

Horticulture:

potential to food and nutritional security

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The horticulture sector is one of the primary driving forces in stimulating a healthy rate of agricultural growth in India wherein share of horticulture has significantly increased. Horticultural crop production has moved out of rural confines to urban areas. Horticultural crops are some of the main components of a healthy diet. The constituents obtained by the human body from fruits and vegetables include water, carbohydrates, fats, proteins, fibre, minerals, organic acids, pigments, vitamins and antioxidants, among others. Fruits and vegetables, especially, are a good source of fibre, selected minerals, vitamins and antioxidants.

Key words: Food, Horticulture, Nutritional, Security; Potential

INDIA's horticultural production with about 300 million tonne during 2017-18 has not only brought prosperity to small and marginal farmers, but also provided food and nutritional security to the Nation. The total horticultural production has increased from 191.8 million tonne in 2006-07 to 295.2 million tonne in 2016-17, an increase by 54 % bears testimony to its significant growth. Fruits and vegetables account for nearly 90% of total horticultural production in the country. Ranked as the second largest producer of fruits and vegetables in the world, horticulture in India has emerged as one of the most important and vibrant parts of Indian agriculture. Contribution of ICAR through horticulture is multi-dimensional by providing support to the farmers and entrepreneur. This has paved the way to face challenges of globalized markets with improved quality production, post-harvest management and value addition through its broad-based entrepreneur driven innovative schemes. India is now the leader in several horticultural crops, namely mango, banana, papaya, cashew-nut, areca-

nut, potato and okra in terms of production.

A large part of the population in India and other neighbouring countries suffers from inadequate micronutrient intake which is a consequence of low dietary diversity and limited consumption of nutrient dense foods. Household and community level horticultural production has the potential to secure this much-needed supply of fresh and readily available vegetables and fruits throughout the year, thereby increasing dietary diversity among its members.

The horticulture sector is expected to grow and contribute to food and nutritional security, provided, the sector is nurtured with focused infrastructure development and has a conducive policy environment.

The answer in horticulture, therefore lies in vertical growth in appropriate location-specific high-value crops with maximum productivity and cost effectiveness. After attaining food security, emphasis on production, protection and post-harvest management of horticultural crops needs to be laid to achieve nutritional security.

Thrust areas in horticulture research

The Horticulture contributes 30.4% to GDP of agriculture, which calls for technology-led development, where ICAR is playing a pivotal role. The thrust areas/research priorities where ICAR is continuously dwelling upon for more horticultural production in the country are as follows:

- Genetic resource enhancement and its utilization, enhancing the efficiency of production and reducing the losses in environment friendly manner.
- Effective management, enhancement, evaluation and valuation of genetic resources and development of improved cultivars, with high quality characteristics, productivity, resistance to pest and disease and tolerant to abiotic stresses.
- Development of technologies to improve the efficiency of breeding to develop cultivars, which meet market needs including taste, freshness, health benefit and convenience beside resistant to biotic and abiotic stress.
- Increasing the value of production by reducing variability in yield,



quality, reducing crop loss and increasing marketability through development and site specific technologies for different horticultural crops.

- Developing system for productive use of nutrients, water and reducing impact of pest and disease through the use of innovative diagnostic techniques.
- Improve the understanding of interaction between native ecosystem and production system and develop best practices to conserve biodiversity and sustainable use of resource.
- Develop the production system that minimizes the production of wastes and maximizes the re-use of waste.
- Enhancing the shelf-life of perishable fruits, vegetables, flowers, product diversification and value addition for better profitability.
- Understand social needs of communities and build the capabilities for practice the change for effective utilization of resources and adoption of technologies and respond to needs including bio-security needs.

An analysis of horticultural growth

Recently in an estimate by *NITI Aayog*, it is analysed that fruits and vegetables give 4 to 10-fold the return from other crop groups namely cereals, pulses and oilseeds. A study on sources of growth indicated that diversification towards horticultural crops is the most powerful factor in raising growth rate of GDP agriculture. A shift in area from non-horticultural crops to horticultural crops adds 0.46% to growth rate of agricultural sector. Due to changes in taste, preferences and food habits, the consumption

pattern in India has been shifting towards fruits and vegetables. Such changes are also happening globally.

Studies on food demand indicated that 1% increase in per caput expenditure results in 1.9% and 1.02% increase in demand for fruits and vegetables, respectively. Thus, per caput intake of fruits and vegetables in the country will keep rising in coming years. Moreover, there is large deficiency of these items in Indian diet. India's import of fruits is rising by 20%/year. All these indicators suggested that demand side prospects for fruits and vegetables are very bright.

Technological developments in horticultural crops facilitated some diversification. Varieties of horticultural crops were developed for cultivation in off season, under diverse climatic conditions and with various attributes to attract consumers. Despite favourable demand and supply side factors, area under fruits and vegetables in the country has remained below 10%. Even with one-tenth share in area, fruits and vegetables contribute more than one-fourth of earnings from crop sector in the country.

Highly elastic demand for fruits and vegetables, preference of

consumers for fresh farm produce and new e-commerce offer vast scope for increase in production of fruits and vegetables and farmers' income in the country. The major constraint however, is marketing. This is reflected in slowdown in diversification towards horticultural crops, very high growth in horticultural imports, large price spread between producers and end users, high level of post-harvest losses, frequent and often violent price fluctuations, low level of processing, and very low post-harvest value addition. The main constraint to expand production of fruits and vegetables is the system of marketing and inadequate processing facility.

Horticulture for nutrition security

Globally horticulture is the major source of food, nutrition and livelihood security. In India, it is the prominent agricultural sector that contributes to highest foreign exchange earnings for country's economy. Nutrition Security implies physical, economic and social access to balanced diet, clean drinking water, safe environment, and health care. Nutrition literacy and leadership at all levels is needed to understand and act. Horticultural crops are

Table 1. Various horticultural crops with properties

Fruits/vegetables	Properties
Banana	Rich source of carbohydrates
Potato, tubers crops	Rich sources of carbohydrates
Leguminous vegetables	Rich in proteins
Nuts	Rich in fats
Various fruits , vegetables and spices	Rich in in phytochemicals
Medicinal plants	Rich in in phytochemicals
Underutilized fruits (<i>Jamun</i> , <i>khirnee</i> , wood apple, tamarind, jackfruit, <i>mahua</i> , <i>karonda</i> etc.)	Rich in minerals
Underutilized leafy vegetables (Indian spinach, horticulture chenopodium, water spinach, drumstick etc.)	Rich in minerals, vitamins, and protein

complete package of a complete food as can be understood from Table 1.

Horticultural crops are some of the main components of a healthy diet to deal with nutritional insecurity. The constituents obtained by the human body from fruits and vegetables include water, carbohydrates, fats, proteins, fibre, minerals, organic acids, pigments, vitamins and antioxidants, among others. These constituents when taken through fruits and vegetables sufficiently take care of nutrition security. In the horticultural sector, there has been 2 to 3-fold increase in production of fruits and vegetables in the last 10 to 15 years. Their area has gone up, particularly in rainfed, hilly, and coastal regions prompting fears of diversion of land from foodgrains. Among fruits, banana, papaya, citrus and mango have contributed to the significant increase. All these are nutritionally rich fruits and their increased production has resulted in decline in real prices and penetration in rural markets. India's horticultural production with about 295.2 million tonne during 2016-17 has not only brought prosperity to small- and marginal-farmers, but also provided food and nutritional security to the Nation.

Ranked as the second largest producer of fruits and vegetables in the world, horticulture in India has today emerged as one of the most important and vibrant parts of Indian agriculture. Horticultural contribution is multidimensional by providing support to the farmers and entrepreneur to face challenges of globalized markets with improved quality production, post-harvest management and value addition through its broad based entrepreneur driven innovative schemes. The most abundant single component of fruits and vegetables is water, which may account for up to 90% of the total mass. Thus fruits and vegetables play a very significant role in nutrition security to alleviate malnutrition.

Biofortified varieties of horticulture for alleviating malnutrition

Nutritious diet is vital for proper growth and development in human beings. It helps preventing diseases,

besides maintaining the body metabolism for physical and mental well-being. Food provides energy, protein, essential fats, vitamins, antioxidants and minerals to meet our daily metabolic requirement. Most of them cannot be synthesized in human body, therefore are to be supplemented through diet. Further, anti-nutritional factors present in edible parts of the food exert adverse effects on human health. Consumption of unbalanced foods affects billions of people worldwide, and leads to poor health and socio-economic conditions. So far, the focus is on the development of high-yielding varieties primarily to feed the ever increasing populations. Indian Council of Agricultural Research has improved the nutritional quality in high-yielding varieties of cereals, pulses, oilseeds, vegetables and fruits. Till now more than 5,600 varieties of different crops are released of which number of biofortified varieties is negligible. These biofortified varieties assume great significance to achieve nutritional security of the country. Lot of efforts were made towards development of biofortified varieties in horticultural crops like cauliflower (var. Pusa Beta Kesari 1), potato (var. Bhu Sona), sweet potato (var. Bhu Krishna), pink/red radish, black carrot and pomegranate (var. Solapur Lal), a giant step towards nutrition security. These varieties contain high α -carotene (cauliflower, potato, carrot), anthocyanin (sweet potato, radish, carrot), iron and zinc (pomegranate).

Marketing of horticultural produce

Horticultural crops, particularly vegetables, are more popular with smaller size land holdings as they have advantage in family labour required for labour intensive production. However, such farmers are severally constrained by scale factor in marketing of produce. In most cases a horticultural crop does not come to maturity at the same time and harvestable produce is distributed over a span of a few weeks. Being perishable, these crops can not be stored at home to make an economical lot for taking to market.

This further lowers the scale of marketable lot of farmers.

The standard mode of disposal of marketable surplus is sale in nearby market yards (*mandi*) which is subject to Agricultural Produce Marketing Committees rules and regulations. This requires produce to pass through long market channel which involves payment of approved and unapproved taxes, market charges, and margins to a large number of intermediaries. Recently some states brought perishable fruits and vegetables out of purview of Agricultural Produce Marketing Committees Act but it has made difference only to small quantity of produce. The practice of marketing, required by market regulation, prevented application of e-commerce in fruits and vegetables and kept producers and consumers apart.

Recently in many cities on-line sale of fruits and vegetables was started by some innovative vendors but it has no back-end support. Market regulations constrain on-line purchases from the farmers/producers which can be of immense benefit to producers as well as consumers. India's experience of milk marketing, which ushered in the White Revolution, offers interesting lessons for harnessing its horticulture potential (Analysed by *NITI Aayog*). Milk and horticulture have lot of similarities. Both are high value, perishable, labour intensive, and income augmenting enterprises. Very stable and robust growth in milk production is attributable mainly to three market factors, namely, institution of milk cooperatives, complete freedom to milk producers and buyers for sale/purchase of milk throughout the country and deregulation of dairy sector.

With similar market conditions India can achieve Horticultural Revolution in a short duration than White Revolution. There is need of two simple measures for this. One, take fruits and vegetables out of Agricultural Produce Marketing Committees Act and make their sale and purchase completely free. This will allow setting up vegetable/fruit collection centres by local entrepreneurs, like milk collection



centres, where farmers can sell even a few kilogram of their produce. In some cases integrators will start pooling the produce for marketing, like informal milk vendors in the countryside. They can make economic lot and sell the produce in a market or they can have direct contact with vendors or other buyers in towns, cities and various consuming centres. This will also encourage private sector to go for contract farming and having assured supply of suitable material for processing.

Many innovative vegetable and fruit sellers in urban areas will be attracted to develop back-end linkage to get direct supply from the producers. India has waited for development of modern value chain in horticulture for a long time but this has not been happening due to legal hurdles and restrictions on free and direct marketing. Two, horticulture producers companies or associations of various types, like dairy cooperatives, can also help farmers in marketing their produce without involvement of long chain of market intermediaries. Some progress was made in this area in the last two years and there are some impressive success stories; such experiences need

to be scaled up. Free marketing of horticultural produce will attract lot of investments in horticultural processing and value chains.

As observed by Prof. Ramesh Chand, *NITI Aayog* that demand side factors and technology are highly favourable for Horticultural Revolution at small farms. What is needed is policy support for market liberalization, producers organizations and processing? Prof. Ramesh Chand stated that these require action both by the states and the central governments. The onus for freeing market for horticultural produce rests with the states while support of central government is crucial for promoting producers' organizations and fruits and vegetable processing.

From horticulture to tourism

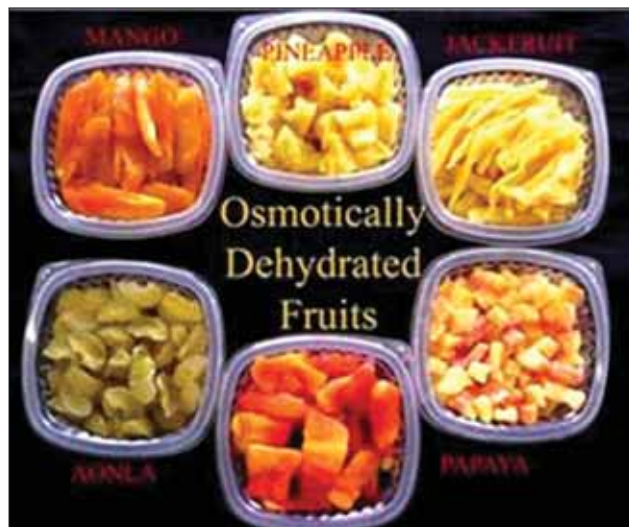
The *NITI Aayog* Forum for North-East India outlined five development missions for promoting sectors like horticulture, tourism and food processing in the region. Other missions cover bamboo-based handicrafts and medium-scale industries with focus on 'Make in North-East'. Horticulture development in North-East will fetch

more entrepreneurship and will boost horticulture production. Linking it with tourism would hasten the process of employment generation, growth and dynamism. Further, the horticultural sector would be diversified with more utilization of fruits and vegetables thus reducing post-harvest loss.

Vertical farming through horticulture

India has made rapid strides in production of horticultural crops, thanks to farmers, scientists and policy makers. Future horticulture is inter-twined with urbanization and peri-urban horticulture. There were limited attempts in protected cultivation focused on selected crops. While the focus on protected cultivation including low-cost shade net cultivation is largely horticulture-based and peri-urban driven, it is a fact that the world is rapidly getting urbanized. Vertical growth is the order of urbanization, often called 'concrete jungle' with a disdain for parks, lakes and greenery. Vertical farming is a concept of blending greenery, landscape with urbanization and using vertical space to enhance productivity. This is largely precision and science driven. There are





opportunities and challenges. Whether one likes it or not, it will change and shape the future world we would be living in. It is better to plan and think ahead of time, addressing productivity, landscape, food safety etc. Better late than never.

Future outlook

To envisage desired growth in agricultural and horticultural sector has to play a key role with following focused research thrust areas:

- Gene prospecting and allele mining in fruits and vegetables grown under various environmental conditions.
- Nutrient dynamics and interaction
- Bioenergy and solid waste utilization.
- Genomics of coconut, mango, banana and *parwal*.
- Insect pollinators for improving productivity and quality of horticultural crops.
- Development of varieties for cultivation in non-traditional areas.
- Standardization of aeroponics and hydroponics techniques in fruits and vegetables production.
- Studies on nutritive quality and nutraceutical traits in fruits and



vegetables.

- Post-harvest and value addition in horticultural crops.
- Modified atmosphere packaging for long storability and transportation of fruits and vegetables.

The way forward

Horticultural crops form an important part of the daily diet as effective nutritional supplements and are scarce of nutritional security, despite their well-known significance from the economic viewpoint. Its significance further amplified in like India (where majority of population is vegetarian and undernourished). The fruit and vegetable sectors of horticulture are most potent to fulfil food requirements of the country and elevate the nutritional and economic status of people.

ICAR horticultural institutes have an extensive network of fruit and vegetable research programmes to develop national and regional technologies, improved varieties, hybrids, vegetable production technologies, IPMs and seed production technologies. These institutes are taking various steps to develop new varieties which can pave the way for nutritional security. However, India has the highest productivity with respect to some horticultural crops like grape and banana, much needs to be done for rest of the horticultural crops.

SUMMARY

Fruits and vegetables rich in nutritive value like aonla, ber and bael

can be grown in degraded lands and concrete efforts are needed from different agencies to reclaim such marginal and degraded soils and bring them under productive cultivation. Focused efforts are required to promote container-growing and kitchen gardening in the urban areas to meet the nutritional requirements of the families. The technology for container-growing of fruits and vegetables is available in a number of research organizations. Such technologies can be popularized among the urban population to ensure adequate nutritional supplementation.

The demand for organic fruits and vegetables is increasing at a rapid pace. Such horticultural produce grown through organic means is nutritionally superior and free from the injurious pesticide residues that are otherwise found in inorganically grown produce. Growing awareness, therefore, about the organic fruits and vegetables would further enhance the supply of nutrients in a safer way. Henceforth the country has to gear itself up to prevent and combat the dual burden of under nutrition and over nutrition and associated health problems. Horticulture is the panacea.

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