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REVIEW ARTICLE

Millets Promotion and Conservation Efforts in India

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Abstract

Millets are a staple food for people residing in the arid regions of Asia and Africa, providing nutrition, resilience, income, and livelihood for millions of smallholder dryland farmers. Realizing the potential of millet, India has focused its attention on millet farming and has taken several initiatives for the promotion of millet production and marketing. Local communities primarily grow and conserve millet, so upholding their rights is crucial to ensure equitable benefits to them. The Agricultural and Processed Food Products Export Development Authority has prepared a comprehensive strategy to promote the export of Indian millet globally. The present study attempts to explore the status of millet production in India and to learn about various policies and measures enacted by the government to promote millet cultivation and utilization in the country.

Keywords: Farmers' rights, Finger millet, Millet cultivators, Millets, Sorghum.

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Introduction

Millets are a collective group of small-seeded annuals that are grown as grain crops, primarily on marginal land in dry areas of temperate, sub-tropical, and tropical regions (FAO, 2023). Millets offer nutrition, resilience, income, and livelihood for millions of smallholder dryland farmers across Sub-Saharan Africa and Asia. Millets have often been called coarse grains. However, owing to their nutritional potential, they are now being referred to as 'nutria-millets or nutria-cereals.' They are one of the cheapest sources of energy, with a high content of digestive fiber, protein, vitamins and minerals. Millets include a group of crops such as sorghum (*jowar*) and pearl millet (*bajra*), and some lesser-known groups of species (Table 1) that contain a range of nutrients. The two main millets that are cultivated on a big scale with global commercial significance are sorghum and pearl millet (Rai *et al*., 1999; Gruère *et al*., 2009). Sorghum is regarded as one of the truly indispensable crops needed for human life because of its many applications and adaptability (Rao *et al*., 2016). Millets are C4 plants that are better suited to hot, semi-arid and arid environments that are prone to drought. India is the country where millet is grown for around 80% of the continent. Despite not being native to India, pearl millet landraces from that country have made significant contributions to the global community by providing earliness, high tillering, high harvest index, and local adaptability (Yadav *et al*., 2017). Additionally, East African millet germplasm has a high potential to serve as a climate-smart, high-yielding genotype for direct production (Manyasa *et al*., 2017).

The oldest millet remains in the world were found in the early neolithic site of Cishan, northern China, and date to approximately 8,200 calibrated years ago (Lu *et al*., 2009). The spread of common

millet to the productive region of the Yellow River resulted in a food surplus, which paved the way for the development of the complex Chinese civilization. As early as 5,300 years ago, small millets were the primary cereal grain in some regions of the Indus civilization (Weber, 1999). The fact that millets are highly significant in Indian culture has been documented as early as 450 CE in a popular Tamil poetic work, the Thirukkural, authored by the saint poet Thiruvalluvar, where he says, "தினைத்துணைநன்றிசெயினும்பனைத்துணையாக் கொள்வர்பயன்தெரிவார்." (*Thinaiththunai Nandri Seyinum Panaiththunaiyaak Kolvar Payantheri Vaar*) which is explained as 'though the benefit conferred is as small as a foxtail millet seed, those who know its advantage will consider it as large as a Palmrah fruit' (Thiruvalluvar, 1812).

Millets are nutria-rich-cereals well adapted to harsh climates and provide various health benefits (Figure 1). However the utilization of millets as food is confined mostly to traditional consumers mainly because of a lack of awareness about their health benefits and the non-availability of consumer-friendly ready-to-eat millet-based products. Recently, millets have gained attention and efforts are underway to obtain their convenient and value-added processed products. Since many households in dry land and hilly regions depend on millets to meet their food needs, it has now been proposed to enlarge the food basket and include millets like jowar, bajra, ragi, etc., in the public distribution system (PDS).

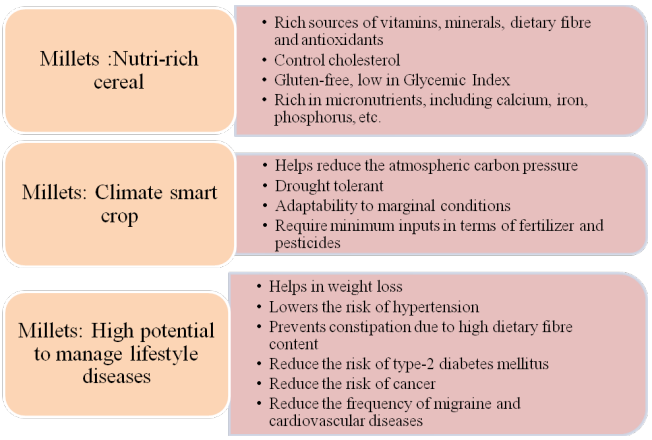

Figure 1: Potential qualities and benefits of millets

Millet Production Status in India

India is the largest producer of millet in the world, contributing 80% of Asia's and 20% of global millet production (FAO, 2021). The average millet production in India in the last five years was 16.46 million tonnes. In 2022-23 the millet production was recorded to be 17.32 million tonnes. Millet production in India during the last five years (APEDA, 2024) is presented in Figure 2.

Bajra or pearl millet is the most widely cultivated millet in India and is the third largest cultivated cereal in terms of acreage and production after rice and wheat. It is also the most drought tolerant species among all the millets grown in

Table 1: Major group of crops under millets and their nutritional benefits

S. No.	Millet	Scientific name	Vernacular name	Specific nutrients	Origin
1	Sorghum	*Sorghum bicolor* (L.) Moench	*Jowar* in Hindi, *Jwari* in Marathi, *Juar* in Bengali, Gujarati, *Jola* in Kannada, *Cholam* in Malayalam, and Tamil	Good source of vitamins, minerals and dietary fibre.	Africa
2.	Pearl millet	*Pennisetum glaucum* (L.) R. Br.	*Bajra* in Hindi, *Sajjalu* in Telugu, *Kambu* in Tamil and *Kambam* in Malayalam	Huge source of proteins	Africa
3.	Barnyard millet	*Echinochloa frumentacea* Link	*Kuthiravali* in Tamil, *Oodhalu* in Kannada, *Odalu* in Telugu, *Kavadapullu* in Malayalam and *Sanwa* in Hindi.	Great source of iron and fiber.	South East Asia
4.	Finger millet	*Eleusine coracana* (L.) Gaertn	*Ragi* in Kannada, *Kelvaragu* in Tamil, *Koovarugu* in Malayalam and *Mundua* in Hindi.	Richest source of Ca and K among cereals	Africa
5.	Foxtail millet	*Panicum italicum* L.	*Thinai* in Tamil, *Kirra* in Telugu, *Thinna* in Malayalam, and *Kangni* in Hindi	Rich in minerals and vitamins.	East Asia
6.	Little millet	*Panicum sumatrense* Roth *ex* Roem. & Schult	*Chama* in Malayalam, *Same* in Kannada, *Samaiin* Tamil, *Sama* in Telugu and *Kutki* in Hindi	Packed with iron and fibre	South East Asia
7.	Proso millet	*Panicumm iliaceum* L.	*Barri* in Hindi, *Panivaragu* in Tamil & Malayalam, *Baragu* in Kannada, *Varigalu* in Telugu	Richer in essential amino acid	East Asia/ Eurasia
8.	Kodo millet	*Paspalum scorbiculatum* L.	*Kodon* in Hindi and Bengali, *Haraka* in Kannada, *Araka* in Telugu, *Kodua* in Oriya and *Kodra* in Marathi	Rich in niacin and riboflavin and minerals like Ca, Fe, P	South Asia
9.	Brown top millet	*Panicum ramosum* L.	*Choti Kangni* in Hindi, *korale* and *kadu-baragu* in Kannada, *andakorra* and *pedda-sama* in Telugu	Rich source Fe, Ca, K, Mg, Zn, P and B group vitamins	South Asia

India. The share of different crops in total millet production during 2022-23 is presented in Figure 3. Six states, namely Rajasthan, Uttar Pradesh, Karnataka, Maharashtra, Madhya Pradesh, and Haryana, account for more than 79.6% of total millet production (APEDA, 2024). Rajasthan alone contributes about 31.3% of total millet production in India.

The USA, Australia, Argentina and Russia are the largest exporters of millet in the world. However, India is the largest producer and exporter of millet in Asia. In the last few years, despite the COVID pandemic, millet export from India has shown an upwards trend. In 2022-23, the export of millet and millet-related products was 169049.11 MT, amounting to Rs 75.45 million US$ (APEDA, 2024). The trend of millet export from India in the last 5 years is presented in Figure 4.

Amongst all the millets, *bajra* is the most important crop exported, both in terms of volume and value. The detail of millet export from India during 2023-24 is presented in Figure 5. The area under small millets has declined considerably in all the states where they were predominantly grown in the past. The introduction of input-responsive high-yielding rice and wheat varieties coupled with the improved irrigation facilities might have resulted in a decline in the acreage and production of millets since the green revolution. Millets registered a 60% decline in the area with a 200% rise in productivity, but production has remained the same during the last seven decades (Yadav *et al*. 2024). From 1966-2021, the area under sorghum has decreased by 76% while there has been a significant increase in the production and yield of rice and wheat (IDI 2023). However,

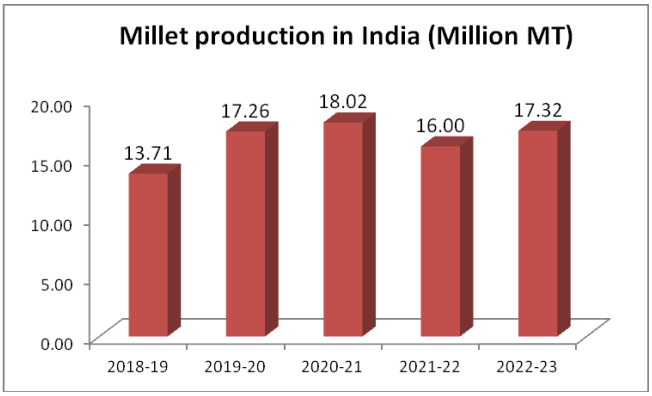

Figure 2: Millet production in India during the last five years

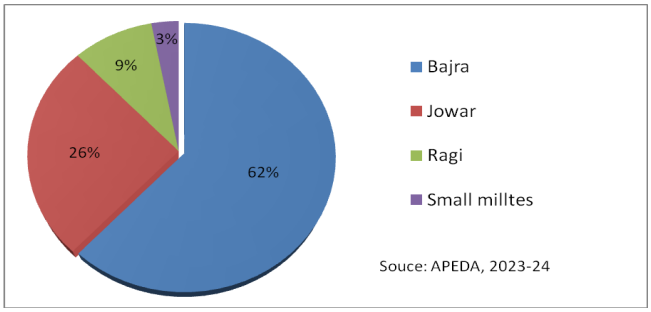

Figure 3: Share of different crops in total millet production

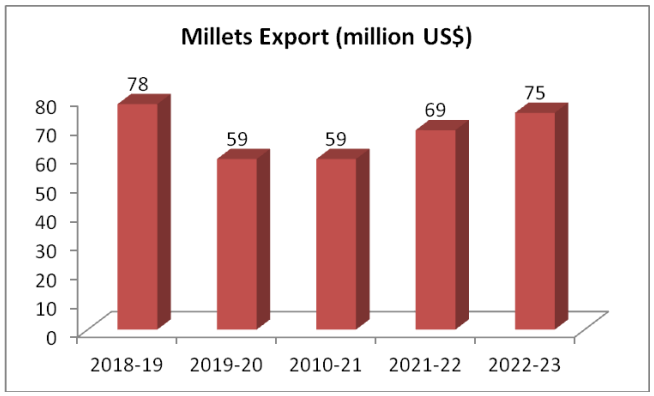

Figure 4: Trends of millet export from India in the last five years

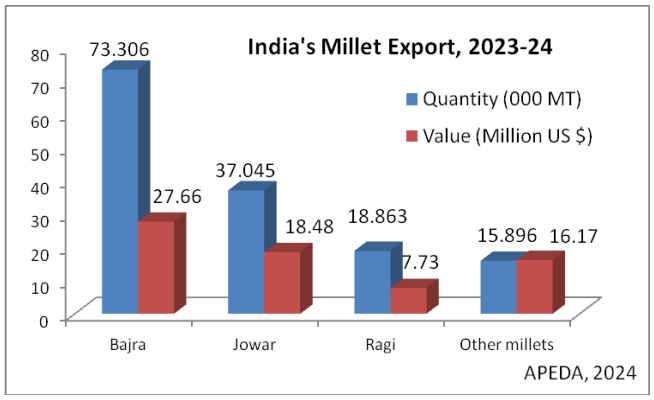

Figure 5: Status of millet export from India during 2023-24

the yield of major millets has increased during the period. Changing food habits and consumer preferences due to rapid urbanization and rising income levels, difficulty in processing small millets, poor quality of the grains and lack of market support are other reasons for the decline in millet production (Hariprasanna, 2023).

Government Initiatives to Promote Millet Production

Millets have wide adaptability to various agro-climatic conditions and can thrive well under areas of high temperature and droughts. Millets are grown in areas with harsh climatic conditions especially inhabited by tribal communities and have been an integral component of the tribal farming system. Recognizing the importance of millet, the government of India has launched a number of programs to promote millet farming in India during the last decade. The government of India has notified millets as nutri-cereals in April 2018. As consumption and production patterns of millet vary greatly from state to state, the Planning Commission has recognized that their procurement is something that can be done better in a decentralized mode, as encouraged in Schedule III of the legislative text (GoI, 2013). Under the National Food Security Mission of the preliminary targets for enhancing food grain production by an additional 25 m tonnes, the share allocated for millets

is 2 million tonnes, *i.e.,* 8% of the enhanced food grain production. Some other initiatives are Integrated Cereals Development Programmes in Coarse Cereals, Initiative for Nutritional Security through Intensive Millet Promotion – INSIMP a part of Rashtriya Krishi Vikas Yojana" – RKVY which is the only comprehensive initiative to support millet production, Rainfed Area Development Programme (RADP): a component of the Rashtriya Krishi Vikas Yojana – RKVY etc. To promote the shipment of nutri-cereals, the Agricultural and Processed Food Products Export Development Authority (APEDA) has prepared a comprehensive strategy to promote Indian millet exports across the globe (PIB, 2023). NITI Aayog signed a Statement of Intent with the United Nations World Food Program in 2021 for mainstreaming millets and supporting India in taking the lead globally in knowledge exchange. All offices of the Department of Food and Public Distribution are directed to include millets in their canteens and in meetings. More than 170 startups have been established and about 400 entrepreneurs are working together for the revival of millets. ICAR is geared up to implement budget announcement 2023-24 on "Supporting IIMR, Hyderabad as Centre of Excellence for sharing best practices, research and technologies at the international level" to make India a Global Hub for "Shree Anna" (Malhotra, 2023). Eight bio-fortified varieties/hybrids of Bajra have been released for cultivation from 2018 to February 2022 (PIB, 2023). However, in the absence of proper market linkages, millet consumption is restricted to rural *haats*, bazaars, tourist spots and festivals. For instance, small help groups engaged in making traditional *khichri,* rice and *papads* usually participate in fairs and events that provide them limited exposure to visitors and tourists. Recently, the government of Chhattisgarh has announced a minimum support price for kodo, kutki and ragi millets to boost millet cultivation. The Government of Tamil Nadu has identified 22 districts that are suitable for millet cultivation and divided the same into two zones for millet cultivation. These zones may be called special millet zones with protection in the lines of bioheritage sites. Apollo Hospitals, Hyderabad has initiated the use of millets in collaboration with over 5,000 women farmers working with the Deccan Development Society. Similarly, the government of Karnataka proposed the inclusion of millet in school mid-day meal programs.

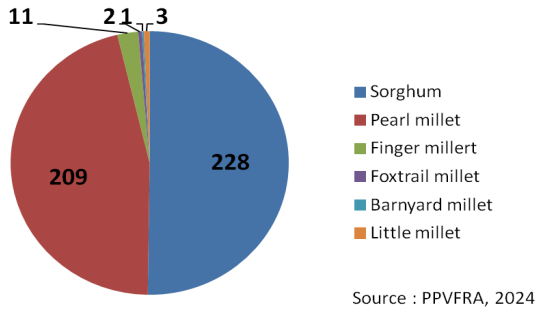

Figure 6: Millet varieties notified and protected under PPVFRA

Government Safeguards to Support/Pprotect Indian Farmers Including Millet Growers

A number of special safeguards are available to protect and promote the interests of farmers to encourage accelerated growth of the agricultural sector, which will ultimately give a fillip to the overall growth of the Indian economy. These include tax incentives in the form of exemption to agricultural income from the income tax and capital gains for the transfer of agricultural property under the Income Tax Act 1961, and exemptions under the Wealth Tax Act 1956 (now abolished). The agricultural sector has received major thrust in the successive five-year plans (Agrawal, 2021) adopted by the Union as well as the State Governments, which includes support from planned as well as non-planned expenditures, subsidies for power, irrigation, fertilizers, and quality seeds. The Government of India has recently launched an ambitious program known as the National Rural Agricultural Development Mission. India was the first country to implement comprehensive legislation for the protection of farmers' rights and enacted "The Protection of Plant Varieties and Farmer's Rights Act, 2001, adopting the *sui generis* system. PPVFR Authority has recognized the contribution of farmers in conserving, improving and making available plant genetic resources for the development of new varieties. A total of 7223 certificates have been issued under the act for the protection of plant varieties, out of which 1586 are farmers' varieties registered under PPVFRA. In millets, 454 varieties have been registered under PPVFRA (Figure 6) but only a few farmers' varieties are registered. In order to recognize the efforts of farmers or communities engaged in the conservation of genetic resources, the authority has established various awards *viz.*, Plant Genome Savior Community Awards, Plant Genome Savior Farmer Award and Plant Genome Savior Farmer Recognition. Five Plant Genome Saviour Community Awards of rupees ten lakh each is awarded every year to the eligible farming communities engaged in the conservation and preservation of plant genetic resources. Ten Plant Genome Saviour Farmers' Awards of rupees one lakh each, and 20 recognition certificates are conferred every year. Till now around 51 awards have been conferred upon the farmers recognizing their contribution.

Millet Conservation Status in India

The National Genebank of India, situated at ICAR-NBPGR, holds about 60,287 accessions of millets, including 159 trait-specific registered germplasm. The largest holdings of millets are at the ICRISAT genebank, which holds about 71,334 accessions of different millets. ICAR-IIMR is one of the national active germplasm sites with the responsibility to collect, conserve, evaluate, document, and distribute

the millet genetic resources to bonafide users within the country. A total of 53,562 accessions of millets are being conserved in the ICAR-IIMR Genebank. In March 2023, about 25,000 diverse accessions of sorghum were showcased on a Field Day at Agricultural Research Station, Washim, Dr. PDKV Akola, to farmers and researchers for utilization. ICAR-NBPGR team has also worked on molecular characterization (*viz*. genetic diversity/population structure analysis/hybrid purity testing) of different millets, including finger millet, kodo millet, proso millet, pearl millet, foxtail millet, little millet, browntop millet, sorghum, barnyard millet. Work has also been done in the area of millet genomics. Leaf transcriptomes have been generated in little millet (*Panicum sumatrense*; Bioproject ID: PRJNA267462), finger millet (*Eleusine coracana* L. Gaertn.; BioProject ID: PRJNA268401) and kodo millet (*Paspalum scrobiculatum*; Bioproject ID: PRJNA278353) for marker development and genes/TFs identification in these crops. SSR markers have been developed in finger millet, little millet, kodo millet, and browntop millet using *in-silico*/genomic library construction/through cross-species transferability/RNA sequencing. Phenotypic (morphological/biochemical) characterization has also been carried out in browntop millet, little millet (>1600 accessions), kodo millet, and barnyard millet to identify trait-specific germplasm. Services are also being provided for DNA fingerprinting of different millets.

Conclusion

Millet cultivation in India is a traditional practice. Farmers are the real conservators of the treasure troves of landraces. However, there is a lack of awareness among traditional cultivators about their rights and benefits for their efforts to conserve and maintain rich biodiversity over centuries. Although after the declaration of the national year of millets by the government of India in 2018, there is a clear-cut increase in the filing and obtaining of PPVFR certificates for millets but, there is a long way to go before the accrual of actual benefits to the farmers and millet cultivators. Further, several barriers exist in the production and commercialization of millet products. The government of India may come up with suitable programs for helping farmers, FPOs, and industries associated with millets and millet-based products and include skill development, technology transfer, filing and obtaining IP registrations within as well as beyond the country to be globally competitive. The recent inclusion of a broader set of species, including small millets, in large-scale security schemes, such as the PDS, is a promising opportunity to leverage the role of these crops beyond the village scale. However, the implementation of this policy must ensure that the diversity held within these traditional crops is not lost in the process, avoiding negative consequences on the conservation of Indian biological heritage. The National Biodiversity Authority and PPVFR authorities should synergize their role in promoting agro-biodiversity. It is suggested to create an IP cell at the district level to facilitate obtaining IP protection for agro products in general and millet products in particular. The PPVFR Authority may create new awards to promote millet cultivation from the National Gene Fund. Likewise, the NBA may also create dedicated awards to improve agro-biodiversity in general and millet diversity in particular. Such measures would encourage millet cultivators and millet-based industries in the country.

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