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PRODUCTION DYNAMICS OF MILLET AND SORGHUM IN INDIA

Dr. Manisha Gupta*
*Corresponding Author
*Research Associate, RBI Chair Unit,
Department of Analytical and Applied Economics, Utkal University, Bhubaneswar

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ABSTRACT----------
Millets and sorghum are important climate-resilient crops that contribute significantly to food security, nutritional sustainability, and dryland agriculture in India. Despite their ecological and nutritional importance, the cultivation of these traditional coarse cereals has undergone major structural changes over time. The present study analyses the changing trends in millet and sorghum production in India during 1991-2024 using secondary data collected from the Food and Agriculture Organization (FAO) Statistics database. The study examines trends in production, area harvested, and yield through descriptive statistics, trend analysis, and Annual Growth Rate (AGR) analysis. The findings reveal that millet production in India has shown an overall increasing trend despite a decline in cultivated area, whereas sorghum production has generally declined throughout the study period. The area harvested under both crops exhibited a continuous downward trend due to crop substitution, urbanisation, and changing dietary patterns. However, productivity levels of millet and sorghum improved over time because of technological advancement, improved farming practices, and increasing awareness regarding climate-resilient agriculture. The study concludes that improvements in productivity have partially compensated for declining cultivated area and strengthened the role of these crops in sustainable agriculture and nutritional security. The study further suggests promoting awareness programmes, market support, and improved infrastructure for millet cultivation nationwide.

KEYWORDS: *Annual growth rate, Climate-resilient crops, Nutritional security, Sustainable farming*

INTRODUCTIION

Agriculture continues to play a vital role in the Indian economy by providing employment, food security, and livelihood support to a large share of the population. Nearly half of India's workforce is dependent on agriculture and allied activities, making the sector crucial for rural development and economic stability. However, Indian agriculture is increasingly facing challenges such as climate change, declining soil fertility, irregular monsoon patterns, and growing water scarcity. These challenges have raised concerns regarding the sustainability of conventional crop production systems that are heavily dependent on irrigation and external inputs. In this context, millets and sorghum have emerged as important climate-resilient crops because of their drought tolerance, low water requirement, and adaptability to marginal and rainfed lands.

India is one of the leading producers of millets in the world, and these crops have traditionally formed an important part of the food systems of tribal, rural, and semi-arid regions. Besides their ecological advantages, millets and sorghum are rich in fibre, minerals, and essential nutrients, making them important for nutritional security and sustainable diets. Theoretically, the study is linked to the concept of sustainable agricultural development, which emphasises crop diversification, environmental sustainability, and food security. Although the expansion of rice and wheat cultivation during the Green Revolution improved food grain production, it also led to the gradual neglect of traditional coarse cereals. Over time, changing dietary habits, market preferences, and crop substitution contributed to the decline in area under millet and sorghum cultivation. However, increasing awareness regarding healthy food consumption and climate-resilient agriculture has renewed interest in these crops. Therefore, analysing the changing trends in millet and sorghum production in India from 1991-2024 is important for understanding their contribution to agricultural sustainability, productivity, and nutritional security.

LITERATURE REVIEW

Millets and sorghum have historically been important components of Indian agriculture, particularly in arid and semi-arid regions where water scarcity and climatic uncertainties limit the cultivation of major cereals. These crops are widely recognised for their nutritional value, climate resilience, and suitability for marginal lands. Several studies have examined their production trends, economic significance, and role in sustainable agriculture in India.

Studies have highlighted the nutritional importance of millets in addressing food and nutritional insecurity. Millets are rich in fibre, iron, calcium, and essential micronutrients, making them important for balanced diets and health improvement (Rao et al., 2017). Similarly, research has shown that millet-based diets can help reduce malnutrition and lifestyle-related diseases because of their superior nutritional composition compared to polished cereals (Swaminathan, 2018). Bamji (2011) also emphasised that diversification from rice-wheat systems towards millets can improve nutritional security and environmental sustainability in India. Several scholars have discussed the climate-resilient characteristics of millet and sorghum cultivation. Seetharam et al. (2006) observed that these crops are highly tolerant to drought and high temperatures, making them suitable for rainfed agriculture. Likewise, Jat (2012) argued that climate-resilient crops such as millets can contribute significantly to sustainable agricultural development under changing climatic conditions. Ravindranath (2011) further noted that climate adaptation strategies in Indian agriculture should prioritise low-water-consuming crops because of increasing climate variability and water stress.

The declining area under millet and sorghum cultivation has also received considerable attention in the literature. Dev (2010) reported that the expansion of irrigated agriculture and the dominance of rice and wheat after the Green Revolution reduced the cultivation of traditional coarse cereals in India. Birthal et al. (2014) similarly found that changing dietary habits, urbanisation, and increasing income levels contributed to declining demand for millets and sorghum. Raju (2018) added that weak market support, limited procurement systems, and lower profitability discouraged farmers from cultivating these crops on a larger scale. Productivity improvements in millet and sorghum cultivation have been associated with technological advancement and better crop management practices. Paroda (2013) highlighted that improved seed varieties, scientific farming methods, and agricultural technologies enhanced the productivity of dryland crops in India. Singh et al. (2016) also observed that productivity growth in millets partially compensated for the decline in cultivated area over time. Similarly, Malik (2017) pointed out that millets require fewer chemical inputs and less water compared to rice and wheat, making them economically and environmentally sustainable crops.

A number of studies have examined the livelihood dimensions of millet cultivation. Nain et al. (2019) found that millet cultivation is economically beneficial for small and marginal farmers because of lower cultivation costs and reduced production risks. Balasubramanian (2013) also observed that millet-based farming systems support livelihood security in tribal and dryland regions by providing stable yields under adverse climatic conditions. In addition, Rajaram (2015) argued that increasing awareness regarding healthy food consumption has revived consumer interest in millets in recent years. However, some studies have identified structural constraints affecting millet and sorghum production in India. Nigam (2014) highlighted that poor value-chain development, inadequate processing facilities, and limited commercialization remain major barriers to millet expansion. Similarly, Longvah et al. (2017) noted that changing food preferences and insufficient market integration continue to reduce the large-scale adoption of millets despite their nutritional and ecological advantages.

Overall, the existing literature indicates that millet and sorghum cultivation in India has undergone substantial structural transformation over time. Although several studies have examined the nutritional importance, climate resilience, policy relevance, and livelihood implications of these crops, limited research has comprehensively analysed their long-term trends in production, area harvested, yield, and annual growth patterns using recent secondary data. In particular, studies integrating millet and sorghum trends over an extended period using updated FAO statistics remain inadequate. Moreover, much of the existing literature focuses either on policy and nutritional dimensions or on region-specific analyses, leaving a gap in understanding the overall production dynamics of these crops at the national level. Therefore, the present study attempts to fill this research gap by analysing the changing trends in millet and sorghum production in India during 1991-2024. The study specifically aims to: (i) analyse the trends and growth patterns in production, area harvested, and yield of millet and sorghum in India; and (ii) examine the changing importance of millet and sorghum in the context of sustainable agriculture and nutritional security in India.

RESEARCH METHODOLOGY

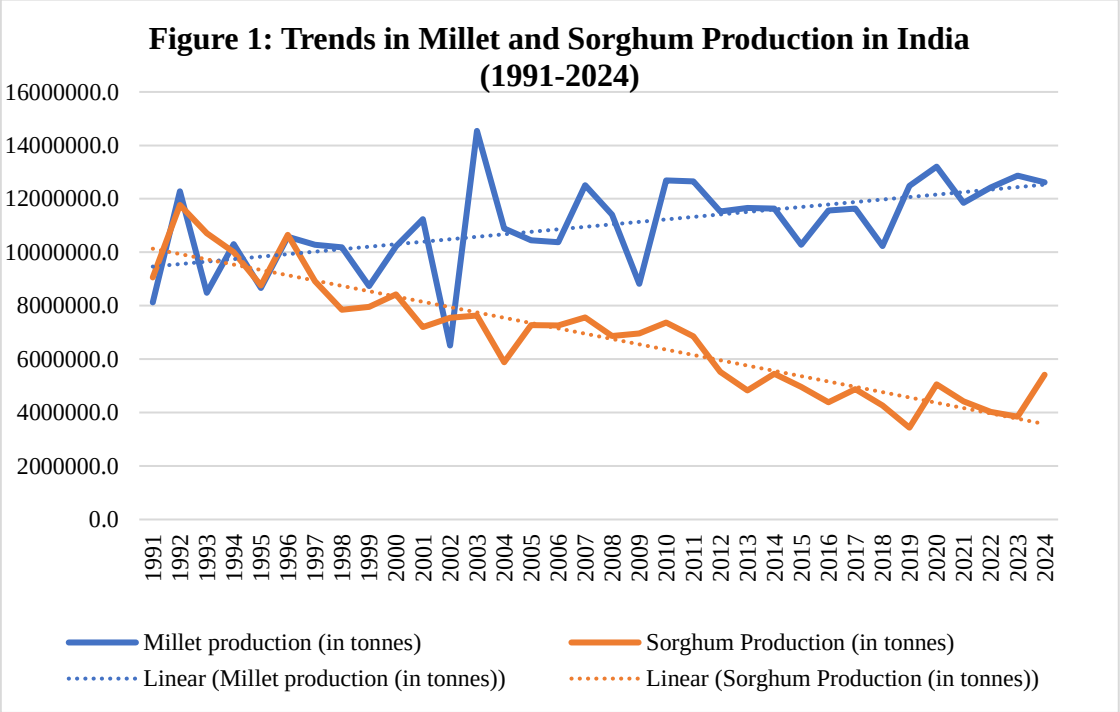
The present study is based on secondary data collected from the Food and Agriculture Organization (FAO) Statistics database for the period 1991-2024. The study focuses on three major indicators of millet and sorghum cultivation in India, namely production, area harvested, and yield. The collected data were compiled and analysed using descriptive and trend analysis techniques to examine the changing patterns in millet and sorghum cultivation over the study period. To analyse the long-term trends, linear trend lines and graphical representations were used for identifying changes in production, cultivated area, and productivity. Descriptive statistical tools such as mean, standard deviation, skewness, kurtosis, minimum, and maximum values were employed to understand the nature and variability of the data. Further, Annual Growth Rate (AGR) analysis was conducted to measure year-to-year changes in production, area harvested, and yield of millet and sorghum.

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Production Trends of Millet and Sorghum in India

The figure 1 presents the production trends of millet and sorghum in India from 1991 to 2024. The trend analysis indicates that millet production has shown an overall increasing pattern during the study period, whereas sorghum production has experienced a continuous decline. Millet production fluctuated during the 1990s and early 2000s due to climatic uncertainties, low policy attention, and the dominance of rice and wheat under the Green Revolution strategy. However, after 2010, millet production began to improve steadily, as reflected in the positive linear trend line. This growth can be associated with increasing government support and policy interventions promoting nutri-cereals and climate-resilient agriculture.

The launch of the Initiative for Nutritional Security through Intensive Millets Promotion (INSIMP) under the National Food Security Mission in 2011-12 played a significant role in encouraging millet cultivation through demonstrations, improved seed distribution, and technological support. Further momentum was provided by state-level initiatives such as the Odisha Millet Mission (2017), which focused on increasing millet production, procurement, processing, and consumption among tribal and rural communities. The declaration of millets as "Nutri-Cereals" in 2018 and the celebration of the International Year of Millets 2023 by the Government of India and the United Nations also enhanced public awareness and market demand for millet-based products.



Source: FAO Statistics Database

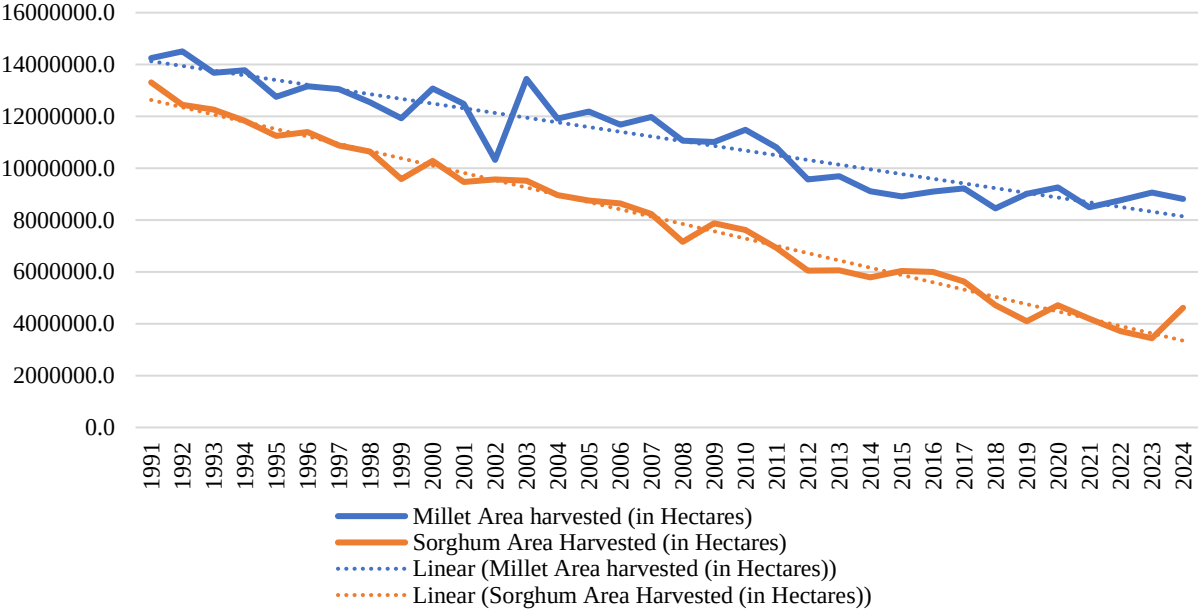
In contrast, sorghum production shows a declining trend throughout the period. The reduction may be attributed to crop substitution, urbanization, declining consumer preference, and greater emphasis on commercial crops. Despite this decline, sorghum continues to remain important in dryland and semi-arid regions because of its drought tolerance and climate resilience. Overall, the figure highlights the revival of millet production in India through targeted policy interventions and growing nutritional awareness.

Trends in Area Harvested under Millet and Sorghum in India

Figure 2 illustrates a declining trend in the area harvested under both millet and sorghum crops in India between 1991 and 2024. Millet cultivation area decreased from nearly 14.2 million hectares in 1991 to around 8.8 million hectares in 2024, while sorghum area declined more sharply from about 13.3 million hectares to nearly 4.6 million hectares during the same period. The downward linear trend lines indicate a long-term contraction in cultivated area, particularly for sorghum. Despite occasional fluctuations, such as temporary increases in millet area around 2003 and 2020, the overall trend remained negative. The reduction in cultivated area may be attributed to crop diversification, urbanisation, changing dietary preferences, and the shift towards more remunerative crops. However, recent policy emphasis on nutri-cereals and climate-resilient agriculture has moderately supported millet cultivation.

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Figure 2: Trends in Area Harvested under Millet and Sorghum in India (1991-2024)

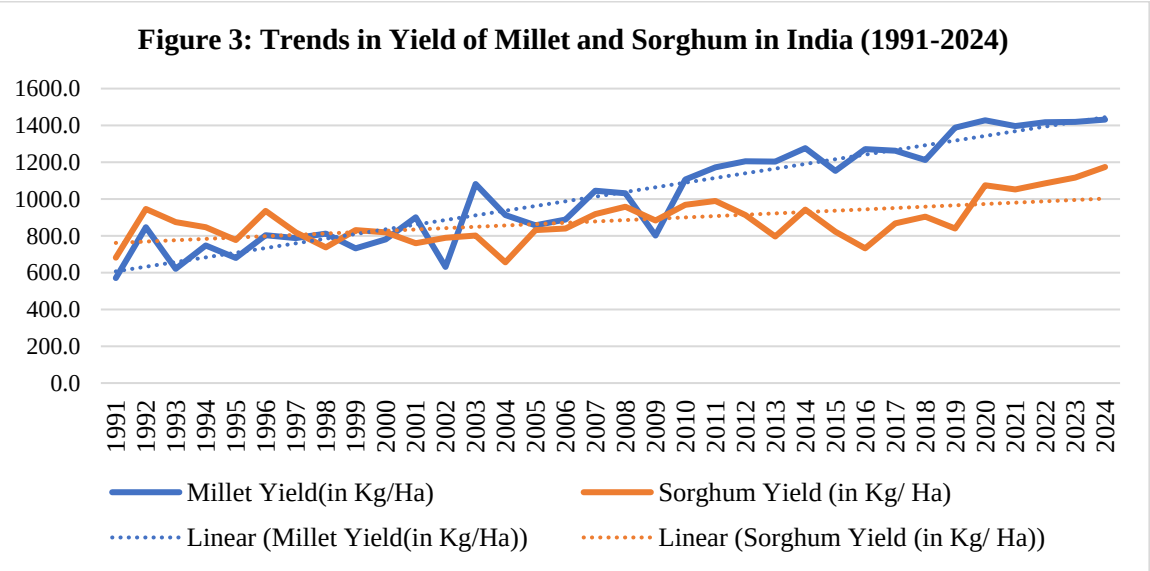


Source: FAO Statistics Database

Trends in the Yield of Millet and Sorghum in India

Figure 3 shows the trends in millet and sorghum yield in India from 1991 to 2024. The productivity of both crops has increased over the study period, although millet yield has grown more steadily than sorghum yield. In the early years, productivity remained relatively low because of traditional farming practices, low technological adoption, and dependence on rainfall. However, improvements in seed varieties, crop management practices, and growing awareness regarding climate-resilient agriculture contributed to higher yields over time. Millet yield increased significantly after the mid-2000s, reflecting rising demand for nutrient-rich cereals and better production practices. Sorghum yields also improved, though fluctuations were more noticeable due to rainfall variability and declining cultivation area. Despite these fluctuations, sorghum continued to perform well in dryland and semi-arid regions because of its drought tolerance. This indicates that although the cultivated area under both crops declined, improvements in productivity helped sustain production levels and strengthened the role of millets and sorghum in sustainable agriculture and nutritional security.

Figure 3: Trends in Yield of Millet and Sorghum in India (1991-2024)



Source: FAO Statistics Database

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Descriptive Statistics of Millet and Sorghum Production in India

The descriptive statistics indicate notable differences in the production performance and variability of millet and sorghum in India during 1991-2024. Millet production recorded a higher average production (10.99 million tonnes) compared to sorghum (6.85 million tonnes), reflecting the relatively stronger position of millet cultivation. Similarly, the mean area harvested under millet (11.13 million hectares) exceeded that of sorghum (7.99 million hectares). Millet yield also remained higher on average (1025.52 kg/ha) than sorghum yield (881.80 kg/ha).

The standard deviation values suggest considerable fluctuations in production and cultivated area for both crops, particularly the sorghum area harvested, indicating instability due to climatic and market-related factors. Yield variability was comparatively lower, especially in sorghum, implying relatively stable productivity growth over time.

Skewness values show that millet production had a moderate negative skew (-0.52), indicating more frequent observations above the mean, whereas sorghum production and yield were positively skewed, reflecting occasional high-value observations. The negative kurtosis values for most variables indicate flatter distributions and lower concentration around the mean, suggesting wider dispersion in the data. Overall, the statistics reveal declining area cultivation but gradual productivity improvements, especially in millet cultivation.

Table 1: Descriptive Statistics of Millet and Sorghum Production in India (1991-2024)

Measure	Millet production (in tonnes)	Millet Area harvested (in Hectares)	Millet Yield(in Kg/Ha)	Sorghum Production (in tonnes)	Sorghum Area Harvested (in Hectares)	Sorghum Yield (in Kg/ Ha)
Mean	10997832.22	11133051.74	1025.52	6853344.04	7989626.29	881.80
Standard Deviation	1691666.44	1915036.26	270.03	2146675.04	2830824.21	121.91
Kurtosis	0.38	-1.40	-1.31	-0.48	-1.12	0.04
Skewness	-0.52	0.09	0.05	0.40	0.10	0.52
Minimum	6511500	8449723	570.6	3437334.88	3442140	656
Maximum	14542200	14505200	1431.4	11769600	13309900	1173.8
Count	34	34	34	34	34	34

Source: Compiled by the author from the FAO Statistics Database

Annual Growth Trend in Millet and Sorghum Production

The annual growth rate analysis of millet and sorghum from Table 2 reveals considerable fluctuations in production, area harvested, and yield over the period 1992-2024, indicating the strong influence of climatic conditions, technological changes, and policy interventions. Millet production recorded both severe declines and remarkable increases. The sharpest fall was observed in 2002 (-42.06%), mainly due to drought conditions affecting agricultural output, while 2003 witnessed an exceptional recovery of 123.33% with significant increases in both cultivated area and yield. Similar volatility is reflected in millet yield growth, highlighting the dependence of productivity on rainfall and improved farming practices.

Sorghum also experienced unstable growth trends, although the area under cultivation generally declined over time. Despite a shrinking cultivated area, sorghum yield showed periodic improvements, suggesting technological advancement and better crop management. The highest growth in sorghum production occurred in 2020 (47.25%) and 2024 (40.85%), accompanied by notable increases in area and yield. Negative growth in several years reflects reduced farmer preference, crop substitution, and climatic stress. The data indicate that productivity growth has increasingly compensated for declining cultivated area in both crops. Government initiatives promoting climate-resilient crops, improved seed varieties, and millet-focused programmes have contributed to recent improvements in yield and production stability.

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Table 2: Annual Growth Trend in Millet and Sorghum Production in India (1992-2024)

Year	Millet production (in tonnes) AGR (%)	Millet Area harvested (in Hectares) AGR (%)	Millet Yield (in Kg/Ha) AGR (%)	Sorghum Production (in tonnes) AGR (%)	Sorghum Area Harvested (in Hectares) AGR (%)	Sorghum Yield (in Kg/ Ha) AGR (%)
1992	51.07	1.83	48.37	29.84	-6.52	38.91
1993	-30.88	-5.7	-26.7	-9.01	-1.5	-7.62
1994	21.34	0.73	20.45	-6.57	-3.54	-3.15
1995	-15.91	-7.43	-9.16	-12.51	-4.82	-8.09
1996	22.17	3.2	18.39	21.73	1.28	20.2
1997	-2.87	-0.83	-2.06	-16.37	-4.54	-12.4
1998	-0.9	-3.91	3.14	-11.95	-2.19	-9.99
1999	-14.28	-4.94	-9.83	1.38	-9.98	12.64
2000	17.05	9.66	6.73	5.96	7.41	-1.36
2001	9.97	-4.57	15.24	-14.61	-7.99	-7.19
2002	-42.06	-17.32	-29.92	4.92	1.05	3.83
2003	123.33	30.34	71.35	1.09	-0.49	1.58
2004	-25.12	-11.37	-15.52	-22.94	-5.8	-18.19
2005	-4.04	2.23	-6.14	23.62	-2.34	26.59
2006	-0.7	-4.13	3.58	-0.09	-1.31	1.23
2007	20.56	2.48	17.64	4.05	-4.72	9.21
2008	-8.76	-7.55	-1.31	-9.21	-13.08	4.46
2009	-22.75	-0.53	-22.33	1.37	10.07	-7.89
2010	43.98	4.31	38.03	6	-3.26	9.57
2011	-0.29	-5.9	5.96	-7.01	-9.07	2.25
2012	-8.91	-11.45	2.87	-19.4	-12.67	-7.7
2013	1.16	1.24	-0.08	-12.54	0.24	-12.74
2014	-0.27	-5.9	5.97	12.74	-4.64	18.22
2015	-11.62	-2.18	-9.65	-8.96	4.27	-12.7
2016	12.43	1.98	10.24	-11.59	-0.55	-11.1
2017	0.66	1.4	-0.73	11.2	-6.23	18.59
2018	-12.01	-8.37	-3.98	-12.56	-16.1	4.22
2019	22.01	6.58	14.48	-19.4	-13.25	-7.08
2020	5.77	2.78	2.91	47.25	15.07	27.95
2021	-10.29	-8.29	-2.18	-12.6	-10.8	-2.01
2022	4.86	3.25	1.55	-8.86	-11.55	3.05
2023	3.54	3.39	0.14	-4.69	-7.38	2.91
2024	-1.89	-2.69	0.82	40.85	33.98	5.13

Source: Compiled by the author from the FAO Statistics Database

DISCUSSION

The present study reveals that millet production in India has shown a gradual increasing trend despite a decline in cultivated area, whereas sorghum production has generally declined during the period 1991-2024. The findings support earlier studies that identified millets as climate-resilient and nutritionally important crops capable of ensuring food security under changing environmental conditions. According to Swaminathan (2012), millets are highly suitable for dryland agriculture because of their low water requirement and adaptability to adverse climatic conditions. Similarly, Anitha et al. (2019) observed that increasing policy support, nutritional awareness, and improved farming practices have contributed to the revival of millet cultivation in India. The increasing productivity of millet and sorghum observed in the study is consistent with the findings of Joshi et al. (2017), who argued that technological progress, improved seed varieties, and better crop management practices have become major drivers of agricultural growth in India. The rise in millet yield after the mid-2000s also reflects the positive impact of government programmes promoting nutri-cereals and sustainable agriculture. Initiatives such as the Initiative for Nutritional Security through Intensive Millets Promotion (INSIMP), the Odisha Millet Mission, and the declaration of millets as “Nutri-Cereals” significantly encouraged production, awareness, and market demand.

The study also found substantial fluctuations in annual growth rates of production, area, and yield, particularly during drought years. This finding supports Gulati and Juneja (2020), who stated that Indian agriculture remains

highly dependent on monsoon variability and climatic uncertainties, especially in rainfed regions. The severe decline in millet production during 2002 and its sharp recovery in 2003 demonstrate the vulnerability of dryland crops to rainfall fluctuations. Likewise, the declining area under sorghum cultivation aligns with the observations of Nagarajan et al. (2007), who reported that farmers increasingly shifted from coarse cereals to commercial and irrigated crops because of better profitability, changing dietary habits, and policy bias toward rice and wheat procurement systems.

However, some studies provide arguments contrary to the present findings. Research by the International Crops Research Institute for the Semi-Arid Tropics emphasised that sorghum still possesses significant potential because of its drought tolerance, low input requirement, and suitability for semi-arid agriculture (ICRISAT, 2018). Similarly, Rao (2015) argued that the decline in sorghum cultivation is not entirely due to low productivity but rather due to inadequate procurement support, weak market incentives, and limited policy attention. Some researchers also contend that the recent millet revival remains regionally concentrated and has not yet resulted in a nationwide transformation because of limited processing infrastructure, low commercialization, and changing urban food preferences. Overall, the findings indicate that despite declining cultivated area, improvements in productivity and increasing policy support have strengthened the role of millets and sorghum in climate-resilient agriculture and nutritional security in India. Sustained technological innovation, effective procurement systems, and market development are essential for ensuring long-term sustainability of these crops.

CONCLUSION

The study highlights significant changes in millet and sorghum cultivation in India during 1991-2024. While the area harvested under both crops has declined over time, millet production and productivity have shown gradual improvement, reflecting growing recognition of their nutritional and climate-resilient benefits. Sorghum production, however, continued to fluctuate due to changing cropping patterns, market preferences, and climatic uncertainties. The findings indicate that improvements in yield and technological advancement have partially compensated for the decline in cultivated area. Millets and sorghum continue to play an important role in sustainable agriculture, dryland farming, and nutritional security in India. Therefore, greater emphasis should be placed on improving market linkages, processing facilities, farmer support systems, and research on improved seed varieties. Awareness programmes promoting the nutritional and environmental benefits of millets and sorghum should also be strengthened to encourage both production and consumption among rural and urban populations.

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