Strengthening Food and Nutritional Security: Strategic Promotion of Underutilized Crops

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ABSTRACT

India, recognized as a global biodiversity hotspot, harbors immense biodiversity. Its diverse agro-climatic zones foster immense plant genetic resources, including a wide range of underutilized crops with high nutritional, ecological, and economic value. These crops often resilient to climatic stresses offer sustainable solutions for food, nutrition, and livelihood security. However, they remain neglected due to limited awareness, market access, and research focus. Strategic measures such as crop diversification, utilization of wild species, biotechnology-driven improvement, conservation through community participation, and value addition are crucial for their promotion. Strengthening institutional collaboration and supportive policies will enable integration of these crops into mainstream agriculture, enhancing climate resilience, dietary diversity, and rural income while contributing to Sustainable Development Goals (SDGs).

INTRODUCTION: India's Biodiversity: A Global Stronghold

India is among the world's 17 megadiverse nations, harboring approximately 7–8 percent of global biodiversity within only 2.4 percent of the Earth's land area, and supporting about 18 percent of the global human population (MoEFCC, 2018; Bawa *et*

al. 2018). India is one of the eight Vavilovian centers of origin for crop plants and possesses immense genetic diversity across a wide range of species, including cereals, millets, fruits, vegetables, pulses, condiments, fiber crops, and oilseeds (Gupta *et al*. 2019).

The IUCN Red List identifies over 76,864 species with different categories of threat status viz., EX - Extinct (141), EW - Extinct In The Wild (46), RE - Regionally Extinct (regional category) (0), CR - Critically Endangered (6,445), EN - Endangered (12,707), VU - Vulnerable (10,596), LR/cd - Lower Risk: Conservation Dependent (108), NT or LR/nt - Near Threatened (4,772), LC or LR/lc - Least Concern (35732), DD - Data Deficient (6,317). Within India, 3,611 are listed in threatened categories according to the IUCN Red List, with EXt (3), EW (2), RE (0), CR (159), EN (292), VU (249), LR/cd (1), NT or LR/nt (113), LC or LR/lc (2474) and DD (318) (https://www.iucnredlist.org/). The biodiversity wealth of India is underscored by the presence of four out of the world's 35 global biodiversity hotspots: The Himalayas, Indo-Burma, Sundaland, and the Western Ghats (Jaisankar *et al*. 2018).

Status and Diversity of Underutilized Crops

Underutilized crops are critically important for sustainable agriculture and food security, particularly in regions where mainstream crops may not thrive. These crops are typically rich in micronutrients, vitamins, minerals, and antioxidants, offering superior nutritional benefits compared to staple crops. Many underutilized crops are resilient to various biotic and abiotic stresses, making them valuable for climate adaptation and resource-poor settings. Additionally, by cultivating and promoting underutilized crops, local economies can benefit from new income opportunities and improved livelihoods through the commercialization of these species.

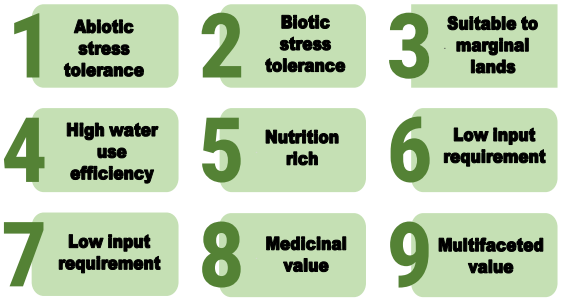

Figure 1. Important features of underutilized crops

India stands as a global center of floristic and economic plant diversity, with a rich heritage in horticultural species such as fruits, vegetables, spices, ornamentals, and medicinal plants, cultivated at both species and intra-specific levels (Figure 2). Approximately 583 species are cultivated across the country, with around 417 belonging specifically to horticultural crops. India's remarkable diversity extends to underutilized fruits, vegetables, plantation crops, and spices, each accompanied by a substantial number of wild relatives. Despite this wealth, only few species, are cultivated commercially, while hundreds of other species remain underutilized and are often confined to specific regions, primarily used by local populations as minor fruits or for medicinal purposes. Some of the underutilized species are listed below

Pseudo-cereals: *Amaranthus* sp., *Fagopyrum* sp., *Chenopodium* sp.

Minor Cereal: *Coix lacryma*

Vegetables: *Momordica dioica*, *Citrullus lanatus*

Oil Seed Crops: *Perilla frutescens, Simarouba glauca, Citrullus colocynthis, Jatropha curcas, Simmondsia chinensis*

Legumes: *Abrus precatorius, Acacia auriculiformis, Afzelia africana, Albizia lebbeck, Bauhinia purpurea, B. malabarica, Canavalia ensiformis, C. gladiate, Cassia hirsuta, Entada rheedii, E. phaseoloides, Erythrina stricta, Flemingia strobilifera,*

Indigofera arrecta, Lablab purpureus, Macrotyloma uniflorum, Mimosa pudica, Mucuna bracteata, M. pruriens, Pachyrhizus erosus, Parkia biglobosa, P. timoriana, P. speciosa, Phaseolus coccineus, P. lunatus, P. acutifolius, Psophocarpus tetragonolobus, Pueraria tuberose, Rhynchosia cana, R. suaveolens, Senna alata, Sesbania grandiflora, Vicia faba, V. sativa, Vigna umbellata, V. subterranean, V. vexillata,

Fruits: *Aegle marmelos, Anacardium occidental*, *Annona muricata*, *Annona* spp., *Artocarpus heterophyllus, A. hirsutus, Averrhoa bilimbi*, *A. carambola*, *Bassia latifolia, Berberis tinctoria*, *Buchanania lanzan*, *Carissa carandas*, *Castanea* spp., *Citrus maxima*, *Cordia dichotoma, C. myxa, Diospyros melanoxylon*, *D. peregrine, Emblica officinalis, Elaeagnus conferta, Elaeocarpus tectorius, Eriobotrya japonica, Flacourtia indica, F. montana, Feronia limonia, Ficus carica, Garcinia gummi-gutta, G. indica, G. mangostana, G. xanthochymus, Grewia subinaequalis, Manilkara achras, Mimusops elengi, Moringa oleifera, Morinda citrifolia, Morus* spp., *Nephelium lappaceum, Olea europaea, Opuntia ficus-indica, Passiflora edulis, Persea americana, Phoenix sylvestris*, *Phyllanthus acidius*, *Pithecellobium dulce, Rhodomyrtus tomentosa*, *Rubus ellipticus*, *R. racemosus*, *Spondias dulcis, Syzygium caryophyllatum, S. jambos, S. cumini, Tamarindus indica, Terminalia catappa, Trapa bispinosa*, *Vaccinium oxycoccos, Ziziphus jujube*, *Z. mauritiana*

Figure. 1. Representative images of few underutilized crops (seeds)

Strategic Measures for Promoting Underutilized Crops

- **Diversifying Crops Beyond the Major Crops**: Over-dependence on a few staple crops such as rice, wheat, and maize must be reduced. There is a critical need to reorient cropping systems toward climate-resilient and nutrient-dense alternatives such as minor millets—barnyard millet, foxtail millet, kodo millet, little millet, and finger millet. Crop systems should be reoriented to address climate change by encouraging the cultivation of climate-resilient, micronutrient-rich cereals. Above mentioned minor millets hold immense potential due to their nutritional value, ecological benefits, and economic security for farmers. These hardy crops are nutritionally rich, require less water, and thrive well in marginal soils, contributing to sustainable food systems and climate adaptation (SDG 13). They support livelihood security (SDG 1) and nutrition improvement (SDG 3), while also promoting soil health and biodiversity (SDG 15). However, challenges remain in palatability and consumer acceptance. Research in food science and nutrition should focus on improving taste, reducing bitterness, and enhancing texture, thereby making millet-based foods more appealing to modern consumers. Value-added products such as millet snacks, ready-to-cook mixes, and fortified foods can bridge the gap between traditional wisdom and contemporary demand.

- **Exploring and Utilizing Wild and Underutilized Species:** The rising wave of "Green Consumerism" and demand for diverse, plant-based diets create opportunities for the revival of wild and neglected crops. These underutilized species serve as "poor man's vegetables" but are in fact nutrient-rich, resilient, and medicinally valuable.

- **Introducing New Crop Species:** Introducing novel crops adapted to diverse climatic and nutritional needs is crucial. Continuous efforts should be made to identify and introduce other such valuable crops.

- **Harnessing Biotechnology and Agronomy for Improvement:** Advanced breeding techniques are essential for improving underutilized crops by manipulating reproductive systems to enhance desired traits. Identifying genes responsible for specific beneficial traits will accelerate crop improvement. Creating comprehensive genomic maps, particularly for small millets, will aid in precision breeding and conservation efforts. Employing molecular markers can speed up domestication by enabling targeted selection of traits related to yield, nutritional quality, and climate resilience.

- **Conservation Strategies and Community-Centric Approaches:** Conservation of underutilized crops must combine *ex situ* (gene banks, seed vaults) and *in situ* (on-farm and community-managed systems) conservation strategies. Community-based on-farm conservation empowers local farmers, particularly women, to act as custodians of traditional varieties. Promotion of Participatory Plant Breeding (PPB) ensures relevance of improved varieties to local conditions while retaining adaptive genetic diversity.

- **Value Addition, Processing, and Market Integration:** Underutilized crops often face barriers such as perishability, low yield perception, and limited consumer awareness. Value-addition technologies—including malting, extrusion, fermentation, and micro-milling can convert these into commercially viable products like millet-based snacks, gluten-free flours, and nutraceuticals. Integrating these crops into public procurement and nutritional schemes can bridge market gaps and elevate consumer demand. Collaborative research among food technologists, entrepreneurs, and agricultural scientists will enhance processing efficiency and consumer acceptance.

- **Policy Framework and Institutional Collaboration:** The domestication and promotion of underutilized crops demand an enabling policy ecosystem. Enhanced coordination among different organizations is vital for developing region-specific action plans linking underutilized crops to sustainable development targets.

CONCLUSION

Underutilized crops in India represent a vast and untapped reservoir of genetic, nutritional, and ecological resources critical for national food security, climate resilience, and biodiversity conservation. Strategic measures such as crop diversification, advanced breeding, value addition, inclusive policy frameworks, and community-centered conservation are essential to unlock their full potential. Integration of these crops into mainstream agriculture, research, and market systems will foster sustainable livelihoods, elevate dietary diversity, and support ecological restoration. By harnessing traditional knowledge and scientific innovation, India can achieve significant progress toward a resilient, healthy, and sustainable future rooted in its rich agro-biodiversity.

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