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Millets: The sustainable grain

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ABSTRACT
Millets are the choice of smart food of 21st century. They are oldest reported grains and share a traditional diet habit in many regions throughout the world. Millet's production is ecofriendly and sustainable to human being, the farmers and the planet. Human civilization, welfare and agriculture production are always threatened by climatic changes with its deleterious effects. Millets are the such wonder grains withstand the droughts and are also good for animals. Millets are the most popular and safe crops for dry land soils and demands very less water for their cultivation. Most of other major crops fail the unpredictable climatic conditions (weather of twenty first century) where millets can sustain. These are rich in nutrition and help in overcoming malnutrition and food insecurity leading to agro-sustainability. Millet production reduces agricultural input expenditure resulting in sustainable development in near future. The current review provides the available information from existing literature either online or offline related to the nutritional importance and health benefiting properties of millet and its role in sustainability in an easily-documented pattern.
Keywords: Millet, climate, nutrition, cultivation, sustainable development

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INTRODUCTION

In the era of climatic changes, it becomes more reality that the world is changing its climate day by day. This situation has effect on agriculture. Agriculture is the building block of society in terms of providing food. The main aim of the green revolution in 1960 was to solve India's food scarcity. Recent days' aim is to provide the food security with sustainable approaches without perturbing the nutritional values. These issues lead to the development of new agriculture system and moving away from monopoly of rice-wheat cropping system. Sustainable agriculture has emerged as a critical global priority, aiming to harmonize food production with environmental preservation and socio-economic prosperity. Millets, the small-seeded grasses, are gaining worldwide attention for their adaptive capabilities to weather changes, nutritional values and agro-sustainability. Millets are often overlooked and presents a distinct array of characteristics that provides sustainable agriculture (Mohod et al., 2023; Raj et al., 2024).
Millets provides a good option to food security in recent years and sustainable development in global aspect. Governments of many countries have begun to recognize the importance of these grains in their agricultural policies. There are many countries like India, Nigeria which are known as millet-producing countries, have begun to recognize the importance of these grains in their agricultural policies. In the year 2023, the International Year of Millets was declared by United Nations. It has further highlighted the global importance of millets in addressing contemporary challenges in agriculture (FAO, 2023). Millets are noticeably able to withstand to a maximum range of temperatures, moisture regimes, and input conditions, including shorter growing seasons showing a great range of adaptibility (Mohod et al., 2023). This review aims to provide a comprehensive analysis of millet in sustainability with a focus on their role in promoting climate resilience, food security, and sustainability.

What is millet:

Millets belong to multiple species of monocotyledonous family. They are merely farmed grasses, small grained and that is the only thing that unites them. Millets are gluten free, a boon to those peoples who are suffering from gluten intolerance. Millets are still considered as very popular in the developing countries as health benefit option despite the population is being urbanized. Millets are making a own niche for organic farmers and specialty food corporations in many industrialized

countries. In India, eight millets species are cultivated in India (Sorghum, Pearl millet, Finger millet, Foxtail millet, Kodo millet, Proso millet, Barnyard millet and little millet) under rain fed conditions.

➢ **The common features of millets are:**

- **Small-seeded grasses:**

Millets belong to the grass family and have small, round seeds.

- **Nutritional value:**

Millets are a good source of protein, carbohydrate, vitamins, minerals and also contain fibre.

- **Gluten-free:**

The gluten free property of millets is making them a good choice for people with gluten intolerance.

- **Versatile:**

Millet's recipes are easy, tasty, highly versatile and healthy. This makes them a replace for traditional grains like rice, wheat.

- **Historical significance:**

Millets have been part of human diets for thousands of years and were staples in some cultures before rice and wheat became dominant.

- **Drought and pest resistance:**

Their ability to thrive in harsh environments and resist pests makes them a valuable crop for food security.

Table 1: Millets and their health benefits (Source: International Year of Millets: India Leading The Way 2023)

Millet	Benefits
Sorghum	Antioxidants reduce the risk of CVD and colon cancer, as well as high in soluble fiber, and reduce the risk of diseases such as type 2 diabetes.
Pearl Millet	It is a rich source of Vitamin E, as well as it protects body tissues from radical damage.
Finger Millet	Helps in the strengthening & development of bones and helps in fighting against anemia.
Foxtail Millet	Rich in calcium, it helps fight diseases such as osteoporosis and reduces the risk of fractures.
Proso Millet	Controls depression, lowers blood pressure, and also acts as an anti-inflammatory.
Kodo Millet	Millet Excellent for strengthening the nervous system.
Little Millet	Helps improve heart health & an ideal food for diabetes as it prevents abnormal spikes in blood sugar levels.
Barnyard Millet	Contains high amounts of iron, and helps in the production of hemoglobin.

Table 2: Millets and their names (Source: International Year of Millets: India Leading The Way 2023)

Millet	Common Name	Botanical name
Sorghum	Jowar	*Sorghum bicolor* (L.)
Pearl Millet	Bajra	*Pennisetum glaucum* (L.)
Finger Millet	Ragi	*Eleusine coracana* (Gaertn.)
Foxtail Millet	Kangni	*Setaria italica* (L.)
Proso Millet	Barri	*Panicum miliaceum* (L.)
Kodo Millet	Kodra	*Paspalum scrobiculatum* (L.)
Little Millet	Kutki	*Panicum sumatrense* Roth ex Roem. & Schult.
Barnyard Millet	Sanwa	*Echinochloa frumentacea* Link

Challenges of millet production:

Though there are many advantages of millet consumption, there remains some disadvantages too. Millets are reported to have lower yielding properties as compared to major cereals like rice and wheat. Due to the lack of robust market infrastructure and value chains hampers the growth of millet production. Changing food habit and social preferences due to urbanization have led to a decline in millet production. Inadequate market infrastructure, such as storage facilities and transportation, has hindered the growth of millet production. This is particularly evident in regions where millets are

still grown primarily for subsistence. The agricultural policies of many countries have historically favored the cultivation of rice, wheat and maize through subsidies, research, and market support. These are the cause of lowering of millet production (Harish et al., 2024).

Millets are magic grains:

Millets are reported a long time ago, around 4500BC, the tiny cereals like proso, kodo, barnyard, foxtail and so on, belonging to grain family Poaceae popularly known as millets. Millets were left mainly underestimated and ignored due to a lack of knowledge that they are just carbohydrates results in gain of weight in the long run. Millets being ignored and not grown properly from that time. (Bordoloi et al.).

Post-Covid era has many downstream health effects and that's why this grain is gaining a good admiration for its exceptional nutritional values. The low glycaemic index helps in controlling weight leads to combat different post covid health issues. Millets contains different carbohydrates which are not similar to other common grains like rice, whaet. These wonder grains help in controlling many lifestyle diseases like fatty liver, constipation, high blood pressure, diabetes, high cholesterol, and poor gut health. People are choosing millets as a healthier option for their daily diet.

Here are some benefits of millets:

1.Immunity booster:

These are immunity booster with the source of high vitamin B1, B3. These grains can replace immunity booster supplements.

2. Rich in protein:

Proso and foxtail millets are rich in protein when compared to wheat, rice and other pulses.

3. Rich in iron:

These are good source of iron, good for expecting mothers and patient of anaemia. Bajra is the highest iron rich grain.

4. High in fibre:

Millets have rich fibre quantity compared to conventional grains. This help to manage digestive problems like constipations and many more. The prebiotic fibre lignan keeps the gut healthy and happy. Moreover, millets are good for diet and have a high satiety value helps to check weight gain. As for comparison, a cup of cooked millets will maintain one's satiety full and satiated for a longer time than two cups of white rice, making it an ideal choice for dieting.

5. Good for diabetics:

Millets have significantly reduced glycaemic index, means these are slowly digested and absorbed, resulting a slower and smaller spike in blood sugar levels.

6. Expels away toxins:

The high antioxidants content (quercetin and catechins) help to neutralise free radicals and excrete out toxins from the kidney and liver.

7. Builds those muscles:

High protein content in some millets like proso and foxtail millet helps to build muscles properly when compared to other traditional grains.

8. Guards the heart:

Triglycerides are known to be reduced markedly if millets are taken twice or thrice weekly. Millets doesn't have bad fat or bad cholesterol so they are heart friendly thereby lowering heart disease and stroke risk.

9. Save the earth, water, and soil:

Millet's production does not need any pesticides, fertilizers unlike the other grains i.e. rice, wheat. They also demand significantly less water in agriculture. Millets are reported to play crucial role in improving field fertility.

Millet recipes are very smart, easy and time saving too, making them a good choice of food if replaced with traditional cereals like rice, wheat. So, anyone can replace rice or wheat with millets without further worry and experience the joy of healthy and wholesome meals.

Advantages of millet production with reference to sustainability:

These wonder crops withstand in dry soil, having low demands of water so beneficial for the land fertility it grows on. It can be said that millets for sustainable future – all while packing for a powerful nutrition rich dish. Many communities are dependent on millets for the food source for centuries but these grains are still underestimated in modern dominating agricultural fields due to lack of knowledge (Das et al., 2022). They can execute the extreme climatic conditions and require minimum investments making them an ideal choice for sustainable agriculture.

Millets are capable to withstand changing climatic conditions with unpredictable rainfall and temperature variations. These features make them a valuable choice in agriculture, ensuring stable yields though weather patterns are not in favour. In the recent days climatic uncertainty, millets are chosen for most sustainable food (Patil et al., 2023). Nowadays, millets are the choice of sustainable crops due to their versatility, low water requirements and adaptability to all unpredictable weather conditions. If addressed properly the challenges of climatic unpredictability and merged with justified agricultural practices, these grains can offer a long-term sustainability in near future.

Millets and Biodiversity

Millets play front role in maintaining preservation of genetic diversity specially for locally adopted strains. Pest and disease resistance are enhanced due to unique genetic traits. Range of millet varieties supports biodiversity, ensuring the conservation of traditional crops and strengthening agricultural sustainability if cultivated properly which results in rich genetic heritage of each region.

Eco-agricultural diversity is restored through its inherent property to grow in varied climates and soils. Millets encourage the integration of diverse crops, fostering a balanced ecosystem if cultivated in a proper manner. The inherent adaptability of millets contributes to resilient agroecosystems, reducing reliance on monoculture and promoting sustainable farming practices for long-term environmental and agricultural health (Patil et al., 2023).

Millets cultivation helps to strengthen the ecological balance of pollinator insects and ultimately the overall ecosystems. As flowering plants, millets attract many pollinating insects like bees, enhancing biodiversity and creating a mutualistic relationship which contributes to the health of surrounding ecosystems and proves to be beneficial also. Highlighting the role of these wonder crop not only in agriculture but also in fostering a sustainable balance within natural environments.

Millets and Water Conservation

Millets have a significantly less water requirements compared to traditional grains like rice making them low water footprint crops. The water efficiency and resilience to dry climate make millets an environmentally friendly choice in regions facing water scarcity. Millet cultivation results in water sustainability addressing concerns about water availability in agriculture.

Millets have exceptional drought adaptability and resistance help them to grow in water-scarce regions. Their adaptability to wide climatic stresses enables cultivation in challenging region, contributing to food security amid water savings. As climate change intensifies, the adaptability of millets becomes increasingly valuable in ensuring stable agricultural yields and sustaining communities facing unpredictable environmental conditions (Mishara, 2023).

Millets are ideal for draught prone regions with minimal water requirements. Their drought tolerance and efficient water use make them a sustainable crop choice, supporting agriculture in regions with water scarcity. By reducing dependence on water-intensive crops, millets offer a sustainable solution for cultivating nutritious grains in regions with limited water resources.

Millets in Agriculture

Millets are considered as staple foods in many populations, providing a primary nutrition source for various communities. Millets have versatile cooking applications, combined with their resilience to varying and tough climatic conditions, makes them dependable staple food option. As climate-smart alternatives, millets offer sustainable food security, showcasing their importance in maintaining dietary traditions and ensuring reliable agricultural yields in the face of environmental challenges (Ghatak et al., 2025).

Millets encourage sustainable agrodiversity by thriving in diverse climates with minimal chemical applications. Their efficient water usage and resilience reduce the environmental impact of agriculture. Farmers can have the option of crop rotation which enhances soil fertility and reduces the need for synthetic fertilizers. Embracing millets promotes eco-friendly, resource-efficient farming, aligning with the principles of sustainable agriculture for a resilient and environmentally conscious food production system. [Source: https://tracextech.com/millets-for-a-sustainable-future/] [accessed date: 12th June, 2024].

Crop rotation through millets provides a good soil health, a sustainable farming practice. The specialized deep root systems prevent erosion and enhance soil quality and fertility. Millets enhance the soil nutrients just like nitrogen fixing plants and hence reducing the reliance on synthetic fertilizers. Crop rotations through millets integration promotes long-term agricultural sustainability by maintaining soil fertility and minimizing environmental impact (Singh et al., 2023).

Millets for a Sustainable Future

- Millets can withstand in semi-arid conditions and have the property of good water efficiency compared to traditional crops. They have the ability to grow in wide range of weather condition which contributes to resilience in every agricultural fields.
- Millet cultivation requires minimal agro-chemical requirements, reducing environmental negative impact. This eco-friendly cultivation and inherent adaptability make millets a sustainable choice of cultivation under draught condition and environmental fluctuation in agriculture.
- Millets demonstrate their adaptability to varied environmental conditions due to climatic changes. These crops are steady and hardy and admired for withstanding drought, high temperatures, and less fertile soil.
- Millets can withstand low water requirements and this ability helps these crops to thrive in challenging climates make them a crucial resource of food security and agricultural sustainability in the face of changing climate patterns.
- Millet cultivation contributes to biodiversity conservation by preserving traditional and locally adapted varieties.
- It is a good thing that many communities play a role in safeguarding agricultural biodiversity by cultivating millets, ensuring a sustainable and stable food system for the future.

CONCLUSION

By promoting millets, we can contribute to a more sustainable and resilient global food system, preserving ecosystems, conserving resources, and enhancing the well-being of farmers and consumers alike. In conclusion, millets are more than just a crop; they represent a pathway toward a more resilient, sustainable, and nutritionally secure future. By integrating millets into mainstream agriculture, we can build food systems that are better equipped to withstand the challenges of climate change, reduce the environmental footprint of food production, and provide healthier dietary options for populations around the world. The worldwide renewed interest in millets, positions these ancient grains at the forefront of the global agricultural agenda supported by strong policy frameworks and innovative market strategies, helps the transformation of the avenue of production and consumption of food.

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