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Finger Millet For The Next Generation Climate Smart Agriculture

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Abstract:

Finger millet *(Eleusine coracana*) is a hardy, climate-smart crop that can help tackle global food security and environmental challenges. It thrives in harsh conditions, needing little water and growing well in poor soils, making it ideal for regions affected by climate change. This nutrient-rich grain is high in calcium, iron, fiber, and essential amino acids, helping fight malnutrition. It also benefits soil health and can be stored for long periods, ensuring food availability during droughts. To maximize its potential, efforts should focus on developing better varieties, improving farming and processing methods, and creating strong market connections. Promoting finger millet supports sustainable agriculture and a more food-secure future.

Keywords: Finger millet, climate smart agriculture, food security, sustainability, malnutrition, resilient crops.

1. Introduction:

Finger millet (*Eleusine coracana*) is a resilient cereal crop cultivated in arid regions of Africa and Asia. It demonstrates high resistance to drought, pests, and poor soil conditions, making it a crucial component of climate-smart agriculture (CSA) (Upadhyaya et al., 2007). This crop aligns with CSA's primary objectives by enhancing food security, increasing climate resilience, and reducing greenhouse gas emissions. Finger millet is rich in essential nutrients, including calcium, iron, and fiber, which can help combat malnutrition, particularly in vulnerable populations (Devi et al., 2014). Its capacity to grow with minimal inputs makes it well-suited for areas experiencing climatic and economic challenges. Additionally, finger millet contributes to soil health, decreases dependence on chemical fertilizers, and supports diversified farming systems within CSA. However, it is not widely grown due to limited research, low consumer awareness, and weak market connections (Pradhan *et al*., 2010). Expanding its use in

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CSA requires better research, supportive policies, and farmer training.

This paper highlights finger millet's adaptability, environmental benefits, and nutritional value, stressing the need for focused efforts to maximize its role in climate-resilient farming.

2. Significance of Finger Millet in Climate-Smart Agriculture

Finger millet, an ancient and resilient cereal, is well-suited to cope with the challenges posed by climate variability. Its inherent characteristics make it a valuable crop for enhancing agricultural sustainability in arid and semi-arid regions.

2.1.Adaptation

2.1.1. Drought tolerance

Upadhyaya *et al.* (2007) highlighted the exceptional drought tolerance of finger millet, attributing it to its deep root system, efficient water use, and ability to thrive in low-moisture conditions. This adaptation enables the crop to withstand prolonged dry periods, making it a reliable food source in arid and semi-arid regions. Additionally, its resilience to drought stress contributes to stable yields, supporting food security in regions vulnerable to climate change.

2.1.2. Heat tolerance

Shivran *et al*. (2016) highlighted that finger millets are inherently drought-tolerant and resistant to pests and diseases, making them reliable crops in challenging environmental conditions.

2.1.3. Soil adaptability

finger millet thrives in marginal and dry lands of arid and semi-arid regions, demonstrating adaptability to low rainfall and poor soils. This resilience is attributed to its C4 photosynthetic pathway, which enhances water-use efficiency and allows the crop to perform well under suboptimal soil conditions. (Muthamilarasan and Prasad, 2021)

2.1.4. Pest and Disease resistance

finger millet is known to be protected from diseases for decades, and several blast-resistant lines have been identified in the past 15 years. Additionally, finger millet seeds can resist storage pests for as long as 10 years, ensuring a year-round food supply or even during crop failures, earning it the popular name of 'famine crop. (Devi *et al*., 2014).

2.1.5 Low water and input requirement

Finger millet thrives in areas with 200-500 mm of annual rainfall, requiring minimal water (1,500-2,000 liters per kg) compared to rice. It grows well in dry conditions, poor soils, and needs fewer external inputs than crops like rice, wheat, and maize.

2.2. Mitigation

2.2.1. Role in Climate Mitigation

Finger millet contributes to climate mitigation through its low input requirements, reduced greenhouse gas emissions, and ability

to sequester carbon in its biomass. By integrating finger millet into farming systems, farmers can reduce their ecological footprint while improving climate resilience.

2.2.2. Reduce Greenhouse Gas Emissions

Rice and rice-based production systems exhibited higher carbon footprints and Global Warming Potential compared to other cropping systems. In contrast, millet-based production systems, including finger millet, demonstrated lower energy requirements and reduced Global Warming Potential, making them more sustainable alternatives. (Ghosh *et al*., 2016)

2.2.3. Potential for Carbon Sequestration

Integrating practices such as efficient irrigation, manure application, and water conservation can enhance soil organic carbon in finger millet cultivation, thus contributing to carbon sequestration and improving soil health. (Ekwangu *et al*.,2023)

2.3.Productivity

Finger millet is a nutritious grain packed with calcium, iron, fiber, and important amino acids, making it a great option for addressing malnutrition, especially in regions suffering from climate change-related crop failures (Devi *et al*., 2014). It helps prevent deficiencies in calcium, which can cause bone and teeth problems, and iron, which can lead to anemia. The crop is also tough, able to grow in hot, dry conditions with little water or fertilizer, making it a dependable choice for small farmers in challenging climates. Including finger millet in meals boosts nutrition and supports food security in vulnerable areas.

3. Ecological and socioeconomic benefits

Finger millet farming helps protect biodiversity by preserving traditional crop varieties and supporting natural farming systems, which improve climate resilience by providing genes for stress-resistant crops (FAO, 2019). It also benefits small farmers by creating jobs, ensuring food security, keeping costs low, and boosting rural economies.

4. Challenges in Promoting Finger millet

1. Labor-Intensive Cultivation: Finger millet requires significant manual labor for tasks like transplanting, weeding, and harvesting, which deters farmers.
2. Perception as Low-Status Food: Seen as food for marginalized communities, its consumption, especially among younger generations, is low.
3. Limited Research and Development Support: Neglected in research, leading to a lack of improved varieties with better yields and resistance to drought and diseases.
4. Susceptibility to Pests and Diseases: Vulnerable to pests like stem borers and diseases such as blast, affecting yields.

5. Market Challenges: Finger millet has lower market prices and suffers from traditional milling methods and limited market access.

5. Strategies for Scaling Finger Millet Adoption in CSA

5.1. Development of Climate-Resilient Varieties: Breeding resilient finger millet varieties requires leveraging genetic and genomic tools to enhance tolerance to drought, heat, salinity, and disease resistance (e.g., blast). Techniques like genomic selection and gene pyramiding can expedite the development of these climate-resilient cultivars.

5.2. Promotion of Sustainable Agronomic Practices: Promoting sustainable practices like crop rotation, intercropping, and conservation tillage improves soil health, water retention, and resilience of finger millet to climate variability, while reducing risks of monoculture farming.

5.3. Capacity Building and Extension Services: Capacity Building and Extension Services: Training farmers on climate-smart practices for finger millet, including improved cultivation, pest management, and efficient input use, is crucial to boost productivity in changing climates.

5.4. Policy Support and Market Development: Policy Support and Market Development: Supportive policies, including subsidies, research funding, and market linkages, can promote finger millet cultivation, ensuring fair prices, reducing post-harvest losses, and enhancing economic viability.

6. Future Prospects

Finger millet *(Eleusine coracana*) is a drought-tolerant, highly nutritious crop that thrives in marginal soils with minimal inputs, making it a reliable food source for regions affected by climate change. Its resilience ensures food security, especially in arid areas, and its long shelf life (up to 10 years) helps during crises. With low water and fertilizer needs, it supports sustainable agriculture and soil conservation. Cultivating finger millet offers economic opportunities for smallholder farmers, tapping into growing markets for nutritious grains.

Conclusion

Finger millet offers a transformative opportunity for climate-smart agriculture due to its adaptability to harsh conditions, low input needs, and high nutritional value. It addresses food security, malnutrition, and environmental challenges by enhancing productivity, promoting biodiversity, and mitigating climate change impacts. Supporting farmers with improved varieties, sustainable practices, and strong market linkages will ensure its scalability, making finger millet a key crop for a resilient and food-secure future.

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