

Minor Horticultural Crops for Nutritional Security

Minor horticultural crops play an important role in improving nutritional security, livelihood sustainability and agricultural diversification in India. These crops are rich sources of essential nutrients, vitamins, minerals, fats and bioactive compounds. Nuts are rich in protein and fats while fruits are excellent sources of vitamin C whereas leafy vegetables are rich in iron, calcium and vitamins. These crops help address micronutrient deficiencies such as anaemia, vitamin A deficiency and protein malnutrition, particularly among rural populations. Research and development efforts by ICAR institutes and agricultural universities have led to the identification of improved varieties and production technologies. Several progressive farmers have successfully adopted crops. Minor horticultural crops offer significant potential for enhancing nutritional security, income generation, crop diversification and climate resilience. However, greater research, promotion and market development are required to mainstream these crops and maximise their benefits.

Keywords: Crop diversification; Income generation; Minor horticultural crops; Nutritional security

INDIA has a rich and diverse heritage of biodiversity, encompassing a wide spectrum of habitats, from tropical rainforests to alpine vegetation and from temperate forests to coastal wetlands. Many horticultural crop species have originated in the Indian subcontinent. In addition to native minor horticultural crops like Jackfruit, Bael, Amla, Ber, Khejri, Jamun, Tamarind, Mahua, Phalsa, Lasora, Karonda, Pilu, Bilimbi, Kokum, Gooseberry, Snake gourd, Pointed gourd, Spiny gourd, Chayote, Legumes, Amaranth, Chenopodium, *etc.*, numerous minor horticultural crops such as Rambutan, Mangosteen, Longan, Avocado, Water apple, Hog plum, Macadamia nut, Kiwifruit, Longsat, Durian, Passion fruit, Dragon fruit, Pulasan, Star fruit, Kale, Asparagus, Small cucumber, Cruciferous vegetables, *etc.* were introduced during the last few centuries to India from South America, Africa, Europe and Southeast Asian countries and many of them have now adapted to Indian conditions (Table 1). ‘Underutilised minor horticultural

crops,’ ‘future horticultural crops,’ ‘aspirational horticultural crops’ or ‘opportunity crops’ refers to the crops that may have high value but are not widely cultivated. Most minor horticultural crops are grown in small quantities around homes or collected from forests, but recently, commercial cultivation of some of these crops has also begun. Native minor and exotic horticultural crops have several distinctive characteristics, including ease of cultivation, stress tolerance and resilience to climate change compared to major horticultural crops. Furthermore, these crops are exceptionally rich in many essential nutrients (beneficial phytochemicals) and have medicinal and health-promoting properties. Their consumption can also contribute significantly to meeting the food and nutritional needs of rural populations, which can play a vital role in ensuring food and livelihood security for poor communities. Since ancient times, many such crops have been collected from forests and used in Ayurvedic and indigenous medicines.



Rambutan – Arka Coorg Arun



Avocado – Arka Supreme



Dragon Fruit (Kalamam)

Table 1. Minor horticultural crops of different agro climatic zones

Agro-climatic zones	Fruit crops	Vegetables	Flowers
Northern Temperate Region	Wood apple, Mahua, Bhotia almond, Sweet pangri, Chiura, Wild apricot, Black hisalu, Yellow hisalu, Blueberry, Kafal, Sea buckthorn, hazelnut <i>etc.</i>	Amaranth, Minor leafy vegetables, Gethi, minor cucurbit vegetables, Bathua, Lai saag, Satavari, Ligude, Keruwa, Lotus stem, <i>etc.</i>	Rhododendron, Wild lily, Piyoli, <i>etc.</i>
North Eastern Hilly Region	Passion fruit, Blood fruit, Burmese grape, Wild pear, Quince, Kachai lemon, Cardamom lemon, Minor citrus species, blood fruit <i>etc.</i>	Amaranth, Poi saag, Water spinach, Lai saag, minor leafy vegetables, Yam, Chayote, Lotus stem, <i>etc.</i>	Lotus, Orchid, <i>etc.</i>
Central Subtropical Region	Bael, Chironji, Khirni, Mahua, Jamun, Kendu, Bael, Karonda, Phalsa, Amla, Toddy palm <i>etc.</i>	Amaranth, Poi saag, Lai saag, Water spinach, minor leafy vegetables, Yam, minor cucurbit vegetables, Tree bean, Water chestnut, <i>etc.</i>	Lotus, Orchid, <i>etc.</i>
North-Eastern Subtropical Region	Mahua, Karonda, Passion fruit, Badhal, Jackfruit, Rose apple, Chalta, <i>etc.</i>	Amaranth, Poi, Water spinach, Lai saag, minor leafy vegetables, Aerial yam, Cucumbers, Beans, Kundru, Water chestnut, <i>etc.</i>	Lotus, Orchid, <i>etc.</i>
North-Western Subtropical Region	Phalsa, Date palm, Ber, Custard apple, Tamarind, Loquat, Lasora, Ker	Amaranth, minor leafy vegetables, Yam, Cucumber, <i>etc.</i>	Celosia, Zinnia, <i>etc.</i>
Arid and Hot Region	Bael, Chironji, Khirni, Mahua, Jamun, Kendu, Kaith, Custard apple, Karonda, <i>etc.</i>	Amaranth, minor leafy vegetables, Aerial yam, cucumber, Basella, Water spinach, legumes, <i>etc.</i>	Gomphrena, Portulaca, <i>etc.</i>
Semi-arid and hot regions	Bael, Chironji, Khirni, Mahua, Jamun, Kaith, Custard apple, Tamarind, <i>etc.</i>	Minor leafy vegetables, mustard greens, <i>etc.</i>	Celosia, Zinnia, <i>etc.</i>
Mid-tropical region	Mahua, Falsa, Khirni, Custard apple, Amla, Bael, Karonda, Jamun, Kaith, Kamalam, Kedu, Karonda, Tamarind, <i>etc.</i>	Amaranth, minor leafy vegetables, Aerial yam, Cucumber, Curry leaves, <i>etc.</i>	Gaillardia, Portulaca, <i>etc.</i>
Southern tropical climate zone	Custard apple, Amla, Bael, Karonda, Jamun, Kaith, Barbados cherry, Bilimbi, Hog plum, Rose apple, Carambola, Karonda, Suriname cherry, Tamarind, Macadamia nut, Kamalam, Hanuman Phal, Jackfruit, <i>etc.</i>	Amaranth, minor leafy vegetables, Aerial yam, Cucumber, Drumstick, <i>etc.</i>	Lotus, Orchid, <i>etc.</i>
Coastal tropical humid region	Avocado, Rambutan, Mangosteen, Kokum, Passion fruit, Malayan apple, other minor Garcinia, Bilimbi, Breadfruit, Hog plum, Barbados cherry, Rose apple, Carambola, Karonda, Suriname cherry, White sapota, Macadamia nut, Kamalam, Hanuman Phal, Jackfruit, Badhal, <i>etc.</i>	Minor leafy vegetables, Yam, Cucumber, Kakrol, Chathail, minor legumes, Drumstick, Curry leaves, <i>etc.</i>	Lotus, orchid Heliconia, torch lily, ornamental ginger varieties, <i>etc.</i>

Table 2. Key nutrients for human and their deficiencies

Vitamin/mineral/nutrient	Symptoms of severe deficiency	Issues
Protein-energy	Weak immune system, stunting	Less availability, deficiency more common in vegetarian diet
Vitamin A/pro-vitamin A/carotenoids	Vision impairment	Bioavailability is low due to interaction with phytates
Vitamin B complex	Neurological disorders, weak immune system	Needs to be consumed frequently as body doesn't build up a store. Vitamin B12 does not occur in plant-based foods
Zinc	Weak immune system, stunting	Bioavailability low from most staple grains; phytate can reduce bioavailability
Iron	Weak immune system, impaired mental development	Bioavailability is low due to interaction with phytates

Nutritional value: The consumption and access to different types of micronutrient-rich fruits and vegetables in adequate quantities is crucial for increasing the nutritional security. The lack of resources for producing and purchasing higher quality foods can sometimes present a barrier to achieving greater dietary diversity, especially in the case of poor populations. With the importance of fruits for dietary quality being increasingly recognized, innovative approaches are being made to increase their production and consumption in poorer regions of the world. Efforts are also underway to help such communities identify, domesticate and cultivate

traditional and wild micronutrient-rich foods as a simple and affordable means of satisfying micronutrient needs. The strategy to eradicate these disorders is to promote a general increase in fruit and vegetable consumption and an intelligent diversification of the diet (Table 2).

Although most of the horticultural crops are low in protein but some underutilised fruits and nuts such as Macadamia nut, Chronji, Indian almond, Pine nut, minor legumes are rich sources of protein while Bael (*Aegle marmelos*), Bread fruit (*Artocarpus altilis*), Jack fruit (*Artocarpus heterophyllus*), Gular (*Ficus glomorta*), Phog (*Calligonum polygonoides*) and many root crops, contain

Table 3. Minor horticultural crops with higher nutrient content

Nutrients	Fruit crops	Vegetables	Flowers
Protein	Sea buckthorn, Chironji, Indian almond, Pine nut, Mahua Kernel	Malabar spinach, Pot Casia, Drumstick leaves, Agathi leaves, Kantha leaves, Kantha leave, Thai eggplant, Indian yam, Five leaf yam	Vegetable fern
Carbohydrate	Bael, Mahua, Custard apple, Khirani, Tamarind, Phog, Durian, Egg fruit, Ker ripe, Bread Fruit, Jackfruit, Tedu, Tamarind, Jherberi, Chest nut, Gular	Spiny bitter gourd, Thai eggplant, Indian yam, Five leaf yam, Kakrol	Kachnar flower, Kamal kakri
Fat	Avocado pulp, Mahua seeds, Pilu seeds, Kokum seeds, Chiura, Indian almond, Hazelnut	Himalayan mayflower, Agathi leaves	-
Vitamin A	Eggfruit, Capegooseberry, Khirani, Persimmon, Mahua, Phalsa, Surinam cherry, Barbados gooseberry, Sea buckthorn, Ker, Blood fruit	Basella leaves, Polpala, Pot Casia, Red amaranth, Drumstick leaves, Agathi	Kachnar flower, Sanai Flower, Wild plantain flower, Vegetable fern, Yellow Gulmohar
Vitamin B1	Chironji, Pine nut, Indian almond	Basella leaves, Polpala, Pot Casia, Red amaranth, Drumstick leaves, Agathi	Kachnar flower, Sanai Flower, Wild plantain flower, Vegetable fern
Vitamin B2	Bael, Wood apple pulp, Mahua flower, Chironji seed	Basella leaves, Polpala, Pot Casia, Red amaranth, Drumstick leaves, Agathi	Kachnar flower, Sanai Flower, Wild plantain flower, Vegetable fern
Vitamin B3	Bael, Soursop, Macadamia nut, Passion fruit, Pine nut, Egg fruit, Tamarind, Mahua flower	Basella leaves, Polpala, Pot Casia, Red amaranth, Drumstick leaves, Agathi	Kachnar flower, Sanai Flower, Wild plantain flower, Vegetable fern, Yellow Gulmohar
Vitamin C	Aonla, Sea buckthorn, Barbados cherry, Jaboticaba, Camu-camu	Malabar spinach, Basella leaves, Polpala, Pot Casia, Red amaranth, Agathi leaves, Kantha leaves	Vegetable fern, Banana flower
Calcium	Chironji seed, Ker, Governor's plum, Phalsa, Mahua flower, Indian Almond, Pilu	Malabar spinach, Basella leaves, Polpala, Pot Casia, Red amaranth, Kantha leaves, Agathi leaves, Anantmul, Kakrol	Vegetable fern
Potassium	Durian, Longan, Phalsa, Bael, Soursop, Jackfruit, Macadamia nut	Malabar spinach, Basella leaves, Red amaranth, Drumstick leaves, Agathi leaves, Kantha leaves	Vegetable fern, Yellow Gulmohar, Plantain flower
Zinc	Durian, Mangosteen, Carambola, Wood apple, Jackfruit	Malabar spinach, Red amaranth, Pot cassia, Kantha leaves, Lesua	Vegetable fern
Iron	Chronji, Ker, Gular, Macadamia nut, Mahua flower, Mahua Fruit, Khejri, Pilu, Jherberi	Malabar spinach, Basella leaves, Pot Casia, Red amaranth, Indian yam, Five leaf yam	-
Magnesium	Durian, Longan, Carambola, Barbados cherry	Malabar spinach, Basella leaves, Red amaranth	-

higher amount of carbohydrates. Most of the nuts as well as pulpy fruits such as Avocado, Mahua seeds *etc.* are rich in fats whereas minor legumes, cucurbits and leafy vegetables such as Amaranth, Basella, Agathi, Indian Yam, Drumstick, Thai egg fruits, Spiny bitter gourd, Kakrol, Teasel gourd, Ivy gourd, Tree bean, Parkia bean, *etc.* are rich in vitamins and minerals (Table 3).

Anti-nutrition factors: The minor fruits and vegetable not only contain nutritionally important bio compounds

but are also sources of other phyto-compounds which at certain critical levels have significant anti-nutritional effects. These anti-nutrient factors may reduce nutrient bioavailability by binding the nutrient in a form that is not recognised by the uptake systems on the surface of intestinal cells, rendering the nutrient insoluble and thus unavailable for absorption or competing for the same uptake system. These compounds include oxalate, phytate, saponins and nitrate, cyanide *etc.* These antinutrient



Macadamia nut



Mangoteen



Kokum



Longan - *Gandaki Longan-1*



Malabar Tamarind



Custard Apple - *Arka sahan*

compound can be reduced by soaking, boiling and fermentation.

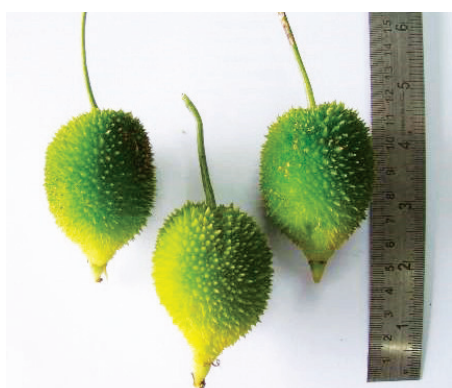
Research and Promotion: Several minor horticultural crops have been identified that have the potential to achieve significant increases in productivity and thus substantially improve national nutritional security at the local and regional levels. The last three decades have witnessed a diversification of research interests in minor horticultural crops. Several important programs have been launched to promote minor horticultural crops for agricultural systems as alternative crops or as sources of new products. Several ICAR institutes and State Agricultural Universities are working on the research and development aspects of these crops. Workshops, field days, seminars, crop fairs and variety shows help in promoting these crops. IIHR, Bengaluru, Central Horticultural Experiment Station, Chettalli, Central Horticultural Experiment Station, Bhubaneswar and Central Horticultural Experiment Station, Godhra have played a significant role in the research and extension of these crops.

ICAR- IIHR, Bengaluru has developed *Arka Sahan* variety of Custard apple; *Arka Ananta* and *Arka Chandra* varieties of Pomelo; *Jamun J-1* of Jamun; *Arka Suguna*, *Arka Samraksha*, *Arka Varna* and *Arka Arunima* in Amaranth, Central Horticultural Experiment Station, Chettalli released *Arka Supreme* and *Arka Coorg Ravi* of Avocado, *Arka Coorg Arun* and *Arka Coorg Peetabh* of Rambutan and *CHESM-1* variety of Malayan apple and identified improved accessions of Kokum, Karonda, Tree gooseberry, Hanuman phal and Pomelo. Central Horticultural Experiment Station, Bhubaneswar developed *Arka Bharat* of Teasel gourd, *Arka Neelachal Shanti* of Spine gourd and *Arka Neelachal Kunkhi* of Ivy gourd. ICAR-Central Institute of Arid Horticulture, Bikaner has developed varieties of

Bael (*Goma Yashi*, *Thar Divya*, *Thar Neelkanth*, *Thar Srishti*), Jamun (*Goma Priyanka*, *Thar Kranti*) and Phalsa (*Thar Pragati*), Chironji (*Thar Priya*) and Mahua (*Thar Madhu*), Khejari (*Thar Shobha*), Kachari (*Thar Kasturi*), Matheera (*Thar Manak*, *Thar Madhur*) and Snapmelon (*Thar Mahak*). ICAR- IIVR, Varanasi has released Amaranth varieties *Kashi Chaulai-1*, *Kashi Suhaavani* and varieties of Basella (poi), Chenopod (bathua), Spinach beet (palak) and Water spinach (karamua sag). BSKVV, Dapoli developed *Konkan amrut* and *Konkan Hatis* varieties of Kokum, *Konkam Bahaduli* of Jamun, several farmers' varieties such as *Siddu*, *Shankara*, *Agrahara* in Jackfruit, *Niranthara* (Round the Year) in Jamun and *Lakshmana* in Tamarind have also been registered. In addition, propagation, production and post-harvest management techniques have also been developed. A large number of plants are being propagated and made available to farmers to facilitate the widespread adoption of these crops. Several private nurseries are also playing a significant role in the multiplication and supply of planting material for these crops. There are many success stories of farmers who have cultivated these crops successfully and earned substantial profits.

Success stories: Several progressive farmers have adopted these crops over the past decade and are reaping substantial profits.

- Mr. Jacob Puttur, from Karnataka, diversified into Rambutan cultivation in an area suitable for Arecanut, Black pepper, Rubber, Banana and other crops. With confidence and strategic management practices, he earned higher prices by selling Rambutan fruits through his own farm outlet. His Rambutan orchard has become a center of attraction for all growers in the region.
- Mr. Renny Jacob, from Kanjirappally, a chartered accountant and plantation owner, replaced Rubber



Spine Gourd - *Arka Neelachal Shanti*



Tissel gourd - *Arka Bharat*



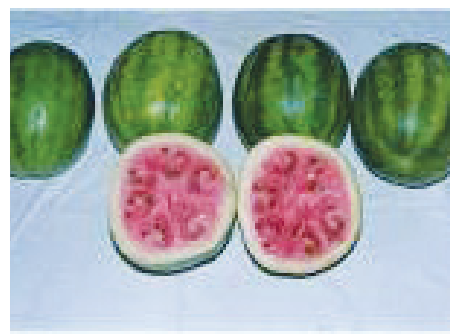
Kundaru - *Arka Neelachal Kunkhi*



Kachri - Thar Kasturi



Khejri - Thar Shobha



Matheera variety - Thar Madhur

trees with Rambutan in 2008 and now harvests 12 tonnes of rambutan annually, with a market value exceeding ₹16 lakhs.

- Mr. Ahmed Kutty, from Kozhikode, Kerala earned good profits by taking interest in Mangosteen cultivation on his land.
- Mr. M K Marlin from Pariyaram village in Chalakudy town, Thrissur, Kerala, engaged in Mangosteen cultivation and marketing. Pariyaram village produces Mangosteen worth more than ₹1 crore every year.
- In Theni district of Tamil Nadu, Mr. R Ramesh, along with his friends, started the Srivaikai Passion Fruit Association. They have cultivated Passion fruit on 150 acres of land in different areas and are exploring market and processing opportunities in Madurai and Chennai.
- Mr. Joseph Louis Kavalam, a retired soldier from Kottayam, Kerala has made his life 'sweet' by cultivating Passion fruit on his 5-acre land. He gets more than 200 kg of fruit daily, which is sold in the market at ₹80/kg (farm gate price).
- Mr. Veerarasu, a progressive farmer from Thandikudi village in Dindigul district of Tamil Nadu, planted 800 Avocado trees in his Coffee plantation in 2002 to provide shade for his coffee plants. He recognised the potential of this crop and is personally promoting it. Now, there are many avocado growers in the Lower Palani Hills of Dindigul district. It is estimated that there are 1.2 million avocado trees there, generating an annual turnover of ₹12–15 crore.
- Mr. Jagadish Giri, a software professional from Bengaluru, planted around 1,000 Dragon fruit plants on his Doddaballapur farm in 2018. Currently, he earns ₹100–150/kilogram of dragon fruit. He sells the fruit in malls and shops in Bengaluru and emphasises that farmers should not depend on a single market, as this makes them vulnerable to market fluctuations.
- Mr. Milind Kulkarni from Deogaon Rangari village of Aurangabad district, Maharashtra has got good dividends and has become an inspiration to many by cultivating Teasel gourd var. *Arka Bharath*. He harvested around 1.5 tonnes of fruits and got income of ₹2,10,000 from 0.17 acre in a span of 6 months.
- Mr. Shankar Murthy, a B.Com. graduate from Kuppalli village, Shivamogga district, Karnataka has started commercial cultivation of Teasel gourd and harvested nearly 3,000 kg and sold at ₹150-200/kg.
- Mr. Venkatesh from Kushal Nagara, Kodagu district

having 300 Teasel gourd var. *Arka Bharath* plants obtained 750 kg and realised a gross income of ₹80,000 from 0.25 acre land from teasel gourd cultivation.

The cultivation of minor horticultural crops has yielded good profits for some farmers, but these successes are limited to certain areas. For their widespread adoption and dissemination, integrated management of genetic resources and extensive identification of nutrient-rich germplasm in high-yielding indigenous and minor exotic horticultural crops is necessary. The valuation of minor horticultural crops and nutrient-rich by-products by the food processing industry needs to create new opportunities for their use in functional foods and therapeutic food formulations. The production and trade of minor horticultural crops, exotic fruits and vegetables are gaining global importance. The cultivation of these horticultural crops offers several benefits. Promoting indigenous horticultural species in different agro-climatic and agro-ecological regions will increase the cultivation, value and utilisation of native crops. However, extensive research is needed to bring nutrient-rich crops into the mainstream and maximise nutritional value without compromising sensory appeal.

SUMMARY

Minor horticultural crops are gaining popularity due to their disease tolerance and health benefits. These crops have tremendous potential in crop diversification. Some of them also hold great promise for the pharmaceutical and processing industries. The area under cultivation and the production of these crops is increasing rapidly. There have been several success stories involving these crops over the past decade. Currently, market prices are high and farmers are earning good profits. As more farmers are getting attracted towards these crops, it is expected that more produce will enter the market in the future. Some work has been done on identifying superior genotypes of these crops, but very limited research has been conducted on their production techniques and post-harvest management. More attention needs to be given to these aspects to sustain the profitability of these crops.

For further correspondence, contact:

Dr. Prakash Chandra Tripathi, Principal Scientist, Horticultural Sciences Division, Indian Council of Agricultural Research, Krishi Anusandhan Bhavan-II, Pusa Campus, New Delhi 110 012, India. Email: prakaashtripathi2000@yahoo.co.in