The International Year of Millet 2023: A Global Initiative for Sustainable Food Security and Nutrition

Abstract

Millets, known for their resilience and nutritional richness, have been recognized globally for their potential in enhancing food security and nutrition. This review paper highlights the significance of the International Year of Millets 2023, a global initiative emphasizing the role of millets in sustainable agriculture, food security, and nutrition. We provide an overview of millets, their classification, nutritional profiles, and global distribution. Millets demonstrate remarkable adaptability to diverse and challenging climatic conditions, contributing to biodiversity and offering ecological benefits. This makes them a significant part of climate-smart agriculture. Millets enhance food availability and positively impact rural livelihoods and economies, contributing to food security. Our review underscores the superior nutritional content of millets in comparison to other major cereals. We shed light on health benefits associated with millet consumption, emphasizing their role in addressing hidden hunger and malnutrition. Despite these benefits, millets face barriers in cultural acceptance and require improved processing techniques. Technological innovations could help in improving processing, creating value-added millet products, while effective marketing strategies could help in overcoming social and cultural barriers. Lastly, we discuss policy initiatives supporting millet cultivation and consumption, particularly reflecting on initiatives during the International Year of Millets 2023. Future policy recommendations for sustained millet promotion are proposed, which include promoting millets as climate-smart crops, improving farmers' access to improved millet varieties and technologies, fostering an environment for millet processing and marketing, and promoting international collaboration for millet research and development.

Keywords: *Millets, Sustainability, Nutrition, Policies, Technology*

Introduction

The United Nations (UN) declared 2023 as the International Year of Millet, recognizing the significant potential these grains have in offering sustainable solutions to global challenges such as food security, nutrition, and climate change [1]. This declaration highlights the international community's concerted effort to promote millets' significance and integrate them into mainstream food systems [2]. The initiative also aims to drive research and development and stimulate investment in millet-related activities, given its exceptional adaptability to harsh growing conditions and high nutritional content [3]. Millets, often called "orphan crops" or "smart foods," have received less attention in comparison to other grains like wheat, rice, or maize. However, these robust grains are traditionally grown in many parts of the world, especially in semi-arid tropical regions of Africa and Asia, playing a crucial role in the diet and economy of millions of smallholder farmers and consumers [4]. The International Year of Millet aims to shed light on these underutilized crops and their benefits. Global food security and nutrition remain major challenges, with an estimated 690 million people still suffering from hunger in 2019 [5]. With the ongoing climate crisis, population growth, and limited natural resources, the situation calls for a transformative approach to our food systems. Millets offer an opportunity in this respect. Millets are incredibly resilient, often thriving in conditions where other crops fail [6]. They require little water, are resistant to pests and diseases, and can withstand high temperatures, making them an ideal crop under climate change scenarios. These characteristics enable millets to provide a reliable source of food, particularly for populations living in vulnerable ecosystems. Nutritionally, millets are a powerhouse. They are high in dietary fiber, proteins, and essential minerals like iron, zinc, and magnesium [7]. They are gluten-free and have a low glycemic index, making them suitable for people with celiac disease and diabetes [8]. Thus, promoting millet consumption can help tackle malnutrition and diet-related non-communicable diseases. This review aims to explore the significance of the International Year of Millet 2023 in a global context. We discuss the role of millets in sustainable agriculture, food security, and nutrition, the challenges associated with promoting their consumption, and the potential policy initiatives and international collaborations to enhance millet production and consumption. By doing so, we hope to provide a comprehensive understanding of the potential of millets in shaping a sustainable and resilient global food system.

Millets

Millets are a group of small-seeded annual grasses traditionally cultivated in arid and semi-arid regions. They are known for their robustness and ability to thrive in marginal lands with poor fertility where other major cereals may not survive [9]. The term "millets" represents a heterogeneous group, consisting of both major and minor millets. The major millets include pearl millet (*Pennisetum glaucum*), foxtail millet (*Setaria italica*), and proso millet (*Panicum miliaceum*), while the minor millets include finger millet (*Eleusine coracana*), kodo millet (*Paspalum scrobiculatum*), little millet (*Panicum sumatrense*), and barnyard millet (*Echinochloa* spp.) [10]. Each type of millet has unique characteristics making it suitable for specific agro-climatic conditions and culinary uses. These classification systems provide a structure to understand and discuss the diverse group of plants classified as millets and their unique contributions to nutrition and sustainable agriculture. Millets, in general, are rich in carbohydrates and dietary fiber. They are also a good source of proteins, and their protein content is comparable to that of wheat and maize [11]. Millets also boast of a high mineral content, including iron, zinc, and magnesium. Pearl millet, the most widely grown type of millet, has the highest protein content among millets and is particularly high in iron and zinc [12]. Finger millet stands out for its high calcium content, which is about ten times that of rice or wheat [13]. Foxtail millet is known for its high energy content, while proso millet has the highest carbohydrate content and provides the most calories among millets. The minor millets, like kodo, little, and barnyard millets, also possess high nutritional value and are particularly rich in dietary fiber [14]. Millets are gluten-free, making them an excellent choice for people with gluten intolerance or celiac disease. Millets are predominantly grown in Asia and Africa, with India, Nigeria, Niger, and China being the largest producers [15]. In Asia, India is the largest producer of millets, especially pearl millet and finger millet. China also grows a significant amount of foxtail and proso millet [16]. In Africa, countries in the Sahel region like Niger, Mali, and Burkina Faso are major producers of pearl millet, an important staple in their diets [17]. The United States and several European countries, while not traditionally large-scale producers, have shown increasing interest in millet production due to their resilience to climate change and nutritional benefits [18].

Role of Millets in Sustainable Agriculture

Millets display exceptional adaptability to harsh environments and can grow in areas with poor soil fertility, high temperatures, and low rainfall, often where other cereals would fail [19]. For example, pearl millet, native to the hot and arid Sahelian zone of Africa, can thrive under extreme heat up to 42°C [20]. Finger millet, in contrast, can withstand cooler temperatures, making it suitable for high-altitude farming [21]. This resilience is due to a combination of physiological traits, including efficient water use, C4 photosynthesis, which allows for increased water-use efficiency, and a deep root system that enables plants to access moisture deep in the soil [22]. Many millet varieties mature quickly, which enables them to escape drought conditions [23]. Millets also contribute to agrobiodiversity and have potential ecological benefits. Traditionally, a range of millet varieties has been cultivated, each with unique adaptations to local conditions, contributing to agroecosystem diversity [24]. This diversity helps to maintain healthy soils, control pests and diseases, and enhance ecosystem resilience to stresses like climate change [25]. Millets often require fewer inputs than other cereals, such as fertilizers and pesticides, leading to lower environmental impact [26]. They also contribute to soil health due to their deep root systems, which improve soil structure, enhance water infiltration, and prevent erosion [27]. Climate-smart agriculture (CSA) is a strategy for increasing sustainable agricultural productivity, enhancing resilience to climate change, and reducing greenhouse gas emissions where possible [28]. Millets have a pivotal role in this context. As discussed, millets can tolerate a wide range of climatic conditions and soils, are less reliant on synthetic inputs, and contribute to biodiversity and soil health. These attributes help to enhance both farm productivity and resilience in the face of climate change [29]. The carbon footprint of millet production is relatively low. Studies have shown that millets have lower energy inputs and carbon emissions than rice and wheat, largely due to their lower need for synthetic fertilizers and irrigation [30].

Millets and Food Security

Food availability, the first pillar of food security, refers to the physical availability of sufficient quantities of food of appropriate quality [31]. Millets play a significant role in this aspect. Millets have the ability to grow in diverse and marginal conditions, including drought-prone, high-temperature, and low-fertility soils where other crops might fail. This robustness and adaptability contribute to maintaining food production under challenging conditions [32]. The early maturity of many millet varieties ensures a fast return on investment and provides food and income early in the growing season, before other crops are ready for harvest [33]. This feature can be crucial in contexts of food insecurity, providing a source of food during the 'hungry season'. Millets are often grown by smallholder farmers in developing countries, and their cultivation can have significant impacts on rural livelihoods and economies [34]. Millets are used not only for human consumption but also as fodder for livestock, another key source of income and nutrition in many rural households [35]. The cultivation of millets can also contribute to rural economic resilience. As a hardy crop requiring fewer inputs than other cereals, millets can provide a reliable source of income for farmers in marginal lands [36]. Given the growing recognition of their nutritional value and demand for gluten-free products, millets offer potential for value addition and improved market opportunities.

Nutritional Importance of Millets

Millets are nutritionally superior to many other commonly consumed cereals. They are rich in dietary fiber, protein, essential fatty acids, and vitamins, especially B vitamins, and are particularly high in essential minerals like iron, zinc, and calcium [37]. For instance, pearl millet has a higher protein content and is richer in iron and zinc than rice, wheat, or maize [38]. Finger millet has three times the amount of calcium found in milk and is also rich in antioxidants [39]. These comparisons illustrate that millets have a nutritionally well-rounded profile and can contribute significantly to a balanced diet, especially in regions where micronutrient deficiencies are prevalent. Consumption of millets has been associated with numerous health benefits. As a whole grain, the high fiber content in millets helps in maintaining gut health, preventing constipation, and reducing the risk of diseases like colorectal cancer [40]. Millet consumption may also contribute to the prevention and management of chronic diseases. For example, studies have shown that millets can help manage blood sugar levels, making them suitable for people with diabetes [41]. Millets are gluten-free, providing an excellent food option for individuals with celiac disease or gluten sensitivity [42]. "Hidden hunger," or micronutrient malnutrition, refers to a deficiency of essential vitamins and minerals in the diet [43]. This form of malnutrition is widespread in developing countries and can lead to serious health problems, including impaired physical and cognitive development [44]. Given their high content of essential minerals like iron and zinc, millets can play a crucial role in addressing hidden hunger. For example, biofortification of pearl millet with iron and zinc has been shown to improve the nutritional status of children in India [45].

Promoting Millet Consumption

Despite their nutritional benefits, millets face certain cultural and social barriers. In some societies, millets are considered a "poor man's crop" or a famine food and are thus less preferred compared to other cereals like rice and wheat (Table 1) [46]. The traditional knowledge and skills required for millet processing and cooking have been lost in many societies due to urbanization and the shift towards convenience foods [47]. Overcoming these barriers requires reorienting public perceptions and reintroducing traditional food processing and cooking techniques. Technological innovations can play a critical role in improving the processing of millets and adding value to millet-based products. Millet processing technologies, such as dehulling, puffing, malting, and milling, have been developed to improve the quality and acceptability of millet foods [48]. Scientific research has resulted in the development of value-added millet products like bread, cookies, pasta, and breakfast cereals that cater to modern tastes and preferences [49]. These products can help promote the consumption of millets among urban populations and in societies where traditional millet foods are less preferred. Successful marketing strategies for millets have often combined promotional activities to raise awareness of the nutritional and environmental benefits of millets, with the development of attractive, value-added millet products. For example, the "Smart Food" initiative in India has successfully promoted the consumption of millets through various strategies including TV cooking shows, school feeding programs, and partnerships with food companies to develop new millet products [50]. Similarly, the "Our Millet" project in South Korea used a variety of strategies including consumer education, development of diverse millet products, and support for local millet farmers, resulting in a significant increase in millet consumption in the country [51].

Table 1: Strategies for Promoting Millet Consumption

S.No.	Strategies	Expected Outcomes
1	Educate about the health benefits of millet	Increased knowledge and awareness about the nutritional benefits of millet
2	Include millet in school meal programs	Children develop taste and preference for millet from an early age
3	Organize cooking workshops using millet	Improved skills and knowledge on how to incorporate millet into daily meals
4	Collaborate with restaurants to offer millet-based dishes	Higher availability and visibility of millet in popular food outlets
5	Encourage farmers to cultivate millet through incentives	Increased production and availability of millet in the market
6	Government policies to subsidize millet prices	Millet becomes a more affordable choice for consumers
7	Social media campaigns promoting millet	Increased interest and curiosity about millet among digital-savvy consumers
8	Partner with health and fitness	Increased endorsement of millet as part of a healthy

	influencers	lifestyle
9	Highlight millet in dietary guidelines	Official recognition of millet as a key part of a balanced diet
10	Retail partnerships for prominent shelf placement	Enhanced visibility of millet in supermarkets, making it a more likely purchase choice

Policy Initiatives and International Collaboration for Millet Promotion

Government policies play a significant role in promoting millet cultivation and consumption. In India, for example, the government included millets in the public distribution system and midday meal schemes to promote their consumption [52]. Similarly, in Africa, millets have been included in school feeding programs in countries like Mali, Burkina Faso, and Ghana [53]. Additionally, many countries have implemented policy measures to support millet farmers. These measures include subsidies for millet seeds and farming equipment, price supports, and improved access to credit [54]. The International Year of Millets 2023 is a global initiative aimed at increasing awareness about the benefits of millets and promoting their cultivation and consumption. The initiative has involved various activities, such as global conferences, workshops, promotional campaigns, and research collaborations [55]. For instance, the initiative has fostered research collaborations among different countries to enhance millet varieties, improve processing technologies, and develop innovative millet products [56]. It has also included policy dialogues to strengthen the policy support for millet cultivation and consumption. Moving forward, policies should focus on promoting millets as climate-smart crops and ensuring their incorporation into climate change adaptation strategies [57]. Policymakers should also aim to improve access to improved millet varieties and technologies for millet farmers, particularly smallholder farmers. Policies should focus on creating an enabling environment for millet processing and marketing. This can involve providing support for the development and scaling-up of millet processing technologies, and promoting the branding and marketing of millet products. Lastly, policies should foster international collaboration for millet research, development, and promotion. This can involve strengthening international research collaborations, sharing best practices, and promoting knowledge exchange on millet promotion among different countries.

Conclusion

The International Year of Millets 2023 highlights the potential of millets in addressing food security, nutrition, and sustainable agriculture. These resilient crops, rich in nutritional value, offer multiple benefits from promoting biodiversity to contributing to climate-smart agriculture. However, challenges in cultural acceptance, processing, and marketing of millets persist. Technology, effective marketing strategies, policy initiatives, and international collaboration can play pivotal roles in overcoming these barriers. Future policies should focus on promoting millets as climate-smart crops, enhancing access to improved varieties, creating supportive environments for processing and marketing, and fostering international collaboration in research and development. By doing so, millets can truly become a solution for sustainable food security and nutrition.

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