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Millets are "Smart Food"

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Millets were among the first plants to be domesticated and serve as a traditional staple crop for millions of farmers in Sub-Saharan Africa and Asia. According to Food and Agriculture Organisation (FAO) of the United Nations, millets encompass a diverse group of cereals including pearl, proso, foxtail, barnyard, little, kodo, browntop, finger and guinea millets as well as fonio, sorghum (or great millet) and teff.

Millets are called "Nutri-Cereals" due to their high nutritional content compared to commonly grown cereals like wheat, rice or corn. Besides, being gluten free and energy dense (source of protein, fat and carbohydrates) millets are rich in minerals (iron, zinc, calcium, phosphorus, magnesium etc.), vitamins and antioxidants. Millets are a rich source of sulphur containing amino acids (methionine and cysteine) that are low in pulses. Hence, millets complement pulses (good source of the amino acid lysine. Lysine is low in millets), to provide balanced and sustainable diets, especially to the underprivileged communities. Thus, millets have the potential to contribute to both human and animal health. Specifically, millets have the potential to be used in developing nutritious food products to address both malnutrition and lifestyle diseases. Millets are the right choice along with pulses to be included into nutritional intervention/community and school feeding programs to address the intergenerational cycle of malnutrition. The ongoing nutritional intervention initiative, being undertaken by International Crops Research Institute for the semi-arid tropics (ICRISAT) titled "Giri Poshana for Particularly Vulnerable Tribal Groups (PVTGs)", using nutritious millet-pulse based food products involving children, adolescent girls, pregnant women, and lactating mothers from tribal communities in Telangana State, India is one such example of mainstreaming millets into local food systems, to promote food and nutritional security.

"Smart Food" is a Global initiative conceived and led by the ICRISAT, along with its partners in Asia and Africa. "Smart Food" is food that fulfils 3 major criteria: "good for you", "good for the planet" and "good for the farmer.

Millets are "good for you", scientific evidence[1] generated by ICRISAT along with Harvest Plus show that millets have nutritional and health benefitting potential, towards: a) reducing iron deficiency anaemia by improving haemoglobin levels. It is important to highlight that ICRISAT has also developed and released the first iron and zinc bio-fortified (iron 70–75 mg kg^{-1} and zinc 35–40 mg kg^{-1}) variety of pearl millet, 'Dhanashakti', in India[2] b) managing & reducing the risk of developing diabetes, as millets are rich in dietary fiber, and have higher amounts of slowly digestible starch (low glycaemic index-GI) c) delaying gastric emptying time and helping in managing blood lipid profile levels d) increasing the calcium retention in humans, thereby having potential in addressing calcium deficiencies. Finger millet is a rich source of calcium. Millets are also a good source of prebiotics and probiotics[3], and hence beneficial for promoting gut health.

Millets are "good for the planet", as they contribute to environmental sustainability. Environmental sustainability, especially with respect to agricultural practices directly relates to choice of alternative and climate resilient crops. These climate resilient crops ideally should: produce less greenhouse gases, must be less resource-intensive, and should

1. Grando, S., Anitha, S., Tabo, R., Tsusaka, T., Givens, I., Madzivhandila, T., eds. (2022). Smart Food for Healthy, Sustainable and Resilient Food Systems. Lausanne: Frontiers Media SA. doi: 10.3389/978-2-88976-263-7
2. Govindaraj, M.; Rai, K.N.; Cherian, B.; Pfeiffer, W.H.; Kanatti, A.; Shivade, H. Breeding Biofortified Pearl Millet Varieties and Hybrids to Enhance Millet Markets for Human Nutrition. Agriculture 2019, 9, 106. https://doi.org/10.3390/agriculture9050106
3. Kunchala, R., Banerjee, R., Mazumdar, S. D., Durgalla, P., Srinivas, V., & Gopalakrishnan, S. (2016). Characterization of potential probiotic bacteria isolated from sorghum and pearl millet of the semi-arid tropics. African Journal of Biotechnology, 15(16), 613-621.

be a good source of macro and micronutrients and having other health benefitting properties required for our well-being. Millets have most of the desirable attributes as mentioned when compared to other major crops (e.g., wheat, rice and maize). Millets are C4 crops; i.e., they have the higher capacity to fix carbon from carbon dioxide in the atmosphere, especially under high temperatures and low transpiration rates. Further, research has shown that millets release less greenhouse gases, which is beneficial in reducing the contributions of the agri-food sector to global warming[4]. The maximum Carbon equivalent emission(CEE)[5] reported[6], for different crops show that millets have the lowest CEE (878 kg C ha-1), followed by sorghum with 916 kg C ha-1. The highest CEE reported for wheat and rice are 4900 kg C ha-1 and 4600 kg C ha-1, respectively. Furthermore, different predictive models have inferred that climate change (elevated temperatures and increased level of carbon dioxide), would reduce production of major cereal crops, except for millets due to their ability to grow in variable climatic conditions and ability to efficiently use carbon dioxide.

Millets are ''good for the farmer" as millets are hardy cereal crops (tolerant to biotic and abiotic stresses) with short growth periods that are roughly between 70–120 days, depending on the variety. Millets are drought-tolerant crops, requiring comparatively less amount of water as compared to rice and wheat and can be grown under a wide range geographical conditions, especially in the semi-arid regions. Millets can grow on soils with little inputs, are relatively more resistant or tolerant to many crop diseases and pests, as compared to wheat and rice, and can survive adverse climatic conditions. Thus, being climate smart - ability to survive drought and extreme temperatures, needing less fertilizer and pesticides (less resource intensive) and potential to increase yields, multiple uses - food, fodder, brewing, biofuels etc., millets are "good for the farmer".

The genetic diversity of millets offers opportunities for economic development through income generating activities in the food sector or in niche markets for specific industrial applications (therapeutics, pharmaceuticals, specialty chemicals etc.). The ICRISAT Genebank established in 1979 at Hyderabad, India serves as a world repository for the collection of germplasm for millets: sorghum, pearl millet, finger millet, foxtail millet, little millet, kodo millet, proso millet and barnyard millet. This collection of the millet germplasm is an opportunity, for the different stakeholders especially the private sector food and food ingredient industry, to discover various nutritional, nutraceutical, and functional ingredients, while leveraging the climate-smart and sustainable nature of millets.

In summary, given the International Year of Millets 2023 (IYM23), provides the right opportunity to promote millets for crop diversification, especially in the regions where food insecurity prevails, as a way forward towards ensuring climate resilient and sustainable nutri-sensitive food systems. Further, appropriate policy support to promote creation of "demand pull" for millets through development and creation of value addition infrastructure and machinery, to be owned and run by smallholder millet farming communities, especially women and youth; providing handholding and business incubation support to promote millet-based entrepreneurship, capacity building in the areas of millet processing, food safety regulations and guidelines and creating awareness on the nutritional and health benefits of millets is critical to mainstream millets in a sustainable manner, beyond IYM23.

Website: www.icrisat.org

(Views are personal)

4. N. Jain, P. Arora, R. Tomer, Shashi Vind Mishra, A. Bhatia, H. Pathak, D. Chakraborty, Vinod Kumar, D.S. Dubey, R.C. Harit, J.P. Singh, Greenhouse gases emission from soils under major crops in Northwest India, Science of The Total Environment, Volume 542, Part A,2016, Pages 551-561, ISSN 0048-9697, https://doi.org/10.1016/j.scitotenv.2015.10.073
5. Carbon equivalent emission (CEE - kg Carbon hectare-1) is a measure of total carbon equivalents calculated based on the Global warming potential (which is the CO2 equivalents).
6. Wang, Jin; Vanga, Sai Kranthi; Saxena, Rachit; Orsat, Valérie; Raghavan, Vijaya. Effect of Climate Change on the Yield of Cereal Crops: A Review, Climate, 2018, Volume 6, https://doi.org/10.3390/cli6020041