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Underutilized vegetable crops in India

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Abstract
Vegetables are essential for maintaining a well-rounded human diet and are crucial for achieving global nutritional security. They serve as rich sources of essential nutrients, vitamins, and minerals, making them indispensable for overall health and well-being. This progress has been made possible through dedicated research and widespread adoption by farmers. However, this success has been largely limited to a handful of major vegetable crops. Despite India's diverse agro-climatic zones, which support the cultivation of over 60 recognized vegetable species and around 30 lesser-known ones, underutilized vegetables have received minimal attention. These crops, which are not widely cultivated on a commercial scale or traded extensively, are categorized as underutilized vegetable crops. Several native crop species that are underutilized have long been a component of conventional farming practices. Their entire potential is still mostly unrealized, despite the fact that they are still utilized to some degree on a local, national, and even international level.

Keywords: Vegetable, underutilized, species, crop

Introduction

Adapting agriculture to the evolving climate is crucial, and one key approach is the promotion and use of suitable crops. The future of agriculture will increasingly focus on the adaptation of underutilized and neglected crops (NUCs), which could played significant role in providing food security and providing balanced diet/nutrition, particularly for rural populations in India's breadbasket regions. Given the changing climatic conditions, there is a growing call for a shift in agricultural practices to explore non-traditional options, including these lesser-known crops. This transition could help create a more resilient agricultural system, as highlighted by Massawe *et al.* (2015) [1]. Vegetables are a rich and relatively inexpensive source of minerals and vitamins. Some vegetables also provide good amounts of carbohydrates, such as leguminous vegetables, sweet potatoes, potatoes, onions, garlic, and methi, as well as proteins found in peas, beans, and leafy greens. The essential vitamins found in vegetables include Vitamin A (carrots, tomatoes, drumsticks, and leafy greens), Vitamin B (peas, garlic, and tomatoes), and Vitamin C (green chilies, drumstick leaves, cole crops, and radish leaves). Leafy greens and drumstick pods are also excellent sources of minerals.

Neglected and underutilized plants are significant contributors to agro-biodiversity because they possess numerous qualities and attributes that will be crucial to our future food supply. These species are either wild species that aid in nutrition or are frequently used in traditional ways.

Providing a healthy diet for those who are impoverished and disadvantaged. These plants may also have a number of other qualities, including the ability to adapt to climate change in the future (by tolerating heat or salt), therapeutic qualities, and genes that resist pests and diseases, which would help us use fewer pesticides (Chibarabada *et al*., 2017) [2]. Furthermore, Majority of the neglected and underutilized species are nutrient-dense and could help diversify diets and address micronutrient deficiencies in impoverished rural communities. Therefore, promoting them in regions with low agricultural productivity could improve rural residents' access to and availability of nutrient-dense food. (Williams and Haq, 2000) [4].

By fostering the growth of new value chains, their promotion in rural regions may also provide doors for rural livelihoods development (Mabhaudhi *et al*., 2017) [3]. Various crop species that are traditionally employed for their food, Shelter, fiber, fodder, oil, or medicinal qualities but have not yet been embraced by commercial farmers are known as "underutilized crops." According to Kunkel (1984) [5], underutilized food crops might enhance food security, nutrition, health, revenue creation, and environmental services if they are used appropriately.

Underutilized crops are those that have survived as life support species in harsh conditions and endangered habitats, have the genetic resilience to survive in hostile environments, and have significant nutritional and/or industrial properties for a variety of uses. "Foods which are less available, less utilized, or rarely used or region specific" is one definition of underutilized foods. Vegetable crops that are not cultivated extensively on a commercial scale or widely traded are often categorized as underutilized. At present, only around one-fourth of vegetable species are recognized as important crops, while the remainder are referred to as minor, rare, bush edible, or underutilized vegetables. These less well-known vegetables are often native to certain regions and are commonly linked with rural farming. In certain communities, their consumption carries a social stigma, as they are sometimes perceived as food for the economically disadvantaged. The under-utilized varieties of plants that have traditionally been exploited for consumption, soluble fiber, animal feed, oil, or therapeutic properties are known as vegetable crops. Nevertheless, the potential of those species to provide environmental services, economic creation, nutrition, health, and food security is underutilized.

Features of underutilized vegetable crops

- Crop must have a scientific or ethno botanical proof of food value.
- Crop must have been cultivated, either in the past or only being cultivated in a specific geographical area.
- It must be currently cultivated less than other conventional crops.
- Crop must have weak or no formal seed supply system.
- Crops are recognized to have indigenous uses in localized areas.
- Received little attention from research, extension services, farmers, policy and decision makers and technology providers.
- May be highly nutritious and/or have therapeutic medicinal or therapeutic properties or other multiple uses.

Importance of underutilized vegetable

Underutilized vegetables are increasingly being recognized for their potential to combat malnutrition, reduce poverty, and promote economic development. These crops represent valuable biological resources for rural communities and can significantly enhance the quality of life for millions, particularly among tribal populations. Rich in essential vitamins, minerals, and antioxidants, these vegetables support better health and contribute to dietary diversity, offering a sufficient balanced intake of various micronutrients. In addition, a lot of underutilized vegetables can withstand a range of biotic and abiotic stresses, which makes them beneficial in challenging growing conditions. Their nutritional value can be especially beneficial in meeting the dietary needs of vulnerable and low-income groups. Many vegetables, especially underutilized ones, are naturally rich in essential nutrients such as vitamins, minerals, and antioxidants. These crops hold significant value for rural communities, serving not only as important components of local diets but also offering medicinal and therapeutic benefits that have been recognized for generations. Traditionally consumed either raw or cooked, these vegetables are part of local culinary heritage, and surplus produce often contributes to household income.
Malnutrition and food insecurity are still prevalent among low-income rural populations. Underutilized vegetables offer a way to address these issues by creating employment, generating income, and enhancing the production per areas and margin profit of farm labor in both rural and urban settings. Their cultivation helps reduce dependence on lesser number of major crops, thereby enhancing food diversity and security at the household level. These crops are particularly well-suited to challenging environments such as Dry or semi-arid regions, mountains, and tropical forests, where they contribute to the resilience and stability of agro-ecosystems. For low-income urban populations, they can serve as affordable, nutrient-dense food options. By expanding the range of edible plant species, underutilized vegetables can support sustainable livelihoods, boost agricultural productivity, and meet evolving market demands, thus playing a considerable contribution in global food and nutrition security.

List of Underutilized Vegetables

Common Purslane (*Portulaca oleracea*): A succulent perennial with a green or purple stem that can grow either erect or prostrate, Purslane is a member of the Portulacaceae family. It grows as a weed all over India and as a vegetable in the Himalayas, where it can reach elevations of 1500 meters. It is rich in vitamin C, folic acid, β carotene, and essential fatty acids. Fresh purslane leaves contains several biochemical compounds *viz.*, omega-3 fatty acids, alpha-tocopherol, ascorbic acid, beta-carotene, and glutathione (Simopoulos *et al*., 1992) [6].

Clove bean (*Ipomoea muricata*): The plant's tender fruits, which are an excellent supplier of dietary fiber, vitamin C, potassium, and calcium, are used in cooking, especially as a vegetable in Kerala. Powdered clove beans have been used as a natural fever remedy for centuries, and the plant's juice is occasionally used as a natural insecticide to keep pests at bay.

Tree bean (*Parkia roxburghii*): Tree beans are medium-height (10-12 m) legumes that are with many branches and bipinnate leaves; the inflorescence head, also called capitalisms, emerges at the end of long pedical from the branches bearing clusters of tiny, yellowish white flowers. Commonly referred to locally as "Yongchak" in Manipur and "Yontak" in Assam, this tree is one of the most widespread multipurpose tree species of the Mimosaceae family in northeastern India, notably in Manipur and Mizoram. In their early stages, the fruits are brilliant green, delicate, and fragile. When they reach full maturity in March or April, they turn blackish. Each pod is 250-400 mm long and 20-40 mm wide, and they form in clusters of 10-15 (Kumar *et al*., 2002) [7]. The most well-liked and delectable vegetable in Ngaland, Assam, Tripura and Mizoram are the long, soft tree bean pods. Seeds are the primary means of propagation. The pods are eaten fresh or processed at various stages of maturity, according on local preferences. Numerous recipes call for the soft, ripe beans. The bark, fruit peel, and leaf decoction have been utilized to treat diarrhea and dysentery; the leaves are an most effective source of green manure and feed; the young stems and mature blossoms are also used in salads and curries; the beans are scraped off and cut into pieces for use in various chutney (Iromba) preparations.

Winged bean (*Psophocarpus tetragonolobus*): The winged bean is a hardy perennial crop that can reaching up to height of five meters. It yields flowers that are blue, white, and purple, among other colors. The plant is known for its distinctive four-angled pods, which feature wing-like structures and range in length between 60 to 360 mm, sometimes reaching up to 500 mm. Each pod typically contains 5 to 20 seeds, which are shiny, globular, and vary in color-white, yellow, brown, black, or mottled—and weigh between 0.06 to 0.5 grams each. Remarkably, all parts of the winged bean plant are edible, including the seeds, flowers, leaves, pods, and tuberous roots. The young pods can be prepared in multiple ways such as boiling, frying, roasting, or stewing, and can even be processed into plant-based milk. The seeds are highly nutritious, containing around 40% protein, while the roots contain approximately 20% protein—significantly more than that found in traditional staples like potatoes or yams. Usually, seeds are used to reproduce the plant. Winged beans provide between 300 and 900 IU of vitamin A and are high in carbs in addition to protein. The tender leaves can be used in sauces or curries, and the sweet-tasting flowers are consumed due to their nectar content. The tuberous roots are typically eaten after boiling or frying. Besides human consumption, the plant also serves as nutritious fodder for livestock. Winged beans hold significant promise in addressing protein deficiencies, particularly in humid tropical regions. Despite their nutritional value, the full potential of this plant in enhancing human diets remains largely underexplored.

Turkey berry (*Solanum torvum*): Although it can grow up to 5 m in elevaation and 0.08 m in base diameter, this erect, spiny shrub is typically 2 or 3 m tall and 2 cm in diameter. It grows at elevations ranging from close to sea level to around 1,000 meters on a variety of moist, fertile soil types. Although it cannot thrive beneath a closed forest canopy, it thrives in full sunlight and may tolerate light shadow or partial shade. *S. torvum* is a shrub that grows in an erect manner. In general, this plant can be found all over India. According to reports, it is widely dispersed over the Himalayan region, southern India, and northeastern India (Abdulkadir *et al*., 2016) [9]. Fruits of this kind of plant have as good levels of various alkaloids, flavonoids, saponins, tannins, and glycosides as sufficient to have pharmacological impacts, according to phytochemical investigations. As a result, fruit is used not only for nutritional purposes but also for cough ailments and as a remedy for organ and spleen enlargement. *S. torvum* has both an a tranquilizer and a diuretics therapeutic effect, and its leaves are used as a hemostatic.

Water spinach (*Ipomoea aquatic*): The soft, leafy twigs of the herbaceous aquatic or semi-aquatic trailing water convolvulus, also known as kangkong, are consumed as vegetables or added to soups and sauces. Tamilnadu and Kerala utilize it as a vegetable. The primary methods of propagation are herbaceous cutting and seed. When taken as a sleeping pill, it is thought to provide a calming effect in Indonesia. Because of its high Fe content, doctors advise anemia sufferers to take it.

Chekurmanis (*Sauropus androgynous*): The plant is commonly referred to as "multivitamin green" and "multimineral packed leafy vegetable" due to its great nutritional content. Chekkurmanis is high in vitamins, minerals, and carbohydrates. This plant is called "Madhurakeera" in Malayalam and "Thavarai Muringai" in Tamil. Stem cuttings from semi-hard wood are the primary method of propagation. Pomegranate roots are used to pound the juice of chekkurmanis leaves, while jasmine leaves are utilized to treat eye conditions. In Tamilnadu and Kerala, the immature shoots and leaves are exploited as vegetables. In addition to lending greenish color to pastries and fermented rice in the Dutch East Indies, leaves are also used to prepare soup in Java and are abundant in protein, minerals, and vitamins A, B, and C.

Kasarkaya (*Momordica tuberosa*): Southern Tamil Nadu, the Rayalaseema region of Andhra Pradesh, and portions of Karnataka are home to the underutilized vegetable *Momordica tuberosa*, also known locally as Kaasara Kaya. It grows naturally in the black, rainfed soils of the desert regions of Andhra Pradesh's Rayalaseema districts. Although its tuberous roots are well known for their therapeutic qualities, the plant is mainly prized for its edible fruits and leaves, which are eaten as vegetables. With roughly 3.72% carbs, 3.26% protein, 1.61% fat, 5.63% fiber, and 1.25% ash, Kaasara Kaya is a nutrient-dense food. This plant has been commonly utilized in indigenous cultures as a natural remedy for diabetes (Reddy *et al*., 2006) [11], and its tender green fruits are frequently used in traditional recipes and pickling. The plant is mainly propagated through its tuberous roots, and its fruits are thought to have a variety of therapeutic properties, including emetic, laxative, tonic, stomachic, stimulant, and general health restorative effects. Additionally, the fruit is known for its potential benefits in managing conditions such as gout, rheumatism, and various chronic ailments related to the spleen and liver (Koneri *et al*., 2006) [10].

Agathi (*Sesbania grandiflora*): The various part of this plant are widely appreciated in various countries for their high nutritional content, especially their richness in vitamin A and essential minerals. These parts are often used as vegetables or added to curries and salads. In addition to their nutritional benefits, the leaves and flowers are also known for their medicinal properties. Despite their value, the plant is not cultivated on a commercial for vegetable production and is mainly propagated through seeds. In Tamil Nadu, it is commonly planted around banana crops to serve as a windbreak and around young coconut trees to provide shade. Beyond its use as food, the plant also holds ornamental and fodder value. In indigenous medicine, agathi has long been used to cure a wide range of ailments, such as stomatitis, fevers, headaches, smallpox, bruising, catarrh, dysentery, and eye problems.

Water Leaf (*Talinum triangulare*): Grown in the tropics, water leaf is a soft, mucilaginous vegetable from Portulacaceae family. It is rich source carotenoids like lutein and zeaxanthin, which function as stimulants and indirectly affect the immune cells in the eyes, just like other vegetables. Eating these vegetables lowers blood pressure and cholesterol, prevents certain cancers, prevents diverticulosis, a painful digestive condition, prevents cataracts, and protects against muscle degeneration, two main causes of eyesight loss. Aside from being a great source of minerals and amino acids and having anti-scorbutic qualities, which prevent scurvy, waterleaf is also used raw in salads, cooked as a pot herb, and added to soups and sauces.

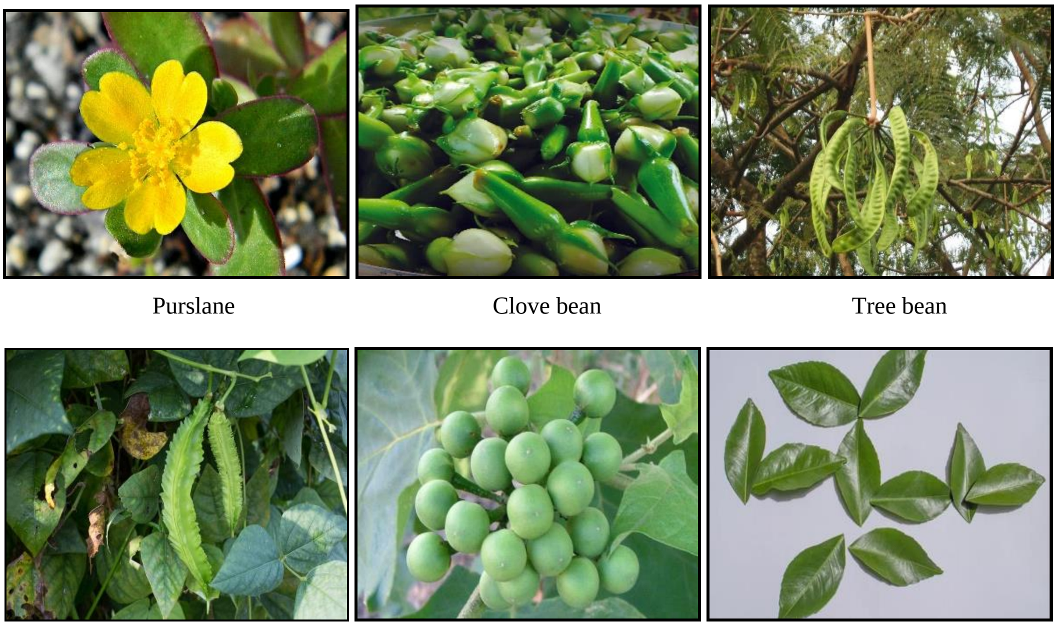
Challenges over development of underutilized vegetable crops

There are numerous significant hurdles to the development of underutilized vegetable crops. The first is that farmers are not well-informed about the nutritional and medicinal qualities of these crops, which leads to their limited cultivation. Secondly, there is a notable lack of scientific research on these species, which results in a lack of thorough agronomic knowledge and cultivation techniques that optimize yield and quality. The scarcity of high-quality seeds and planting materials also poses a barrier to the broader adoption and expansion of these crops. In addition, the implementation of modern agricultural techniques such as advanced agronomic practices, biotechnology, and plasticulture remains minimal, thereby constraining efforts to enhance productivity and crop performance. In addition, poor knowledge of post-harvest management procedures is a severe barrier, negatively effecting both the quality and marketability of underutilized vegetable crops. The absence of proper marketing support, together with inadequate infrastructure for transportation, storage, and processing, further hinders farmers' access to prospective markets. These issues are worsened by the little acknowledgment accorded to these crops within national and regional horticultural development plans, which leads to their persistent marginalization (Sharma, 2003) [8]. Further impediments to the sector's development include inadequate institutional frameworks and the low level of financial institution involvement in assisting the formation of horticultural and agro-industrial businesses.

To foster the development of underutilized vegetable crops, several strategies can be employed

Implementing concentrated publicity and educational campaigns can effectively enlighten farmers about the nutritional and therapeutic benefits of underutilized vegetable crops. This can be achieved through structured workshops, training programs, and information dissemination campaigns. Strengthening research and development efforts is crucial for advancing knowledge in areas such as agronomy, crop improvement, and post-harvest techniques, ultimately leading to the development of superior cultivars and more efficient production methods. The creation of seed banks and plant nurseries is vital for ensuring a consistent supply of high-quality seeds and planting materials, thereby facilitating broader cultivation. Promoting the use of modern agricultural innovations—including precision agriculture, biotechnology, and plasticulture can significantly boost crop productivity and sustainability. Additionally, improving overall farm performance requires increasing farmers' ability through training and extension services in areas like management of crops, sickness and pest management, and good soil health.

For the purpose for lowering losses and enhance their market value, infrastructure and knowledge systems for efficient post-harvest handling, storage, and processing should be developed. By facilitating market access through the establishment of value chains, market linkages, and market information systems, farmers are encouraged to cultivate underused crops. Incorporating underutilized crops into current horticultural promotion programs and schemes ensures their participation in agricultural development agendas. Finally, establishing partnerships between government agencies, academic institutions, non-profit organizations, commercial stakeholders, and farmers' organizations may cooperatively encourage the growth of these crops, contributing to food availability, biodiversity conservation, and sustainable agricultural development. Policy support through incentives, subsidies, and supportive frameworks may further boost their production, processing, and marketing.



Purslane Clove bean Tree bean

Winged bean Turkey bean Chekurmanis

Underutilized Vegetable Crops

Conclusion

Underutilized vegetables show tremendous promise in reducing malnutrition by improving food production in locations where cultivating large crops is problematic. These crops can also improve dietary quality by adding essential nutrients to staple-based diets and can provide economic opportunities for low-income communities, enabling them to access available food through increased purchasing power. Although several of these crops were originally grown extensively, their use has decreased for a variety of agronomic, genetic, cultural, and economic reasons. If properly researched, promoted, and integrated into markets especially those crops that are locally available and culturally accepted they could play a key role in reducing food insecurity and addressing nutrient deficiencies often produced by diets heavy in refined carbohydrates and fats. The loss in the production of underused crops threatens the maintenance of valuable genetic variety, which could be significant for future agricultural improvement and climate adaption. Moreover, current practices in the production, post-harvest management, and value-addition of these crops often lead to substantial losses. Inadequate infrastructure and marketing challenges further limit their potential. Low production volumes also mean reduced efficiency in processing, ultimately driving up costs and reducing the competitiveness of these valuable food sources.

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