www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
Impact Factor (RJIF): 6.34
TPI 2025; 14(11): 54-59

www.thepharmajournal.com
Received: 25-08-2025
Accepted: 30-09-2025

Prema Borkar
Gokhale Institute of Politics and Economics (Deemed University), Pune, Maharashtra, India

Corresponding Author:
Prema Borkar
Gokhale Institute of Politics and Economics (Deemed University), Pune, Maharashtra, India

Trends and decomposition analysis of millets production in Maharashtra

Prema Borkar

DOI: https://www.doi.org/10.22271/tpi.2025.v14.i11a.26311

Abstract
Millets, a diverse collection of small-seeded grasses, are cultivated worldwide as cereal products or grains for human and animal consumption. Despite their high nutritional value and capacity to flourish in unfavourable conditions, millets are not fully utilized. Millets have more vitamins and minerals than rice and wheat. The objective is to examine the patterns in Maharashtra's production of sorghum, bajra, ragi, and other minor millets from 1966-1967 to 2023-2024. With 43 percent (13.5 million tons) of the world's millet production in 2024, India is the top producer in the globe. The nation produced 17.24 million metric tons of millets with an average yield of about 1,262 kg per hectare on a total planted area of 12.88 million hectares. The country's yearly per capita millet consumption has dropped significantly during the last 60 years, from 30.94 kg to just 3.87 kg. Between 2016 and 2022, the area under cultivation of millet decreased significantly in Maharashtra, as did the production of important millets including bajra and sorghum. The productivity per hectare has shown varied tendencies, with bajra productivity marginally improving and sorghum productivity reducing, despite overall production declining.
The compound growth of the sorghum area is negative and significant when the entire study period (1966-1967 to 2023-2024) is taken into account, while the growth rate of output was negative and non-significant. Sorghum productivity, on the other hand, was favourable and statistically non-significant. The growth rate of other millets was negative but none of them was significant. According to decomposition analysis, the yield impact was the only factor responsible for the increase in millet output between 2005 and 2024. The primary cause of Maharashtra's declining millets production was determined to be the yield component. Due to the limited supply of resources, it is essential to increase millets' productivity through the use of improved technologies, such as hybrid millet cultivation and a range of production techniques, in order to meet the projected increase in demand.

Keywords: Compound growth rate, decomposition analysis, millets, production

Introduction
Millets are small-seeded plants that can grow in both arid and semi-arid environments. They are also known as dry land cereals or nutri-cereals. Millets thrive in a variety of climates. Millets are classified according to their grain size. The major and minor millets, including sorghum (Jowar), pearl millet (Bajra), and small millets (Kodon, Cheena, Kutki, Ragi, and Kakun). They are rich in phytochemicals, minerals, protein, and dietary fiber. Millets have 7 to 12 percent protein, 2 to 4 percent fat, 65 to 75 percent carbs, and 15 to 20 percent fiber.
In 2024, India accounted for 43 percent of the global millet production, which amounted to 12.2 million tons. The country's cultivated area of millets was 12.88 million hectares, with an average yield of approximately 1,262 kg per hectare and a production of 17.24 million metric tons (APEDA, 2023). Rajasthan is the state with the most land under millets cultivation (36%), followed by Maharashtra (21.67%) and Karnataka (13.46%) at the national level. The country's annual per capita consumption of millets has declined significantly over the past six decades, from 30.94 kg to a mere 3.87 kg. India declared 2018 the National Year of Millets and renamed these commodities "Nutri-Cereals" in recognition of their multifaceted utility.
These policy initiatives may have contributed to the US$ 75 million increase in millets exports over the period of five years, which occurred in 2022-23. The United Nations adopted a resolution on March 5, 2021, designating the year 2023 as the International Year of Millets, further emphasizing the importance of millets in ensuring nutritional security. 72 nations endorsed this resolution (PIB, 2023). Nevertheless, there is a significant amount of work to be done in order to fully realize the potential of millet to enhance food and nutritional security.

This paper analyzes the trend and growth rate in area, production and productivity of various millets in Maharashtra. It also analyzes the various millets production by decomposition analysis.

Materials and Methods

The study utilizes secondary sources of time series data from the website of the Agricultural Statistics at a Glance, Directorate of Economics and Statistics, Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India. The data was collected from 1965-66 to 2023-24. To get an insight into millet production trends, compound annual growth rates (CAGR) were estimated as follows:

Compound Growth Rate (CGR): In the present study, the compound growth rate of area, production, and productivity for the millet crops in Maharashtra was estimated to study the growth rate in area, production, and productivity. The compound growth rates were found to be very convenient for any comparison of growth between two periods and two crops. It seems more appreciable to analyze the movement of crops in terms of compound rather than linear growth rate (Dandekar, 1980) [3]. Hence the compound growth rates were computed for the millet crops in Maharashtra. The compound growth rates are usually estimated by fitting a semi-log trend equation of the form.

Log Y t = α + t βt + ε …………….. (1)

Where, Yt = Area, production and productivity of selected major agricultural crops in years ‘t’

T = Year which takes value 1, 2,……,

α and β are the parameters to be estimated

ε = Random error term

Equation (1) was estimated using ordinary least squares (OLS) technique. The t-test was applied to test the significance of β. This equation is generally used on the consideration that change in agricultural output in a given year would depend upon the output in the preceding year.

Decomposition Analysis

From 2004-05 to 2023-24, additive decomposition was implemented. This approach decomposes the overall change in production into three effects: area effect (percentage contribution of area), yield effect (percentage contribution of yield), and interaction effect (percentage contribution of interaction). The area contribution refers to production derived from increased area using the base year average yield, the average yield contribution pertains to production resulting from enhanced yield with the base year area, and the interaction contribution denotes production arising from the combined effects of increased yield and area. This is detailed as follows:

Let P_o and P_n be production in base year and nth year.

$P_o = A_o . Y_o$ 1

$P_n = A_n . Y_n$

Where A_o, A_n represent area Y_o, Y_n represent yield for the base year and nth year, respectively. The base year and nth year observations are triennium averages.

$P_n - P_o = \Delta P$

$A_n - A_o = \Delta A$ 2

$Y_n - Y_o = \Delta Y$

From 1 and 2 we can write

$P_o + \Delta P = (A_o + \Delta A)(Y_o + \Delta Y)$

$\Delta P = (A_o + \Delta A)(Y_o + \Delta Y) - P_o$

$= (A_o + \Delta A)(Y_o + \Delta Y) - A_o . Y_0$

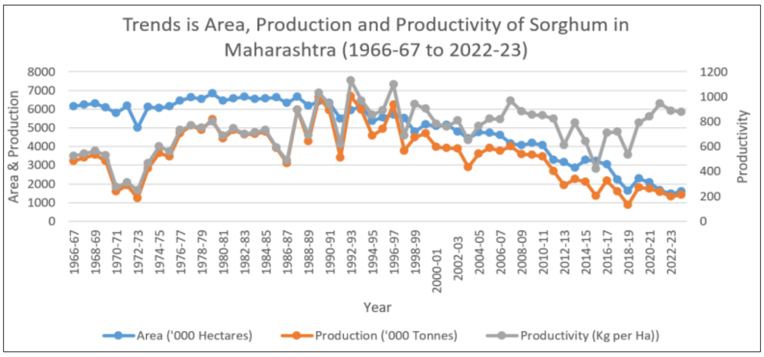
$= (A_o.Y_0 + \Delta A Y_o + \Delta Y A_o + \Delta A \Delta Y - A_o.Y_0)$

$\Delta P = \Delta A Y_o + \Delta Y A_o + \Delta A \Delta Y$

Consequently, the total shift in production is divided into three effects: the area effect, the yield effect, and the interaction effect. These are represented in terms of the percent change in production (ΔP), which results in a percentage that estimates the percentage contribution of productivity, area, and their interaction.

Results and Discussion

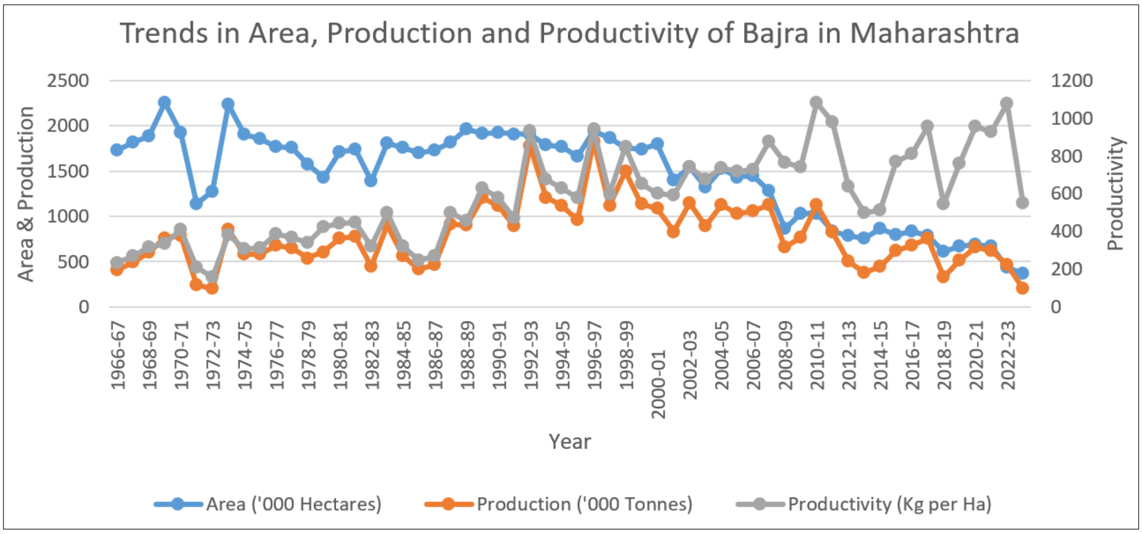
Trend in area, production, and productivity of Sorghum in Maharashtra: The trends for the area, production, and productivity of sorghum in Maharashtra depicted in Figure 1 highlight substantial changes over the past few decades. Since the late 1960s, there has been a constant decline in the area under millet cultivation, with a notable drop from 2010-11 (4060 thousand hectares) to 2023-24 (1600 thousand hectares). In contrast, the yield of sorghum in Maharashtra was 523 kg per hectare reaching an average of 1032 kg per hectare in 1989-90. This increase suggests the adoption of improved farming practices and technologies. Even though the cultivation area has decreased, the rising yield levels have helped maintain a relatively stable production level over time, with some fluctuations, indicating efforts to sustain production levels or potential shifts in agricultural practices. The yield of sorghum in Maharashtra further declined to 878 kg per hectare in 2023-24. The production of sorghum in Maharashtra was 3208 thousand tonnes in 1966-67 and reached a peak of 6635 thousand tonnes in 1989-90 and further declined to 1404 thousand tonnes in 2023-24.



Source: Agricultural Statistics at a Glance, Directorate of Economics and Statistics, DAC, GoI.

Fig 1: Trends in area, production and productivity of Sorghum in Maharashtra

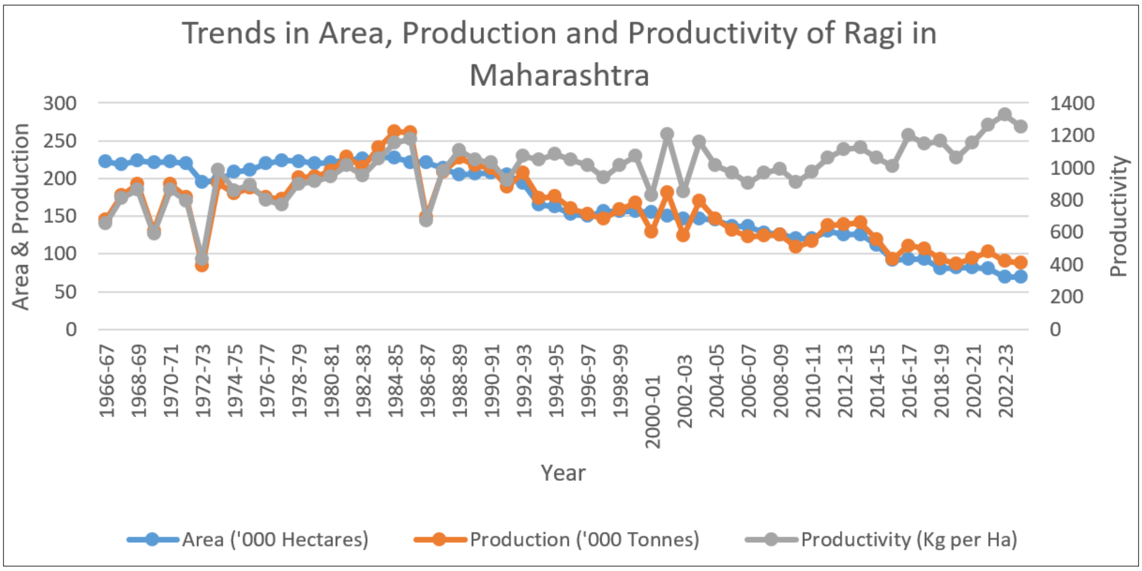
Figure 2 showed the trends in area, production and productivity of bajra in Maharashtra over a period from 1966-67 to 2023-24. Since 1966-67, there has been a consistent decline in the area under bajra cultivation, with a notable drop from 1727 thousand hectares in 1966-67 to 367 thousand hectares in 2023-24. The production of bajra was 404 thousand tonnes in 1966-67. It increased to 1779 thousand hectares in 1992-93 and further declined to 201 thousand tonnes in 2023-24. The yield of bajra was 234 kg per hectare and increased to 549 kg per hectare in 2023-24.



Source: Agricultural Statistics at a Glance, Directorate of Economics and Statistics, DAC, GoI.

Fig 2: Trends in area, production and productivity of Bajra in Maharashtra

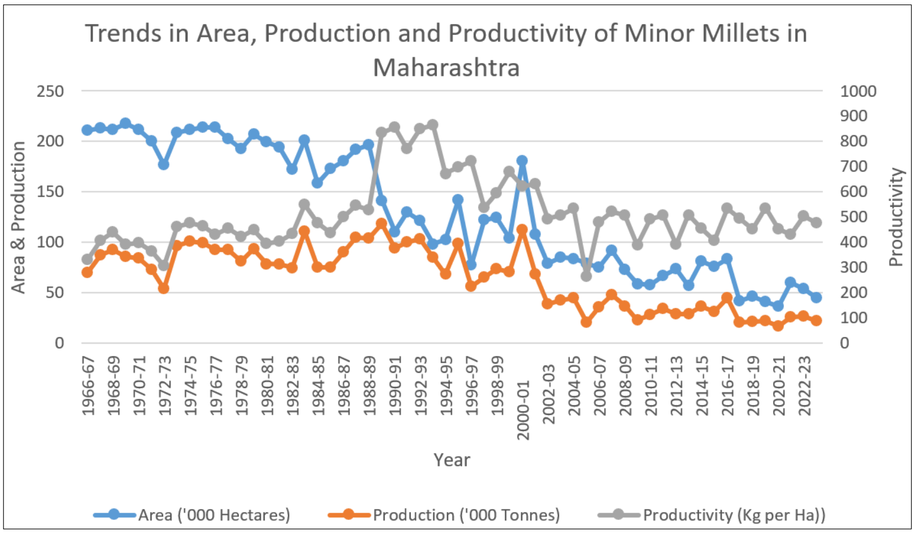
Figure 3 demonstrated the trends in area, production and productivity of Ragi in Maharashtra. It depicts declining trend in area under ragi cultivation from 222 thousand hectares during 1966-67 to 70 thousand hectares in 2023-24. At the same time the production has also decreased from 145 thousand tonnes in 1966-67 to 88 thousand tonnes in 2023-24. Whereas, the productivity of ragi in Maharashtra has increased from 653 kg per hectare to 1251 kg per hectare in 2023-24.



Source: Agricultural Statistics at a Glance, Directorate of Economics and Statistics, DAC, GoI.

Fig 3: Trends in area, production and productivity of Ragi in Maharashtra

The trends in area, production and productivity of minor millets in Maharashtra is depicted in Figure 4. It depicts the declining trend in area under ragi cultivation from 211 thousand hectares during 1966-67 to 45 thousand hectares in 2023-24. At the same time the production decreased from 70 thousand tonnes in 1966-67 to 22 thousand tonnes in 2023-24. Whereas, the productivity of ragi in Maharashtra has increased from 330 kg per hectare to 477 kg per hectare in 2023-24.



Source: Agricultural Statistics at a Glance, Directorate of Economics and Statistics, DAC, GoI.

Fig 4: Trends in area, production and productivity of in Maharashtra

Table 1: Compound growth rate of area, production and productivity of millets

	Area	Production	Productivity
Sorghum			
1965-66 to 1994-95 (post green revolution)	0.02**	2.96**	2.94**
1995-96 to 2023-24 (post economic liberalization)	-4.54**	-5.07**	-0.56**
1965-66 to 2023-24	-2.07**	-1.24 NS	0.84 NS
Bajra			
1965-66 to 1994-95 (post green revolution)	0.20 NS	3.41**	3.21**
1995-96 to 2023-24 (post economic liberalization)	-4.92 NS	-4.43**	0.51 NS
1965-66 to 2023-24	-1.96**	0.18 NS	2.18**
Ragi			
1965-66 to 1994-95 (post green revolution)	-0.49 NS	1.10 NS	1.60 NS
1995-96 to 2023-24 (post economic liberalization)	-2.92 NS	-2.12**	0.82 NS
1965-66 to 2023-24	-1.94 NS	-1.21**	0.74**
Minor Millets			
1965-66 to 1994-95 (post green revolution)	-2.21**	0.55 NS	2.83**
1995-96 to 2023-24 (post economic liberalization)	-3.60**	-4.64**	-1.10 NS
1965-66 to 2023-24	-2.95**	-2.69**	0.26 NS

** significant at 5 percent

The growth rate of area, production, and productivity of sorghum was positive and significant during the post green revolution. During the post economic liberalization period, area, production and productivity was negative and significant. When the entire period under study is considered (1966-67 to 2023-24), the compound growth of area is negative and significant. The growth rate of production of sorghum was negative and non-significant. While the productivity of sorghum was positive and non-significant.

The compound growth rate of production and productivity of Bajra was positive and significant during the post green revolution period. Whereas, the compound growth rate of area was positive and non-significant. In the post economic liberalization period, area and productivity was found to be non-significant. When the entire period under study is considered (1950-50 to 2023-24), the compound growth rate of productivity is positive and significant. The growth rate of area of bajra was negative but significant. Whereas, the growth rate of production was positive but non-significant.

During the post green revolution period, the compound growth rate of production and productivity of Ragi was found to be positive and non-significant. Whereas, the growth rate of area was found to be negative and non-significant. The compound growth rate of productivity of Ragi was positive and non-significant during the post-economic liberalization period. However, the compound growth rate of production was negative and significant. During the overall period of study, the compound growth rate of Rabi area was found to be negative and non-significant. The growth rate of production was negative and non-significant. Whereas, the growth rate of productivity was positive and significant.

During the post green revolution period, the growth rate of minor millet's area was negative and significant. The compound growth rate of production was positive but non-significant. Whereas, the productivity was positive and significant. In the post economic liberalization period, the area and production were negative but significant. The growth rate of productivity of minor millet was negative and non-significant. The growth rate of area and production of overall study period was negative and non-significant. Whereas, the productivity of minor millets was positive but non-significant.

Area, Production, and Productivity of Millets in Major Growing States of India (TE 2023-24)

The state-wise break up of area, production and productivity of millets is presented in Table 2.

Table 2: State-wise Area, Production, and Productivity of Millets in India

Sr. No.	States	Area (Lakh ha)	Production (Lakh tonnes)	Productivity (Kg/ha)
1	Rajasthan	47.75 (39.18)	48.09 (31.27)	1007
2	Maharashtra	20.82 (17.08)	17.15 (11.05)	824
3	Karnataka	14.25 (11.69)	17.49 (11.37)	1227
4	Uttar Pradesh	13.47 (11.05)	26.98 (17.54)	2003
5	Madhya Pradesh	6.40 (5.25)	12.68 (8.25)	1982
6	Haryana	5.90 (4.84)	11.94 (7.76)	2024
7	Tamil Nadu	4.69 (3.85)	11.94 (7.76)	1327
8	Gujarat	2.64 (2.17)	4.51 (2.93)	1707
9	Others	5.97 (4.90)	8.72 (5.67)	
10	India	121.88	153.79	1262

Note: Figure in the parentheses indicates the percentage share

Table 2 indicates that Rajasthan, Maharashtra, Karnataka, Uttar Pradesh, and Madhya Pradesh ranked as the top five states regarding cultivated lands. Rajasthan leads with 31.27 percent of total millet production. However, there is a minor alteration in the ranking of other states regarding productivity. Uttar Pradesh occupies the second position with 17.54 percent of overall production, followed by Karnataka (11.37 percent), Maharashtra (11.05 percent), and Madhya Pradesh (8.25 percent). States such as Haryana, Tamil Nadu, and Gujarat are significant producers of the millet crop. The maximum yield of millets was recorded in Haryana (2024 kg/ha), followed by Uttar Pradesh (2003 kg/ha) and Gujarat (1707 kg/ha) during the TE 2023-24.

Decomposition Analysis

A decomposition analysis was carried out to estimate the percentage contribution of area, yield, and interaction effect of area and yield in increasing the production of millets. Table 3 shows the decomposition analysis for the three periods i.e., 2005-2014, 2015-2024, and 2005-2024. The results are presented in Table 3.

Table 3: Decomposition analysis of area, productivity and their interaction

Year	Area Effect	Yield Effect	Interaction Effect
Sorghum			
2005-2014	80.88	26.13	-7.01
2015-2024	237.90	-238.84	100.94
2005-2024	103.35	-8.98	5.63
Bajra			
2005-2014	107.31	-12.17	4.86
2015-2024	139.27	-59.94	20.67
2005-2024	109.75	-25.77	16.02
Ragi			
2005-2014	-427.80	574.15	-46.35
2015-2024	181.55	-105.23	23.68
2005-2024	157.68	-104.10	46.41
Minor Millet			
2005-2014	123.14	-29.83	6.69
2015-2024	96.67	4.81	-1.48
2005-2024	112.39	-16.24	3.85

Table 3 shows that during 2005-2014, the area and yield effect of sorghum was positive, whereas the interaction effect was found to be negative. However, in the next period i.e., 2015-2024 registered negative yield, while the area and the interaction effect was found to be positive. When the entire time period is considered (2005-2024), the area and the interaction effect was positive, indicating the production decrease was solely due to yield effect. The yield component was found to be the driving force for the decline in jowar production.

During 2005-2014, the area and interaction effect of bajra was positive, indicating the production decrease was solely due to yield effect. However, in the next period i.e., 2015-2024 registered negative yield effect, while the area and the interaction effect was positive. When the entire time period is considered (2005-2024), the area and the interaction effect was positive, indicating the production decrease was solely due to yield effect. The yield component played an important role for declining yield in bajra production in Maharashtra.

In 2005-2014, the area and interaction effect of Ragi was negative, indicating the production increase was solely due to yield effect. The yield effect is very high accounting for 574.15 percent. During 2015-2024 registered yield effect to the extent of -105.23 percent, while the area and interaction effect was positive. When the entire time period is considered (2005-2024), the area and the interaction effect was positive, indicating the production increase was solely due to yield effect. The yield effect was found to be negative in Maharashtra.

During 2005-2014, the area and interaction effect was positive, indicating the production decrease was solely due to yield effect. The yield effect was found to be negative. However, in the next period i.e., 2015-2024 registered negative interaction effect, while the area and the interaction effect was found to be positive. When the entire time period is considered (2005-2024), the area and the interaction effect was positive, indicating the production decrease was solely due to yield effect. The yield component was found to be negative in minor millets in Maharashtra.

Conclusion

From the study, a declining trend in area, production and productivity of various millets is observed in Maharashtra. However, the compound growth rate of sorghum area is negative and significant. The growth rate of production of sorghum was negative and non-significant. While the productivity of sorghum was positive and non-significant. The compound growth rate of bajra's productivity is positive and significant. The growth rate of area of bajra was negative but significant. Whereas, the growth rate of production was positive but non-significant. The compound growth rate of Rabi area was found to be negative and non-significant. The growth rate of production was negative and non-significant. Whereas, the growth rate of productivity was positive and significant.

The major millet-growing states are Rajasthan, Maharashtra, Karnataka, Uttar Pradesh, and Madhya Pradesh. The decomposition analysis concluded that an increase in production of sorghum, bajra, ragi and minor millets during the period 2005 - 2024 was only due to yield effect. Since the supply of resources is limited in nature, to meet the future increased demand, the productivity of millets should be boosted by adoption of improved technologies like hybrid millet cultivation and various techniques of production.

References

1. Directorate of Economics and Statistics. Agricultural Statistics at a Glance. New Delhi: Department of Agriculture and Cooperation, Ministry of Agriculture,

Government of India; various years.
2. Anbukkani P, Nithyashree ML. Production and consumption of minor millets in India - a structural break analysis. Indian Journal of Agricultural Economics. 2016;71(3):419-432.
3. Dandekar VM. Introduction to seminar on data and methodology for the study of growth rates in agriculture. Indian Journal of Agricultural Economics. 1980;35(2):1-12.
4. Government of India. Agricultural Statistics at a Glance 2022. Department of Agricultural Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare; 2022. Available from: https://agriwelfare.gov.in/en/Agricultural_Statistics_at_a_Glance
5. Gowri UM, Shivakumar KM. Millets - miracle grains: growth trends and cost effectiveness in India. Agricultural Research Journal. 2020;57(5):805-812.
6. Harish MS, Bhuker A, Chauhan BS. Millet production, challenges, and opportunities in the Asia Pacific region: a comprehensive review. Frontiers in Sustainable Food Systems. 2024;8:1386469. https://doi.org/10.3389/fsufs.2024.1386469
7. Indian Institute of Millets Research. Vision 2050. Hyderabad: IIMR; 2015.
8. King E. Impact of reduced drudgery of women in production and post-harvest processing of small millets. MSSRF Working Paper No. 9. Chennai; 2017.
9. Kumari P, Thakur A, Sankhyan NK, Singh U. Millet production and consumption in India and their nutritional aspects. Just Agriculture. 2023;3(5):46-54.
10. Mahendra Dev S. Small farmers in India: challenges and opportunities. Emerging Economics Research Dialogue, Beijing, China; 2012 Nov 14-15.
11. Michaelraj PSJ, Shanmugam A. A study on millets-based cultivation and consumption in India. International Journal of Marketing, Financial Services and Management Research. 2013;2(4):49-58.
12. Uma Gowri M, Prabhu R. Millet production and its scope for revival in India with special reference to Tamil Nadu. International Journal of Farm Sciences. 2017;7(2):88-93.