POLICY BRIEF
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Madhya Pradesh Rajya NITI Aayog

Unveiling The Resilience and Nutritional Significance of Millets in Sustainable Agriculture

Abstract

Millets, a group of small-seeded cereal grains, have been cultivated for thousands of years and are a staple food in many parts of the world. However, in recent decades, millet cultivation has declined as more attention has been given to other cereal crops like rice, wheat, and maize. Interestingly, millets accounted for over 40% of all cultivated grains before the Green Revolution, surpassing even wheat and rice (ICRISAT 2017). This policy brief highlights the importance of millets in sustainable agriculture and their nutritional significance, emphasizing the need for their promotion and integration into modern farming systems to enhance food security, resilience, and nutrition.

Keywords: *Millet, Nutrition, climate-resilient*

JEL Classification: O_{14}, O_{31}, O_{40}, O_{30}

Madhya Pradesh Rajya Niti Aayog policy briefs are prepared on specific policy issues on contemporary social, economic and governance issues for policymakers. This Policy brief has been developed under the guidance of Shri Babu Singh Jamod, CEO, MPRNA and Shri Deepak Asai, Advisor, MPRNA.

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*Views are personal. Usual disclaimers apply.

Millets are often referred to as superfoods and their production can be seen as an approach for sustainable agriculture in a healthy world. Millets such as jowar, bajra, kodo-kutki, etc. are known to have multiple benefits like- they have high nutritional value. Millets are well-adapted to diverse agroecological conditions and are known for their resilience in the face of climate variability. They require less water, fewer inputs, and exhibit tolerance to drought and extreme temperatures. This resilience makes them a crucial component of sustainable agriculture strategies.

The concepts of nutritional security and food security are deeply intertwined and crucial for the well-being of individuals, communities, and nations. Despite the growth in global food production, supply, and distribution, the persistent problems of poor nutrition and food insecurity continue to prevail. The world population is projected to reach 8.5 billion by 2030, necessitating increased food production (UN DESA 2022). Climate change and rainfall patterns further strain sustainable agriculture. The COVID-19 pandemic has exacerbated undernourishment, with 768 million affected (Angel 2021). This emphasizes the urgent need to address nutritional and food security concerns on a global scale. Although there have been improvements, climate change, conflicts, and instability can heavily affect food security, especially in developing countries. Promoting practices like crop rotation, mixed cropping, and crop diversification becomes crucial in the face of climate change. Resilient crops like millet, thriving in challenging environments, play a significant role in sustainable agriculture and bolstering food security.

Considering the advantages of millets, and viewing them as a tool to fight food security in the country, the Government of India launched a national-level millet promotion program in September 2018. The program has been dove-tailed in the existing National Food Security Mission (NFSM) under the name NFSM Nutri-Cereals Programme. The NFSM identified 24 districts of Madhya Pradesh to be included in the NFSM-Nutri-Cereals Programme. In line with the Central Government's initiatives and schemes, the Government of Madhya Pradesh launched the MP State Millet Mission. India's G20 presidency in 2023 had taken steps to advance millet production and consumption globally by aligning it with the International Year of Millets.

Millets are a nutritional powerhouse, rich in protein, healthy fats, vitamins (especially B vitamins), minerals like iron and calcium, and dietary fiber (Kulkarni DB* 2018), making them a vital component of a balanced diet. Additionally, they are naturally gluten-free, fostering dietary inclusivity, and have a low glycemic index, which aids in blood sugar management, particularly in regions with a high prevalence of diabetes. Beyond their nutritional significance, they are highly water-efficient needing as little as 350-400 mm (ICRISAT 2016), making them suitable for water-scarce regions, and possess drought tolerance, ensuring food security in water-stressed areas. Their short growth period (60-90 days) allows for efficient crop rotation ('India Millet Initiative n.d.), enhancing soil health and reducing pest and disease pressures. Millets also maximize nutrient utilization, reducing the reliance on synthetic fertilizers and pesticides while requiring less

energy for production compared to other cereals (Rao 2021), ultimately contributing to sustainable agriculture.

Millet's global outlook: Production-consumption, National and International Perspectives

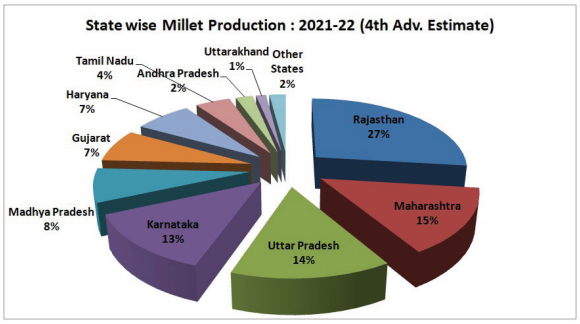
Millet production is widely influenced by various factors such as climate, soil quality, and agricultural practices. Millets are primarily cultivated as a cereal crop for human consumption, but they are also use as animal feed, biofuel, and in certain industrial applications.

area (ha)2021		production (t) 2021	
India	9255550	India	13208480
Niger	6145774	China	2700493
Sudan	2807000	China, mainland	2700000
Mali	2079082	CNiger	2146706
Nigeria	1767390	Nigeria	1926950
Chad	1117818	Mali	1487683
Burkina Faso	976335	Ethiopia	1173000
Senegal	968218	Senegal	1039860
China	900308	Sudan	901000
China, mainland	900000	Burkina Faso	705344

area (ha) 2022		production (t) 2022	
India	8488150	India	11849190
Niger	6780623	Niger	3656958
Sudan	2500000	China	2700495
Mali	2104437	China, mainland	2700000
Nigeria	2000000	Nigeria	1941220
Chad	1194064	Mali	1844664
Burkina Faso	1043257	Sudan	1675000
Senegal	969693	Ethiopia	1150000
China	900310	Senegal	1097033
China, mainland	900000	Burkina Faso	907744.8

According to the United States Department of Agriculture (USDA), the global production of millet in 2023 was approximately 30,792,000 metric tons. India was the leading producer, accounting for 39% of the world's production, followed by Niger, China, Nigeria, and Mali (USDA). In 2022, global millet production was reported to be 30.9 million tonnes, with India contributing 38% of the total production (FAOSTAT). Currently, millets are used in the diets of about 90 million people in Africa and Asia. Africa accounts for more than 55 percent of global production, followed by Asia (Reddy 2023). Sorghum and pearl millet are the primary millet crops grown worldwide, followed by barnyard and kodo-kutki millets.

India leads with 37.5% of the total global millet production (Meena 2021), especially in Pearl Millet (Bajra) and Sorghum (Jowar), contributing around 19% of the world's production in 2020. Pearl Millet makes up 40.51% of this production, followed by Sorghum at 8.09%. The main millet-producing states in India include Rajasthan, Karnataka, Maharashtra, Uttar Pradesh, Haryana, Gujarat, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, and Uttarakhand, collectively responsible for approximately 98% of India's millet production in 2020-21, with Rajasthan leading at 28.61% (APEDA 2023).



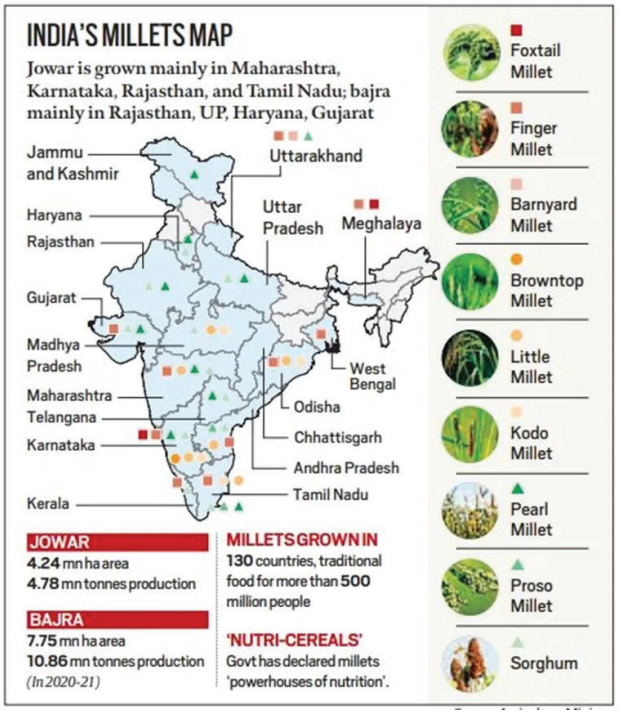
India is the largest global millet producer, with a total production of approximately 12.46 million metric tonnes, cultivated across an area of 8.87 million hectares (Sachan 2023) Farmers often struggle to receive fair prices due to inadequate marketing, packaging, and branding. This has led to a decline in millet cultivation and production in recent years, despite India's dominant position in various millet categories.

Millet consumption

Millet consumption varies globally, with some regions considering them staples, while others have lower consumption. Recently, millets gained attention in developed countries as gluten-free alternatives and "health foods." The expanding domestic production has further boosted the export of millet. According to Director General for Commercial Intelligence & Statistics (DGCI & S), the millet exports in India rose by 8% to 159,332.16 metric tons in 2021-22 against 147,501.08 metric tons in 2020-21, which is anticipated to boost the local millet production (Mordor Intelligence 2023).

Geographic Distribution of Millets in Different States of India:

1. Karnataka: Karnataka is a major hub for millet cultivation in India. The state has a long history of growing millets, especially finger millet (ragi), pearl millet (bajra), and foxtail millet. Districts like Mandya, Davangere, and Tumkur are known for their significant millet production.
2. Rajasthan: Rajasthan is another key state where millets thrive. Pearl millet is the dominant variety grown here, with the arid and semi-arid regions of the state providing favorable conditions for its cultivation.



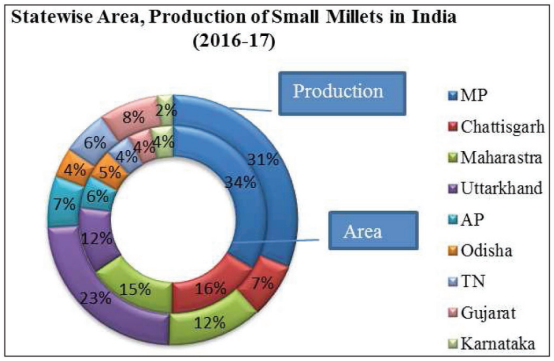
3. Andhra Pradesh and Telangana: These states have a strong tradition of cultivating millets, with pearl millet and sorghum (jowar) being the primary varieties. Telangana's Warangal district is renowned for its jowar production.
4. Maharashtra: Maharashtra has a diverse range of millets, including pearl millet, foxtail millet, and little millet. The Vidarbha region and parts of Marathwada are notable millet-growing areas.
5. Tamil Nadu: In Tamil Nadu, finger millet (ragi) is a staple crop, particularly in the southern districts. The state has been actively promoting millet cultivation as part of its nutrition and food security initiatives.
6. Madhya Pradesh: Millet cultivation in Madhya Pradesh has been steadily increasing, with a focus on pearl millet,

sorghum, kodo and kutki. The state's Malwa region is known for its millet production.

Kodo Kutki: Cultivating a Nutrient-Rich Future

Paspalum scrobiculatum, commonly known as Kodo millet, is an annual grain grown in Nepal, India, Philippines, Indonesia, Vietnam, Thailand, and West Africa. Kodo millet is indigenous to India, and it is believed to have been domesticated some 3000 years ago (House et al., 1995). In India Kodo Millet is extensively cultivated in states such as Madhya Pradesh, Chattisgarh, Maharashtra, Tamil Nadu, and Karnataka, including the Jhum fields of Arunachal Pradesh. The plant is referred to as Arikelu in Telugu, Varagu in Tamil, Varak in Malayalam, Arka in Kannada, Kodo in Hindi, and Kodra in Punjabi. While it is a minor crop in most areas, the Deccan plateau in India relies on it as a major food source due to its hardiness, drought tolerance, and capacity to thrive in marginal soils, yielding 450–900 kg of grain per hectare (Stephen et al. 1986). Kodo millet's resilience allows subsistence farmers to grow nutritious crops in challenging environments with limited water and marginal lands. Additionally, its nutrient-rich composition, featuring proteins, fiber, and minerals, addresses malnutrition issues in these communities. The gluten-free aspect further enhances its versatility, making it a valuable dietary choice for diverse needs.

Picrorhiza kurroa, commonly known as Kutki, is a perennial herb native to the alpine Himalayan region, particularly found in India, Nepal, and Tibet. In India it is found in the Himalayas, ranging from Kashmir to Sikkim at elevations of 2,700-4,500 m (Debnath et al, 2020). This herb grows in the wild in the hills of Himachal Pradesh, Uttaranchal, Uttar Pradesh, Jammu & Kashmir, Sikkim, and Arunachal Pradesh (NMPB). However, in the western Himalayan regions of China, Pakistan, Nepal, and Bhutan it thrives at altitudes of 3,000-5,000 m. Kutki is widely known as Katuka, Kuru, Katvi, Katurohini, and Katki in various regions, showcasing its versatility and significance in traditional medicine practices. The plant is known for its medicinal properties and has been traditionally used in Ayurvedic medicine. In 1997, kutki was listed in appendix II of the Convention on International Trade in Endangered Species (CITES 2014). Although not widely cultivated, efforts have been made to preserve and generate export-quality organic ethical Kutki.



Status of Kodo-Kutki in India: In India, Kodo-Kutki is being cultivated in 6.19 lakh ha area with production of 4.41 lakh ha. The productivity level is 714 kg / ha. The data showed that Kodo-Kutki was mainly cultivated in eleven states, with Madhya Pradesh accounting for about 30 per cent of the area, followed by Chhattisgarh (14.41 per cent) and Maharashtra (13.52 per cent). Similarly, the production share in Madhya Pradesh is also high, followed by Uttarakhand, and Maharashtra (Gowri 2020).

Millet Scenario in Madhya Pradesh: Madhya Pradesh, a significant millet producer in India due to its favorable agro-climatic conditions and suitable soil, cultivated 83,500 thousand hectares of millets in 2019-20, yielding 74.80 thousand tonnes. This state is known as the origin of small grain crops like Kodo-Kutki, with a 2021-22 production of 62 thousand metric tons and a productivity of 885 kg/hectare. Madhya Pradesh holds immense potential for increasing local millet cultivation, including Jowar, Bajra, Kodo, and Kutki, with significant opportunities for value addition. The State Millet Mission, currently managed by the Department of Agriculture, has set objectives and allocated budgets of around 13 crores and 10 crores for the financial years 2021-22 and 2022-23, respectively (APEDA 2023).

Table- District-wise production of Millets in MP

AREA (000' HECTARE) and PRODUCTION (000' TONNE)

S. No.	District	2017-18		2018-19		2019-20	
		Area	Production	Area	Production	Area	Production
1	Balaghat	2.300	1.30	1.900	1.50	4.300	3.40
2	Chhindwara	21.000	9.70	20.600	6.80	14.800	5.20
3	Jabalpur	5.500	5.50	3.400	3.70	6.000	7.10
4	Katni	1.500	1.50	1.400	1.40	0.300	0.30
5	Mandla	28.100	25.00	25.300	17.30	26.100	21.50
6	Dindori	31.500	23.80	31.600	23.90	31.600	37.20
7	Narsinghpur	0.600	0.40	0	0	0	0
8	Seoni	2.700	1.10	0.400	0.20	0.200	0.10
	TOTAL	93.200	68.30	84.600	54.80	83.500	74.80

Source: State Agriculture Department

Expected Area Expansion:

The Centre is drawing up an ambitious plan to increase millet production in the country to 45 million tonnes (mt) by 2030 (ICRISAT 2022). This expansion is driven by factors such as the nutritional benefits of millets, their resilience to climate change, and their potential for income generation for small farmers. Additionally, APEDA has set a target of achieving USD 100 million in millet exports by 2025 (APEDA 2023), emphasizing global reach and promoting millets in the International Year of Millets 2023. The growing use of millets in infant food and nutrition products, coupled with increasing consumer awareness of their health benefits, is strengthening the industry's growth.

Strategy to improve the status of millets include expanding cultivation, establishing seed hubs, improving shelf-life, and ensuring MSP for Small Millets, especially in non-traditional areas (The associated chambers of commerce and industry of India, 2022). To further expand markets for millets, a synergistic framework could be developed to study the market segments and map emerging food trends to top importing countries. Likewise in order to expand millet markets globally, a coordinated approach can be employed further.

Challenges in millet production

Millet production faces several challenges that impact its cultivation and market demand.

- Lack of public awareness about the nutritional benefits of millets, which has led to limited adoption of millet-based products.
- Limited distribution and lack of market access for millets, which makes it difficult for farmers to sell their crops.
- Research and development of millets is limited, which hinders the development of new products and markets.
- Millets are often seen as "poor man's food" and are not valued as highly as other crops, which can discourage farmers from growing them.

- Difficulties in obtaining organic certification for millets can hinder their promotion in organic farming.
- Millets face competition from other crops that are more widely grown and have established markets.

Despite these challenges, there is growing interest in millets as a climate-resilient and healthy food option. Governments and policymakers can take steps to address these challenges and promote the cultivation, procurement, and consumption of millets to realize their full potential.

Promotion and Policy Recommendations:

1. Subsidies and Incentives- To bolster millet cultivation and encourage sustainable agricultural practices, it is imperative to provide financial incentives and subsidies to farmers. While Madhya Pradesh has allocated funds for two years, it's essential to note that other states have committed budgets for five years. So, MP can also increase the period of Millet Mission to 5 years as more time should be given to make this project a remarkable success. It is advisable to provide subsidies and financial incentives, similar to successful models of other state governments where farmers receive Rs. 10,000 per hectare, with the potential for an increase to Rs. 25,000 per hectare for millet crops and promotional incentives of Rs. 9,000 per hectare and Rs. 10,000 per acre for choosing Kodo-Kutki crops over paddy. Additionally, offering support in the form of fertilizers, pesticides, and equipment can further encourage millet farming.
2. Extension Services- Following the state's successful approach, which includes a state-level committee, led by the Agriculture Production Commissioner to oversee the program, including training, study trips, and events at district and state levels. Now more efforts should be made to emphasize millet promotion and capitalize on the growing millet market. To boost millet adoption, we suggest including at least one millet-based dish in government food service programs. Strengthening extension services to educate farmers about millet cultivation, bolstering agricultural advisory services, organizing events engaging millet stakeholders, establishing dedicated outlets, integrating millet into social welfare schemes, and launching nutrition education campaigns are key actions to enhance millet consumption and awareness.
3. Seed improvement and seed bank - In alignment with other states' commendable efforts in seed improvement, it is advisable to expand upon these initiatives. To further enhance seed quality and accessibility, consider partnering with organizations like the National Bureau of Plant Genetic Resources (NBPGR) and establish Community Seed Centers in every block. Furthermore, maintain your support for farmers in cultivating certified seeds and extend assistance to Kodo growers for substantial profitability.
4. MSP -To encourage millet cultivation and support farmers, governments must include all millet varieties in Minimum Support Price (MSP) schemes. Large-

scale procurement of millets should be systematically organized in millet-cultivating districts, based on relevant intervention prices, to stimulate production and create a conducive environment for millet farming. Drawing inspiration from other states millet procurement can ensure fair returns for farmers. By setting MSPs for millet varieties like Kodo and Little Millets, governments can safeguard farmers from price fluctuations, promoting millet cultivation on a wider scale.

5. Allied organization: In Madhya Pradesh, the government has collaborated with organizations such as the Madhya Pradesh State Minor Forest Produce (Trading and Development) Co-operative Federation Limited (M.P. Van Evam Shak Prasanskaran Sahakari Sangh Limited) and ATMA (Agricultural Technology Management Agency) to promote millet cultivation among SHGs (Self-Help Groups) and FPOs (Farmer Producer Organizations). To further bolster the efforts of allied organizations in promoting millet cultivation, it is crucial to forge collaborations with entities like FAs (Farmers' Associations), and CBOs (Community-Based Organizations). These partnerships can facilitate farmer capacity building and the conservation of diverse millet varieties. Drawing inspiration from other states, MoU can be done with agriculture research organizations like the Indian Institute of Millet Research to increase productivity, ensure access to quality seeds, and establish regional seed banks dedicated to millets. By fostering such alliances and agreements, we can further advance millet cultivation and agricultural sustainability.
6. Research and Development- To advance millet cultivation and sustainability, Significant investment in millet research and development is vital. This should involve creating higher-yielding, disease-pest-resistant millet varieties adaptable to various local conditions. Expanding initiatives such as the cost of cultivation survey and research partnerships with District Mineral Foundation (DMF) areas, the University of Cambridge and ICRISAT may prove beneficial. Prioritizing research and development will drive innovation and enhance millet agriculture, benefiting both farmers and consumers.
7. Market Access- Building on Madhya Pradesh's successful initiatives, we strongly recommend further investment in the millet sector. This involves supporting millet value chains to ensure farmers have reliable access to profitable markets, empowering farmer collectives and cooperatives to enhance their marketing capabilities, collaborating with the government for fair pricing, enabling quality certifications for FPOs and SHGs, and launching awareness campaigns. These strategic actions can significantly shift the perception of millets from 'poor man's food' to a 'healthy alternative,' thereby benefiting the entire value chain, from farmers to consumers.
8. School Feeding Programs- Drawing inspiration from the successful endeavors of the Madhya Pradesh government, like introducing millets in hostels, millets should be included in school feeding programs to encourage their consumption

among children and promote healthy eating habits. Moreover, integrating millets into state nutrition initiatives such as the Public Distribution System (PDS) and Aganwadis, these steps can enhance accessibility and make millets a staple in the diet of the wider population.

9. Organic Farming-To encourage organic farming and facilitate the growth of millet cultivation, it is imperative to address the challenges associated with obtaining organic certification for millets. By streamlining the organic certification process for millets, we can provide greater incentives for farmers to adopt organic farming methods, ultimately benefiting both agriculture and the environment.
10. Monitoring- For effective scheme implementation and monitoring, the govt should form a District Level Monitoring Committee, led by the Collector and including key stakeholders like Deputy Director, Farmer Welfare and Agricultural Development, and Market Secretary. Local NGOs and Community Resource Persons (CRPs) should be involved in monitoring program activities at the block level. Additionally, a user-friendly web portal and mobile app should be developed to streamline monitoring efforts. This integrated approach will enhance transparency and accountability in program implementation.
11. The establishment of decentralized processing units should be pursued as a means to generate employment opportunities and augment farmer income.
12. Incorporate a dedicated subject on agricultural education with a focus on millets in university and school curricula to promote nutritional awareness, sustainable agriculture, and economic opportunities.
13. Encourage the establishment of millet processing units in Madhya Pradesh by offering subsidies to private industries, fostering economic growth and promoting the nutritional benefits of millets.

Conclusion:

Millets are a hidden treasure in sustainable agriculture, offering resilience in the face of climate change and significant nutritional benefits. To achieve food security, improve nutrition, and promote sustainable farming practices, governments, agricultural organizations, and development partners must invest in the research, promotion, and policy support necessary to revitalize millet cultivation. By embracing millets, we can build a more resilient and nutritious future for agriculture and food systems.

In conclusion, millets are a resilient and nutritious crop that can play an important role in sustainable agriculture and food security. Governments and policymakers should take steps to promote the cultivation, procurement, and consumption of millets to realize their full potential.

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