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Shri Anna: A path to nutrition and ecological balance

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Shri Anna (millets) *are cultivated from ancient times in India. Although, their cultivation has reduced after Green revolution, it is increasing gradually through demonstration and awareness of their beneficial nature. In this regard, the Indian government declared 2018 as Natinal Year of Millet and United Nations declared 2023 as International Year of Millets to promote their cultivation in face of climate change. They are drought tolerant, contains vitamins, dietary fibre and minerals, less intensive and resilient crop. This article discusses the role of* Shri Anna *in promoting environmental sustainability while strengthening nutrition and livelihoods among farming communities.*

Keywords: Millets, Nutritional benefits, Resilience, Sustainable environment

MILLETS constitute an important group of nutritious cereals belonging to the Poaceae family and are among the earliest domesticated crops in human history. In India, they are recognised as 'nutricereals' because of their superior nutritional value and health-promoting properties. Compared with major cereals such as wheat and rice, millets generally contain higher levels of proteins, dietary fibre, vitamins, and essential minerals such as iron, calcium, and zinc. They are naturally gluten-free and possess a low glycemic index, making them suitable for individuals affected by celiac disease and diabetes. Owing to their rich composition of bioactive compounds, millets exhibit antioxidant, anti-inflammatory, and disease-protective properties that contribute to improved metabolic and digestive health.

Beyond nutrition, millets play a critical role in environmental sustainability. Agronomically, they are resilient and climate-smart crops that tolerate drought, high temperatures, and erratic rainfall, requiring significantly less water than rice and wheat. Millets grow well in marginal and degraded soils with minimal external inputs such as fertilisers and pesticides, thereby reducing the ecological footprint of agriculture. Their relatively high resistance to pests and diseases further minimises chemical dependency, supporting biodiversity conservation and soil health. In the context of climate change, millets offer a sustainable pathway for climate adaptation and mitigation by enhancing agro-ecosystem resilience, lowering greenhouse gas emissions, and conserving scarce natural resources such as water and fertile land.

India is currently the largest producer of millets in the world, contributing about 38.4% of global millet production (FAO 2023). Major millet-producing states include Rajasthan, Maharashtra, Karnataka, Uttar Pradesh, Gujarat, and Haryana, with Rajasthan contributing the highest share. During the financial year 2024, total millet production in India was estimated at about 15.38 million tonnes (mt) across approximately 12.19 million hectares. A wide range of species such as pearl millet (bajra), sorghum (jowar), finger millet (ragi), buckwheat, and small millets are cultivated, playing a vital role in the food and nutritional security of rainfed and semi-arid regions.

Although, millets cultivation and consumption declined after the Green Revolution, renewed awareness of their nutritional and ecological benefits has led to their resurgence as 'superfoods'. Growing domestic demand, expanding exports, and policy support have strengthened their economic importance. Recognising their global value, the United Nations declared 2023 as the International Year of Millets, providing renewed momentum to research, market development, and value-chain strengthening. In this context, *Shri Anna* emerges not only as a nutrition-rich food source but also as a cornerstone of environmentally sustainable, climate-

resilient, and inclusive agricultural development.

Types of *Shri Anna*

In India, millets are broadly classified into two major categories: major millets and minor millets. The major millets include sorghum (jowar), pearl millet (bajra), and finger millet (ragi or *mandua*), whereas the minor millets include kodo millet, barnyard millet (*sawa/sanwa/jhangora*), foxtail millet (*kangni*), and little millet (*kutki*). Commonly cultivated millets include pearl millet, finger millet, foxtail millet, barnyard millet, kodo millet, sorghum, and little millet.

Production status

Millets constitute one of the major cereal grain groups consumed globally, particularly in the arid and semi-arid regions of Africa and Asia, with significant production concentrated in countries such as India and China. These crops are valued not only for their high nutritional quality but also for their importance in agro-industrial applications and their suitability for cultivation under marginal environmental conditions. Owing to their resilience to drought and adaptability to diverse agro-climatic conditions, millets have emerged as an important component of sustainable agricultural systems and food security strategies in developing regions.

At the global level, millets rank as the sixth most widely produced cereal crops. According to estimates, world millet production reached approximately 31.02 mt, with India emerging as the leading producer, followed by Niger and China (FAO 2020). Other significant millet-producing countries include Burkina Faso, Mali, and Senegal. Although millets are not widely consumed in developed countries, they remain a staple food for large populations in many developing nations and play a crucial role in ensuring nutritional and food security (APEDA 2023).

In the Indian context, millet production has demonstrated a steady upward trend in recent years. India is one of the largest producers of millets in the world, and millet cultivation has gained renewed importance among Indian farmers due to the crop's inherent drought tolerance and low input requirements. Government initiatives, particularly under programmes such as the National Food Security Mission, have significantly contributed to the promotion and expansion of millet cultivation. As a result of these policy interventions and increasing awareness of the nutritional benefits of millets, production levels have continued to rise. Recent production trends indicate sustained growth in millet cultivation across several states, reflecting both increased farmer adoption and supportive agricultural policies.

Physical and functional characteristics of millets

Millet grains exhibit wide diversity in kernel morphology, anatomical structure, and physicochemical behaviour across species, which directly influences their processing performance and food applications. Based on seed covering, millet kernels are classified into two structural types: utricle-type and caryopsis-type grains. Utricle-type millets, such as finger millet, proso millet and foxtail millet, possess a loosely attached pericarp that encloses the seed in a sac-like structure, easily separable from the thick, protective seed coat (testa). In contrast, caryopsis-type millets, including pearl millet, fonio and teff have a pericarp firmly fused with the seed

Table 1. Nutritive value, origin and major millet cultivating states in India

Common name	Scientific name	Type of millets	Key nutritive values	Centre of origin	Major cultivating states
Pearl millet (Bajra)	*Pennisetum glaucum*	Major millet	Rich in protein, dietary fibre, iron, zinc; gluten-free; low glycemic index; strong antioxidant properties; beneficial for heart health and diabetes management	Tropical West Africa (Sahel region)	Rajasthan, Maharashtra, Gujarat, Haryana, Uttar Pradesh
Finger millet (Ragi/*Mandua*)	*Eleusine coracana*	Major millet	High calcium, iron, fibre; B-complex vitamins; supports bone health and diabetes control; antioxidant-rich	East-Central Africa (Uganda region)	Karnataka, Tamil Nadu, Uttarakhand, Odisha, Maharashtra
Sorghum (Jowar)	*Sorghum bicolor*	Major millet	Rich in fibre, protein, iron, phosphorus; gluten-free; supports digestive health and metabolic balance	Africa (Ethiopian region)	Maharashtra, Karnataka, Telangana, Madhya Pradesh
Proso millet	*Panicum miliaceum*	Major millet	Good source of protein, B-vitamins, minerals; low glycemic index	Central and Eastern Asia	Madhya Pradesh, Uttar Pradesh, Bihar
Foxtail millet (*Kangni*)	*Setaria italica*	Major/Minor (varies by classification)	Rich in iron, fibre, protein; antioxidant properties; supports blood sugar regulation	China (East Asia)	Karnataka, Andhra Pradesh, Telangana, Tamil Nadu
Kodo millet (*Kodara*)	*Paspalum scrobiculatum*	Minor millet	High fibre, iron, antioxidants; beneficial for diabetes and digestive disorders	India and West Africa	Madhya Pradesh, Chhattisgarh, Tamil Nadu
Barnyard millet (*Bhagar/Jhingora*)	*Echinochloa frumentacea*	Minor millet	Low glycemic index; rich in iron, fibre; suitable for weight management and diabetes	Japan and India	Uttarakhand, Tamil Nadu, Karnataka
Little millet (*Kutki/Samai*)	*Panicum sumatrense*	Minor millet	Rich in iron, zinc, fibre; supports digestive and metabolic health	Southeast Asia	Karnataka, Tamil Nadu, Chhattisgarh, Odisha

coat, forming a compact and structurally integrated grain. These structural differences significantly affect dehulling efficiency, milling performance, nutrient retention, and storage stability.

Functional properties of millets such as water and oil absorption capacity, swelling power, solubility, emulsifying and foaming properties, viscosity, bulk density, and gel-forming ability govern their behaviour during hydration, heating, fermentation, and extrusion. These properties define their suitability for bakery products, porridges, extruded snacks, composite flours, and ready-to-eat foods.

Nutritional quality of millets

Nutritional quality is fundamental to human health and physiological development. Improving dietary quality is a key strategy for addressing food insecurity and malnutrition. Whole-grain and plant-based diets are associated with reduced risks of chronic diseases such as cancer, diabetes, obesity, and cardiovascular disorders. Within this context, millets have emerged as nutritionally superior cereal grains all over world.

Millets possess a rich nutrient profile characterised by high antioxidant activity, substantial dietary fibre, low glycemic index, and naturally gluten-free proteins. Approximately 70% of the grain consists of carbohydrates, mainly soluble carbohydrates and dietary fibre. The starch fraction comprises amylose and amylopectin, accounting for nearly 70–80% of total polysaccharides. It provides essential minerals such as calcium, iron, zinc, phosphorus, and potassium, along with B-complex vitamins including niacin (B3), thiamine, riboflavin, and folic acid. They also contain bioactive compounds such as polyphenols, tannins, and phytates that contribute to antioxidant activity and may slow cellular ageing.

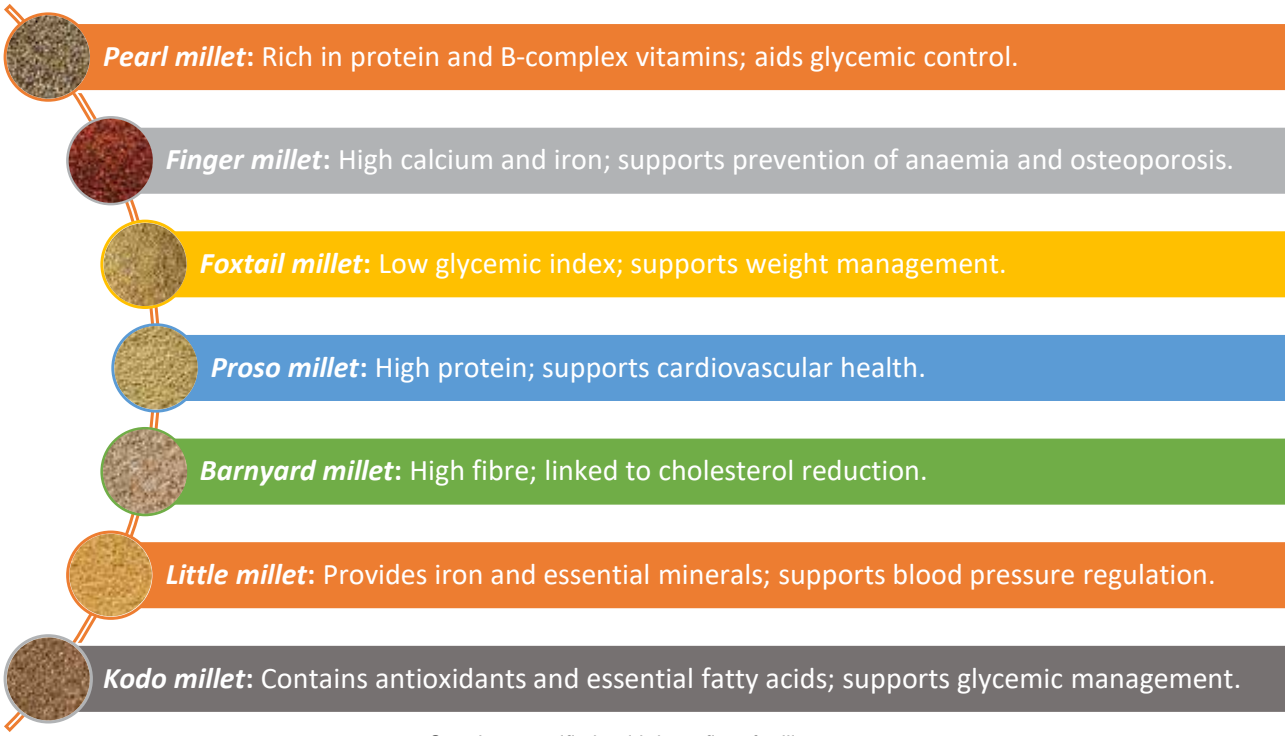
Finger millet is particularly notable for its exceptionally high calcium content (approximately 344 mg/100 g), making it one of the richest plant-based calcium sources. Resistant starch present in millets resists digestion in the stomach and small intestine and functions as dietary fibre, offering physiological benefits comparable to non-starch polysaccharides. Given that global cereal demand is projected to reach approximately 3,036 mt by 2028 (OECD/FAO 2019), millets represent an important resource for future food and nutritional security.

Health benefits of millets

Plant-based diets rich in whole grains are linked to reduced risks of chronic diseases including cancer, cardiovascular diseases, diabetes, metabolic syndrome, and neurodegenerative disorders. Most millet varieties are gluten-free and easily digestible. Limitations include occasional allergic reactions, limited long-term studies, and minor sensory concerns such as slight bitterness.

Processing

Processing enhances nutritional quality, shelf stability, and consumer acceptance. Techniques such as soaking, germination, malting, fermentation, milling, puffing, and extrusion improve digestibility and reduce antinutritional factors like phytates. Primary operations include cleaning, destoning, dehulling, drying, milling, sieving, and packaging. Advanced technologies such as microwave heating, infrared treatment, and cold extrusion have expanded product diversity, enabling production of pasta, noodles, flakes, and ready-to-eat products. However, challenges remain, including limited specialised technologies, infrastructure constraints, post-harvest losses, and competition from subsidised cereals.



Species-specific health benefits of millets

Value addition of millets

Environmentally sustainable crop

Millets promote environmental sustainability by supporting resource-efficient and climate-resilient agricultural systems. They require significantly less water than major cereals like rice and wheat, as they are primarily rainfed crops adapted to low and erratic rainfall conditions. This reduces dependence on irrigation and groundwater extraction, conserving freshwater resources in drought-prone and semi-arid regions. Millets also grow well in marginal and degraded soils with minimal external inputs, requiring fewer chemical fertilisers and pesticides due to their natural resistance to pests and diseases. This lowers soil and water pollution, reduces agrochemical residues, and supports healthier agro-ecosystems.

In addition, millets are climate-smart crops that contribute to climate change adaptation and mitigation. Their tolerance to heat stress, drought, and poor soil conditions make them highly resilient to climate variability and extreme weather events. Low input requirements translate into reduced energy use and lower greenhouse gas emissions, decreasing the carbon footprint of agriculture. Millet-based farming systems enhance agrobiodiversity by promoting crop diversification and reducing monoculture dependence, which improves ecosystem stability, pest–predator balance, and long-term soil health. Through these ecological functions, millets integrate food production with environmental protection, making them a cornerstone of sustainable and climate-resilient agricultural development.

SUMMARY

Shri Anna (millets) represents a cornerstone of sustainable and climate-resilient food systems by integrating nutrition, environmental sustainability, and livelihood security. Their rich nutritional composition, proven health benefits, and ability to thrive under low-input, stress-prone, and resource-scarce conditions make them vital for strengthening food and nutritional security while conserving natural resources. As climate-smart crops, millets support water conservation, soil health improvement, biodiversity protection, and reduction of agriculture's carbon footprint, thereby promoting ecologically balanced agro-ecosystems. With India leading global production and actively promoting millet cultivation through policy support and awareness initiatives, these traditional grains are regaining prominence in modern agriculture. Advances in crop improvement, high-yielding and stress-tolerant varieties, improved agronomic practices, and innovations in value addition and processing have enhanced productivity, market demand, and farmer adoption. Continued investment in sustainable production, green processing infrastructure, resilient supply chains, and consumer awareness will be essential to fully realise the nutritional, economic, and ecological potential of *Shri Anna* in future sustainable food systems.

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