NEW ERA AGRICULTURE MAGAZINE

Finger Millet Cultivation: An innovative strategy to alleviate malnutrition

[1]Kshirod Chandra Sahoo, [2]Vipin Kumar

Abstract: -

Finger millet is minor millet having low water requirement crop which can grow in adverse soil condition. It provides higher energy and nutrients like calcium, iron, phosphorus and zinc. It also recognized as miracle crop due to their economic and nutritional value as well as aesthetic properties. It is having gluten free which is taken by all group of consumers in their diet. Millets are resistant to major disease and pest which gives higher production and productivity to growers as compared to other crops. The presence of phenolic compounds in outer layer of graing gives the insect pest resistance characteristics which is included in eco-friendly farming and also prevent erosion in hilly areas. The preferred characteristics attract tourist in muticuisine. Different schemes and incentives provided by state and central government for distributing the products to consumers. To alleviate the malnutrition and feeding the growing population it is regarded as good alternative in long run.

Keywords: Finger millet, nutrients, aesthetic, scheme & malnutrition

Introduction:

Finger millet (*Eleusine coracana*) is a minor millet under family poaceae, also known as ragi with significant nutritional, economic, and ecological benefits. Malnutrition affects millions of people and posing a serious threat to food security. Globally, there are nearly 149 million (21.9%) children are stunted and nearly 45% deaths of children (<5 years) due to malnutrition (Gupta *et. al*, 2020). In india, 15.2% population are undernourished & 38.4% children are stunted. There is 70% and 38% children are deficient in iron and zinc respectively (Das *et. al*, 2016). It is rich in carbohydrate, protein which will improve the nutritional quality of crop. The crop has the ability to grow and extract the micronutrients from insoluble sources (Thapliyal. *et. al*, 2015). Millets are grown from ancient era that

[1]Kshirod Chandra Sahoo, [2]Vipin Kumar
Department of Soil Science, Post Graduate College of Agriculture,
Dr. Rajendra Prasad Central Agricultural University,
Pusa (Samastipur), Bihar, 848125

are used for their nutritional characteristics, high tolerance to abiotic stresses with low cost. Finger millet are gluten free and effective for person affected by celiac disease. Finger millet though low in fat content and substantial polyunsaturated fatty acid conent (Antony *et al*., 1996). The fatty acid which is present in finger millet was palmitic acid and linoleic acid next to oleic acid. Its farming reduces the necessary inputs like chemical pesticides and fertilizers, enhance biodiversity conservation and protects vulnerability of wild species. It is a key component in sustainable agriculture identified by government and policy makers. In global community, to eradicate hidden hunger and nutritional insecurity, millet serves as a durable, nourishing and long-term solutions. The usefulness of millets reduce the risk of cardiovascular disease, prevent cancer, lower blood pressure, delay gastric emptying, limit tumor growth, increase gastrointestinal bulk and slow fat absorption. Different value added products made from millet boost income of farmers by ready-to-eat and ready-to-cook foods. It stimulate production, commercialize the products which ultimately lead to income generation, job development and nutritional security. Finger millet can be taken as alternative crop in today's climate change scenario to tackle hidden hunger and disease proneness. In India the area and production of finger millet is 1.17 million hectares and 1.79 million tonnes respectively. The major states are Karnataka, Maharashtra, Tamil Nadu, Andhra Pradesh, Odisha, Jharkhand, and Uttarakhand accounting more than 90% of production.

Fig.1 Finger millet crop

1. Nutritional Value

⇨ **Rich in Nutrients**: Finger millet is a rich source of vital nutrients, offering high levels of calcium, iron, dietary fiber, and essential amino acids such as methionine. According to research conducted by Vijayakumari *et al.* (2003) finger millet is important source of calcium and iron. Calcium deficiency mainly affect to bone and teeth disorder, iron deficiency leading to anemia can be corrected by taking finger millet in our daily diet. Zinc content of the sixteen varieties of finger millet ranged from 0.92 to 2.55 mg/100 g with a mean value of 1.34 mg/ 100 g (Singh and Srivastava,

2006). The phosphorous content ranged from 130 to 295 mg/kg with a mean value of 180.43 mg/kg (Singh and Srivastava, 2006).

- **Gluten-Free**: Finger millet is inherently free of gluten, making it an ideal choice for those with gluten intolerance or celiac disease. Research has shown that the starches present in finger millet are slowly digested and assimilated than other cereals (Kavitha and Prema, 1995). Finger millet consumption on regular basis reduce the risk of diabetes mellitus (Gopalan, 1981) and gastrointestinal tract disorders (Tovey, 1994). Presence of high polyphenols and dietary fiber contents in millet attribute this property (Chethan *et al*., 2008).
- **High in Dietary Fiber**: Finger millet promotes digestive health, assists in regulating blood sugar levels for diabetes management, and contributes to effective weight control. The grain contain stable radical intermediates which prevent the oxidation of food ingredients, particularly fatty acids and oils (Maillard *et al.,* 1996**).** There is higher total antioxidant capacity of finger, little, foxtail and proso millets and their total carotenoids content g in the millet varieties varies from 78–366 mg/100 g. Total tocopherol content in finger and proso millet varieties were higher (3.6–4.0 mg/100 g) than other millet varieties.
- **Calcium-Rich**: Finger millet contains the highest calcium levels among cereals, which supports strong bones and helps prevent osteoporosis. Research conducted on various location reveals that calcium concentrations ranging from 115.5 to 589.3 mg/100g among different genotypes, with some exception upto 1,400 mg/100g. The consistently high calcium levels make finger millet approximately 10 times richer than rice, wheat, or maize, and three times higher than milk.

Nutritional Information

Finger Millet	
Nutrients	Per 100g
Protein (g)	8
Carbohydrate (g)	70
Fat (g)	1
Minerals (g)	2.5
Fibre (g)	3.2
Calcium (mg)	348
Phospborous (mg)	280
Iron (mg)	4
Energy (kcal)	338
Thaimin (mg)	1.3
Niacin (mg)	0.9
Approximate Values	

Fig.2 Nutritional Value of Finger millet

- **Miracle grain:** It is having nutritional profile in terms of micronutrient

concentration, gluten-free status, presence of phytochemicals, resistant starch, fiber content and medicinal benefits. Various health benefits such as antidiabetic, antioxidant and anticancer effects, which have been recognized due to partial retention of phytates (Thompson, 1993).

2. **Economic Value**

- **Low Input Costs**: Compared to other cereal crops, finger millet demands significantly less investment in fertilizers, pesticides, and irrigation. According to research in India's Bastar district showed cultivation costs of Rs. 33,336.02 per hectare which is significantly lower than major cereals like rice and wheat. Seeds represent only 1.73% of total cultivation costs.
- **Resilience to Adverse Conditions**: Finger millet's drought tolerance and adaptability lower the risk of crop failure, providing farmers with more consistent and reliable yields. It demonstrates outstanding drought, heat and temperature tolerance making it invaluable for arid and semi-arid regions. The crop can survive extended periods of water deficit, with some genotypes showing remarkable recovery even after severe stress. Research has identified specific varieties like PR202 and ML-365 as particularly drought-tolerant, capable of maintaining productivity even under water-stressed conditions. It may be due to enhanced antioxidant property, C4 mechanism and osmotic adjustment.
- **Affordable Staple Food**: As a resilient and nutrient-dense crop, finger millet plays a vital role as a staple food in economically challenged areas. In eastern & south Africa and some parts of asia, it consumed as staple food due to non availability of major cereal crops. In India, mostly it is taken as important crop in states like Karnataka, Tamil nadu, Madhya Pradesh, Jharkhand, Odisha, Bihar and parts of Uttar Pradesh.
- **Local Markets**: In areas where finger millet is commonly consumed, it stimulates local trade and economic activity. Studies reveal that 92.5% of finger millet farmers prefer direct selling to local consumers, indicating strong local market connectivity which ensure reducing intermediary cost maximizing their income.
- **Tourism and Cuisine**: Culinary tourism is boosted by traditional finger millet dishes, enhancing its economic significance. It is now growing from

indigenous tribal cuisines to contemporary restaurant menus. It become central to authentic culinary experiences that showcase regional food heritage. In Arunachal Pradesh's Chug Valley, the Monpa community has revitalized their traditional kongpu (finger millet) cuisine through innovative tourism initiatives. In, Karnataka Tourism officially promotes Ragi Mudde as a signature cultural dish, offering tourists an authentic taste of traditional South Indian cuisine. In Jharkhand, Ajam Emba restaurant in Ranchi serves as the state's only establishment dedicated to indigenous tribal cuisine, featuring madua (ragi) momo made from finger millet flour that combines traditional nutrition with contemporary appeal.

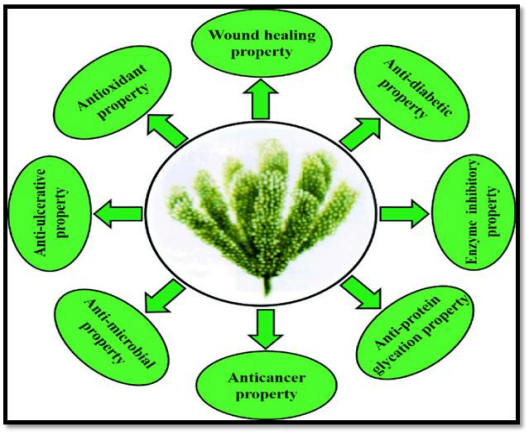

Fig.3 Aesthetic value of Finger millet

3. Ecological Value

- **Short Growth Cycle**: Finger millet's short growth cycle allows it to flourish even under irregular rainfall conditions. Different varieties developed which are having less than 4 months duration (near about 110 days) which can be easily grown under resource poor condition suitable for cropping system.
- **Resistance to insect-pest**: Seetharam and Ravikumar (1994) indicated that the resistance to fungal attack properties in finger millet grain due to tannins and phenolics content of grain. It also act as a physical barrier to the fungal invasion. The seed coat helps in preventing the fungi and bacteria growth. The inherent natural resistance contributes significantly to lower input costs compared to other cereals that require regular pest management interventions.
- **Low Water Requirement:** Finger millet is exceptionally drought-resistant, making it well-suited for areas with scarce rainfall. The crop requires only 350-500 mm of water during its entire growth cycle, significantly less than rice (100-300 cm) or wheat, reducing irrigation costs substantially.
- **Eco-Friendly Farming**: Growing finger millet supports sustainable

farming by lowering expenses linked to low resources utilization. It is having environment friendly due to low Water Usage & Climate Resilience, Reduced Carbon Footprint & Soil Health and Biodiversity Enhancement. It can thrives in drought-prone and marginal areas, requiring minimal irrigation compared to rice or wheat. Millets generally have a lower carbon footprint than other staple crops which leads to reduced greenhouse gas emissions and conservation of water resources. It can be grown in mixed cropping systems with legumes or other cereals, supporting biodiversity and minimizing pest outbreaks.

- **Prevention of Erosion**: Finger millet's thick, fibrous roots help anchor the soil, minimizing erosion on hillsides and slopey land. Finger millet improves soil health with its deep root system, preventing erosion and fostering soil structure.
- **Minimal Use of Chemicals**: Finger millet can be grown with minimal reliance on synthetic fertilizers and pesticides, thereby decreasing environmental pollution. Major cereals exhibit low nitrogen use efficiency and utilize only half of applied fertilizers but finger millet responds favourably to low soil nutrient status. The crop can produce quality grain even in nitrogen deficient conditions, reducing fertilizer dependency and associated costs.
- **Diverse Varieties**: Cultivating finger millet supports the conservation of diverse traditional and local varieties, enhancing agricultural biodiversity. The varieties having Ca, Fe rich and Zn biofortified which increases the biodiversity of varieties. . Biofortified varieties such as CFMV 2 contain 39.0 mg/kg iron, while Ethiopian NAROMIL 3 was specifically developed as a high-iron variety for addressing iron deficiency anaemia. For example germplasm lines FM 2085, FM 2079, and FM 1986 with consistently high iron content exceeding 70 mg/kg. Zinc concentrations range from 0.4 to 25.3 mg/100g among different varieties. The CFMV 2 biofortified variety contains 25 mg/kg zinc.
- **Support for Pollinators**: Flowering finger millet plants offer shelter and nourishment for pollinators such as bees. Millet cultivation in general, including finger millet, can contribute to ecosystem health by providing flowering plants that attract bees and other pollinating insects, potentially

offering some indirect support for pollinators on a landscape level. Self pollination mainly attributed by the bees by growing finger millet.

- **Resilience to Temperature Extremes**: Finger millet can endure high temperatures, making it well-suited for cultivation in regions affected by global warming. Normally it can grow in temperatures of about 27–32°C but certain genotypes exhibit improved tolerance under higher temperature stress and may maintain yield better than standard varieties.
- **Health Benefits**: Various value added products made from finger millet like flour, malt, snacks, and beverages, creating additional income streams for farmers. It is also consumed to recover from anemia, prevents from osteoporosis, controls liver disorders, blood pressure, cardiovascular diseases and asthma (Ramashia *et al*., 2019). Cancer, diabetes, osteoporosis, and neurological diseases can be prevented by diets high in plant polyphenols. According to Rao and Muralikrishna**,** Millet contains glycoside compounds, protocatechuic acid in the form of ferulic acid which bound with phenolic compounds.

Government and Institutional Support

1. **Subsidies and Incentives**: Many governments and organizations promote finger millet cultivation as part of food security and climate-resilient agriculture programs.

Different schemes and incentives are:

I. **National Food Security Mission – Nutri Cereals:** Finger millet is included under the Sub-Mission on Nutri-Cereals that includes cluster demonstrations, high-yielding seed distribution, modern farm machinery, efficient water-use equipment, plant protection inputs, soil health enhancement, and farmer training.

II. **Pradhan Mantri Rashtriya Krishi Vikas Yojana (PM RKVY):** States can promote millets using these funds to support crop diversification and adopt improved practices. The scheme has an ₹8,500 crore budget for 2025–26.

III. **Production Linked Incentive Scheme for Millet-Based Products (PLISMBP):** It support micro, small, and medium enterprises producing millet-based that it contains 15% millet in Ready-to-Eat and Ready-to-Cook products It also provides incentives based on sales growth and encourages domestic sourcing of millet. It launched for FY 2022-23 to FY 2026-27 with ₹800 crore outlay.

IV. **Agricultural and Processed Food Products Export Development Authority (APEDA):** It promotes millet exports and market linkage internationally. It has an allocation of ₹80 crore for 2025–26 and supports exporters through dedicated forums and online portals.

V. **State-Level Initiatives and Farmer Producer Companies:**

- Different programs like the Odisha Millet Mission (OMM) which enhance improved cultivation practices such as the System of Millet Intensification.
- Minimum Support Price (MSP) for finger millet is announced to ensure fair income for farmers. Formation of Farmer Producer Companies which provide inputs like seed, organic input and helps in market linkage for sale of products.

2. **Market Linkages**: Better market access provided by cooperatives and NGOs increases farmers' earnings from cultivating finger millet. It includes the district coordinators and other users by transport mechanism to deliver the product to end users. Specialized millet portals (e.g., Millets Hub) connecting bulk buyers, food processors and exporters. e-NAM (National Agriculture Market) integrates state mandis for electronic bidding and nationwide allocation of the product. Agricultural Produce Market Committees (APMC): Physical auction floors where traders bid competitively; linked to Minimum Support Price (MSP) procurement during procurement windows. Suitable mobile based apps providing real-time market prices, buyer leads, and digital payment settlement. Farmer Producer Organization (FPO) are formed to promote the marketing of products and their accessibility at ground level.

Conclusion:

The United Nations General Assembly declared 2023 as the " International Year of Millets". India increase the millet production during its G20 leadership. Finger millet provides minerals like iron, zinc & calcium. Different foods can be made from millets like ready to serve and processed food products which gives nutritional value and sustain food security. It is good alternative crop as it requires less nutrient and water as compare to other cereals. It can also tolerant to disease and pest. Studies show benefit-cost ratios ranging from 1.05 to 2.15 across different cost categories. So, it is cost effective, environment friendly and sustainable solution to eradicate the problems in arid to semi-arid regions of India. Millets are organic grains which will bring agricultural security. It also appear to hold considerable promise for nutrition and

food security in the pace of growing global population, climate change scenario and raising agricultural expenses.

Reference:

1. Antony U, Sripriya G, Chandra TS (1996). Effect of fermentation on the primary nutrients in finger millet (*Eleusine coracana*). J. Agric. Food Chem., 44: 2616-2618
2. Chethan S., Sreerama Y.N., Malleshi N.G. (2008) Mode of inhibition of finger millet malt amylases by the millet phenolics. Food Chem. 111:187–191
3. Cuvelier M.E., Richard H., Berset C. (1992) Comparison of the antioxidative activity of some acid–phenols: structure activity relationship. Biosci. Biotechnol .Biochem. 56(2):325
4. Das, S., & Green, A. (2016). Zinc in crops and human health. *Biofortification of food crops*, 31-40.
5. Gopalan C. (1981) Carbohydrates in diabetic diet. India: Bulletin of Nutrition Foundation p3
6. Gupta, O. P., Pandey, V., Narwal, S., Sharma, P., Ram, S., & Singh, G. P. (Eds.). (2020). *Wheat and barley grain biofortification*. Woodhead Publishing.
7. Gull, A., Jan, R., Nayik, G. A., Prasad, K., and Kumar, P. (2014). Significance of finger millet in nutrition, health and value added products: a review. *J. Environ. Sci. Comput. Sci. Eng. Technol.* 3, 1601–1608.
8. Kavitha M.S., Prema L. (1995) Post prandial blood glucose response to meals containing different CHO in diabetics. Indian J. Nutr. Diet 32:123–126
9. Kumar, A., Babu, C. G., Reddy, V. C., and Swathi, B. (2016a). Anti-nutritional factors in finger millet. *J. Nutr. Food Sci.* 6:491.
10. Maillard M.N., Soum M.H., Boivia P., Berset C. (1996) Antioxidant activity of barley and malt: relationship with phenolic content. L.W.T. Food Sci. Technol. 3:238–244
11. Pradhan, A., Nag, S. K., and Patil, S. K. (2010). Dietary management of finger millet controls diabetes. *Curr. Sci.* 98, 763–765. doi: 10.1017/S0007114510002977
12. Ramashia, S. E., Anyasi, T. A., Gwata, E. T., Meddows-Taylor, S., & Jideani, A. I. O. (2019). Processing, nutritional composition and health benefits of finger millet in sub-saharan Africa. *Food Science and Technology*, *39*, 253-266.
13. Rao MVSSTS, Muralikrishna G (2001) Non-starch polysaccharides and bound

phenolic acids from native and malted finger millet (ragi, Eleusine coracana, Indaf-15). Food Chem 72:187–192

14. Sarita, and Singh, E. (2016). Potential of millets: nutrients composition and health benefits. *J. Sci. Innov. Res.* 5, 46–50.
15. Seetharam A., Ravikumar R.L. (1994) Blast resistance in finger millet— its inheritance and biochemical nature. In: Riley K.W., Gupta S.C., Seetharamn A., Mushonga J.N. (eds) Advances in small millets. International Science Publisher, New York, pp 449–465
16. Shibairo, S. I., Nyongesa, O., Onwonga, R., and Ambuko, J. (2014). Variation of nutritional and anti-nutritional contents in finger millet (*Eleusine coracana* (L.) Gaertn) genotypes. *IOSR J. Agric. Vet. Sci.* 7, 6–12. doi: 10.9790/2380-071110612
17. Shukla, A., Lalit, A., Sharma, V., Vats, S., and Alam, A. (2015). pearl and finger millets: the hope of food security. Pearl and finger millets: the hope of food security. *Appl. Res. J.* 1, 59–66.
18. Singh P., Srivastava S. (2006). Nutritional composition of sixteen new varieties of fingermillet. J. Community Mobilization Sustainable Dev., 1(2): 81-84.
19. Thompson L.U. (1993) Potential health benefits and problems associated with antinutrients in foods. Food Res. Int. 26:131–149
20. Tovey F.I. (1994) Diet and duodenal ulcer. J. Gastroenterol Hepatol. 9:177–185
21. Thapliyal, V., & Singh, K. (2015). Finger millet: potential millet for food security and power house of nutrients. *International or Research in Agriculture and Forestry*, *2*(2).
22. Vijayakumari J., Mushtari Begum J., Begum S., Gokavi S. (2003) Sensory attributes of ethinic foods from finger millet (*Eleusine coracana*). Recent Trends in Millet Processing and utilization. In: Proceeding of National Seminar on Processing and Utilization of Millet for Nutrition Security held on October 7-8,2003 organized under RNPSI (NATP) at CCSHAV, Hisar. pp. 7-12.