UP (17.0)	UP (11.9)	UK (19.5)	UK (11.5)
	3	TN (15.4)	TN (14.0)	MAH (11.1)	GJ (10.5)	TN (7.4)
	4	UP (14.1)	AP (9.8)	TN (9.3)	TN (8.1)	KTK (6.7)
	5	KTK (9.5)	MAH (8.8)	UK (7.3)	CG (7.9)	MAH (6.7)

Table-6: Production Concentration (HHI) of major millet crops for benchmark years.

Period/Crop	Jowar	Bajra	Ragi	Small Millets
1975–76	0.208	0.146	0.252	0.136
1985–86	0.220	0.138	0.272	0.159
1995–96	0.332	0.167	0.441	0.165
2005–06	0.325	0.205	0.550	0.115
2015–16	0.189	0.354	0.458	0.116
2025–26	0.202	0.177	0.574	0.136
Average HHI (1975–2026)	0.267	0.207	0.393	0.139
Production-weighted long-run HHI	0.263	0.164	0.371	0.116
Classification	High	Moderate	Very High	Low

Note: HHI values < 0.15 indicate low concentration, 0.15–0.25 moderate concentration, values > 0.25 high concentration.

Table-7: Top 5 Yield-Performing States (kg/ha) for Major Millet Cropsacross Benchmark Years (1975–76 to 2025–26).

Year	Jowar	Bajra	Ragi	Small Millets
1975–76	TN(876), KTK(841), MP (681), ORS(661), UP(651)	PUN (1040), TN(733), GUJ (726), UP(721), J&K (656)	TN(1498), KTK(1166), AP (1143), UP(1015), GUJ (948)	GUJ(907), WB(801), TN (717), J&K (714), NAG(693)
1985–86	ORS(980), MP(905), TN (880), UP(666), AP (650)	TN(1163), PUN(871), UP (741), BH(609), AP(588)	TN(1542), MAH(1178), UP (1140), KTK(1082), AP (968)	ArP(941), UP(797), ORS (643), J&K (638), BH (628)
1995–96	UP(948), MAH(889), KTK(869), TN(860), MP (849)	UP(1260), TN(1095), GUJ (975), AP (954), MP (874)	TN(1817), KTK(1587), UP (1351), AP(1167), MAH(1050)	ArP(990), UP(964), TN(779), AP (741), NAG (731)
2005–06	AP(1324), GUJ(1138), KTK(1095), MP(1088), UP(1065)	MP(1491), UP(1434), GUJ (1169), TN(1158), HAR (1147)	KTK(1838), TN(1332), UK(1243), WB(1214), AP (1197)	UK(1176), NAG (1060), ArP(982), GUJ (872), TN(743)
2015–16	AP (2052), MP(1951), TN (1380), GUJ(1340), TEL(1000)	HAR(2129), MAH(772), MP (544), AP(250), GUJ (248)	TN(3013), KTK(1685), WB(1136), AP (1062), MAH(1011)	UK(1259), TN(1164), GUJ (1111), ArP (1002), AP (961)
2025–26	AP(3656), TEL(2386), MP (2035), UP(1705), GUJ (1703)	MP(2863), GUJ(2403), HAR(2389), UP(2164), KTK(1161)	TN(2486), AP(1706), KTK(1506), UK(1472), MAH(1376)	GUJ (2314), TN(1286), UK(1199), KTK(1109), AP (1020)

Note: Rankings are based on actual state-wise yield data from the uploaded datasets. States with cultivated area below 10,000 hectares in the respective benchmark year were excluded to avoid distortions arising from very small production bases.

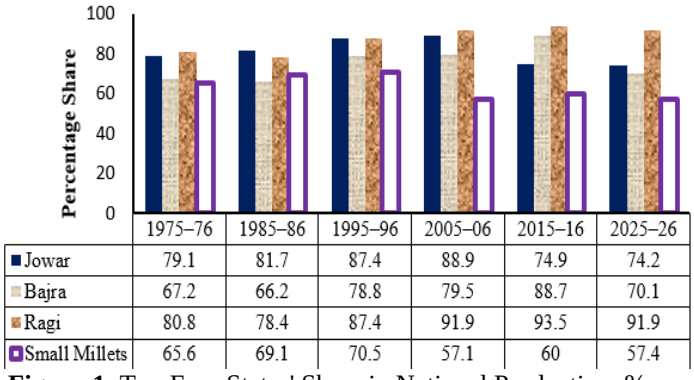


Figure-1: Top Four States' Share in National Production, %.

Table-8: State-wise Yield Gap (2025–26).

Crop	High Yield State	Yield (kg/ha)	Lowest Yield State	Yield (kg/ha)	Gap Ratio
Jowar	Andhra Pradesh	3656	Haryana	526	6.95
Bajra	Madhya Pradesh	2863	West Bengal	430	6.66
Ragi	Tamil Nadu	2486	Chhattisgarh	237	10.49
Small Millets	Gujarat	2314	Maharashtra	464	4.99

The β-convergence estimates are presented in Table-9 and it clearly indicates that interstate yield disparities have narrowed during the period for all four millet crops. The estimated β coefficients are negative and statistically significant ($p < 0.001$). Although the negative β coefficients are statistically significant, the relatively low R^2 values indicate that initial productivity explains only a limited share of interstate differences in subsequent productivity growth, suggesting that other structural, technological, agro-climatic and institutional factors also influence productivity dynamics. Bajra exhibited the highest convergence ($\beta = -0.2919$), followed by Small Millets ($\beta = -0.1928$) and Jowar ($\beta = -0.1832$), whereas Ragi showed the slowest convergence ($\beta = -0.0862$). The negative and significant β coefficients support Hypothesis H_5. They show that states with lower initial productivity generally achieved faster growth in yield than states that started with higher productivity. This indicates the presence of β-convergence across millet crops. However, the rate of convergence was not the same for all crops.

Table-9: Convergence Coefficient (β) Estimates for Major Millet Crops.

Crop	Constant(α)	β Coefficient	p-value	R^2
Jowar	1.232	−0.183	<0.001	0.088
Bajra	2.013	−0.292	<0.001	0.144
Ragi	0.600	−0.086	<0.001	0.042
Small Millets	1.251	−0.193	<0.001	0.094

Production Volatility Analysis: Production stability is an important indicator of the sustainability of millet cultivation, particularly under rainfed conditions. Table-10 presents the Cuddy–Della Valle Instability Index (CDVI) for the four millet crops. Small Millets witnessed the highest instability in both cultivated area (23.03%) and production (25.28%). This points that for most millet crops, fluctuations in cultivated area has been the main driver of output changes. The Table-10 also shows a clear decline in instability over time - particularly in the later decades and most notably for Small Millets. This also indicates that the factors associated with production instability are different for the different crops.

State-level estimates show significant regional difference in production stability (Table-11). In Jowar, Karnataka recorded comparatively stable production, whereas Andhra Pradesh and Madhya Pradesh showed greater fluctuations in area and yield. Gujarat and Haryana emerged as the most stable Bajra-producing states, while Rajasthan exhibited comparatively high production instability despite its dominant contribution to national output. Ragi remained relatively stable in Karnataka, Maharashtra, and Uttarakhand, but Andhra Pradesh found to have greater variability. Small Millets showed the highest instability with Andhra Pradesh, Uttar Pradesh, and Tamil Nadu recording fluctuations in area and production, while Uttarakhand remained the stable producer. These results support H_3.

Correlation Analysis: The high correlation coefficients (Table-12) demonstrate the strong association between cultivated area and production that indicates that changes in area were closely associated with changes in output. Jowar (0.973), Ragi (0.969), and Small Millets (0.861) display positive and high correlations between area and production, signifying that output changes largely reflected changes in cultivated area. Bajra shows a comparatively weaker relationship (0.737) thereby showing a greater contribution of productivity improvements in the production growth. Because production is an identity involving area and yield, the correlation results are interpreted descriptively rather than as evidence of causal relationships. The results show that higher productivity by itself did not lead to continuous growth in millet production. Cultivated area was found to be the main factor behind long-term growth in the production. This supports Hypothesis H_1, which states that cultivated area had a large effect on millet production than changes in productivity.

Yield Decomposition: The decomposition analysis given in Table-13 show the contributions of changes in cultivated area, yield, and their interaction to long-term production changes across India's major millet crops. The results reveal divergent growth trajectories. Bajra was the only crop to record a substantial increase in production (+79.72 lakh tonnes), whereas Jowar (−51.52 lakh tonnes), Ragi (−8.30 lakh tonnes), and Small Millets (−15.46 lakh tonnes) found to have net production declines. For all four crops, the area Effect was generally negative; indicating that reduction of cultivated area was the primary constraint on long-term production, whereas productivity improvements somewhat compensated for these losses.

Jowar experienced the largest production decline, primarily because the negative Area Effect outweighed the positive contribution of yield improvement. The sharpest decline occurred during 2005–06 to 2015–16, when simultaneous reductions in cultivated area and productivity resulted in a production loss of nearly 34 lakh tonnes. Production recovered slightly during 2015–16 to 2025–26, due to a positive Yield Effect (+32.24 lakh tonnes) but this was insufficient to reverse the long-term decline. In case of Bajra, production growth was largely driven by yield improvement (+136.22 lakh tonnes), despite a negative Area Effect (−16.74 lakh tonnes). The production growth was accelerated during the period 2015–16 to 2025–26 due to a positive and large Area Effect (+128.72 lakh tones). Consequently, Bajra remained the only millet to achieve continuous production growth over the study period. Ragi and Small Millets continued to experience production declines because effect of reductions in cultivated area exceeded the gains from improved productivity.

Table-10: Decade-wise Instability (CDVI %) of Area, Production and Yield of Major Millet Crops

Crop	Variable	1975-76 to 84-85	85-86 to 94-95	95-96 to 04-05	05-06 to 14–15	15-16 to 25–26	75-76 to 25-26
Jowar	Area	1.84	3.42	2.76	4.87	9.39	7.21
	Production	7.55	15.44	10.42	6.66	10.52	14.25
	Yield	6.62	12.49	9.26	9.08	5.27	11.75
Bajra	Area	4.34	8.15	7.69	17.64	17.09	13.96
	Production	19.92	27.98	24.71	16.35	12.26	23.71
	Yield	17.84	22.22	17.67	28.41	21.33	28.39
Ragi	Area	3.13	3.55	4.92	7.62	6.75	10.12
	Production	12.67	5.88	16.3	13.38	13.39	13.19
	Yield	9.91	5.45	13.94	6.98	9.3	12.11
Small Millets	Area	2.68	3.45	1.75	4.96	9.87	23.03
	Production	11.44	9.75	6.34	8.52	11.12	25.28
	Yield	9.41	6.26	5.96	5.89	5.67	17.82

Table-11: State-wise Instability (CV and CDVI %) of Major Millet-Producing States (1975–76 to 2025–26).

Crop	State	Coefficient of Variation (CV%)			Cuddy–Della Valle Instability Index (CDVI %)		
		Area	Production	Yield	Area	Production	Yield
Jowar	Maharashtra	37.2	41.1	19.7	10.3	25.6	19.2
	Karnataka	35.1	27.0	22.1	16.3	18.3	15.9
	Madhya Pradesh	77.5	63.5	41.1	21.8	29.6	19.4
	Andhra Pradesh	86.1	55.7	72.5	25.5	24.8	37.3
	Tamil Nadu	39.6	39.5	20.6	19.9	28.9	19.3
Bajra	Rajasthan	12.2	67.2	66.1	12.2	53.3	49.6
	Gujarat	40.8	30.4	51.3	14.5	29.9	34.2
	Uttar Pradesh	8.4	51.7	49.4	8.4	43.2	41.7
	Maharashtra	37.9	42.2	36.6	18.9	41.2	24.2
	Haryana	23.5	43.1	51.6	16.0	22.1	18.8
Ragi	Karnataka	19.1	21.1	20.6	12.1	20.9	17.0
	Tamil Nadu	48.6	32.1	35.1	19.5	27.0	21.0
	Maharashtra	34.8	31.0	15.9	7.8	15.7	12.6
	Uttarakhand	29.0	20.2	11.0	12.3	11.0	--
	Andhra Pradesh	77.4	73.1	12.8	25.6	25.8	11.1
Small Millets	Madhya Pradesh	75.0	57.9	66.8	17.3	30.0	40.9
	Tamil Nadu	100.4	90.2	26.2	44.6	43.2	16.3
	Uttar Pradesh	108.7	104.2	23.1	49.1	55.2	22.8
	Andhra Pradesh	127.0	115.5	32.6	68.5	67.6	21.3
	Uttarakhand*	9.5	10.6	8.4	6.7	10.1	7.6

Note: *****Uttarakhand was formed in 2000**.**

Table-12: Pearson Correlation Matrix (State-wise Cross-sectional Data: 1975–76 to 2025–26).

Crop	Production-Area ρ(A,P)	Area–Yield ρ(A,Y)	Production–Yield ρ(P,Y)
Jowar	0.973	−0.071	0.002
Bajra	0.737	−0.034	0.057
Ragi	0.969	0.106	0.186
Small Millets	0.861	−0.294	−0.149

The decomposition analysis points to a clear conclusion: changes in cultivated area were the main driver of long-term millet production trends. Productivity gains, while positive, were not large enough to offset the losses from shrinking acreage. These results lend strong support to H_2 and are in line with the correlation findings. This highlights the importance of policies that concurrently ensures stability in millet cultivated area and promote productivity growth. Above results show that four sets of analysis - decomposition, correlation, concentration, and instability - point to the same conclusion.

The contraction of cultivated area has been the dominant factor behind long-term changes in millet production. Productivity improvements have played a compensatory role. The only exception is Bajra, where yield growth successfully offset the decline in acreage.

Discussion: What explains the long-term decline in millet production? The findings point visibly to shrinking cultivated area as the primary reason. Jowar, Ragi, and Small Millets all lost substantial area over the study period, as farmers shifted towards more remunerative and better-supported crops like rice and wheat. The decomposition analysis confirms this: in all three crops, the negative area effect outweighed gains from yield improvement. The high and positive correlations between area and production—0.973 for Jowar, 0.969 for Ragi, and 0.861 for Small Millets—suggest that production has been more sensitive to area changes than to productivity gains.These findings support the findings of earlier studies that the area under millets has declined substantially over time and that area reallocation away from these crops has been an important component of agricultural transformation in India[22-24].

Table-13: Decomposition of Changes in Millet Production into Area, Yield and Interaction Effects (Lakh tonnes).

Crop	Period	Area Effect	Yield Effect	Interaction Effect	Total Change
Jowar	1975–76 to 1985–86	0.03	6.89	0.00	6.93
	1985–86 to 1995–96	-30.22	30.59	-9.07	-8.70
	1995–96 to 2005–06	-21.91	6.44	-1.51	-16.98
	2005–06 to 2015–16	-22.79	-15.86	4.74	-33.91
	2015–16 to 2025–26	-17.66	32.24	-13.43	1.15
	1975–76 to 2025–26	-74.09	102.49	-79.89	-51.49
Bajra	1975–76 to 1985–86	-4.56	-17.56	1.40	-20.72
	1985–86 to 1995–96	-4.58	24.87	-3.11	17.17
	1995–96 to 2005–06	1.51	20.93	0.59	23.03
	2005–06 to 2015–16	-55.26	147.26	-105.90	-13.90
	2015–16 to 2025–26	128.72	-17.93	-36.66	74.14
	1975–76 to 2025–26	-22.84	122.91	-48.95	51.12
Ragi	1975–76 to 1985–86	-2.44	-0.39	0.03	-2.79
	1985–86 to 1995–96	-6.71	8.92	-2.38	-0.17
	1995–96 to 2005–06	-3.22	2.00	-0.26	-1.48
	2005–06 to 2015–16	-7.72	3.57	-1.17	-5.32
	2015–16 to 2025–26	5.01	-2.79	-0.77	1.45
	1975–76 to 2025–26	-13.65	11.26	-5.62	-7.97
Small Millets	1975–76 to 1985–86	-6.20	-1.14	0.37	-6.97
	1985–86 to 1995–96	-5.68	2.59	-1.22	-4.30
	1995–96 to 2005–06	-2.92	-0.44	0.16	-3.19
	2005–06 to 2015–16	-1.74	1.66	-0.63	-0.71
	2015–16 to 2025–26	-1.50	1.98	-0.77	-0.29
	1975–76 to 2025–26	-17.53	23.52	-21.43	-15.44

Bajra presents an exception to this overall pattern. The exceptionally large positive Area Effect observed during 2015–16 to 2025–26 suggests a revival of Bajra cultivation, possibly reflecting increased adoption of improved hybrids, enhanced market demand, stronger policy support, and growing recognition of millets under national nutrition and climate-resilience programmes. The negative Yield and Interaction Effects during the same period indicate that sustaining production growth in future would require technological improvement and efficient farm management. These findings are consistent with findings of earlier studies[3,23].

Production of various millets is not uniform as some states lead in the production of a particular crop. Ragi production is led by Karnataka throughout the period. Bajra saw its regional dominance shift over time and top producers are Rajasthan and Haryana in the recent period. Small Millets showed comparatively low production concentration. We found that there were significant interstate variations in productivity for all the millet crops considered and that these differences were consistent throughout the period under consideration. However, the study also finds that the lower productivity states are converging with the higher ones although significant differences still characterize productivity. The convergence analysis showed that Bajra recorded highest pace of convergence while Ragi convergence was the lowest. The findings are in tandem with earlier studies in their assessment of agricultural productivity [25,26].

It was found that small millets had the highest instability percentiles for both area and production followed by Ragi. On the other hand, Bajra recorded the highest instability values for yield. Ragi was the most stable millet crop as it registered moderate levels of instability for area, production, and yield. The study observed that there are substantial interstate differences in productivity and they persist for the entire study period for all millet crops. However, it is seen from the convergence analysis that lagging states are catching up with the better performing states. But substantial difference in productivity still exists. The convergence analysis reveals that Bajra recorded the strongest convergence, whereas Ragi exhibited the slowest adjustment. The observed tendency of lagging states to catch up with better-performing states is also consistent with the evidence of β- and σ-convergence reported in earlier studies of Indian agricultural productivity[25,26].

The instability analysis showed that Small Millets recorded the highest instability in cultivated area and production. Bajra, on the other hand, exhibited the highest instability in yield despite productivity gains. Ragi emerged as the most stable millet crop, reflecting its relatively balanced performance in terms of area, production, and yield.

Overall, the empirical findings support H_1, H_2, H_3, H_4, and H_5. Area contraction exerted a stronger influence on production than yield improvements, production remained regionally concentrated, significant interstate differences in instability and productivity persisted, and the β-convergence estimates indicate a gradual narrowing of interstate yield disparities. The study contributes to the existing literature in several important ways. Unlike previous studies, which have generally examined growth, instability, decomposition, or regional performance separately, the present analysis integrates long-term trend analysis, regional concentration, decomposition analysis, productivity convergence, instability analysis, and correlation analysis within a single analytical framework using state-level longitudinal data covering the period 1975–76 to 2025–26.

From the above, we may conclude that technological progress alone is not sufficient to ensure increase in millet production when cultivated area contract. The approach to achieve long term increase in production has to be two pronged. First, adoption of better technologies and agronomic practices by way of adoption of improved seeds, better irrigation systems, balanced nutrient management, mechanization, and other advanced farm practices. Secondly, the policy intervention for making the millet production more economically attractive so that it can lead to an increase in cultivated area. This can be done by remunerative prices, effective procurement systems, value-chain development, decentralized processing, climate-resilient technologies, and region-specific production support. The integrated approach will not only enhance productivity but it would also tackle the basic constraints responsible for the decline in cultivated area, thereby ensuring constant growth in millet production over the long run in the country.

Conclusion

In this study we have examined the long-term trends in millet cultivation for the period 1975–76 to 2025–26 using Indian state-level data. The results showed a decline in cultivated area in case of all the four millet crops but the magnitude was not uniform for all the crops. The contraction in the area cultivated resulted in reduction in the total production in case of the three millet crops, viz., Jowar, Ragi, and Small Millets. The case of Bajra is different because here improvement in productivity has compensated the impact of reduction in cultivated area and observed an increase in the production. Here, it may be noted that the reduction in area was lowest in case of Bajra. The decomposition of changes in production into 'area effect', 'yield effect' and 'interaction effect' pointed out that contraction in cultivated area is the main factor determining long-term production trends. The yield effect has somewhat reduced the extent of production loss to a small degree but was unable to offset the negative area effect.

We found that top producing states have by and large retained their position among top five. Ragi production became largely concentrated in Karnataka. Bajra exhibited changes in regional distribution of production, and Small Millets remained relatively more geographically dispersed. The β-convergence analysis indicates that lower-yielding states have narrowed the

productivity gap with better-performing states but still significant interstate differences in productivity still exist. The area, production and yield has shown significant variability from year to year. The instability analysis shows that Small Millets recorded the greatest instability in cultivated area and production, whereas Bajra experienced comparatively higher variability in productivity. The study found that improving productivity alone will not be sufficient to raise millet production if the continued decline in cultivated area is not simultaneously addressed.

The policy options are therefore is to have a two pronged strategy focusing on yield improvements and expansion of area cultivated. The first part may be achieved by better farm management, adoption/making drought-tolerant varieties, improved irrigation and increasing use of technology. The second part is by policy interventions to provide economic incentives to the farmers by making the millet production more profitable. This can be done by procuring the millets at Minimum Support Prices (MSP), streamlining procurement process, promotion of millet-based food products and similar measures. The renewed policy emphasis on millets following the International Year of Millets 2023 did provide a timely opportunity to strengthen these interventions. Thus a balanced approach which promotes productivity growth, stabilizes cultivated area, and improves market incentives may enhance the production of millets to enable nutritional security, climate resilience and farmers' livelihoods.

References

1. Dayakar Rao, B., Bhaskarachary, K., Arlene Christina, G. D., Sudha Devi, G., Vilas, A. T., & Tonapi, A. (2017). Nutritional and health benefits of millets. *ICAR_ Indian Institute of Millets Research Rajendranagar, Hyderabad*, 2, 38-57.
2. Karnik, N. N. (2024). Production of nutri-cereals in India: A decomposition analysis. *Journal of the Indian Society of Agricultural Statistics*, 78(3), 213–220.
3. Yadav, O. P., Singh, D. V., Kumari, V., Prasad, M., Seni, S., Singh, R. K. & Mohapatra, T. (2024). Production and cultivation dynamics of millets in India. *Crop Science*, 64(5), 2459-2484.
4. Sukanya, T. S., Prabhakar, K., Gowda, K. T., Swarna, R., Hariprasanna, K. & Tonapi, V. A. (2022). Good agronomic practices for higher yield in Small Millets. *ICA—All India Coordinated Research Project on Small Millets. Hyderabad: ICAR-Indian Institute of Millets Research*.
5. Gupta, S. M., Arora, S., Mirza, N., Pande, A., Lata, C., Puranik, S., & Kumar, A. (2017). Finger millet: a "certain" crop for an "uncertain" future and a solution to food insecurity and hidden hunger under stressful environments. *Frontiers in plant science*, 8, 643.
6. Nayak, S. H., Singh, H., Srivastava, S. K., Nithyashree, M. L., & Balasubramania, M. (2025). Millets' status in India: An integrated assessment for harnessing their potential. *Indian Journal of Agricultural Economics, 80*(2), 441–459.
7. Anbukkani, P., Balaji, S. J., Nithyashree, M. L., & Prakash, P. (2017). Production and consumption of minor millets in India – a structural break analysis. *Annals of Agricultural Research,* 38(4), 1-8.
8. Chaudhary, J., Shelar, R., Thakur, K., Singh, R., &Rimpika. (2023). Millets in India: Production, consumption and impact on food security. *Asian Journal of Agricultural Extension, Economics & Sociology,* 41(8), 151–162.
9. NITI Aayog (2023). *Promoting millets in diets: Best practices from Indian states.* Government of India.
10. Minhas, B. S. & Vaidyanathan, A. (1965). Growth of crop output in India, 1951–54 to 1958–61: An analysis by component elements. *Journal of the Indian Society of Agricultural Statistics*, 17(2), 230–252.
11. Shetty, S. A. (1970). Agricultural production trends and components. *Indian Journal of Agricultural Economics*, 25(2), 28.
12. Madhu, D. M., Basavaraj, G., Manisha, V. V. D., Hanumanthappa, R., & Moolimane, C. B. (2024). An overview of millets production in India: Growth and instability. *Journal of Experimental Agriculture International,* 46(10), 213-225.
13. Bodkhe, V.R., Shende, N.V., Bagde, N.T. and Warade, S.V. (2025). Dynamics of major millets in India. *International Journal of Agriculture and Food Science*, 7(8), 401-405.
14. Das, B. S., Singh, P., Sangeetha, V., Bhowmik, A., & Ray, P. (2019). Growth and instability in area, production, productivity and consumption of millets in India: An analysis. *Indian Journal of Extension Education, 55*(4), 158–161.
15. Renjini, V. R., Ranjan Kumar, R., Asha Devi, S. S., Balasubramanian, M., Nithyashree, M. L., Mazumder, C., & Harbir Singh (2024). Export potential of millets from India: Current status and short-term forecast. *Indian Journal of Economics and Development,* 20(3), 532–541.
16. Hayami, Y. & Ruttan, V. W. (1985). *Agricultural development: An international perspective.* Johns Hopkins University Press.
17. Bhutani, S. (2024). Millets Sector in India: Trends, Role, Challenges, and Way ahead. *Journal of Rural Economics*, 61(4), 508–519.
18. Murty, V. V. N., Rao, D. S., & Sain, M. (2007). Simulation modeling to quantify yield gaps in sorghum and pearl millet in India. *Journal of Agricultural Research*, 45(2), 123–134.
19. Yamuna, N., Kolekar, D. V. & Rakesh, N. (2024). Trend and instability analysis of area, production, productivity of

millets in India. *Journal of Scientific Research and Reports*, *30*(8), 686-699.

20. Nayak, A. K., Satpathy, B. S., Pradhan, S., Jeepsa, N. M., Barik, S., Kumar, M., & Mishra, S. K. (2026). A data-light composite climate resilience index reveals superior drought resilience of millets in rain fed agro ecosystems. *Scientific Reports*.
21. Banerjee, R., Bharti, B., Das, P., Barman, S., Devi, S., & Ankita, A. (2024). Comprehensive analysis of millets in India: Area, production, cost of production and export statistics. *Current Agriculture Research Journal, 12*(3).
22. Birthal, P. S., Joshi, P. K., Negi, D. S., & Agarwal, S. (2014). *Changing sources of growth in Indian agriculture: Implications for regional priorities for accelerating agricultural growth* (IFPRI Discussion Paper No. 01325). International Food Policy Research Institute.
23. Malathi, B., Appaji, C., Reddy, G. R., Dattatri, K., & Sudhakar, N. (2016). Growth pattern of millets in India. *Indian Journal of Agricultural Research,* 50(4), 382–386.
24. Jena, D., & Mishra, S. (2022). Growth and Decomposition of Millets in Odisha: 1960-61 to 2019-20. *Agricultural Science Digest*, 42(3), 272-277.
25. Murtaza, M., & Masood, T. (2020). Inter-district variation and convergence in agricultural productivity in India. *Agricultural Economics Research Review*, 33(2), 219-228.
26. Mukhopadhyay, D., & Sarkar, N. (2019). Convergence of foodgrains productivity In Indian agriculture. *International Journal of Food and Agricultural Economics*, *7*(3), 229-241.