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MILLET PRODUCTION IN INDIA-AN UPDATE

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ABSTRACT

Most of the millets have evolved to thrive in diverse environment. Millets are now considered as environmentally, economically and ecologically friendly sources of food and nutrition. India leads global millet production, contributing 40% (approx. 11.57-17.24 million metric tons) to total output, with Rajasthan, Maharashtra, and Karnataka as top producers. Around 154 varieties of millets (Sorghum – 43; Pearl millet – 52; Little millet – 11; Proso millet – 4; Kodo millet – 4; Finger millet – 28; Foxtail millet – 8; Barnyard millet – 4) have been released in India from 2014 to 2021. In India, the top five states that produce millets are Rajasthan (bajra / sorghum), Karnataka (jowar / ragi), Maharashtra (ragi / jowar), Uttar Pradesh (bajra) and Haryana (bajra). Other millets such as Tef (*Eragrostis tef*) and Fonio (*Digitaria exilis*) are grown in countries such as Ethiopia, Eritrea, Australia, West Africa, Sudan, Nigeria, Togo, Senegal and Mali for food grain and fodder. Millets contain high amount of proteins, fibre, B-complex vitamins, micronutrients, trace elements, phyto-nutrients including phytic acid that have the capacity to lower cholesterol and phytate, which are associated with reducing the risk of cancer.

Keywords: Millets, Nutritional Value, Nutraceutical and Functional Properties, Ancient Millets, Importance of Millets Cultivation

1 INTRODUCTION

Millets are classified as functional food due to their nutritional composition and the nutraceutical properties [1-169-172]. The traditional knowledge about the functional and nutraceutical benefits of millets-based food items have been handed down through generations [168]. Kaur et al., (2024) [1], Mohanan et al., (2025) [2], Jacob et al., (2024) [172], and Mukherjee et al., (2025) [3] reviewed that millets, often known as “miracles grains have garnered renewed global interest due to their numerous health benefits, rich nutritional composition, resilience to extreme climatic conditions, and minimal environmental footprint [1-3,4-35-140-172]. Millet, one of the earliest cultivated domestic crops from the family *Poaceae* (*Graminae*), is beneficial with regard to nutrition because of its high protein, carbohydrate, dietary fiber, minerals (calcium, magnesium, phosphorus, and iron), and vitamin content [1-3,4-35-140]. In addition, these round-shaped small cereal grains are gluten-free and have a low glycemic index [1-11,12-140]. The UN declared 2023 as “the International Year of Millets” due to their potential to solve concerns of nutrition, food security, and climate change in

a sustainable manner [1-3,4-35-140-173]. This indicates a transition of millets from an “orphan crop” to being used as ingredients for products (with or without fermentation) that are nutrient-rich, climate-resilient, sustainable, and health-promoting effects[1-3,4-35-140]. They are normally resistant to diseases and pests, can thrive on less fertile, dry soil, and can be harvested in 70 to 80 days. Mohanan et al., (2025) [2] indicated that millets resistance to pests and diseases is due to various factors such as the presence of phenolic compounds that inhibit pathogens or pests, the hardness of millet grains which control pest infestation, and the presence of storage proteins (e.g., prolamins) in grains which act as a physical barrier and are indigestible by fungal or insect proteases [1-13-140]. Furthermore, millets can comply with climate change and outperform other grains like wheat and rice in terms of challenging growth conditions and nutritional value [1-14–16-140]. As a major cereal crop in the dry and semi-arid tropical regions of Asia and Africa, they serve as a staple food for human consumption as well as fodder for animals [1-17-140-172]. Some of the traditional millets that are cultivated and consumed include brown top millet (*Urochloa ramosa*), little millet (*Panicum sumarense*), kodo millet (*Paspalum scrobiculatum*), foxtail millet (*Setaria italica*), pearl millet (*Pennisetum glaucum*), jowar (*Sorghum bicolor*), finger millet (*Eleusine coracana*) and barnyard millet (*Echinochloa esculenta*) [1-141-168-173].

A lot of research has been carried out and the presence of micronutrients, phytochemicals and trace elements has been reported [1-168-172]. Due to urban migration, rise in population and the subsequent need of catering to the growing population, the emergence of cereals such as rice and wheat led to the decline of the importance of millets [168]. Now, again due to the persistent efforts to re-introduce millets as mainstream crop has gained positive results in the form of declaration of 2023 as ‘International Year of Millets’ and even the urban population in India preferring food items from millets [1-168-172]. This is due to slow dispersal of knowledge about the nutritional composition of millets [140-168]. Apart from this fact, millets can withstand extreme climatic conditions and can grow in harsh soil and are water-resilient crops[140-168]. Around 154 varieties of millets have been released in India [140-168-172]. Efforts have been made to encourage cultivation, production and distribution of millets with several incentives to farmers, investors, startup agencies, entrepreneurs, state agencies, stakeholders and exporters [140-168]. Srinivasan and Abirami (2026) [168] reported that from 2014 to 2021, nearly 154 varieties of millets have been released in India (Sorghum – 43; pearl millet – 52; little millet – 11; proso millet – 4; kodo millet – 4; finger millet – 28, foxtail millet – 8; barnyard millet – 4) [168]. ICAR and IIMR are encouraging farmer producer organizations; schemes such as Production Linked Incentive (PLI) are being supported to enhance the value addition[141-168-172].

Mohanan et al., (2025) [2] reviewed that there are different types of millet, including finger, pearl, sorghum, little, foxtail, proso, kodo, barnyard, and brown top [1-49-140-172]. They are classified into major and minor millets based on their grain size[1-49-140]. Additionally, there is another class known as pseudo-millets, which includes amaranth and buckwheat[1-49]. Since the latter group does not belong to the *Poaceae* botanical family, which consists of “real” grains, they are called pseudomillets [1-19,29-140-172]. However, they have comparable nutritional qualities such as high protein, dietary fiber, mineral, and vitamin contents, like true millets [1-50,51-140-172].

2 MILLETS: HISTORY

According to Mohanan et al., (2025) [2], the oldest known millet remains in the world were discovered in an early neolithic site of northern China, dated to approximately 8350–6750 BC; they were identified as proso or common millet [1-50,51-140]. Later, foxtail millet content was identified in millet remains that were dated to after 6750 BC [2-140]. Before rice and wheat gained widespread attention, millets were staple foods in the semi-arid parts of East Asia (China, India, Russia, Japan, and Korea) and still remain significant foods in those regions [1-19-140]. Furthermore, millets served as a staple food throughout the entire Eurasian continent. Evidence of the cultivation and consumption of millets (foxtail and proso millets) dating back to the Middle Jeulman pottery period (around 3500 BC) and in the Mumun period (1500–100 BC) in the Korean Peninsula has been reported by several studies [1-20,21-40]. In Japan, millets and their ancestors, such as barnyard and green foxtail grass, were cultivated dating back to the middle Jomon period (around 2500–1500 BC) [1-2-56].

Millets are thought to be among the ancient cultivated crops of the world and have been found to be staple food material in parts of Central and Eastern Asia, European countries, Russia, China, India, and parts of Africa. Most of the millets originated from Africa and later domesticated in other parts of the world [1-55-140-172].

3 MILLET PRODUCTION IN INDIA

India, well known for its agro-biodiversity and climatic zones has diverse crop cultivation practices [141-168-172]. India leads global millet production, contributing 40% (approx. 11.57-17.24 million metric tons) to total output, with Rajasthan, Maharashtra, and Karnataka as top producers [141-168]. Despite a historic decline in area, 2026 data shows renewed focus on high-yield, climate-resilient farming, with the millet-based snack market expected to grow significantly, reaching US\$ 4.12 billion by 2032[141-168-172]. Millets contain high amount of proteins, fibre, B-complex vitamins, micronutrients, trace elements, phytonutrients including phytic acid that have the capacity to lower

cholesterol and phytate, which are associated with reducing the risk of cancer [1-4-141-168-172]. India is the largest producer of millets in the world according to Agricultural and Processed Food Products Export Development Authority (APEDA) [141-168]. India contributes about 38.4 percent of global millet output. India produces about 15.38 million tonnes of millets every year [141-168-172-172]. Millets production in India supports food security, rural income and climate resilience[141-168]. These grains grow in semi-arid regions and depend on low water [141-168]. This makes millets useful for farmers in drought-prone zones. Rajasthan is the highest producer of millet grains in India, contributing roughly 27% to 30% of the total, and over 40% of the country's pearl millet (bajra) production [141-168]. It leads in both total acreage and overall production, primarily growing bajra, followed by Maharashtra and Karnataka [141-168]. Millet of India includes pearl millet, sorghum, finger millet, foxtail millet, barnyard millet, kodo millet and little millet[141-168]. These grains have higher protein, fibre and minerals compared to rice and wheat. They grow in dry soils and tolerate heat better [141-168]. This strengthens India's food system. India has grown millets for many years. Demand for millet foods increased due to health awareness [141-168-172]. Government of India supported the improved production of millets [141-168-172]. Many Indian states focused on improving yields, building processing units and creating export opportunities. Millets producing states in India now include regions that earlier depended on rice and wheat[141-168]. This shift supports nutrition and climate resilience. Millets require less water. They grow in dry areas and help farmers reduce crop loss [141-168-172]. They fit well in low-rainfall states like Rajasthan, Gujarat and Maharashtra[141-168]. Most millet producing states in India depend on monsoon. Millets grow even with limited rainfall. They also support soil health because they need fewer chemical inputs. Millets offer diverse uses [141-168]. They are used for flour, porridge, snacks, drinks and bakery items. Food companies promote them as healthy foods [141-168]. Farmers in major millets producing states in India earn steady income from these crops [141-168-172]. Government programs link farmers to markets and this helps build long-term production [141-168-172]. India's major millet producing states include Rajasthan, Maharashtra, Karnataka, Uttar Pradesh, Gujarat, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, Telangana and Uttarakhand [141-168]. These states grow different varieties such as bajra, jowar, ragi, foxtail, little millet and barnyard millet. Production strength depends on local climate, soil type and traditional farming systems [141-168-172].

Millets are cereals, traditionally cultivated and consumed by low-income group farmers and those who knew about the significance of these underutilized crops [141-168-172]. Large-scale cultivation and promotion of millet consumption could help to meet the sustainable development goals such as 'attaining zero hunger', 'end hunger', achievement of food security and improving nutrition and promotion of sustainable agriculture [141-168-172]. Most of the millets have evolved to thrive in diverse environment. Due to climate change, increasing population and unreliability of vegetables, the researchers and policy makers are currently focused on millets as most of them can survive in extremely harsh conditions, without any need of human intervention. Millets are now considered as environmentally, economically and ecologically friendly sources of food and nutrition [141-168-172].

Rajasthan produces about 48.09 lakh tonnes of millets [141-168-172]. Dry climate and sandy soil help strong output [141-168]. Pearl millet and sorghum remain the main crops grown across large areas every year. Rajasthan contributes nearly one-third of India's bajra production [141-168]. This makes it the largest producer of bajra in India. Farmers depend on monsoon, so millets reduce climate risk. Bajra fields stretch across western and central districts with stable production [141-168]. Demand for bajra flour rises due to nutrition awareness. Rajasthan holds the highest percentage share among millet producing states in India. Large cultivation area, suitable climate and strong local consumption support consistent annual millet production[141-168-172].

Maharashtra produces about 25.58 lakh tonnes of millets [141-168-172]. It contributes nearly 40 percent of India's sorghum[141-168]. It also grows pearl millet and finger millet. Marathwada and Vidarbha rely on millets due to rainfall uncertainty. Sorghum remains central to rural diets [141-168]. Farmers maintain traditional millet systems that suit dryland farming and support stable yields even in low-rainfall years [141-168]. Karnataka produces about 22.79 lakh tonnes of millets [141-168]. It leads finger millet production in India. Southern districts specialise in ragi and sorghum, grow foxtail and other small millets [141-168]. Ragi and sorghum forms part of everyday meals in Karnataka. [141-168]. This consistent demand supports farmers with reliable income. Uttar Pradesh produces about 21.58 lakh tonnes of millets [141-168]. Western UP grows pearl millet and sorghum. Soil and climate support high bajra yields [141-168]. Gujarat produces about 13.48 lakh tonnes of millets. Pearl millet is the main millet grown across dry and semi-arid zones [141-168-172]. Climate supports high bajra output. Bajra flour demand grows due to nutrition awareness. Tribal districts grow small millets for local consumption [141-168-172]. Gujarat maintains steady harvests across semi-arid regions and continues to expand its millet market. Madhya Pradesh produces about 12.68 lakh tonnes of millets. The state grows small millets, pearl millet and sorghum [141-168-172]. Large dry land regions support wide cultivation across tribal and rural areas every year. Tribal communities grow kodo and kutki [141-168]. These small millets attract higher prices in niche markets. Farmers rely on traditional knowledge to maintain steady production. Many districts continue to expand millet acreage due to low water needs and reliable yields [141-168]. Tamil Nadu produces strong quantities of ragi and small millet. Finger millet remains dominant across multiple districts [141-168]. The state also grows foxtail millet and little millet in different agro-climatic zones [141-168-172]. Tamil Nadu invests in processing facilities that produce flour, mixes and snacks. These value-added products increase farmer income [141-

168]. The state maintains a solid percentage share among ragi producing states in India and supports long-term millet growth [141-168-172]. Andhra Pradesh grows foxtail millet, little millet and ragi [141-168-172]. These crops support agriculture in drought-prone areas. Farmers depend on millets when rainfall varies. Production remains steady across multiple districts [141-168-172]. Millet-based foods gain popularity across the states [141-168]. Companies produce snacks, flour and ready mixes sourced from local farmers. Rising demand increases cultivation incentives [141-168]. Many regions use millets for crop rotation to maintain soil strength. Uttarakhand grows barnyard millet and finger millet [141-168]. Hill regions suit small millets due to cooler climate and terraced fields. Production remains steady across high-altitude zones. Farmers rely on traditional millet systems with low chemical use [141-168-172]. These grains support nutrition in remote villages. Demand for hill millets rises due to higher mineral content and organic cultivation practices followed in many regions [141-168-172]. Haryana focuses mainly on pearl millet. Dry regions and sandy soils support strong bajra growth. Mechanized farming improves grain quality and increases efficiency across major districts [141-168]. Haryana holds a smaller percentage share among millet producing states in India, but strong market access and modern farming practices help maintain steady production. Its contribution remains important to overall bajra supply[141-168-172].

4 MILLET BASED PACKAGED FOOD MARKET

The Global Millet Based Packaged Food Market is projected to experience significant expansion, growing from a valuation of USD 44.39 Million in 2025 to USD 75.73 Million by 2031, reflecting a CAGR of 9.31% [169]. These packaged goods, which include items such as pasta, bakery products, and ready-to-eat snacks, are value-added consumables derived from nutrient-rich grains like pearl millet and sorghum [169]. This market growth is primarily fueled by a rising international preference for low-glycemic and gluten-free dietary choices, alongside government efforts to support climate-resilient, sustainable agriculture[169]. Data from the International Crops Research Institute for the Semi-Arid Tropics indicates that annual global millet consumption reached approximately 30 million tonnes in 2024, demonstrating a substantial existing consumer base for these heritage grains [169]. Manufacturers in India are increasingly using advanced extrusion technologies to process nutrient-dense grains like ragi and sorghum into contemporary textures, such as flakes, puffs, and savory crispies, which appeal to younger demographics who prioritize taste alongside health [169]. This innovation addresses the palatability barrier that previously hindered mass adoption, allowing millet brands to compete directly with conventional rice and corn-based snacks in impulse aisles[169]. The commercial success of this strategy is highlighted by Inc42's January 2025 report, which notes that Wholesome Foods projected a revenue of INR 168 crore for fiscal year 2025, largely driven by its expanded portfolio of value-added, kid-friendly snacking products[169].

Shrotri and Deotale (2026) [170] reviewed those various initiatives like the International Year of Millets (2023), National Food Security Mission, and FSSAI's Eat Right India campaign, which have triggered enhanced visibility and demand for millets [170]. Shrotri and Deotale (2026) [170] also indicated that newer, emerging technologies of processing like extrusion, fermentation, malting, and blending have been used to produce a range of innovative ready-to-eat and functional millet-based products for modern lifestyle choices [170]. Yet, there are several issues standing in the way of reinvigorating millet demand, related to supply chain inefficiencies, inadequate processing infrastructure, and poor consumer awareness[170-172].

5 MILLET PRODUCTION IN INDIA: CHALLENGES

Millet production faces steady challenges [141-168-172]. Awareness remains low outside specific regions. Many farmers prefer rice or wheat because procurement is predictable in these crops. Market infrastructure for millets is still limited in several Indian states. Key challenges include: Weak demand in rural markets. Irregular procurement leading to unpredictable income [141-168]. Low processing capacity near farms. Strong competition from rice and wheat in public distribution systems. On the other hand, millet demand is expected to grow in the coming years [141-168]. Food brands add new millet-based items each year to meet rising interest. Startups in health food and nutrition use millets for gluten free and low glycemic products. This creates more value for farmers. Areas with growth potential include: Processing units in top producing states [141-168-173]. Value added foods like millet snacks and ready mixes. Export opportunities for premium varieties. New agri-startups that support contract farming. Farmers in semi-arid regions gain from this shift[141-168-173]. Millets use less water compared to major cereals. This supports sustainable agriculture and improves long term income stability. Srinivasan and Abirami (2026) [168] are of the opinion that preparation of millet-based products and marketing may be challenging; but marketing options may be viable for ready-to-cook or ready-to-eat recipes [141-168-173]. Due to the mounting population pressure, millets may become a staple in household in 2025[141-168-173]. Srinivasan and Abirami (2026) [168] reported that the government empaneled Group of Ministers, core committee members, task forces, logos, slogans, convention of stakeholders, action points etc. are some of the initiatives by the government for enhancing the productivity, cultivation, marketing and creation of awareness about the nutritive value of millets (Ministry of Agriculture and Farmers Welfare (2022) [168]. Ancient grains, along with millets can be cultivated for biofortification – breeding of crop varieties with high levels of

micronutrients [168]. Low-glycemic index noodles, pasta, snacks are some of the food products of the future to combat non-communicable diseases such as cardiovascular diseases, respiratory ailments and diabetes [168-173].

Despite this potential, the industry encounters major obstacles regarding processing efficiency and supply chain logistics, which hinder the scalability of mass-market production. The decentralized nature of sourcing raw materials frequently results in quality inconsistencies and increased operational costs. These factors create a significant barrier for manufacturers attempting to match the price points of conventional staple foods within the global retail sector, thereby limiting broader market penetration [168-173].

6 CONCLUSION

India is the largest producer of millets in the world according to APEDA. India contributes close to 38.4 percent of global production. India is the largest producer of millets in the world. The country grows a wide range of millet varieties across different climatic zones. Production is supported by strong domestic demand, traditional practices and government programmes. India supplies millet exports to Africa, Asia and Europe due to high output and reliable supply chains. The global average yield of millets is 1229 kg/ha. In India, the top five states that produce millets are Rajasthan (bajra / sorghum), Karnataka (jowar / ragi), Maharashtra (ragi / jowar), Uttar Pradesh (bajra) and Haryana (bajra). Other millets such as Tef (*Eragrostis tef*) and Fonio (*Digitaria exilis*) are grown in countries such as Ethiopia, Eritrea, Australia, West Africa, Sudan, Nigeria, Togo, Senegal and Mali for food grain and fodder. Rajasthan ranks at the top in bajra production. The state produces the largest share due to wide rainfed farmlands and hardy bajra hybrids suited for low rainfall. Districts such as Alwar, Bikaner, Barmer, Jaipur and Nagaur contribute the most. High temperature and sandy soil help maintain strong yields in most years. Karnataka leads ragi and sorghum production. Farmers in Mandya, Tumakuru, Ramanagara and Kolar districts grow large volumes of ragi. Tamil Nadu and Andhra Pradesh follow with production from districts like Dharmapuri, Salem and Chittoor. These states support ragi farming through local demand and state-level millet missions. Karnataka leads ragi and sorghum production. Farmers in Mandya, Tumakuru, Ramanagara and Kolar districts grow large volumes of ragi. Tamil Nadu and Andhra Pradesh follow with production from districts like Dharmapuri, Salem and Chittoor. These states support ragi farming through local demand and state-level millet missions. India holds a strong position in millet production due to large cultivation areas across Rajasthan, Maharashtra, Karnataka and other key states. Rajasthan leads in bajra, while Karnataka leads in ragi and sorghum. Demand grows in cities due to health focus and steady expansion of packaged millet foods. Government missions improve seed supply, training and procurement. Farmers face issues such as low awareness and competition from rice and wheat, but new export orders and rising value added products create strong future opportunities. India remains the world's largest millet producer and continues to guide global millet growth.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding the publication of this paper.

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