

## Underutilized Fruit Crops: Nutritional Profile, Conservation Approaches and Emerging Opportunity with Reference to Climate Change

\*Rutuja Dadaso Nale

Ph. D Scholar, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth Rahuri, Ahmednagar, Maharashtra-413722, India

\*Corresponding Author's email: [rutujanale2502@gmail.com](mailto:rutujanale2502@gmail.com)

Underutilized fruit crops represent a significant source of genetic, nutritional, and ecological diversity that remains largely unexploited in mainstream agriculture. Neglected and underutilized species (NUS) are also referred to as underutilized fruit crops. Certain fruit crops such as kair, khejari, lasoda, phalsa, and pilu, often cultivated in the region and utilized by local communities, possess significant potential to enhance global food and nutritional security, especially regarding climate change impacts. These neglected fruits offer several benefits, including hardy nature, high productivity, resistance to abiotic stresses, adaptability to marginal environments, yet they have been primarily ignored because of the worldwide prevalence of a few key crops, limited commercial interest, inadequate research investment, and insufficient policy support. Underutilized fruit crops serving as abundant sources of vital micronutrients such as vitamins, minerals, antioxidants, dietary fiber, and phytochemicals, with these crops offering potential medicinal and social advantages. Many underused fruit crops show significant resilience to agro-climatic conditions because they are drought-resistant, thrive in poorly drained soils, and require fewer resources, making them ideal for cultivation in regions where conventional fruit crops may struggle due to climate change.

**Keywords:** Arid region, Climate change, Nutritional security, Underutilized fruit

### Introduction

Global food system are extremely susceptible to environmental changes including server weather events, pest infestations, and shifts in temperature and rainfall patterns, presenting a major risk to food security and sustainability because of their vulnerability to intricate and unpredictable changes. The prevalence of a narrow variety of crops in the worldwide food supply has heightened its susceptibility. Presently more than half of the world's caloric intake is derived from just three staple crops, rice, maize and wheat; while a wide variety of nutrient-rich species that were once cultivated and consumed by humans remain underutilized (Hunter *et al.*, 2019). This over reliance on a narrow crop base increases the exposure of food systems to climate related risks and diminishes dietary diversity. In this context underutilized fruit crop emerge as a promising solution to address the dual challenge of food and nutritional insecurity in a changing climate (Chivenge *et al.*, 2015). Recognized by the FAO as Future Smart Food (FSF), these crops possess untapped potential to combat hunger and malnutrition. These crops are known for unique adaptive traits such as drought resistance, adaptability to marginal lands and low input requirement making well them well suited for cultivation under adverse conditions. Numerous ecosystem services, such as provisioning, regulating, cultural, and sustaining functions, are provided by underutilized crops and promote human health and well-being as well as environmental sustainability. Essential micronutrients are provided,

dietary diversity is increased, income-generating opportunities are established, and rural resilience is reinforced. The importance of incorporating underutilized plant species into routine farming techniques is highlighted by studies conducted in a variety of agricultural ecosystems across several countries. Intentionally incorporating such traits can enhance crop diversity, mitigate the adverse impacts of climate change, and strengthen farming communities' ability capacity to adapt to challenging circumstances, thereby supporting global efforts initiatives to establish food systems that are sustainable, resilient to climate change, and nutrition-focused.

### Climate Change and Underutilized Fruits

Agricultural production essential for human survival and development is profoundly affected by the rapid global climate change (Karki *et al.*, 2020). There is a rapid progress in climate change than expected resulting in new environmental circumstances for the growth of horticulture crops primarily fruit crops. These days prolonged droughts are becoming a major hazard in some areas while severe heat waves or frost are already having an effect in other areas also. The impact of climate change could be positive or negative; however, they directly affect the quality of the produce and total production. Being perennial in nature fruits crops are mostly affected due to climate change. Underutilized fruit plants that have some special adaptive features like deep tap root systems, leaf shedding in summer, water binding mechanism, wax coating, hairiness, sunken and covered stomata in leaves, tolerance capacity to salinity and alkalinity, synchronization of flowering and fruiting during rainy season or at maximum water availability offer scope in semiarid and arid environment. Fruit crops have longer life cycles compared to other crops making them more challenging to cultivate under stress and less able to adjust to changing environmental conditions. The inherent potential of underutilized fruits from environmental problems sustains a sustainable production chain including different tactics for plant management including plant breeding operations that take advantage of variances. Numerous fruit crop have ability to withstand with adverse agro climatic conditions. Species such as aonla (*Emblia officinalis*), custard apple (*Annona squamosa*), ber (*Zizyphus mauritania*) and tamarind (*Tamarindus indica*) are well-known for their drought resistance and ability to thrive in poor soils and marginal lands.

### Conservation and Genetic Resource of Underutilized Fruits

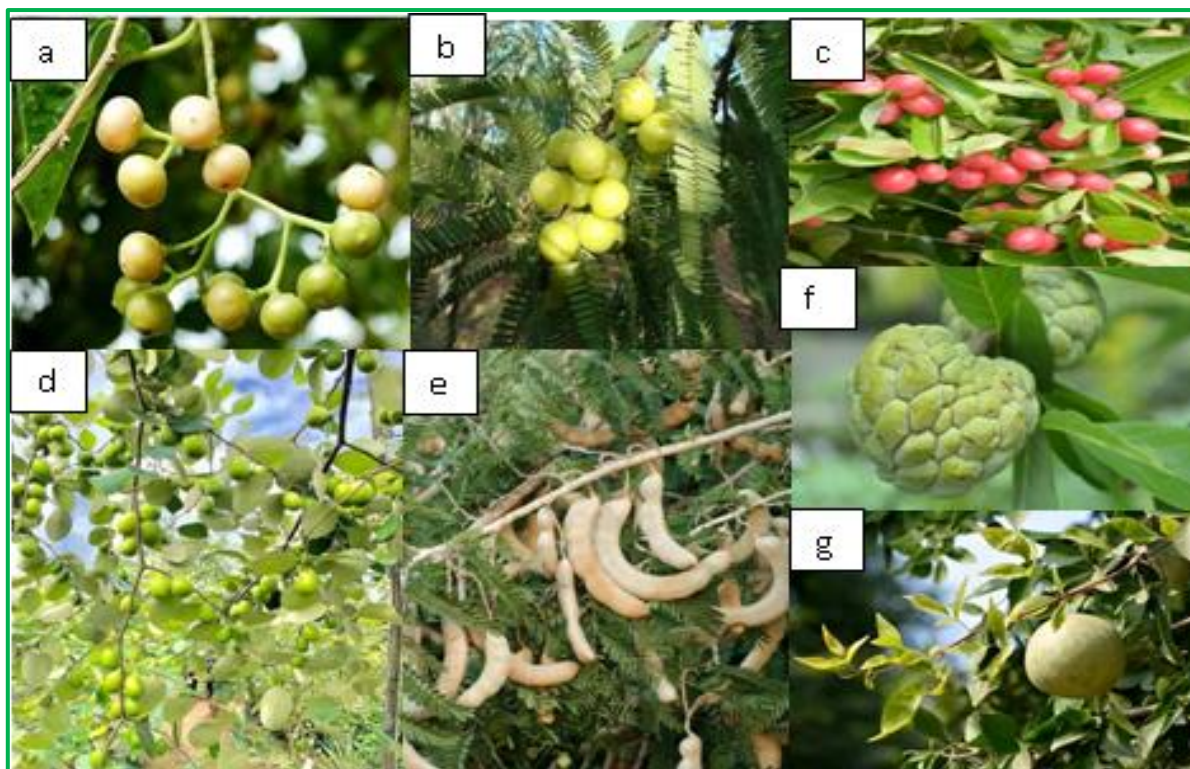
A wide range of diversity in terms of species, varieties and genetic traits is available in underutilized fruit crops in different parts of the country which represent a valuable but often overlooked component of global agricultural biodiversity (Li *et al.*, 2020). India is home of variety of underutilized fruits commonly found in semiarid and arid regions which includes annona, bael, aonla, lasoda, karonda and phalsa (Figure 1) while some tropical underutilized *Garcinia species* (kokam, Malabar tamarind and Mysore gamboge), *Grewia species* (phalsa), *Madhuca indica* (mahua), *Manilkara hexandra* (khirmi), *Phoenix sylvestris* (wild date), *Pithecellobium dulce* (Manila tamarind), *Salvadora species* (pilu and meswak), *Syzygium cumini* (jamun) and *Tamarindus indica* (tamarind). Numerous universities and institutes started various programs to conserve underutilized fruits. One of such institute is NBPGR New Delhi where over 2552 accessions of 16 underutilized fruits have conserved which has been collected by various organizations in India. The distribution of underutilized fruit crops span diverse agro-climatic regions from tropical rainforests to arid deserts reflecting their ability to adapt to varied environmental conditions. While some underutilized fruit crops are cultivated on a small scale in specific geographic regions, others remain largely wild or semi-wild awaiting exploration and domestication. This diversity and distribution of underutilized fruit crops are crucial for enhancing agricultural resilience, preserving genetic resources and promoting dietary diversity (Meena *et al.*, 2022). Genetic variability can be effectively utilized for the development of improved varieties in fruit crops in general as limited work has been done on arid fruit crops in particular, which are perennial in nature. The general objectives in crop improvement of UUF are to improve the quality attributes in addition to fruit yield. The other important objectives in breeding of UUF includes the development of



varieties/rootstocks, which perform well even under extremes of temperature regimes and can withstand water stress or have low water requirement, besides tolerance for other abiotic and biotic stresses.

### Nutritional Significance of Underutilized Fruit

The nutritional values of Most of the underutilized fruits are recommended to be included in diet because of their nutritional values. They are widely used in formulations of various ayurvedic medicines owing to rich in minerals, vitamins and phytochemicals. These fruits are rich in flavour and aroma. Beside their importance for nutritional, therapeutically and economic value, diversity of these fruits also has cultural and social value contributing to the stability of ecosystem. Cultivation and consumption of these crops may be helpful in overcoming the nutritional deficiencies predominant in rural and tribal areas. They also improve socio-economic conditions of poor masses of the country.



**Figure 1:** Underutilized fruit crop: a) Phalsa, b) Aonla, c) Karonda, d) Ber, e) Tamarind, f) Custard apple, g) Bael

### Future Opportunity

In rural or tribal regions, underutilized fruit varieties make a significant contribution to alleviating malnutrition and poverty, particularly where access to fresh produce is often restricted or non-existent. Over the past few years, public sector research institutions have concentrated on enhancing these underutilized fruit crops. New crop varieties have been developed using selection and hybridization, offering enhanced adaptability, higher yields, and improved quality traits for arid and semi-arid regions. Locally adapted species serve as a reservoir of genes that provide resistance to stress, and these could be useful in breeding future crop varieties that are tolerant to stress. Optimization of various production methods has been carried out by different establishments, encompassing techniques like rootstock selection and grafting/budding, as well as practices for spacing plants, canopy management, the regulation of nutrients and water, crop management, plant protection, post-harvest management, and value enhancement. The promotion of these underutilized fruit crops can be accelerated by offering training and demonstrations of the developed technologies to the end-users. Focus should be placed on developmental activities like setting up planting nurseries to guarantee the availability of quality planting materials as well as establishing processing units to scale up their value-added products commercially through entrepreneurship, self-help

groups, or farmer producer organizations (FPOs). The Indian government is supporting commercial orchard development by providing high-quality planting materials for a range of fruit crops, including underutilized ones, through initiatives like the Mid-Hill Development Program, the Tribal Sub-Plan, and the Scheduled Caste Sub-Plan. Policies should be created that promote biodiversity conservation on farms, acknowledge, and offer financial aid to individuals and communities working to conserve and utilise these crucial, underutilized native fruit species.

## Conclusion

Underutilized fruit crops have considerable potential to address several critical global issues, among them malnutrition, biodiversity decline, and climate change. Characterized by high levels of essential nutrients and a natural resistance to harsh environments, these fruits have the capacity to boost food security and encourage sustainable agricultural practices. It is essential to conserve their genetic diversity both in their natural habitats and in conservation collections to preserve their distinctive characteristics. By incorporating these crops into conventional farming, value chains, and policy frameworks, we can uncover new economic possibilities and cultivate food systems that are more resilient to climate change. Adopting underutilized fruit varieties is crucial not only for well-being but also as a tactical move toward a healthier and more sustainable future.

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