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FROM FORGOTTEN INDIGENOUS CROPS TO INNOVATIVE AND FUTURE FOODS

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Introduction

Food security is no longer defined simply by having enough calories. A sustainable food system must provide diverse, nutritious and affordable foods while remaining functional under increasing climatic pressure. Rising temperature, irregular rainfall, drought and water scarcity are already challenging agricultural production and food access. These conditions have renewed interest in traditional and neglected crops that are adapted to the local environment and broaden the food base (Ali & Bhattacharjee, 2023; Purba & Krishnaswamy, 2025). India possesses a rich diversity of such foods. Fruits including amla, bael, ber, jamun, karonda, tamarind and jackfruit together with traditional vegetables such as drumstick leaves, amaranth, bathua, purslane and colocasia leaves, have long formed part of regional diets. Despite their nutritional and cultural importance, many have received limited attention in modern food systems. Their reintroduction strengthens dietary diversity by creating new opportunities for farmers and food enterprises (Sood *et al.,* 2023; Marappan *et al.,* 2025).

Fig.1: From forgotten crops to future foods through value addition and food technology

Dietary diversity is fundamental to nutritional adequacy. Diets centred on a small number of staple cereals supply energy without providing sufficient amounts of micronutrients, fibre and protective phytochemicals. The FAO–WHO guidance on healthy diets emphasises variety and regular consumption of nutrient-dense foods, taking into account local food availability and cultural preferences (FAO & WHO, 2024). Traditional fruits and vegetables can provide vitamin C, carotenoids, folate, potassium, fibre and diverse phytochemicals making them useful components of strategies to reduce micronutrient deficiencies. Climate change adds another dimension to this issue. Environmental stress affects foods are production, prices and availability, by influencing dietary choices. Studies from India indicates rising temperatures are associated with reduced dietary diversity among children aged 6–23 months, although the magnitude varies by season, age and household circumstances (Rajkhowa & Chakrabarti, 2024). Therefore, climate resilience should be considered for maintaining crop yields but also in maintaining access to nutritionally diverse foods.

Why Underutilized Crops Deserve a Second Look

Agricultural production has increasingly focused on a major staple, *viz.*, rice, wheat and maize. These crops are indispensable, but excessively dependent on a narrow crop portfolio increases exposure to climatic and biological disturbances. Introducing locally adapted crops along with major staples can distribute production risks and provide alternative sources of food and income (Ali & Bhattacharjee, 2023; Shafiq *et al.,* 2025). Millets, sorghum, amaranth, cowpea and many other traditional crops have particular interest as some grow under heat, limited moisture and relatively poor growing conditions. Plants associated with semi-arid regions are valuable for exploring food production strategies suited to water-limited environment (Joshi *et al.,* 2023). Recent studies indicate that neglected and underutilized crops support dietary diversity, livelihood opportunities and climate adaptation when they are integrated with appropriate production and market strategies (Purba & Krishnaswamy, 2025; Shafiq *et al.,* 2025). Traditional fruits represent a largely untapped resource. Amla, jamun, ber, bael, karonda, wood apple, tamarind and jackfruit contain a range of nutrients and bioactive compounds and can be converted into products with greater shelf life and market value (Marappan *et al.,* 2025). The Himalayan region similarly harbours fruits viz., sea buckthorn, kafal, hisalu, kilmoṛa, timla, bedu, wild apricot and Himalayan wild pear. These species are associated with local food traditions and valuable components of regional plant diversity (Deepika *et al.,* 2024). Traditional leafy vegetables also deserve greater attention. Drumstick

leaves, amaranth, purslane, colocasia leaves, ivy gourd and basella expand dietary choices and make better use of locally available plant resources.

Nevertheless, underutilized does not automatically mean superior. A crop must be assessed for its nutritional composition, environmental adaptability, resource requirements, postharvest stability, affordability, consumer acceptance and commercial feasibility. The objective should be selective mainstreaming of promising crops rather than promoting underutilization status alone as evidence of value (Purba & Krishnaswamy, 2025; Marappan *et al.,* 2025). This approach fits the concept of sustainable diets. Food production and consumption influence land, water, resource use and greenhouse-gas emissions. Increasing the share and diversity of plant-based foods supports environmental objectives, when production and supply chains are appropriately managed (Wadi *et al.,* 2024).

From Underutilized to Value-Added

Nutritional potential alone cannot bring a neglected crop into the mainstream. Many traditional fruits are seasonal and highly perishable, limiting their availability and increasing the risk of postharvest loss. Food processing can overcome these constraints by converting them into stable, convenient and marketable products (Marappan *et al.,* 2025). Amla can be developed into beverages, powders and dried products; bael into beverages and fruit-based snacks; tamarind into sauces, beverages and confectionery; and jackfruit into flour and convenience foods. Leafy vegetables can be converted into powders and instant formulations. Such products can extend the utilization period of seasonal crops by generating additional value beyond the farm gate. The processing technology must be matched to the characteristics of the raw material. Excessive heating or unsuitable storage can compromise sensitive nutrients and bioactive compounds. Technologies such as freeze-drying, spray drying, controlled dehydration and encapsulation provide opportunities to improve stability while preserving desirable nutritional and functional properties.

Value addition strengthens rural economies. Diversified farms supply several types of raw materials, while small and medium food enterprises convert them into beverages, bakery products, snacks, powders, jams and functional foods (Table 1). The successful mainstreaming of neglected crops nevertheless requires better planting material, production knowledge, postharvest infrastructure, product development, quality assurance, market connections and consumer awareness (Marappan *et al.,* 2025; Shafiq *et al.,* 2025). Thus, food technology provides the link between crop diversity and consumer demand. A nutritionally valuable crop

becomes much more relevant to the future food system when it is transformed into a safe, stable, convenient and appealing product.

Table 1. Selected innovative products developed from traditional and underutilized crops

No.	Underutilized raw material	Innovative product	Technology used	Nutritional/functional significance	Reference
1	Jamun pomace (*Syzygium cumini*)	Antioxidant nutraceutical tablets	Freeze-drying, ultrasound-assisted extraction and direct compression	Converts a fruit-processing by-product into a value-added nutraceutical and utilizes its anthocyanins and other bioactive compounds	Kaur *et al.* (2023)
2	Tamarind seed kernel (*Tamarindus indica*)	Tamarind-kernel fortified functional chocolate	Statistical optimization, ingredient fortification and product characterization	Provides an innovative route for utilizing tamarind seed; the optimized formulation showed enhanced protein, iron, phenolics, flavonoids and antioxidant activity	Verma *et al.* (2025)
3	Custard apple (*Annona squamosa*)	Spray-dried custard-apple pulp powder	Spray drying, maltodextrin encapsulation and response surface optimization	Converts a highly perishable fruit into a stable powder and facilitates retention and utilization of valuable phytonutrients	Shrivastava *et al.* (2021)
4	Bael (*Aegle marmelos*)	Functional bael fruit leather	Controlled dehydration and vacuum packaging	Provides a shelf-stable form of bael containing fruit-derived fibre and bioactive constituents; vacuum packaging supported storage stability	Khanal *et al.* (2023)

These examples illustrate that advanced processing can reposition traditional crops as ingredients for contemporary foods. Importantly, innovation is not necessary to replace traditional resources with exotic raw materials; it can involve re-engineering familiar crops into products suited to modern lifestyles.

Preserving Biodiversity May Begin at the Dining Table

Crop conservation is not limited to seed banks and research stations. It also depends on whether crops continue to be cultivated, traded, prepared and consumed. Traditional foods are embedded in regional cuisines and seasonal practices, carrying knowledge that can disappear when the associated crops are no longer grown. Maintaining demand for traditional fruits, vegetables and pulses can contribute to both food diversity and cultural continuity. Evidence from different food systems indicates that mainstreaming traditional crops can support nutrition, livelihoods and sustainability when the production is connected with suitable value chains and consumer markets (Ngigi *et al.,* 2023; Sood *et al.,* 2023). This gives consumers an important role in conservation. When farmers see sustained demand for a traditional crop, continued cultivation becomes economically meaningful. The pathway can be represented simply as:

Crop diversity → cultivation → value addition → consumer demand → continued production → conservation

In this sense, the kitchen can become an extension of the conservation system. A crop that remains on the plate has a better chance of remaining in the field.

Building a Future Food System from Traditional Resources

The future food system does not require a new generation of crops. Many useful resources already exist within traditional agricultural landscapes. The greater challenge is to connect indigenous knowledge with contemporary science. Plant breeding improves productivity and adaptation, while climate-smart cultivation supports production under changing environmental conditions. Food technology extends the shelf life of seasonal crops, further nutritional and biochemical research identifies their valuable constituents. Product development, quality assurance and consumer education then converts scientific knowledge into commercially viable foods. A practical pathway is:

Farmer diversification → sustainable production → processing → product innovation → nutritional evaluation → market development → consumer acceptance

Such integration is increasingly recognised as essential for realising the contributions of neglected and underutilised crops to nutrition, resilience, and livelihoods (Purba & Krishnaswamy, 2025; Shafiq *et al.,* 2025).

Conclusion

The next nutrition revolution does not require the discovery of new food. It begins by rediscovering foods that have been part of local diets for generations. Indigenous and underutilized crops offer a practical opportunity to connect nutrition, biodiversity, climate adaptation and rural livelihoods. Their successful revival requires more than conservation. Farmers need suitable planting material and production support; processors need appropriate technologies; scientists need to establish nutritional and functional benefits; enterprises need reliable markets; and consumers need products that are affordable, safe and appealing. A resilient food system should be evaluated not only by how much food it produces under drought, heat or erratic rainfall, but also by whether people can access diverse, nutritious, safe and culturally relevant foods. Underutilised crops can contribute to this goal when their nutritional, environmental, and economic potential is fully realised. The task is not simply to preserve forgotten crops. It is to give them a new role in the food system. By combining traditional knowledge with modern food technology, crops once regarded as marginal can become ingredients for innovative products, rural enterprises and healthier diets. The future of food may not always lie in discovering something new; sometimes, it begins with rediscovering what we already have.

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