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FOOD AND NUITRITIONAL SECURITY OF MILLETS: A SUSTAINABLE SOLUTION FOR TRIBAL COMMUNITIES

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Keywords	Abstract
P Millets, Nutritional security, Tribal communities, Sustainable Agriculture practices, Climate change.	E Millets are small-seeded cereals that play a Pivotal role in ensuring food and nutritional requirements of people, especially among socially disadvantaged sections. There are many variants of millets like, pearl millet, finger millet, foxtail millet, and sorghum, by and large, millets thrive in arid and semi-arid climatic regions. Millets are staple food for several tribal communities. This study looks in to nutritional contents of millets such as dietary fiber, proteins, vitamins, and minerals like calcium, iron, and zinc which is prevent malnutrition and hence a disease-resistant life. The Study also focuses on how the millet cultivation can play a role in sustainable agriculture practice, improve soil fertility and increase biodiversity. Additionally, the study finds that millet farming can provide a sustainable source of income too for tribal communities. The overall objective of this study is to show that millet cultivation and consumption has the potential to replace conventional paddy and wheat farming for ensuring food and nutritional security of tribal populace, particularly in the emerging scenario of climate change and food-shortages. It therefore advocates concerted administrative and institutional policies and initiatives for promotion of millet farming of all varieties, their widespread consumption and all-round marketing.



1. INTRODUCTION

Food and nutritional security are a major worldwide issue, especially for tribal populations, hunger, poverty, and restricted access to sustainable agriculture practices, and the adverse effects of climate change. Particularly Tribal communities face distinct social and environmental challenges. Recently global food system is facing multiple challenges of climate change and lack of resources, highlighting the improving demand for food sources that are nutritious, resilient and sustainable. Millets, also referred to known as "nuitri-cereals" are a potential alternative crop, especially for tribal populations who have traditionally grown and consuming this grain. Millets, which are small-seeded cereals including sorghum, finger millet, foxtail millet, and pearl millet, provide a sustainable solution to problems. These crops easily can grow in arid and semi-arid regions, thrive on marginal soil with less water, fertilizer or pesticides. Their ability to survive extreme weather conditions including droughts and erratic rainfall emphasizes their potential to provide food security with limited resources. They are essential in tackling the dual issues of food security and sustainable agriculture because of their adaptability and high nutritional qualities.

Tribal communities, who frequently depend on natural resources and subsistence farming for their livelihood, face particular challenges high rate of poverty, limited access to modern agricultural techniques, and a dependence on government schemes. They still face food insecurity because land degradation, changing agricultural goals, and climate change, although they have a variety of traditional knowledge about farming methods. Tribal farmers may revive their ancient farming method and provide a long-term sustainable solution to these problems by integrating millets in to their farming systems. Millets are an excellent source of fiber, vitamins (particularly the B-complex), minerals (iron, calcium, and magnesium), and antioxidants, among other essential elements. Their high fiber content can help with weight loss, cholesterol lowering, diabetes control, and digestive health. They are an effective alternative for anyone with celiac disease or gluten sensitivity because they are also gluten-free. Millets are known for their ability to thrive in challenging environmental conditions, including drought, low soil fertility, and high temperatures. This makes them a valuable crop in regions with erratic rainfall and limited access to water resources. It has been proven to provide a variety of health benefits. Millets are versatile and have a wide range of culinary uses. These nutrients have a key role in preventing malnutrition, particularly in tribal communities that are more resistant. Frequently consumption of millet has been associated with better health outcomes, such as increased immunity and a lower prevalence of illnesses connected to a inactive lifestyle. Despite their benefits, traditional crops like wheat and rice have frequently replace millets.

Furthermore, encouraging millets might provide tribal tribes' greater economic influence. In addition to being a subsistence crop, millets have the potential to be an excellent commodity. For indigenous people, encouraging the production and consumption of millet has major socioeconomic advantages. Tribal farmers can create sustainable lifestyles by reviving traditional agricultural practices and creating market connections for millet products. Millets are an excellent alternative to conventional farming practices, which are often environmentally harmful and water intensive. To achieve this

potential, millet production, consumption, and marketing must be advanced with coordinated efforts. Enhancing market connections, increasing knowledge of millet's benefits and promoting utilization to traditional agriculture should be the main objectives of institutional and administrative measures.

2. REVIEW OF LITERATURE

*** ON THE BASIS OF AWARNESS**

Madhuri et al (2024) et al Millets, a kind of small-seeded grass, are an important staple food in semiarid tropical climates, especially in Asia and Africa. Previously considered secondary crops, their popularity has increased due to their higher nutritional profile and resistance to climatic challenges like drought and high temperatures. Despite their importance, millets have received little education attention, owing to hybridization issues connected with their tiny flowers. Recent developments highlight the possibility for using genetic variety to boost nutritional content, yield, and favorable agronomic features his is consistent with the worldwide desire for climate-resilient, nutrient-dense food crops. Thus, millets have promise as sustainable crops, contributing to food security and nutrition in vulnerable areas, emphasizing the importance of modern development techniques in realizing their full potential.

Mansi I, et al, (2023) In this study, author highlights the historical significance and nutritional value of millets, it emphasizing their role in addressing global challenges such as climate change and food security. The purpose of this study to emphasize the importance of reintegrating millets in to modern agricultural practices and diets. The objectives include promoting millets as climate-resilient crops, exploring their nutritional benefits, and advocating for policy measures to support cultivation, marketing, and consumption. The review aims to contribute to sustainable goals by recognizing millets as a key component in achieving nutritional security and enhancing awareness of their health benefits.

Himanshu Tiwari et al, (2023) This literature review highlights the global issue of hidden hunger caused by micronutrient deficiencies and explores the potential of millet-based integrated farming systems as a solution. It discusses the nutritional value and resilience of millets, as well as the challenges hindering their adoption. The review emphasizes the need for research, policy support, infrastructure development, and consumer awareness to promote millet production. It also addresses the impact of climate change on food security and the role of millets in mitigating these challenges. Overall, the review underscores the importance of millets in addressing hidden hunger and improving global food and nutritional security.

Apurba Baruah et al, (2023) The review of literature discusses those millets as "Nutri-cereals" and "Superfood" due to their adaptability in adverse conditions and nutritional benefits. Millets were neglected in Favor of popular cereals like rice and wheat, leading to health issues. However, with the challenges of the 21st century, there is a growing demand for millets for farming. Researchers have developed value added millet-based products due to their nutritive value and gluten-free nature. In



this review also highlights that the importance of millets in addressing nutritional insecurity and promoting health.

❖ ON THE BASIS OF AGRICULTURAL PRACTICES

Ayush Mishra (2023) The research emphasizes how important millets are in tackling issues like nutritional inadequacies, harmful agricultural practices, and climate change. Agriculture is more climate-resilient thanks to millets, which are ancient crops that are high in nutrients, environmentally friendly, and require less water and fertilizer. Their tripartite security—food, nutritional, and financial—benefits human health and the environment. Millets are easy to digest, high in proteins, vital amino acids, vitamins, and minerals like phosphorus and iron, and they also support the neurological system. Sustainable agriculture, which prioritizes ecological balance and soil health, is consistent with millet cultivation. By migrating to millet-based farming from a rice-wheat-centric system, long-term agricultural sustainability, resource conservation, and better nutritional habits are achieved.

Lalit Kumar Sanodiya, et al, (2023) In this review examine that the significance of millets as a major cereal food-grain crop with high nutritional value and health benefits. Millets are referred to as "famine crop" because of their capacity to maintain yields during famines. However, due to their neglect, they were historically referred to as "orphan crops". In this study also focuses on the importance for adding value to millets in order to satisfy consumer needs, reduce post-harvest losses, improve nutrition, and improve self-life. Millets are useful for sustainable agriculture and food security in the context of climate change because of their ability to survive difficult environments.

Neha Dwivedi et al(2023)The literature highlights the significant potential of millet crops in enhancing agricultural sustainability in India. Millets have been traditionally cultivated in the country and offer various environmental, economic, and social benefits. Environmentally, millet farming is resilient to drought, requires less water, enhances soil fertility, and conserves biodiversity, making it a sustainable choice amid climate change challenges. Economically, millets present opportunities for small-scale farmers by diversifying cropping systems, reducing production costs, and improving food security, thereby contributing to livelihood enhancement and market expansion. Socially, millet cultivation empowers women by improving household nutrition, generating income, and enabling greater participation in decision-making processes. Additionally, millets are recognized for their role in addressing malnutrition and providing affordable, nutrient-rich food options.

Choudhary et al,(2023)The literature highlights millet's significance as a vital element of sustainable farming. Frequently referred to as a "forgotten crop," millet has qualities including resilience to climate change, minimal input and water needs, and the capacity to enhance biodiversity and soil health. Historically important, millet supports food, nutritional, and economic security while supporting sustainable agricultural objectives by providing nutritional advantages such proteins, critical amino acids, and key minerals. Its implementation is hampered by issues including low awareness, market limitations, and research shortages, despite its promise. Case studies demonstrate how well it works to improve livelihoods and address climate problems. In order to fully realize

millet's potential for sustainable agriculture, the study advocates for millet-based systems and urges more research, regulatory changes, and public awareness.

***** ON THE BASIS OF GOVERNMENT SUPPORT

Dr. B. Maheswari (2024) the literature emphasizes the crucial part millet growing plays in the agricultural and socioeconomic structures of Tamil Nadu. In the state's agricultural traditions, millets—such as finger millet, pearl millet, and foxtail millet—have played a crucial role in ensuring food security, rural livelihoods, and environmental sustainability. A vital crop in the face of climate change, they are resilient to a variety of agro-climatic situations. With its high protein, fiber, and vital vitamin content, millets tackle the issues of food security and malnutrition. Analysis by district for 2019–2020 highlights Tamil Nadu's substantial millet output. Issues like shifting dietary habits and sustainability concerns call for solutions including value-added goods, awareness campaigns, and instructional programs.

C. Tara Satyavathi & B. Venkatesh Bhat(2024) The literature review focuses on the revival of millet cultivation and consumption in India due to growing awareness of its nutritional benefits and its potential in mitigating climate change effects on food production. The purpose is to explore strategies for mainstreaming millets in food and nutritional security through increased awareness, promotion of supply and demand, and policy initiatives. The objective is to analyze the current status and propose measures to strengthen the millets value chain, encompassing production, marketing, and policy support.

Anita Medhekar (2024) the literature review provides a comprehensive overview of the Indian government's initiatives to empower women, particularly in rural areas, through economic dimensions, education, and employment opportunities. The focus is on the 2012 'Nutritional Security' policy, incentivizing rural women in millet cultivation. Millets, with a rich cultural heritage, offer health benefits and sustainable agriculture solutions in the face of climate change. The narrative emphasizes the role of women in millet cultivation for food and income, citing the recognition and awards received by successful farmers like Mogulamma. Additionally, the review touches upon poverty alleviation, sustainable societies, the concept of polycrisis, and the broader goals of sustainable development and economic progress.

Nilesh B. Mohod et al, (2023) the purpose of this literature review is to underscore the global significance of the International Year of Millets 2023, focusing on the pivotal role of millets in sustainable agriculture, food security, and nutrition. The paper provides a comprehensive overview of millets, covering their classification, nutritional profiles, and global distribution. Emphasizing their resilience to diverse climates, the review highlights millets' contribution to biodiversity and ecological benefits, positioning them as integral to climate-smart agriculture. Furthermore, the review addresses the nutritional superiority of millets, their positive impact on rural livelihoods, and their potential to combat hidden hunger and malnutrition. Despite these advantages, cultural barriers and processing challenges persist, suggesting a need for technological innovations and effective marketing strategies. The literature review concludes by discussing policy initiatives, especially

those during the International Year of Millets 2023, and proposes future recommendations to sustainably promote millet cultivation globally.

On the basis of review of different literatures following research gap has been formulated.

3. RESEARCH GAP

Limited awareness on food and nutritional benefits of millets.

4. OBJECTIVE OF THE STUDY

- 1. To know the awareness levels of the nutritional benefits of millets among tribal populations.
- **2.** To explore role of millet cultivation and agricultural practice for enhancing food and nutritional security among tribal communities

5. RESEARCH METHODOLOGY

The present study focuses on the awareness of the nutritional benefits of millets among tribal populations, explore role of millet cultivation and agricultural practice for enhancing food and nutritional security among tribal communities. I gathered 150 relevant research papers, academic publications, reports, and other reliable materials about millets by doing a comprehensive literature search including various articles, website, published book, magazines and journal of government agencies, and government department data sources. The study finds that millet farming can provide a sustainable source of income too for tribal communities.

■ FOOD SECURITY AND NUTRITIONAL IMPORTANCE OF MILLETS

Millet cultivation plays a crucial role in ensuring the food security and nutritional well-being of tribal communities, serving as a sustainable and resilient agricultural practice deeply rooted in their cultural heritage and traditional knowledge. Promoting millet farming among tribal communities not only enhances their food security by diversifying their agricultural practices but also contributes to preserving indigenous food cultures and biodiversity. Through cultivating millets, tribes can attain sustainable nutrition sources resilient to climate fluctuations, thereby reducing dependency on single crops. Millets are rich in nutrients such as proteins, dietary fiber, vitamins, and minerals. It can help combat malnutrition and address deficiencies. They are gluten-free and have a low glycemic index, making them suitable for people with celiac disease or those looking to manage their blood sugar levels. Additionally, millets are rich in micronutrients, contributing to overall health and well-being. In addition to these, millets are rich in phytochemicals that promote health, such as lignans, polyphenols, phytosterols, phytoestrogens, and phycocyanins. Millets such as Jowar (10.4 g), Bajra (11.6 g), Proso millet (12.5 g), and foxtail have proteins per hundred grams.

Compared to rice (6.8 g), millet (12.3 g) and barnyard millet (11.6 g) are much higher and equivalent to wheat (11.8 g). Compared to rice (6.8 g), wheat (11.8 g) is significantly greater.

Finger millet is higher in calcium and mineral content than rice and wheat, but having less protein (7.3 g). Fiber content is higher in all millets than in the fine cereals (Table 1).

Table 1: Nutritional value of millets (per 100 g)



Majhi, Aishwarya & Mohanty, Jyotirmay (2025). Food and Nuitritional Security of Millets: A Sustainable Solution for Tribal Communities. International Journal of Multidisciplinary Research & Reviews, 4(3), 116-126.

Crop	Protein	Carbohydrate	Fat	Crude oil	Mineral	Calcium	Prosperous
		(g)	(g)	(g)	matter	(mg)	(mg)
Sorghum	10.4	72.6	1.9	1.6	1.6	25	222
Millet							
Pearl millet	11.6	67.5	5.0	1.2	2.3	42	296
Finger	7.3	72.0	1.3	3.6	2.7	344	283
millet							
Proso millet	12.5	70.4	1.1	2.2	1.9	14	206
foxtail	12.3	60.9	4.3	8.0	3.3	31	290
millet							
Kodo millet	8.3	65.9	1.4	9.0	2.6	27	188
Little millet	8.7	75.7	5.3	8.6	1.7	17	220
Barnyard	11.6	74.3	5.8	14.7	4.7	14	121
millet							
Barley	11.5	69.6	1.3	3.9	1.2	26	215

Source: National Institute of Nutrition (NIN), Hyderabad

■ ROLE AND IMPORTANCE OF MILLET FARMING AND FOOD SECURITY

Millet farming plays a crucial role in ensuring food security, particularly in regions prone to harsh climates and challenging agricultural conditions. Here are several ways millet farming contributes to food security:

▶ Adaptability to Adverse Conditions:

Drought Tolerance: Millets are highly resilient to drought and can thrive in arid and regions where other staple crops like rice and wheat struggle.

Soil Fertility: They can grow in poor and marginal soils, which are often unsuitable for other crops. Short Growing Season: Many millet varieties have a short growing cycle, allowing for multiple harvests in a year.

> Nutritional Value:

Rich in Nutrients: Millets are rich in essential nutrients such as protein, fiber, vitamins, and minerals. They are particularly high in iron, calcium, and antioxidants.

Gluten-Free: Millets are naturally gluten-free, making them suitable for people with gluten intolerance or celiac disease.

Economic Benefits:

Low Input Costs: Millet farming generally requires low inputs like water, fertilizers, and pesticides, making it more cost-effective for farmers, especially smallholders.

Market Potential: There is growing awareness and demand for millets as health foods in urban markets, providing economic opportunities for rural farmers.



Biodiversity and Sustainable Agriculture:

Crop Diversity: Including millets in cropping systems enhances biodiversity, reduces dependency on a single crop, and mitigates risks associated with crop failure.

Sustainable Practices: Millet farming often employs traditional and sustainable agricultural practices that promote soil health and environmental sustainability.

> Climate Change Resilience:

Climate Adaptation: Millets' resilience to extreme weather conditions makes them a viable option for climate-smart agriculture.

Carbon Footprint: Millets typically have a lower carbon footprint compared to other major cereals due to less intensive farming practices.

► Food Security and Livelihood:

Staple Food: In many regions of Africa and Asia, millets are a staple food, providing a reliable source of calories and nutrition for millions of people.

Income Stability: The ability to grow and sell millets provides a stable income for farmers, contributing to rural livelihoods and economic stability

■ CHALLEGES AND OPPORTUNITIES OF MILLETS

Limited awareness on food and nutritional benefits of millets:

Cultivation and promotion of millet is one of the significant challenges faced in sundergarh in limited awareness of among the farmers and consumer about nutrition benefits and importance of millets. Many farmers lack sufficient knowledge of the agronomic procedures and methods involved in millet growing. Similarly, consumers might not be aware of millets' many culinary applications and health benefits.

To address these challenges, it is necessary to implement awareness campaign, training program and knowledge-sharing programs aimed at farmers and consumers.

Providing information about nutritional benefits of millets can help generate demand and encourage their production. For millets to be successfully cultivated and commercialized, strong market connections are essential. Farmers needs to equitable pricing for their product and access to reliable market.

Climate change and Strategies for adapting:

Climate change is one of the significant challenges facing to agriculture, including millet cultivation in sundergarh, Extreme weather events, higher temperatures, and irregular rainfall patterns can all affect agricultural productivity and growth. Millets, due to their resilient to water scarcity, are well suitable for smart agriculture practices. Encouraging millet varieties that are resistant to heat, drought, and other environmental challenges is crucial. Farmers can better adjust to shifting climatic circumstances with the aid of research and breeding initiatives aimed at creating climate-smart millet varieties. Furthermore, millet production systems may become more resilient by using climate-smart



agricultural strategies including conservation agriculture, integrated soil fertility management, water collection, and effective irrigation methods.

> Facilities for processing and infrastructure:

Millet producers face difficulties due to inadequate infrastructure and processing facilities. Postharvest losses may arise from inadequate storage facilities, while value addition and product diversification are impeded by a lack of processing facilities. To overcome such challenges, investments in infrastructure development, such as the building of processing facilities, storage facilities, and milling machinery, might be made. With these facilities, farmers would be able to properly store their crops, process millet grains to increase their value, and satisfy the needs of various markets.

▶ Government scheme and policy support:

Government scheme and support play important role in promoting millet cultivation in sundergarh. Encouragement of policies that simplify market access, offer subsidies for equipment and supplies, and incentivise millet production can increase farmers' confidence and motivate them to cultivate millet. Additionally, research and development projects, capacity-building programs, and financial support may provide farmers with the resources, and ability to implement sustainable millet production methods. The revival of millets in sundergarh can result in better food security, higher farmer incomes, and sustainable agricultural systems by tackling these issues and embracing the possibilities.

6. LIMITATION AND SCOPE OF THE STUDY

The present study focuses on tribal communities, those who belongs to vulnerable and marginalized to food and nutritional insecurity. Study focuses on millets can play a crucial role in sustainable agriculture practice and economic development to replace conventional paddy and wheat farming, particularly in the emerging scenario of climate change and food-shortages. It therefore advocates concerted administrative and institutional policies and initiatives for promotion of millet farming of all varieties, their widespread consumption and all-round marketing.

7. FINDING AND CONCLUSION

Millets have emerged as a sustainable solution to address food and nutritional security among tribal communities, Because of their low water requirement, highly resilient to extreme weather conditions, tolerant high temperatures, poor soils, and adaptability to climate change make them an ideal crop for tribal communities .Millets provides highly nutrition's and compounds, such as proteins, dietary fiber, vitamins, and minerals like calcium, iron, and zinc, which is offer multiple health benefit for all and can prevent the malnutrition, to overcome food scarcity in difficult periods and contributing to the food and nutritional security.

8. AUTHOR(S) CONTRIBUTION

The writers affirm that they have no connections to, or engagement with, any group or body that provides financial or non-financial assistance for the topics or resources covered in this manuscript.



9. CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

10. PLAGIARISM POLICY

All authors declare that any kind of violation of plagiarism, copyright and ethical matters will take care by all authors. Journal and editors are not liable for aforesaid matters.

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