

February 2025



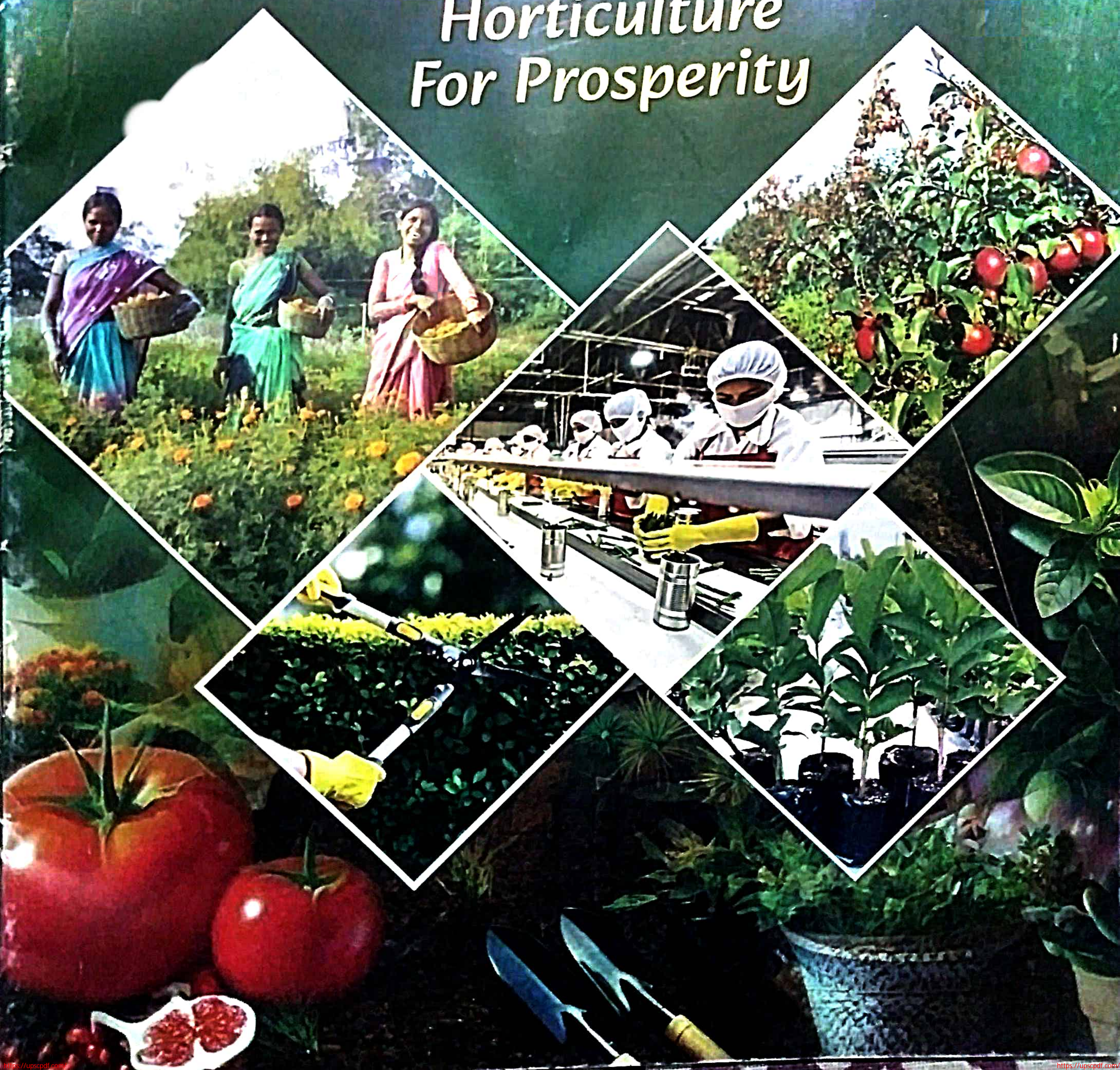
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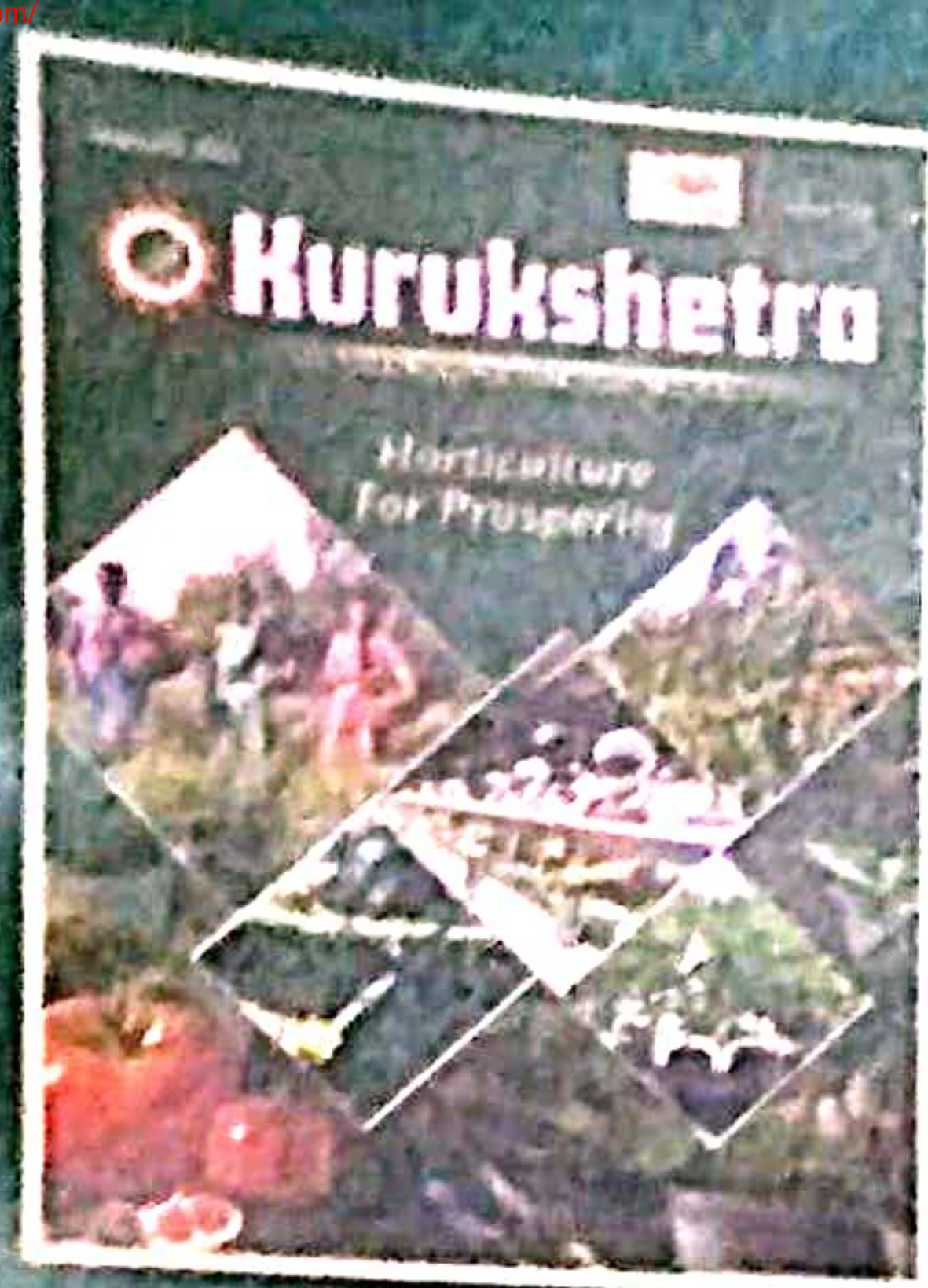


Kurukshetra

A RURAL DEVELOPMENT MONTHLY SINCE 1952

*Horticulture
For Prosperity*





Kurukshetra

A Rural Development Monthly since 1952

Vol. 73 | No. 04 | Pages 52 | February 2025

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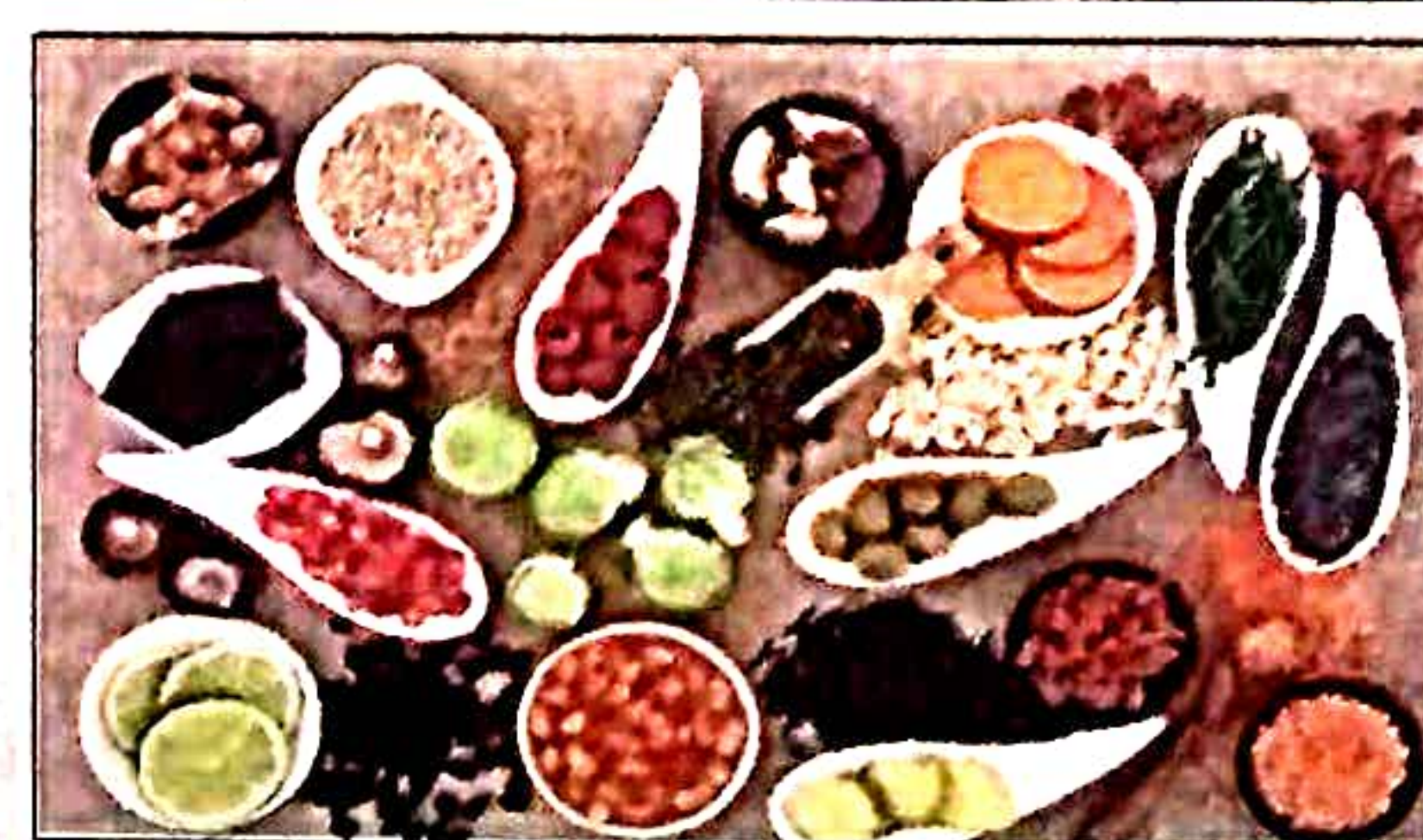
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Editorial



India stands as one of the world's largest producers of horticultural crops. With its vast and diverse climate conditions, India is well-suited for a variety of horticultural practices. This sector not only provides a livelihood to millions but also contributes significantly to the country's economy and food security. Despite these promising prospects, there are challenges that hinder its growth potential, ranging from technological gaps to inadequate infrastructure.

The Government of India has launched various schemes to address the specific needs of the horticulture sector. The National Horticulture Mission (NHM), launched in 2005, laid the foundation for boosting the sector by focusing on areas like improving production, post-harvest management, and market access. Mission for Integrated Development of Horticulture (MIDH) is an umbrella scheme that combines various sub-schemes to provide a comprehensive approach to horticultural development. Paramparagat Krishi Vikas Yojana (PKVY) launched in 2015, promotes organic farming practices in India, which is particularly important for horticulture crops due to the growing global demand for organic produce. Pradhan Mantri Fasal Bima Yojana (PMFBY) primarily a crop insurance scheme, it is essential for the horticulture sector as it protects farmers from losses due to natural calamities or pests, which are common risks for horticultural crops.

These schemes offer financial assistance, training, infrastructure support, and technological advancements that are crucial for increasing productivity, reducing post-harvest losses, and ensuring better market access for horticultural products.

Despite these strides, Indian horticulture faces numerous challenges that hinder its full potential. One of the primary issues is the lack of access to quality seeds, modern technology and research in horticultural practices. While some regions are adopting advanced irrigation systems, pest management techniques, and high-yield varieties, many farmers still rely on traditional practices. This results in low productivity, increased vulnerability to pests and diseases, and poor quality control. Another critical challenge is the fragmented landholdings and the lack of cooperative models among small and marginal farmers.

Amid these challenges, India's horticultural sector is ripe for transformation, particularly with growing consumer demand for organic, nutritious, and regionally distinctive produce. One of the most promising areas of growth is the expansion of organic farming. As awareness about health and the environment increases, there is a shift towards organic and sustainable agriculture practices, opening new markets for horticultural produce. The Government schemes promoting organic farming give farmers a competitive edge in both domestic and international markets.

Horticulture in India holds immense promise for economic development, rural employment, and food security. However, it requires a multifaceted approach to address the challenges it faces. Investment in infrastructure, access to technology, better market linkages, and research on crop management could propel the sector to new heights. This issue of Kurukshetra comprehensively discusses about the present scenario of Horticulture in the country, its challenges, solutions, Government initiatives and future prospectus of the sector. □



Fruit Based Farming Systems for Improved Income and Livelihood

Fruit-based farming systems represent a transformative approach to enhancing agricultural sustainability, economic resilience, and nutritional security in India. Government initiatives, including subsidies for irrigation and cold storage, have supported the growth of fruit farming by addressing challenges related to water management and post-harvest losses. By improving infrastructure and marketing networks, India has seen an increase in both domestic consumption and export potential, making fruit crops a key driver of rural development.

* Prahlad Deb

** Souvik Ghosh

India holds a prominent global position in agricultural production, largely driven by its vast and diverse agro-climatic zones and a significant portion of its population engaged in agriculture. As the second most populous country in the world, India ensures food security for over

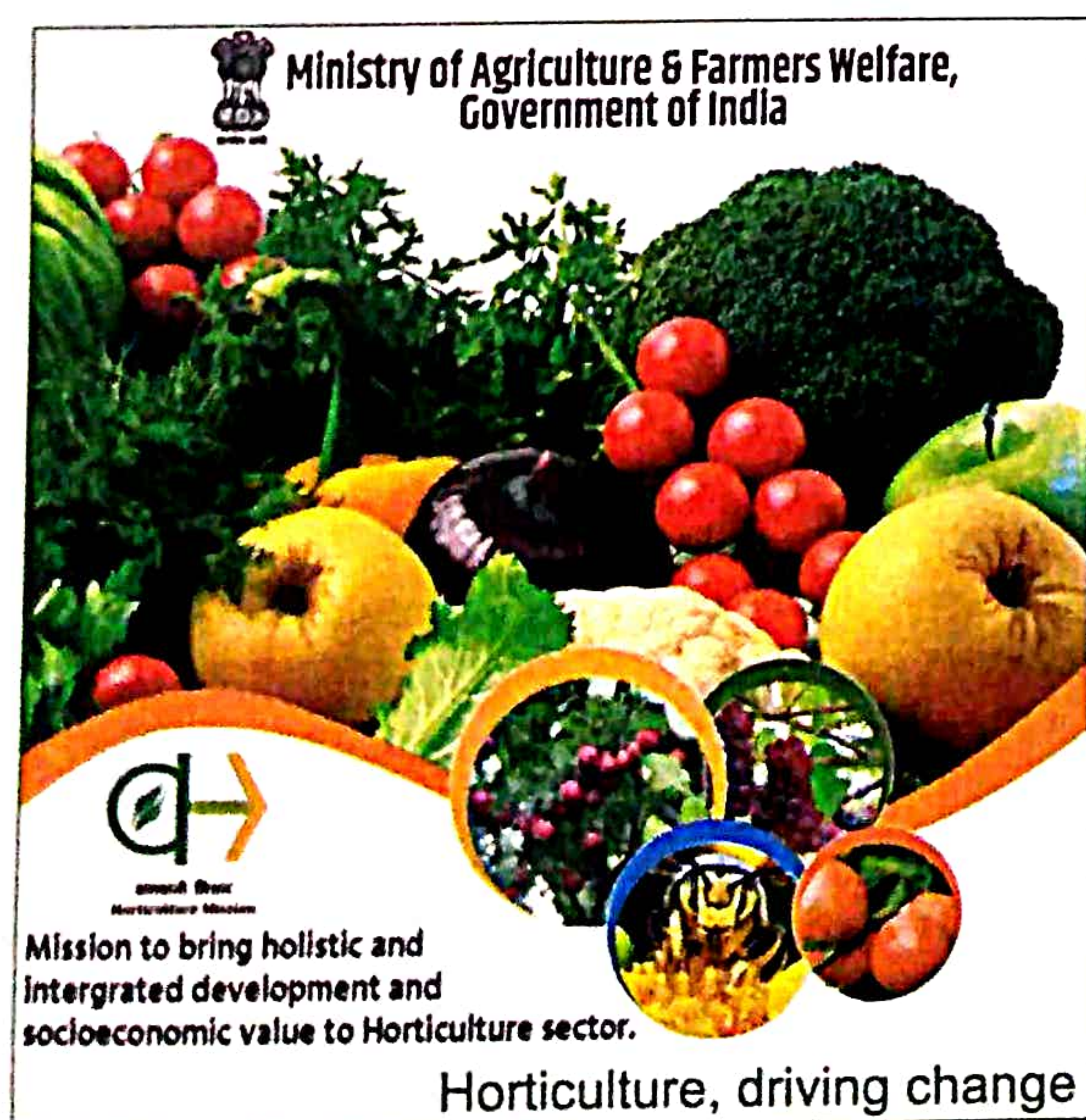
1.4 billion people (WHO, 2023) while being a major exporter of agricultural commodities. The horticulture sector has made a significant contribution in Indian agriculture with an estimated production of 353.19 million tonnes in 2023-24, while fruit production has reached 112.73 million tonnes that is targeted to reach 244 million tonnes by 2047 (MoA&FW, GOI, 2024). An

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annual growth rate of 2.29% in the fruit production is attributed to significant increases in the output of key fruits such as mango, banana, lime, lemon, grapes, and custard apple. These fruits remain critical contributors to the sector, driven by rising demand and improved cultivation practices. Mango production continues to dominate, supported by India's status as the world's largest producer of this fruit. Bananas also play a pivotal role, benefiting from extensive cultivation in states like Tamil Nadu, Maharashtra, and Andhra Pradesh. The grape industry, with a strong export focus, has shown steady performance due to advancements in post-harvest management and cold storage facilities (NHB, 2024). With its diverse agro-climatic zones, India remains a global leader in fruit production, though challenges like climate change and resource constraints persist.

Fruit crops play a crucial role in enhancing income, nutrition, and employment in India, contributing significantly to the agricultural sector. Government initiatives, including subsidies for irrigation and cold storage, have supported the growth of fruit farming by addressing challenges related to water management and post-harvest losses. By improving infrastructure and marketing networks, India has seen an increase in both domestic consumption and export potential, making fruit crops a key driver of rural development. As these crops continue to grow in prominence, they offer sustainable solutions for poverty alleviation and economic resilience in India's agricultural landscape.



India's fruit export sector has experienced significant growth in recent years. Between April and August 2023, the country exported mangoes worth approximately \$47.98 million, marking a 19% increase from the same period in the previous fiscal year (MoC&I, GOI, 2024). The United States emerged as a key destination, importing over 2,000 metric tonnes of Indian mangoes during this timeframe. Additionally, India has expanded its fruit exports to 41 countries, including new markets such as Iran, Mauritius, the Czech Republic, and Nigeria. These developments underscore India's growing presence in the global fruit export market. India's total exports in 2023-24 are estimated to reach \$776.68 billion, a marginal increase from the previous fiscal year. In 2023-24, exports of fresh fruits increased by 32.6% year-over-year to 4.9 lakh MT (APEDA, 2024), reflecting a robust demand in international markets. The processed fruits and juices segment also demonstrated resilience, with exports valued at \$696.33 million in 2023-24 (APEDA, 2024).

Benefits of Fruit-based Farming System

The fruit-based farming system involves integrating fruit cultivation with other agricultural practices, such as growing vegetables, legumes, or livestock. It focuses on enhancing land productivity, soil health, and farm income by diversifying crops. This system promotes sustainability by utilizing complementary crops that reduce pests, improve soil fertility, and minimize environmental degradation. Farmers often choose fruit varieties suited to local climates and market demand. By integrating crops and animals, the system offers multiple income streams, reduces financial risk, and contributes to ecological balance, supporting both economic and environmental sustainability in farming. Few major benefits are:

Economic Upliftment: The cultivation of fruit crops boosts income for farmers, especially smallholders, as many fruit crops are high-value crops with a strong domestic and international market demand. Exporting fruits contributes to India's foreign exchange reserves, enhancing economic growth. Export-oriented fruit farming fosters long-term economic development, benefiting both farmers and the national economy.

Balancing Environmental Sustainability: Fruit-based farming systems promote environmental sustainability by integrating soil conservation practices like mulching, contour farming, and crop rotation to prevent erosion and



improve soil health. Carbon sequestration is enhanced through tree planting. Additionally, the diverse range of crops fosters biodiversity, supporting beneficial insects and natural pest control. By promoting eco-friendly practices such as organic farming, minimal pesticide use, and water-efficient irrigation, fruit-based systems ensure long-term environmental sustainability while boosting farm productivity.

Contribution to Better Health: As one of the world's largest producers of fruits, India benefits from a diverse range of fruit crops, which are not only vital for the economy but also improve the nutritional status of the population by providing essential vitamins, minerals, and antioxidants, supporting public health. These systems also support food security by diversifying crops, reducing dependence on a single source of income, and ensuring a steady supply of fresh, locally grown produce, thus strengthening the resilience of rural communities against food shortages.

Offering Livelihood Diversification: Integrating fruit cultivation with other agricultural practices ensures diversified livelihood options, reducing reliance on a single crop. This minimizes the risk of crop failure due to unpredictable weather or market fluctuations. Processing and value addition, such as making jams, juices, or dried fruits, create additional income streams for farmers. Moreover, these systems offer employment opportunities, especially for rural women and youth, in areas like harvesting, processing, packaging, and marketing, fostering economic growth and community development.

Scope of Fruit-based Farming System

Growing suitable commercial fruits in arid soils under rain-fed conditions is feasible with drought-

tolerant varieties like pomegranates, grapes, aonla, annona, and date palms. These fruits require minimal water and can thrive in harsh climates. Implementing water conservation techniques like drip irrigation and mulching can further enhance productivity, making fruit farming a viable and profitable option in arid regions.

Encouraging agroforestry and mixed cropping systems can enhance fruit-based farming systems by integrating fruit trees with other crops or livestock. This approach increases biodiversity, improves soil health, and reduces pest and disease risks. It also provides multiple income streams, ensures better land use efficiency, and enhances environmental sustainability, making it a viable and resilient farming strategy for diverse agro-climatic regions.

Promotion of horticulture tourism (horti-tourism) through fruit-based farming systems offers a unique opportunity to attract tourists to farms growing fruits like mangoes, grapes, and apples. Visitors can experience farm activities, fruit picking, and eco-friendly practices, while learning about sustainable agriculture. This boosts farm income, supports local economies, and promotes awareness of fruit farming and environmental sustainability.

Protected cultivation of high-value fruit crops, such as strawberries, dragon fruit and other thrust fruits such as guava, papaya, pineapple etc., under Hi-Tech crop production systems, including polyhouses and greenhouses, is increasingly viable in India. These systems optimize climate conditions, conserve water, and improve crop yields by controlling temperature, humidity, and pests. With advancements in technology and government support, this method can enhance productivity, increase profitability, and enable year-round production of high-value fruits, making it an attractive option for farmers.

Cultivation of future fruits like dragon fruits, kiwi, avocado, passion fruit, rambutan etc. in fruit based farming system will definitely enhance productivity, diversify income sources, and ensure year-round revenue, empowering rural communities (APEDA, 2023).

Key Components for Fruit-based Farming

Crop Selection and Zoning: Identifying suitable fruit crops based on agro-climatic conditions ensures optimal growth and productivity. Different regions of India

have distinct climate zones that support specific fruit varieties, such as mangoes in tropical and subtropical semi-arid to sub-humid areas, litchi in subtropical northern Gangetic plains, pineapples in humid tropical and subtropical areas of south and north eastern India, banana in tropical and subtropical humid climate, lime-lemon in coastal areas, or apples and mandarins in cooler hill stations. Promoting region-specific fruit clusters helps farmers select crops best suited to local conditions, reducing risks and improving yields. It also encourages the development of specialized markets, enhances farm income, supports biodiversity, and boosts rural economies by focusing on high-value, climate-adapted crops.

Production and Distribution of Quality Planting Materials: The production and distribution of quality planting materials are critical to the success of fruit-based cropping systems. Healthy, disease-free, and genetically superior plant material ensures higher yields and better resistance to pests and diseases. Establishing certified nurseries and promoting research on improved varieties can provide farmers with access to top-quality planting materials (NABARD, 2024). This leads to enhanced productivity, reduced crop failure risks, and long-term sustainability, driving the success of fruit-based farming systems.

Research and Development: Investment in high-yield and climate-resilient fruit varieties is vital for the successful adoption of fruit-based cropping systems in India. These varieties are better equipped to withstand extreme weather conditions, such as droughts and floods, and produce higher yields. By promoting research and development in these varieties, farmers can achieve stable, profitable production, reduce risks associated with climate change, and improve food



security, ultimately enhancing the sustainability and scalability of fruit-based farming.

Development of Infrastructure: Developing infrastructure like pack houses, cold storage, transportation, and processing units is essential for expanding fruit-based cropping systems in India. These facilities ensure proper handling, preservation, and timely distribution of perishable fruits, reducing post-harvest losses. Coldstorage extends shelf life, while processing units add value to fruits, boosting profitability. Efficient transportation networks further facilitate market access, making fruit farming more viable, profitable, and sustainable for farmers.

Adoption of Climate Resilient Crop Cultivation Strategies: Selection of climate resilient crops like pineapple, aonla, ber, bael, khejri, fig, jamun, pomegranate, custard apple for drought prone areas; banana, papaya, sapota, jackfruit for uplands of heavy rainfall areas; mano and litchi for subtropical cooler *Terali* foot hills are most important. Proper salt tolerant rootstocks should be used when fruit crops are grown in the coastal areas having salinity issues. Drought and flood tolerant rootstocks can also be used for vulnerable areas. Provision of wind breaks and adoption of shade net covering can prevent the fruit plants damage from cold or heat wave. Incorporation of *in situ* rainwater harvesting technologies like percolation pits, check dams, farm ponds, stepwells, recharge wellsetc. can reduce the chance of water scarcity in drought prone areas. Live mulch, soil mulch, plastic covering can also reduce evapo-transpiration and thereby conserving soil moisture during extreme summer and winter too.

Capacity Building: Skill development programs for farmers, focusing on advanced fruit cultivation techniques such as precision farming, pest management, and post-harvest handling, empower farmers to enhance productivity. Providing targeted support to women and marginalized groups fosters inclusive growth, enabling them to participate in and benefit from fruit-based farming. This holistic approach improves livelihoods, promotes gender equality, and strengthens rural economies through sustainable agricultural practices.

Development of Market Linkages: Strengthening supply chains and ensuring direct market access are crucial for the success of fruit-based cropping systems in India. By reducing intermediaries, farmers can secure



Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)

better prices for their produce. Facilitating export opportunities through certification (e.g., GlobalGAP) ensures compliance with international standards, opening up global markets. Market linkage promotion for fruit growers in India is increasingly facilitated through e-marketplaces, mobile applications, and artificial intelligence. Platforms like eNAM (National Agriculture Market) is an online platform launched by the government to facilitate direct trade between farmers and buyers. It integrates existing APMC (Agricultural Produce Market Committee) mandis, allowing farmers to access better market prices, transparency, and reduced intermediaries, thus promoting a unified national agricultural market. Mobile apps like Kisan Suvidha, AgriApp, Farmers Fresh Zone, mKisan, Pusa Krishi etc. help farmers access real-time market prices, crop advisory, and weather forecasts. AI tools analyse market trends, predict demand, and optimize supply chains, improving pricing and marketing strategies. These technological advancements empower farmers with better market access, improved profitability, and reduced post-harvest losses, thereby fostering growth in the fruit-based farming sector.

Schemes for Financial Support: The Govt. of India offers several schemes for horticulture to provide financial support, including the National Horticulture Mission for infrastructure and technology, Pradhan Mantri Kisan Sampada Yojana for processing and cold chain development, and Mission for Integrated Development of Horticulture for promoting sustainable

practices and improving productivity. The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) aims to improve irrigation systems for enhancing agricultural productivity, including fruit crops. By promoting water conservation and efficient irrigation, PMKSY helps to increase the productivity and sustainability of fruit farming, ensuring better yields, reduced water wastage, and improved income for farmers.

Challenges and Gaps in Establishing Fruit-based Farming System

Land Fragmentation: Small landholdings significantly hinder the scalability of fruit-based farming systems. Fragmented land makes it challenging for farmers to adopt modern agricultural practices, mechanization, and efficient irrigation systems, which are crucial for large-scale production. The limited land also reduces the scope for diversified crops or high-density planting, leading to lower productivity. Farmers face difficulties in accessing markets, capital, and technology, as the small scale restricts their ability to invest in quality inputs. Moreover, smallholders are less likely to benefit from economies of scale, resulting in higher costs and lower profitability in fruit farming.

Knowledge Gaps: A significant knowledge gap hinders the adoption of advanced fruit-based farming systems by the farmers. Limited awareness of modern techniques such as high-density planting, integrated pest management, and climate-resilient practices leads to rely on less efficient traditional methods. The

lack of access to training, technology, and resources further exacerbates this issue. As a result, productivity remains low, and the potential of fruit farming systems is underutilized. Bridging this knowledge gap through education, extension services, and exposure to innovation is critical for the system's success.

High Initial Investment: High initial investment to establish fruit orchards poses a major bottleneck for expanding fruit-based cropping systems. The purchasing cost of quality saplings, setting up irrigation systems, and investing in soil preparation and fertilisation is substantial. Additionally, the time requirement for fruit trees to mature and start yielding further delays returns on investment. Small farmers, who dominate Indian agriculture, often lack access to adequate credit or face high-interest rates, making it difficult for them to afford these investments. This financial barrier limits the widespread adoption of fruit-based systems and hinders area expansion.

Climate Vulnerability: Climate vulnerability, including the risks of droughts, floods, and other environmental issues, is a significant barrier to expanding fruit-based farming systems in India. Irregular rainfall patterns, extreme temperatures, and water scarcity affect the growth and productivity of fruit crops, making them less reliable. Floods can damage orchards, while prolonged droughts reduce water availability for irrigation. These unpredictable climatic conditions create uncertainty, making farmers hesitant to invest in fruit orchards, which require long-term commitment

and planning. The absence of robust climate adaptation strategies and infrastructure further exacerbates the challenge, limiting the area under fruit-based farming.

Post-harvest Losses: Post-harvest losses in India significantly hinder the expansion of fruit-based farming systems due to inadequate storage and processing facilities. Inadequate value addition technologies, cold chains, refrigerated pack houses, and air-cargo facilities leads to spoilage and waste, especially for perishable fruits. These losses reduce the profitability of fruit farming and make it challenging for farmers to access distant markets. Without proper infrastructure to extend shelf life and improve quality, many farmers are unable to realize the full potential of their produce, limiting the growth and expansion of the sector.

Market Instability: Market instability and price fluctuations in the fruit sector often arise due to unpredictable supply and demand dynamics, inadequate infrastructure, and lack of buyer confidence. Without consistent quality, proper storage, and timely availability, buyers hesitate, causing price volatility. This uncertainty discourages investment, hampers market linkages, and impacts farmers' earnings, leading to a cycle of market instability. Lack of minimum support price (MSP) for fruits can lead to price fluctuations, often affecting farmers' income. The government does, however, offer schemes like Price Support Scheme (PSS) to help regulate prices for certain fruits during market downturns, ensuring stability in the agricultural sector.

Way Forward

An integrated approach combining fruit farming with field crops, livestock, fishery, and forestry can significantly enhance the fruit-based farming system in India. This synergy optimizes resource utilization, improves soil health, and diversifies income sources. Livestock can provide manure for fertilization, while fish farming offers additional income through aquaculture. Forestry can protect the environment and improve biodiversity. This holistic approach reduces risks, enhances productivity, and strengthens farmers' resilience to climate change. Moreover, it contributes to rural livelihoods by creating jobs, improving food and nutritional security, and fostering sustainable practices.

Promoting Public-Private Partnerships (PPP) is crucial for expanding and establishing fruit-based cropping systems in India. Collaboration between the government and private sector can drive technology

Guava Arka Kiran

A climate-resilient variety recommended for Andhra Pradesh, Karnataka, and Maharashtra Tamil Nadu with a yield potential of 38 to 40 kg /tree/year.





development, provide primary investments, and enhance infrastructure for efficient farming. PPPs can facilitate the adoption of advanced agricultural practices, such as precision farming, climate-resilient techniques, and efficient post-harvest management. Private players can contribute by providing funding, expertise, and market linkages, while the government can offer policy support, subsidies, and research. This partnership can accelerate area expansion, ensure better yields, and create value-added products, improving farmers' income through a sustainable, profitable fruit farming ecosystem.

Value chain development in fruit-based farming can significantly enhance rural incomes by focusing on processing, branding, and export-oriented policies. Establishing processing units enables farmers to add value, extend shelf life, and improve marketability. Branding helps differentiate high-quality Indian fruits, ensuring premium pricing in domestic and international markets. The Agricultural and Processed Food Products Export Development Authority (APEDA) plays a key role by promoting fruit exports, ensuring compliance with global standards, and enhancing quality. APEDA facilitates post-harvest infrastructure development, such as cold storage and processing units, reducing losses and increasing shelf life. It also supports branding, certification, training, financial assistance, and marketing, boosting global recognition of Indian fruits. Export-oriented policies will facilitate opening new markets, increasing demand and driving fruit exports. By improving farmers' value realization and promoting sustainable agriculture, value chain development fosters rural economic growth and enhances livelihoods.

Supporting climate resilience programs and promoting climate-smart agriculture techniques for

fruit-based farming systems can greatly uplift the livelihoods of rural communities and increase growers' incomes. Techniques like water-efficient irrigation, drought-resistant fruit varieties, agroforestry, and soil conservation practices can mitigate the impacts of climate change and help farmers adapt to unpredictable weather patterns, reduce crop losses, and enhance yields. The Government of India has launched several climate resilient agriculture programmes. The National Mission on Sustainable Agriculture promotes climate-

smart practices, focusing on soil health and water conservation. The National Adaptation Fund for Climate Change (NAFCC) provides financial assistance for state-level climate adaptation projects. These initiatives help farmers adopt resilient practices, reduce vulnerabilities, and ensure long-term agricultural productivity.

Strengthening farmer producer organisations (FPOs) can significantly boost fruit-based cropping systems. By pooling resources, farmers can access better inputs, technology, and infrastructure. Cooperative marketing helps reduce intermediaries, ensuring fair prices and improving market access. This collective approach enhances bargaining power, reduces risks, and boosts profitability, fostering sustainable growth in the fruit farming sector.

Conclusion

Fruit-based farming systems represent a transformative approach to enhancing agricultural sustainability, economic resilience, and nutritional security in India. By integrating diverse crops and adopting innovative practices, these systems not only increase productivity and income for farmers but also contribute to environmental conservation and rural development. However, addressing challenges like land fragmentation, knowledge gaps, and market instability requires collaborative efforts from the government, private sector, and farmer communities. Strengthening infrastructure, promoting climate-resilient practices, and fostering public-private partnerships can unlock the full potential of this sector. As India continues its journey towards agricultural excellence, fruit-based farming systems hold the promise of sustainable growth, equitable development, and a robust agricultural future. □



Beekeeping Generating Employment Opportunities

Honey has been revered across ancient cultures since time with the earliest usages of honey being stored and used dating back to more than 5,000 years with research findings indicating that honey cultivation dating back even further. In ancient India, according to ayurvedic texts, there were eight different types of honey used for internal and external applications related to treatment. With the advent of time, the usage and application of honey along with its value-added products has acted as a force multiplier for countries to develop their own unique brands thereby increasing their exports and fostering growth. India with its diverse flora is home to many varieties of honey is one of the major players in the world with specific emphasis given to promote scientific beekeeping of honey in a mission mode to tap into its full potential to become a game changer in the 21st century.

*** Dr. Prabhat Kumar**

Honey bees represent one of nature's remarkable creations, offering numerous benefits to humanity. They produce the beloved sweet substance known as honey, which is derived from the sugary secretions of plants, such as floral nectar, or from the secretions of other insects like honeydew. This process involves regurgitation, enzymatic activity, and the evaporation of water. Honey is stored in wax structures referred to as honeycombs. As humans began to master the art of domesticating

bees and managing them in hives, leading to significant advancements in beekeeping practices. India, with its rich diversity of flora and fauna, stands as one of the world's mega-biodiversity hotspots with a potential to unlock beekeeping as a way of life[2].

Migratory Beekeeping in India

To successfully engage in commercial migratory beekeeping, beekeepers typically assess the available floral resources and plan their migrations accordingly. In northern India, commercial beekeepers typically

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relocate their colonies between the plains and hilly regions. From October to November, colonies are moved to the plains of Uttaranchal, Uttar Pradesh, Haryana, Punjab, and Rajasthan to take advantage of rapeseed and mustard blooms. In December and January, the colonies are transferred to eucalyptus plantations in Uttar Pradesh and Haryana. Additionally, from February to March, bee colonies are relocated to litchi orchards in Ram Nagar and Dehradun, sunflower fields in Punjab and Haryana, and forest plantations in Uttar Pradesh to access Shisham flowers (Indian Rosewood) until May.

Overview of Beekeeping in India

Rev. Father Newton conducted research in 1909 and designed a hive specifically for Indian hive bees, and established apiaries in Tamil Nadu. The state of Travancore initiated beekeeping efforts in 1917, followed by Mysore in 1925, Kashmir around 1927, Punjab in 1933, and Uttar Pradesh in 1938. Post Independence, the Khadi and Village Industries Commission (KVIC) recognized beekeeping as a significant initiative. In 1980, ICAR launched the 'All India Coordinated Project (AICP) on Honey Bee Research and Training,' headquartered at CBRTI in Pune. In 1993, the Department of Agriculture and Cooperation (DAC), placed a strong focus on beekeeping by initiating a National Scheme for facilitating the approval of research, training, and development projects related to beekeeping across various State Agriculture Universities

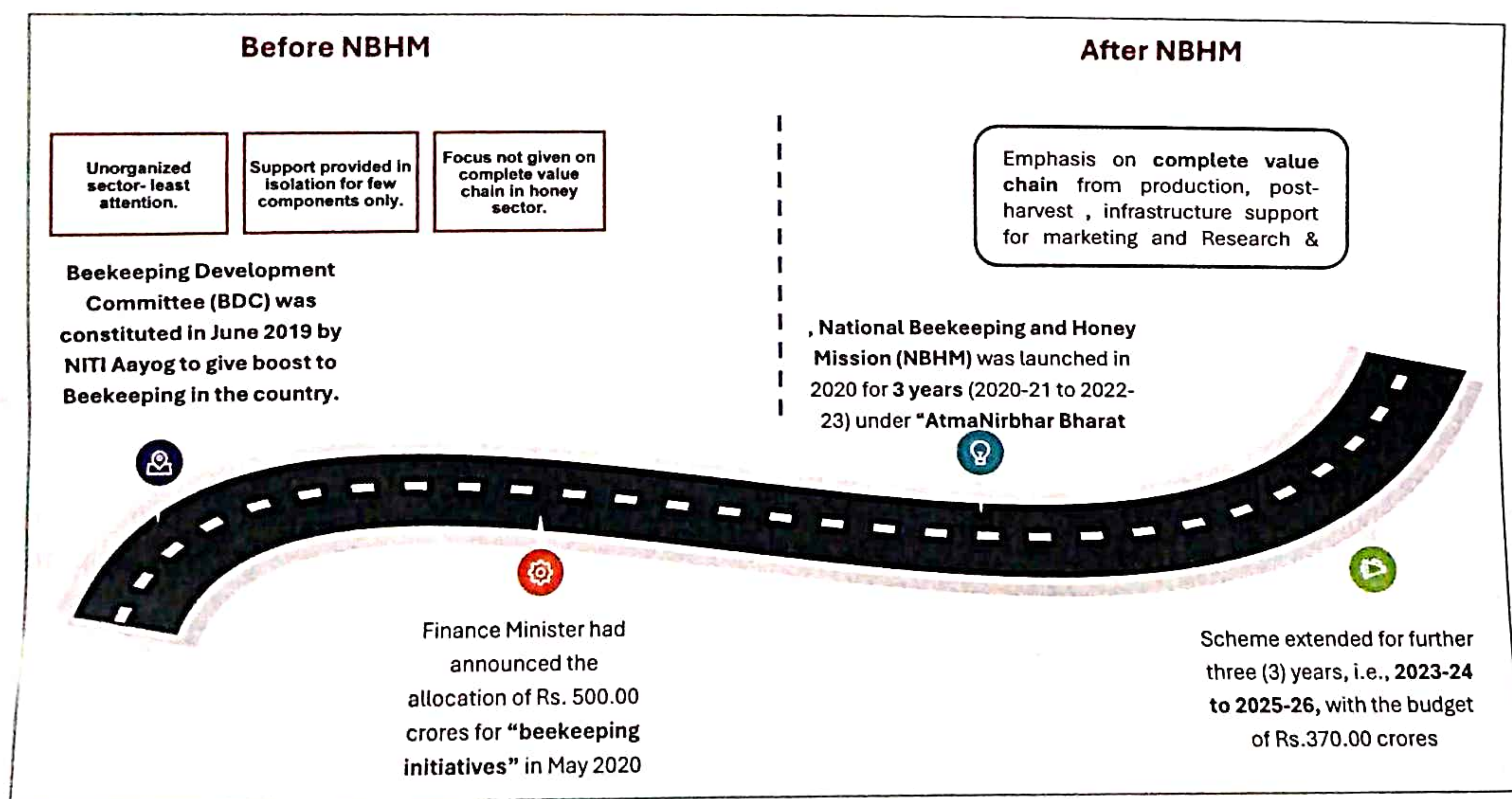
(SAUs), State Departments, Government and Non-Government Organizations (NGOs) and through Small Farmers' Agri-Business Consortium (SFAC) enabled in forming the National Bee Board as a Registered Society under Societies Registration Act, XXI of 1860 on 19th July, 2000 & promoted by SFAC. The National Bee Board was reconstituted in 2006 with Secretary DA & FW as its chairman and is the nodal agency for the National Beekeeping and Honey Mission.

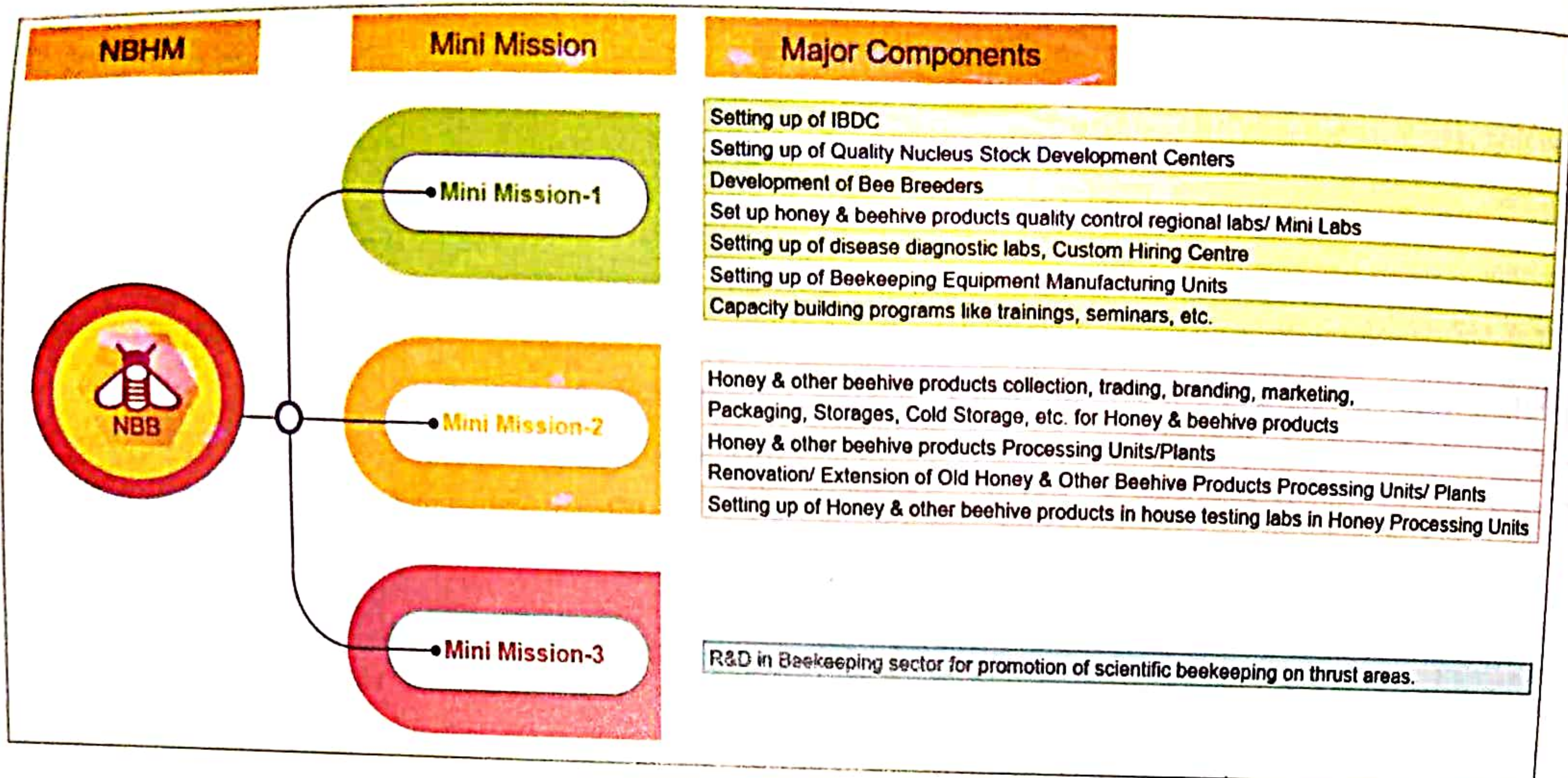
National Beekeeping and Honey Mission (NBHM)

To realize the objectives of the "Sweet Revolution," there was a recognized need for the comprehensive development of beekeeping. In response, the Government of India approved the Central Sector Scheme (CSS) known as the "National Beekeeping and Honey Mission (NBHM)" to promote and advance scientific beekeeping practices, production of high-quality honey and other beehive products and is being implemented through the National Bee Board (NBB). The mission was introduced as part of the Atma Nirbhar Bharat initiative during the 2020-21 period, focusing on the nationwide enhancement of beekeeping.

Honey Market in India

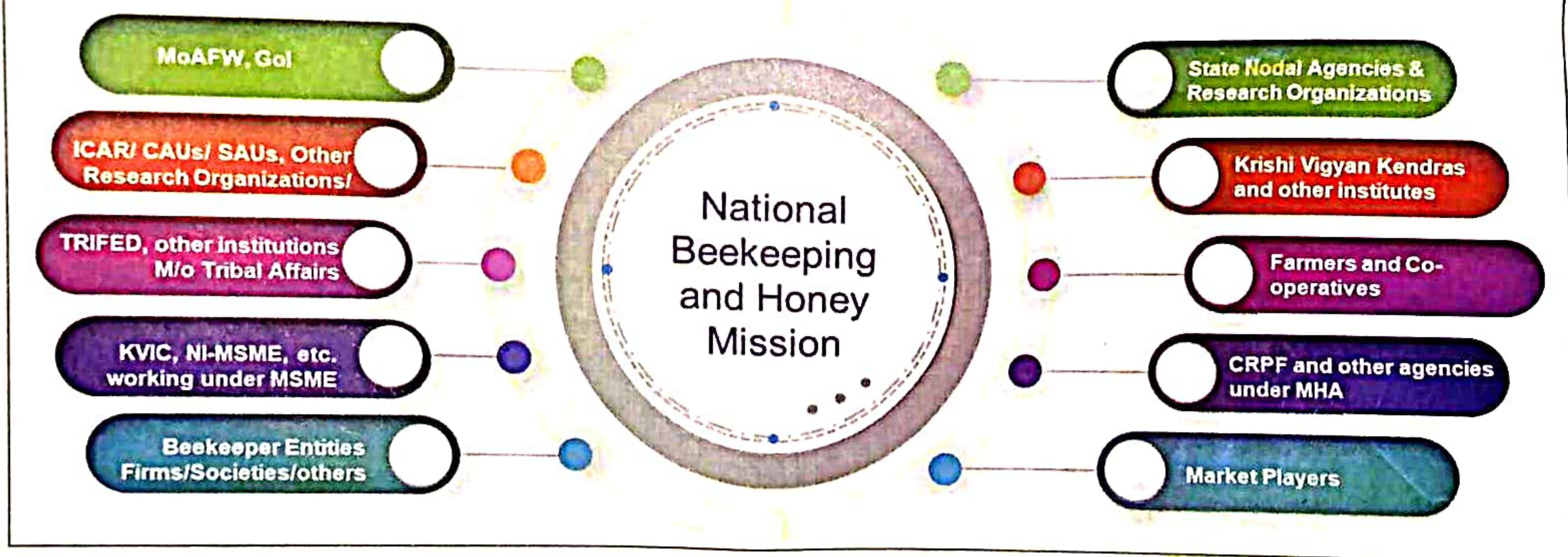
The honey market in India has experienced remarkable expansion over the last ten years, fuelled by a growing awareness of health benefits, an escalating preference for natural sweeteners, and





National Beekeeping and Honey Mission

NBHM Ecosystem



supportive government policies aimed at promoting beekeeping. With its rich heritage in honey production and consumption, India ranks as one of the top producers and exporters of honey globally. According to an IMARC report, the Indian honey market was valued at INR 25.2 billion in 2023 and is expected to exhibit a CAGR of 7.3% during 2024-2032 reaching INR 48.6 billion by 2032, India is one of the top 10 major natural honey exporting countries in the world. During 2019–20, the recorded export of natural honey was 59,536.75 MT for Rs 633 crore. The major export destinations were USA, UAE, Saudi Arabia and Qatar. The demand for organic honey in the international

market could be leveraged for promoting organic beekeeping guidelines.

Capital Infrastructure

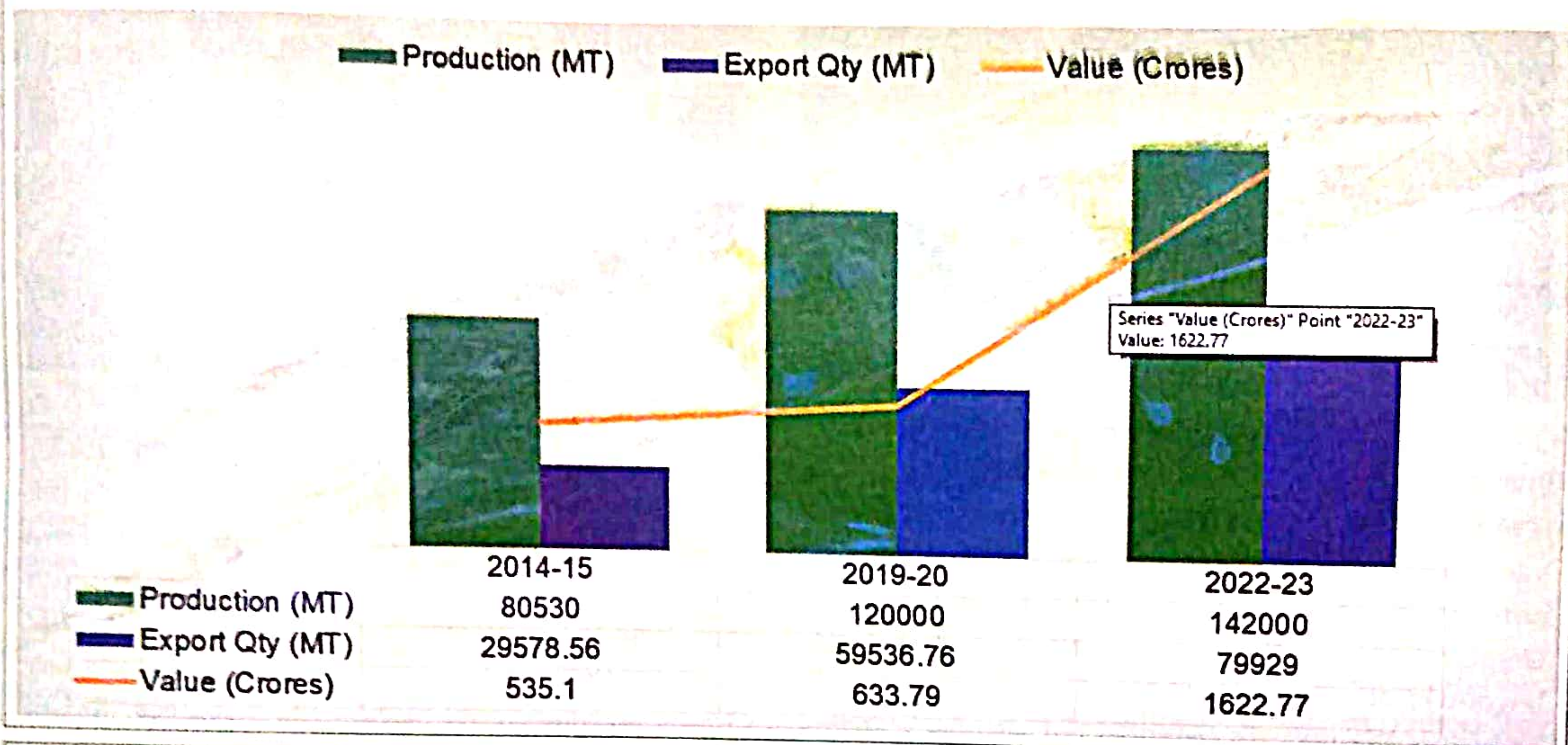
World Class State-of-the-Art Honey Testing Labs have been established, additionally, with more under the anvil, under development. In addition, Mini honey Testing Labs set up ensuring in certification of product, adding value through branding, fetching better prices in the market, to ensure that the production is also robust, NBHM mission has also commissioned Honey processing units set up across multiple states.

Human Capital

In recent efforts to empower communities and enhance skills, over 35,000 individuals have been trained in scientific beekeeping, a fantastic step towards sustainable agriculture. Additionally, more

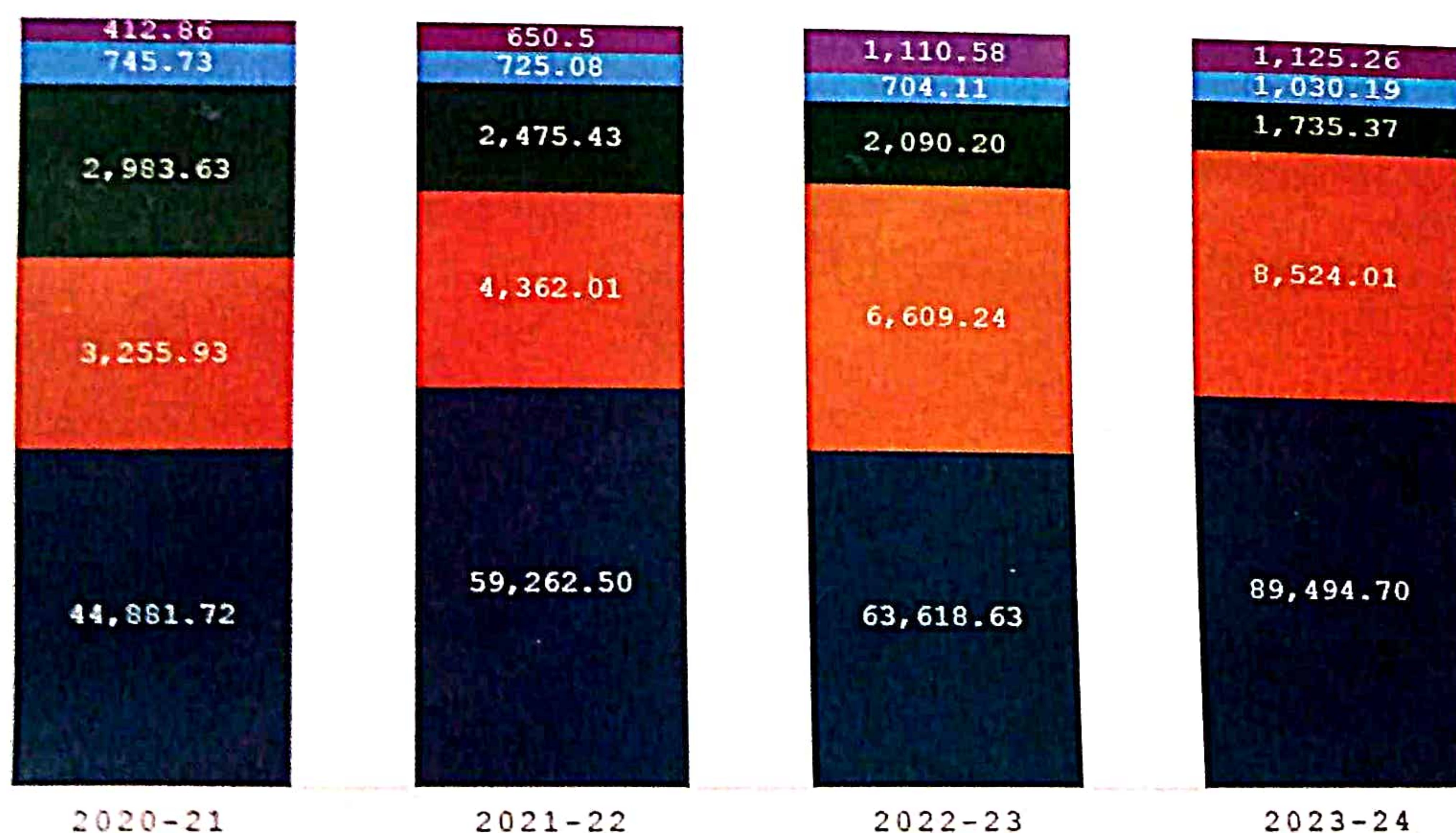
than 5,000 farmers received valuable training from NDDDB, playing a crucial role in the Mission objectives. With a focus on towards women's empowerment, with 72 batches consisting of 25 women each trained through specialized self-help groups. Furthermore, in

Major Achievements of NBHM Mission



Honey Export by country in last 4 years (FY 20-21 to FY 23-24) - (QTY In MT)

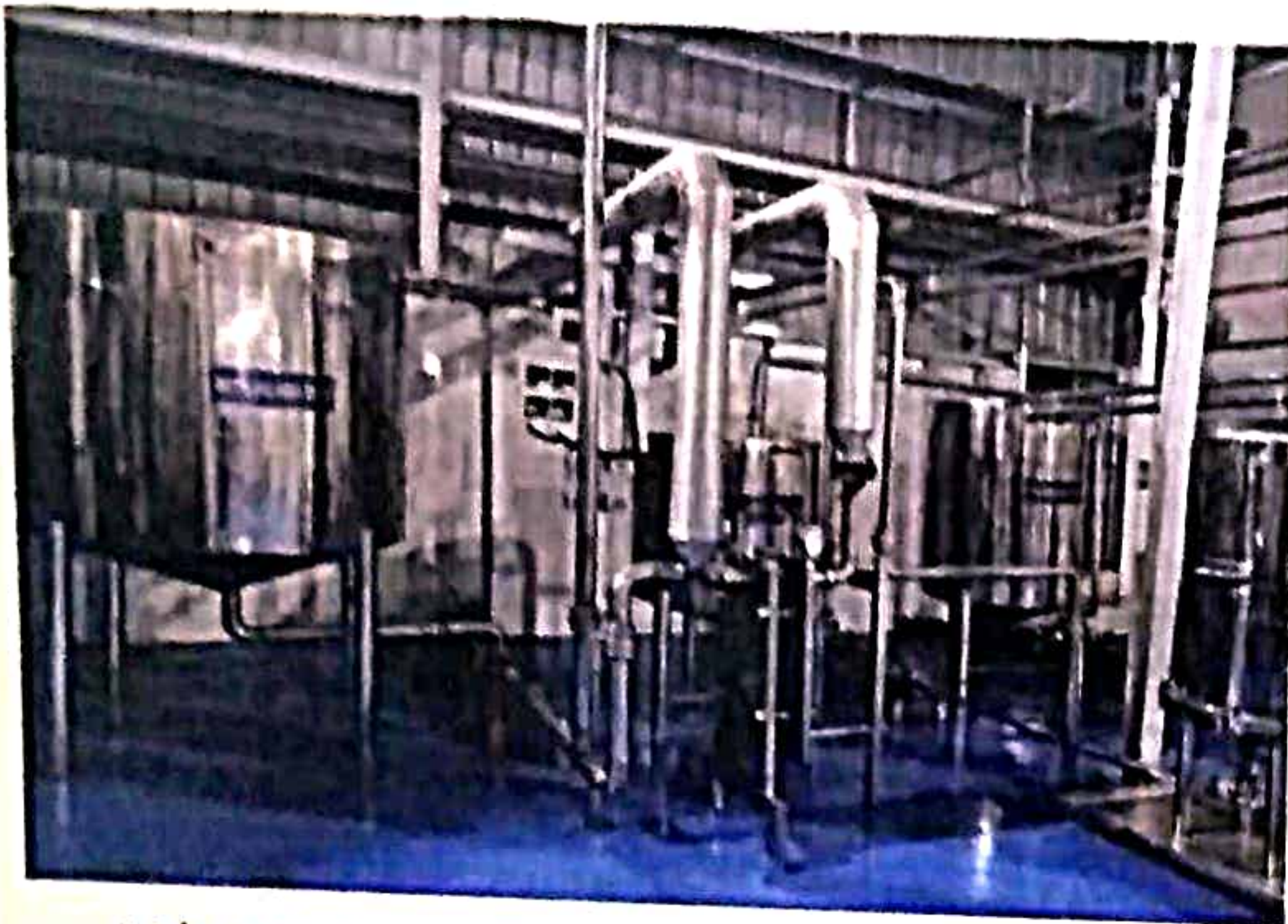
■ U S A ■ UAE ■ Saudi Arabia ■ Qatar ■ Libya



(Source: Agricultural and Processed Food Products Export Development Authority (APEDA))

SUCCESS STORIES

Sweet Success Story from Northeast India



M/s Salt Range Foods has been a beacon of hope and opportunity for local beekeepers. As one of the few commercial-level facility of its kind in the North-east region, it has created a direct market linkage, benefitting about beekeepers, Honey Farmer Producer Organizations (FPOs). This unit's impact extends beyond local communities, the unit showcases not only highlights the region's potential but also underscores the importance of supporting local industries for sustainable growth and recognition.



late 2023, 144 CAPF units saw over 800 master trainers equipped with essential skills. These initiatives not only build capacity but also create a positive re-enforcement in spreading knowledge on scientific beekeeping for community uplifting.

Revolutionizing Beekeeping in High Altitude Regions

High Altitude honey has been receiving a lot of

Empowering Women in Tamil Nadu through Honeybee Rearing



Established under the National Beekeeping & Honey Mission (NBHM) with an outlay of ₹120 lakhs, this initiative has brought remarkable progress to the region. A total of 37 Self-Help Groups (SHGs) have been formed across 13 districts in the state, each consisting of 25 women members. A total of 887 women members have registered and are undertaking various activities such as honeybee rearing, honey production, and nursery management. Training on honeybee rearing has empowered these women, enabling them to sell their products to tourists generating additional income.



buzz lately, with projects launched across six diverse high-altitude states in India. These regions are a home to range of honey varieties, including Acacia, Solai, Jamun, Wild Ajwain, and Alfalfa honey, each with its unique flavor and benefits. To support this growing interest, several initiatives have been set up, like mini testing labs in Bandipora, Pulwama, Kupwara, and Ramban, alongside honey processing and testing

units in Uttarakhand and Assam along with disease diagnostic labs in Himachal Pradesh and Uttarakhand, and capacity-building programmes in Assam and Sikkim aimed at empowering local beekeepers along with research studies delving in the can provide valuable insights on aspects into beekeeping.

Such sustained initiatives will help in establishing a diverse ecosystem of bee-friendly flora and bee species across high altitude areas, the development of infrastructure such as bee breeding facilities, bee disease diagnostic labs, and equipment manufacturing units. Furthermore, capacity building programmes have contributed to the comprehensive growth and development of local communities, while promoting high altitude honey within mainstream domestic markets.

Digital Initiatives

Madhukranti Portal launched in 2021, to achieve traceability of honey as well as registration of beehive products on the digital platform. More than 20 lakhs colonies and 15,000+ beekeepers have registered in portal. This portal allows registrations of Processing Units / Traders / Aggregators / Exporters, uploading photos of bee-colonies with geo-coordinates, Insurance support to beekeepers for INR 1 lakh.

Further, Open Network for Digital Commerce (ONDC), an inclusive e-commerce initiative of Department of Promotion of Industry and Internal trade (DPIIT), under Ministry of commerce has embarked in bringing together shoppers, technology platforms, and retailers all under one roof. ONDC also has honey based FPOs with uploaded with products, expand from input business to value added business, in achieving higher e-commerce revenues.

Policy Initiatives

MEP - Safeguarding Domestic Honey Industry

Directorate General of Foreign Trade (DGFT) released an notification concerning the Minimum Export Price (MEP) as US\$ 2,000 F.O.B per Metric Tonne (PMT) for honey exports, extending the previously established deadline of December 31, 2024, to December 31, 2025, designed to prevent price undercutting in the international arena, thereby fostering fair trade practices and safeguarding the domestic honey industry from price fluctuations and underscores the government's commitment to regulating the honey export sector.

Quality Standards

Three (3) Quality Standards in Honey established under FSSAI namely honey, bee-wax and royal jelly.



Royal Jelly

Price : 15,000- 20,000/Kg



Honeybee Propolis

Price : 2,000- 5,000/Kg



Bee Venom

Price : 80 lakh - 1 crore/Kg



Beeswax

Price : 1,000- 1,500/Kg



Bee pollen

Price : 2,000- 3,000/Kg



Comb honey

Price : 8,00-2,000/Kg

Source : India mart/ Exportersindia.com

FSSAI has notified operationalization of revised standards for honey in accordance with the Food Safety and Standards in 2020. In order to adequately meet these challenges, NBHM has embarked on setting up world class infrastructural facilities like setting up of State-of-the-Art Quality Control Labs for testing of honey & other beehive products at Regional Levels and Mini Labs at main honey producing Districts/ states, also getting NABL accredited labs which will test Indian honey will help in consumers an assurance of accessing quality honey, and will raise the bar for Indian honey in global markets.

Tapping Export Potential of Value Addition Products

Honey remains the most significant primary product from beekeeping, however there is an emerging demand for value-added items such as beeswax, pollen, propolis, royal jelly, and bee venom in International markets. Royal Jelly commands high prices in the international market, sold as a dry powder in capsules or blended with honey. Bee Pollen is recognized as a super food and quickly reaching favorable prices in the market, with significant potential.

Bee Venom, known to contain anti-inflammatory, anti-viral properties and is used as an essential

ingredient especially to treat arthritis is so expensive that one gram would cost between Rs 5,000 and 15,000. Similarly, products like propolis helping heal minor wounds, promoting oral hygiene, aiding inflammation, and treating cold sores. Beeswax is used in lip balm, hand creams moisturizers; and in cosmetics such as eye shadow, blush, and eye liner making it a valuable ingredient in the cosmetic sector.

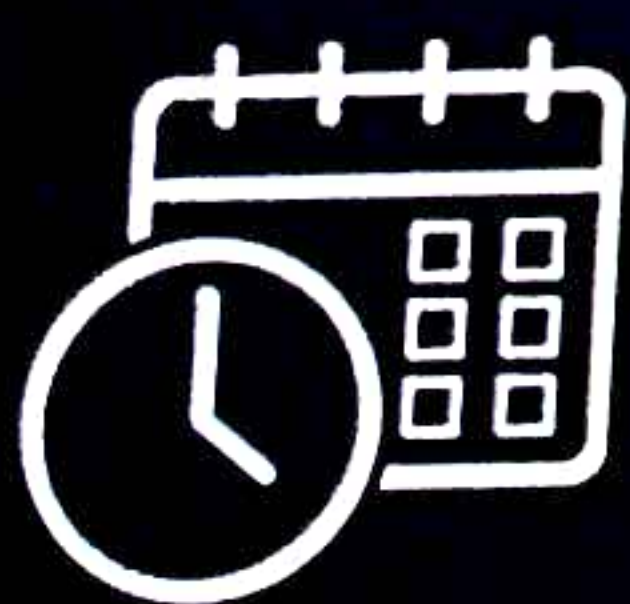
Future Roadmap

India's diverse climate, distinct geographical terrains, soil varieties and agro-climatic zones contribute to a remarkable array of honey types produced by different species of honeybees. Currently, there is a concerted effort underway to analyze Indian honey in terms of its composition, metabolites, and potential therapeutic benefits. Addressing this issue through chemical fingerprinting and honey profiling, along with geographical indication (GI) tagging, could significantly enhance the livelihoods of beekeepers and serve the broader national interest. Also, focusing on the value-added products of honey, establishing robust market linkages between the farmers, traders, processors and exporters will help in creating a productive partnership for the sector. □

GEOGRAPHY

Online / Offline

JUNE & JULY BATCHES



Morning (9.30)
Evening (6.00)

Course Coverage

- Course Duration 5.5 months (daily classes)
- Online / Offline classes (Live Lecture)
- Individualistic Mentorship
- Course Begins with fundamentals of NCERT
- 19 Tests/ Answer Writing practice included
- Complete syllabus taken by Neetu Singh



UNPARALLED STANDARDS

UPSC TOPPERS SINCE

2010 AIR 5	2017 AIR 5
2011 AIR 5	2018 AIR 5
2012 AIR 6	2019 AIR 6
2013 AIR 7	2020 AIR 7
2014 AIR 5	2021 AIR 4
2015 AIR 20	2022 AIR 41
2016 AIR 4	2023 AIR 98



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Clean Plant Programme Revolutionizing Indian Horticulture

The Clean Plant Programme is set to revolutionize India's horticulture sector by providing farmers with access to virus-free, high-quality planting material, regardless of their landholding size or socio-economic background. With its comprehensive strategy, the Clean Plant Programme marks a transformative step toward building a more sustainable, productive, and prosperous future for Indian horticulture, ensuring farmers, consumers, and the economy all benefit from enhanced horticultural practices.

***Dr. Shashi Bhushan**



India's horticulture sector, with its vast diversity of climate and soil conditions, has long been a cornerstone of the nation's agricultural landscape. As the second-largest producer of fresh fruits and vegetables globally, only behind China, India holds immense potential to meet both domestic and international demand. However, to sustain and expand this leadership, the sector faces the challenge

of enhancing crop quality, boosting productivity, and ensuring long-term sustainability. Recognizing the need for strategic intervention, the Union Cabinet made a groundbreaking decision on August 9th, 2024, by approving the Clean Plant Programme (CPP) under the Mission for Integrated Development of Horticulture (MIDH), with an investment of Rs. 1,765.67 crore.


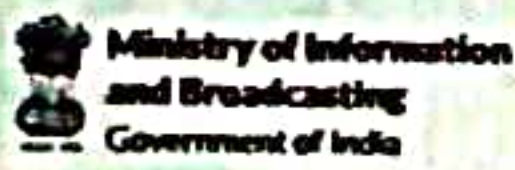
The Clean Plant Programme is set to revolutionize India's horticulture sector by providing farmers with

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access to virus-free, high-quality planting material, regardless of their landholding size or socio-economic background. This inclusive approach aims to level the playing field, especially for small-scale and marginalized farmers, empowering them with the tools needed to thrive in an increasingly competitive agricultural environment. By improving the quality of planting material, the CPP promises to enhance crop yields, reduce plant disease-related losses, and strengthen long-term food security for India.

In addition to providing better access to planting material, the CPP will streamline the certification processes and offer targeted infrastructure support to nurseries. The programme plans to establish nine state-of-the-art Clean Plant Centres across India, which will serve as hubs for research, development, and distribution of clean plant material. These facilities will introduce cutting-edge horticultural technologies, helping farmers access advanced solutions for cultivating healthy and productive crops. The programme also takes into account the country's diverse agro-climatic conditions, focusing on developing region-specific clean plant varieties to help farmers adapt to local environmental challenges.


This integrated approach will not only increase productivity but will also make Indian agriculture more resilient to the impacts of climate change, ensuring that the sector remains viable and sustainable in the face of evolving weather patterns. The Clean Plant Programme's commitment to improving plant health



KEY CABINET DECISIONS
09th August, 2024

Clean Plant Programme *under*
Mission for Integrated Development of Horticulture

- **Investment:**
₹1,765.67 crore
- **Aims to revolutionise India's horticulture sector**
- **Ensuring enhanced quality and productivity of fruit crops**





KEY CABINET DECISIONS
09th August, 2024

Clean Plant Programme *under*
Mission for Integrated Development of Horticulture

Benefits:

- **Consumers:**
Superior, virus-free produce with enhanced quality
- **Exports:**
Strengthened global export position, increase in market share



and crop quality offers numerous benefits across the horticulture value chain. From farmers who will receive superior planting material to consumers who will enjoy healthier, more nutritious produce, the programme is poised to transform Indian horticulture. By improving the competitiveness of Indian fruit and vegetable exports, the CPP strengthens India's position as a global leader in the sector.

With its comprehensive strategy, the Clean Plant Programme marks a transformative step toward building a more sustainable, productive, and prosperous future for Indian horticulture, ensuring farmers, consumers, and the economy all benefit from enhanced horticultural practices.

Empowering Stakeholders, Enhancing Quality: The Far-Reaching Benefits of the Clean Plant Programme

The Clean Plant Programme (CPP) brings with it a host of significant benefits that extend across various stakeholders in the horticulture sector, including farmers, nurseries, consumers, and the broader export market. Each of these groups stands to gain from the program's strategic interventions, which are designed to foster sustainable growth, improve product quality, and increase market competitiveness.

For Farmers, the most immediate benefit of the CPP is the potential for increased crop yields. By providing virus-free, high-quality planting material, the programme ensures that farmers can grow healthier plants that are less prone to diseases, resulting in better yields. This not only enhances productivity but

also opens up new income opportunities for farmers. Higher-quality produce, free from the constraints of plant viruses, is likely to fetch better prices in the market, directly boosting the income of farmers and improving their financial sustainability in the long run.

For Nurseries, the Clean Plant Programme offers a transformative opportunity. Streamlined certification processes and the provision of infrastructure support will enable nurseries to efficiently propagate clean planting material at a larger scale. This will ensure that nurseries can meet the growing demand for high-quality plants and contribute to a more robust horticulture sector. Additionally, the program's emphasis on sustainability will help nurseries grow in a manner that benefits both their business and the environment, encouraging eco-friendly practices and long-term viability.

For Consumers, the benefits are equally substantial. With the widespread adoption of the CPP's virus-free plants, consumers will have access to superior produce that is not only free from harmful pathogens but also enhanced in taste, appearance, and nutritional value. This means that fruits will not only be safer to eat but also more flavorful and nutritious, offering a more satisfying and healthy food experience for Indian households.

On the global stage, the Clean Plant Programme holds significant promise for India's export market. By ensuring that the country's fruit crops meet the highest standards of quality and disease-free certification, India will be better positioned to strengthen its presence in

the international fruit trade. As demand for premium, virus-free produce rises worldwide, India stands to gain a competitive edge in the global market. This will not only expand export opportunities but also increase the country's share of the international fruit trade, positioning India as a key player in global agriculture.

Hence, the Clean Plant Programme offers a holistic approach that benefits all stakeholders in the horticulture value chain. From farmers and nurseries to consumers and global markets, this initiative promises to create a more resilient, productive, and sustainable horticultural ecosystem in India.

Building a Robust Future: Core Components Driving the Clean Plant Programme

The Clean Plant Programme (CPP) is underpinned by several core components designed to establish a robust infrastructure for the propagation of high-quality, virus-free planting material across India. One of the key pillars of the CPP is the establishment of Clean Plant Centres (CPCs), which will serve as state-of-the-art facilities dedicated to the production and certification of clean plant material for various fruit crops.

A total of nine advanced CPCs will be strategically located across India, with each centre focusing on specific fruit types. These centres will be equipped with cutting-edge diagnostic and therapeutic facilities, including tissue culture laboratories, to ensure the propagation of virus-free plants. The CPCs will play a crucial role in maintaining the health and integrity of planting material, acting as hubs for research, development, and the distribution of clean plants to farmers nationwide.

The Clean Plant Centres will be situated at key agricultural institutions across the country, with each one specializing in a particular type of fruit. For instance, Grapes will be handled by the National Research Centre (NRC) in Pune, while Temperate Fruits such as Apples, Almonds, and Walnuts will be managed at the Central Institute of Temperate Horticulture (CITH) in Srinagar and Mukteshwar. The Citrus Fruits sector will be supported by the Central Citrus Research Institute (CCRI) in Nagpur and the Central Institute for Arid Horticulture (CIAH) in Bikaner. Other centres will focus on crops like Mango, Guava, Avocado, and Litchi, with dedicated centers in Bengaluru (Indian Institute of Horticultural Research, IIHR), Lucknow (Central Institute for Subtropical Horticulture, CISH), and Pomegranate at



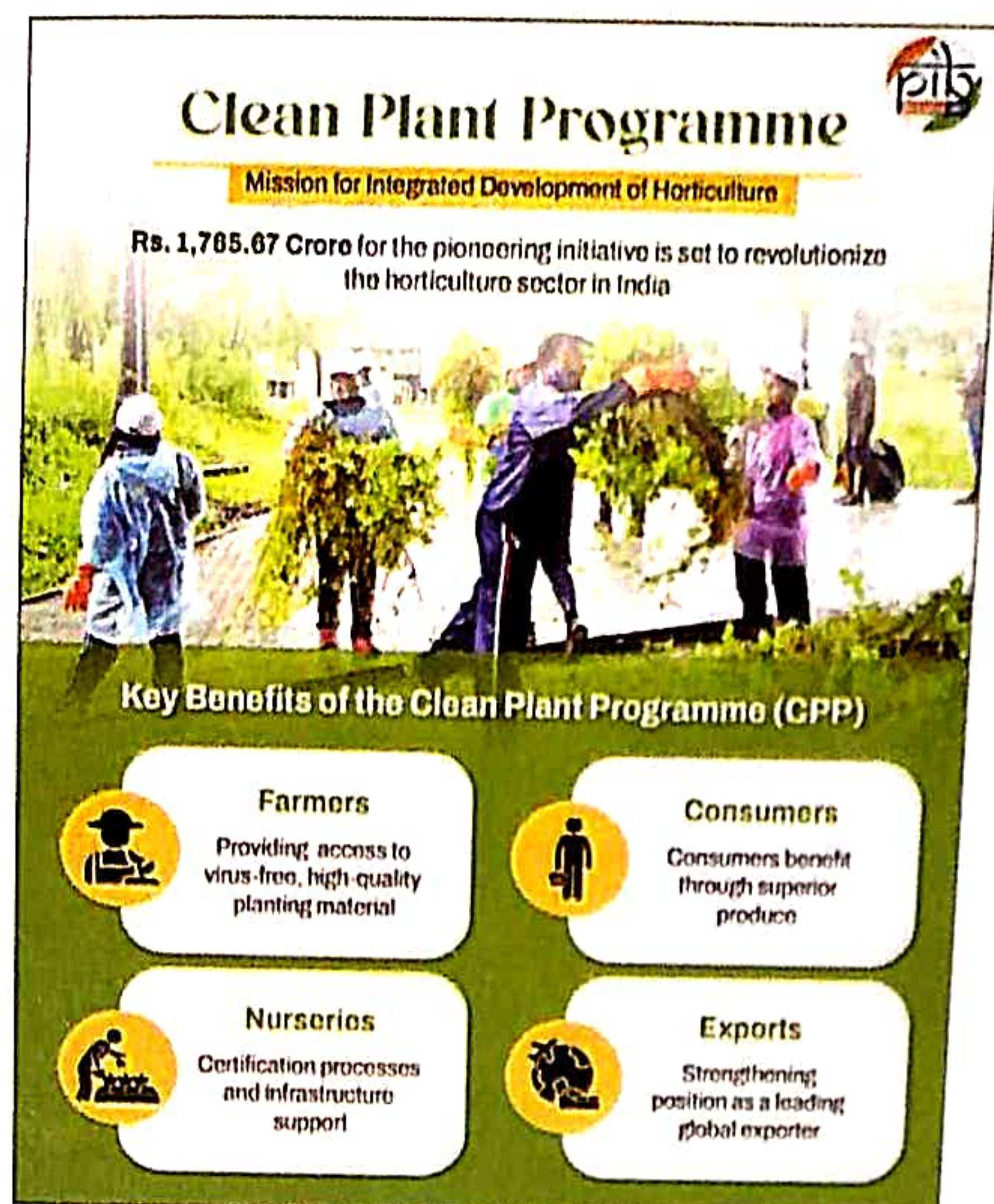
KEY CABINET DECISIONS
09th August, 2024

Clean Plant Programme *under*
Mission for Integrated Development of Horticulture

Benefits:

- Farmers:**
Access to virus-free, high-quality planting material
- Nurseries:**
Streamlined certification & infrastructure support





the NRC in Sholapur. Additionally, the programme will also support tropical and sub-tropical fruits in Eastern India, ensuring that diverse agro-climatic conditions are addressed with region-specific varieties and technologies.

These specialized centres will be instrumental in ensuring that India's horticulture sector can access the highest-quality, disease-free planting material for a wide range of fruit crops. By strengthening the infrastructure and scientific capabilities of these CPCs, the Clean Plant Programme aims to lay a solid foundation for sustainable, high-yielding horticulture that benefits farmers, consumers, and the broader agricultural economy.

Ensuring Quality and Traceability: Strengthening the Certification and Legal Framework

A key element of the Clean Plant Programme (CPP) is the establishment of a robust certification and legal framework to ensure the quality and traceability of planting material. Under the Seeds Act of 1966, a certification system will be implemented to hold producers and distributors accountable, ensuring that farmers receive virus-free, high-quality seedlings. This system will enforce clear standards and maintain records, creating a transparent mechanism for plant material production and sale.

In parallel, the CPP will enhance infrastructure in large-scale nurseries, vital to the horticulture value chain. Targeted support will improve facilities

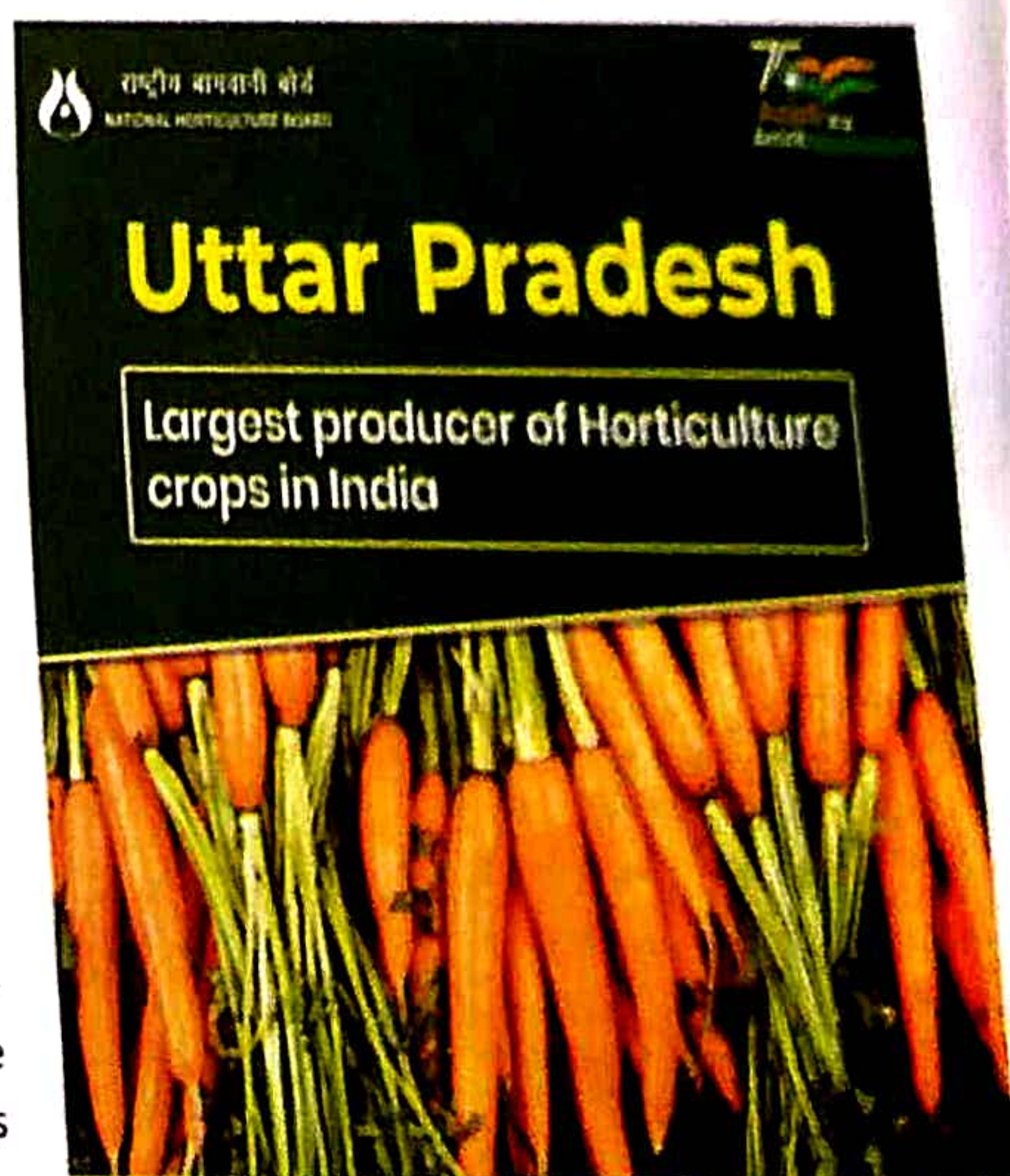
for propagation, storage, and distribution, enabling nurseries to efficiently supply clean planting material at scale. These infrastructure upgrades will enhance efficiency, sustainability, and quality control, ensuring farmers have access to healthy planting material for increased crop yields.

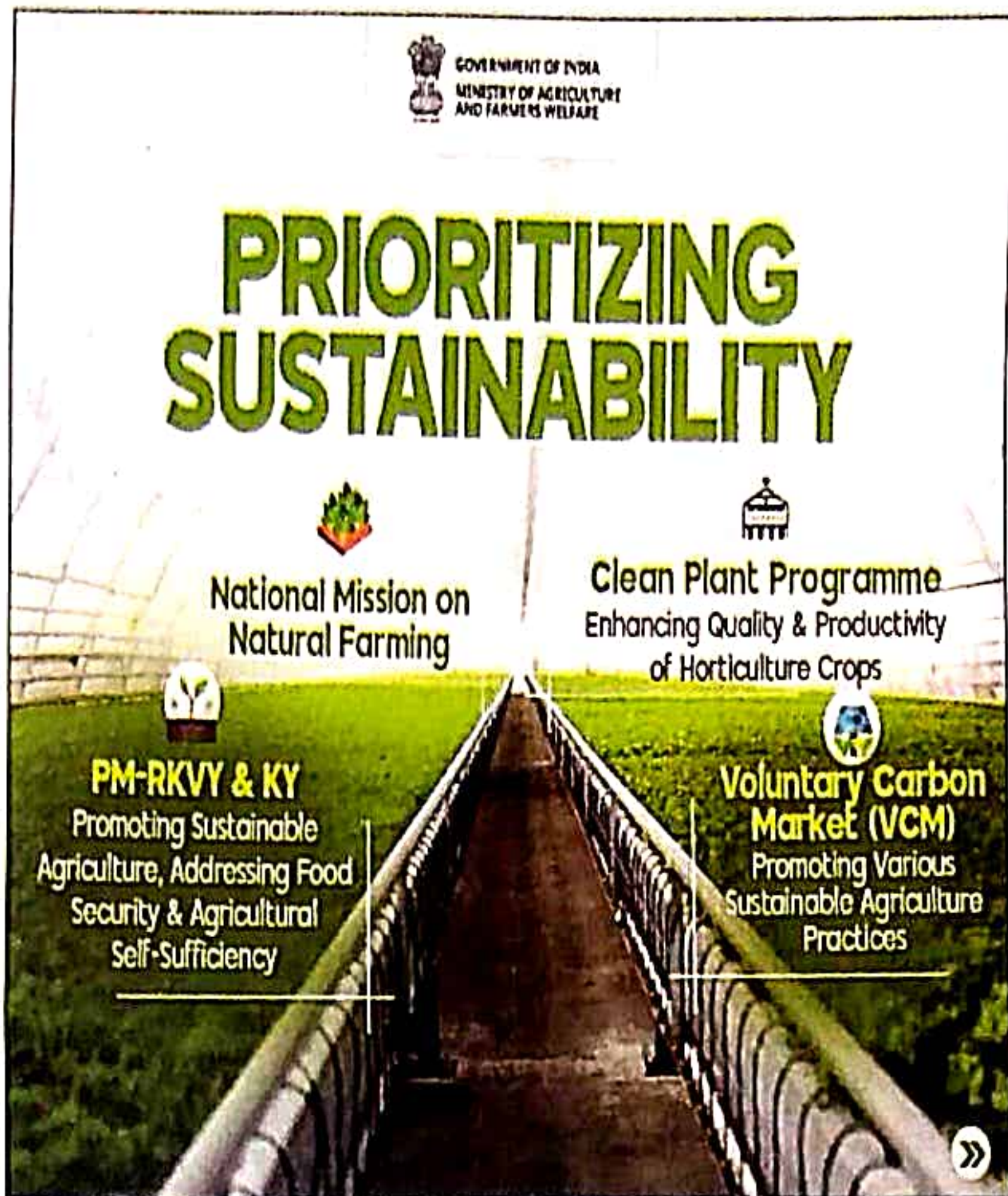
Together, the regulatory framework and infrastructure development will establish a cohesive system, ensuring the widespread availability of clean plant material and reinforcing sustainable agricultural practices.

Synergizing Growth: Integrating CPP with MIDH for Sustainable Horticulture

The Clean Plant Programme aligns seamlessly with the Mission for Integrated Development of Horticulture (MIDH), a flagship initiative launched by the Government of India in 2014-15 to promote the holistic growth of the horticulture sector. While MIDH addresses cultivation, infrastructure, and post-harvest management across a broad range of crops, the CPP focuses specifically on enhancing the quality of planting material, particularly for fruit crops.

MIDH supports diverse crops such as fruits, vegetables, spices, and more, while the CPP emphasizes providing clean, virus-free planting material. This targeted approach addresses critical plant health issues, directly impacting productivity and sustainability in horticultural farming. The integration of the two programs strengthens India's horticulture sector by





ensuring high-quality planting material is available to farmers, thus improving yields and contributing to long-term agricultural growth.

Together, the CPP and MIDH form a comprehensive strategy to elevate India's horticulture sector, creating a more resilient, sustainable ecosystem that benefits farmers, consumers, and the economy.

Transforming Horticulture: Key Initiatives Under MIDH for a Sustainable and Resilient Future

Under the Mission for Integrated Development of Horticulture (MIDH), several transformative measures are being implemented to foster the growth and sustainability of India's horticulture sector. These initiatives focus on improving the infrastructure, productivity, and market access for farmers, creating a more resilient and productive horticultural landscape across the country.

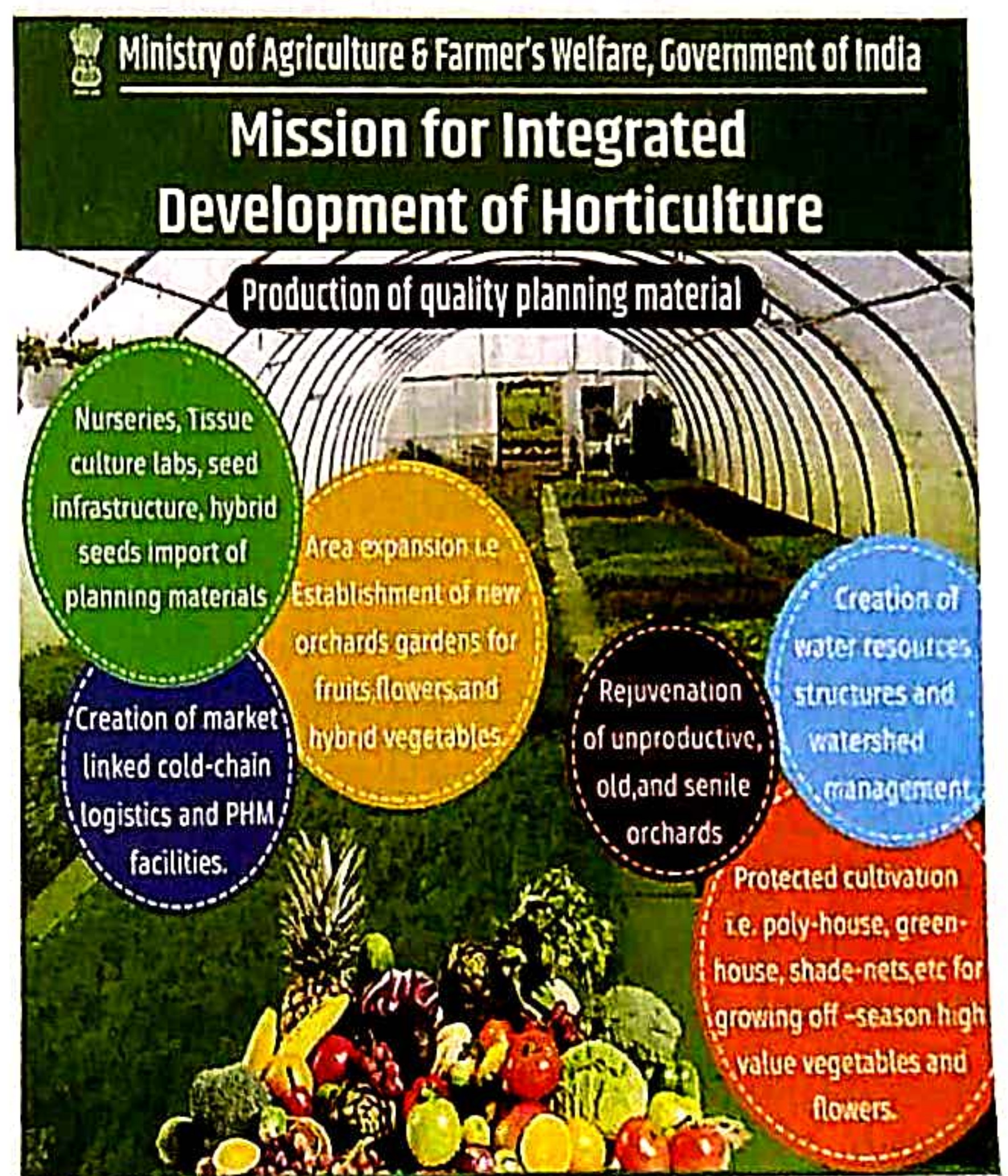
One of the key components of MIDH is Plantation Infrastructure Development, which involves the establishment of nurseries and tissue culture units aimed at producing high-quality seed and planting material. By ensuring that farmers have access to superior planting material, this measure lays the foundation for improved crop yields and healthier orchards. In addition to infrastructure development, Area Expansion is being prioritized, with efforts focused on creating new orchards and gardens for various crops, including the integration of advanced technologies like drip irrigation to ensure efficient water use and

improved crop productivity.

Rejuvenation is another critical focus area under MIDH, with programs designed to revitalize old, unproductive orchards. This initiative helps extend the productive life of orchards, ensuring that they continue to provide valuable yields for farmers. Alongside this, Protected Cultivation is being promoted through the establishment of poly-houses, greenhouses, shade net houses, and walk-in tunnels, which provide a controlled environment for growing high-value crops. These facilities are complemented by micro irrigation systems, which further optimize water use, increase crop output, and improve sustainability.

MIDH also emphasizes Organic Farming by encouraging farmers to adopt organic practices, obtain organic certification, and establish vermi compost units. This helps improve soil health, reduce dependency on chemical inputs, and create a more sustainable farming system. In parallel, the creation of Water Resources is being prioritized, with the development of community tanks, on-farm ponds, and water harvesting systems to ensure a steady supply of water, especially in regions prone to drought or water scarcity.

Pollination Support is another important area under MIDH, with beekeeping programs aimed at producing bee colonies, honey bee hives, and related equipment. This initiative enhances pollination efficiency, leading to better crop yields, particularly for fruits and vegetables that rely on insect pollination. To further improve farm productivity, Horticulture Mechanization programs are



**GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE
AND FARMERS WELFARE**

Post Harvest Management Infrastructure

Assistance can be availed by

- Individuals
- Self Help Groups (SHGs)
- Group of Farmers/Growers/Consumers
- Farmers Producer Organizations (FPOs)
- Agricultural Produce Market Committees (APMC)
- Partnership/Proprietary Firms

Follow for more info: 



providing farmers with modern equipment like power tillers, tractors, and plant protection tools, making farming more efficient and reducing labor costs.

MIDH also focuses on Human Resource Development through a variety of programs, including awareness campaigns, farmer training sessions, exposure visits, and study tours. These initiatives empower farmers with the knowledge and skills they need to adopt new technologies and improve their farming practices. In addition, Post-Harvest Management (PHM) Infrastructure is being developed, with facilities like cold storage, pack houses, ripening chambers, reefer vehicles, processing units, and food processing facilities being set up, particularly in the North Eastern States. These investments ensure that farmers can store, process, and transport their produce efficiently, reducing post-harvest losses and improving the quality of fresh produce in the market.

Finally, Marketing Infrastructure is being developed to improve farmers' access to markets. This includes the creation of static and mobile vending carts, retail outlets, rural markets, and wholesale markets, along with the establishment of direct market platforms that connect farmers with consumers, ensuring fair prices and greater profitability for agricultural products.

Together, these measures under MIDH create a comprehensive, multi-faceted approach to the development of India's horticulture sector. By focusing on infrastructure, sustainable practices, and market linkages, MIDH is paving the way for a brighter,

more prosperous future for Indian farmers and the horticultural industry as a whole.

Empowering Farmers: Promoting Inclusivity and Sustainability Through the Clean Plant Programme

The CPP prioritizes inclusion and sustainability, aiming to provide affordable access to clean, virus-free planting material for all farmers, regardless of landholding size or socio-economic background. This ensures that even small-scale and marginalized farmers can improve productivity and income, fostering equitable growth in the horticulture sector. The programme also empowers women farmers by actively involving them in planning, resource access, training, and decision-making, promoting gender equality in agricultural development.

Furthermore, recognizing India's diverse agro-climatic conditions, the CPP takes a region-specific approach, developing clean plant varieties and technologies tailored to local environmental challenges. This strategy maximizes productivity and sustainability, benefiting farmers across the country.

In essence, the CPP combines enhanced plant health and productivity with a strong commitment to inclusivity and environmental sustainability, paving the way for a more resilient and equitable future for Indian horticulture.

Fostering Sustainability: CPP's Synergy with National and Global Environmental Initiatives

The CPP plays a crucial role in India's horticulture sector while aligning with national and global environmental initiatives like Mission LiFE (Lifestyle for Environment) and the One Health approach. This alignment strengthens India's commitment to sustainability, environmental stewardship, and holistic well-being.

The CPP supports Mission LiFE's goal of promoting sustainable lifestyles by encouraging farming practices that reduce reliance on harmful chemicals. By providing virus-free, high-quality planting material, the programme enables healthier crops that require fewer chemical inputs, thus minimizing the ecological footprint of agriculture and fostering long-term environmental sustainability.

Similarly, the CPP aligns with the One Health approach, which emphasizes the interconnection between human, animal, and environmental health.



By ensuring healthy, virus-free plants, the programme not only protects the environment but also safeguards human health and food security. Fewer crop diseases and reduced chemical use contribute to a healthier ecosystem and a more resilient agricultural sector.

Additionally, the CPP enhances India's self-reliance by reducing dependence on imported planting materials. By developing region-specific clean plant varieties and fostering local production, the programme strengthens domestic agriculture, reduces vulnerability to global supply chain disruptions, and positions India as a potential leader in global fruit production and export.

Thus, the CPP's alignment with Mission LiFE and the One Health approach underscores its role in promoting sustainable, healthy, and resilient agricultural practices. By reducing import dependency and supporting India's position in global markets, the programme paves the way for a prosperous, sustainable future for Indian horticulture.

Collaborative Leadership: Ensuring Success Through Strategic Implementation and Oversight

The CPP will be implemented and overseen by the National Horticulture Board (NHB) in collaboration with the Indian Council of Agricultural Research (ICAR). This strategic partnership combines NHB's extensive horticultural network and ICAR's research expertise, ensuring the program's objectives are achieved efficiently. NHB will lead the coordination, while ICAR

will contribute to the development of clean plant technologies, varieties, and best practices, fostering growth and sustainability in India's horticulture sector.

Through this collaboration, the CPP will ensure the availability of high-quality, virus-free planting material, boosting the productivity and quality of horticultural crops across the country. This comprehensive, science-driven approach will enhance both the quantity and quality of India's fruit production, benefiting farmers, consumers, and the global market. The programme will help India strengthen its position as a global leader in horticulture, creating new opportunities for fruit exports.

Conclusion: A Transformative Step Towards Sustainable Horticulture

The Clean Plant Programme (CPP) stands as a pivotal initiative that promises to reshape the future of India's horticulture sector. By ensuring access to high-quality, virus-free planting material, the programme addresses critical challenges of crop health and productivity, driving sustainability and resilience. Through its inclusive approach, it empowers farmers of all sizes, including marginalized groups, and strengthens India's competitive edge in the global market. Supported by cutting-edge infrastructure and a robust certification framework, the CPP will not only enhance domestic production but also increase export potential, positioning India as a global leader in horticulture. □



Food Processing of Horticultural Crops

Food processing has a critical role in achieving food and nutrition security. It is required to increase the shelf life of foods and is of utmost importance for perishable commodities like fruits and vegetables to optimize nutrient availability and food quality, and reduce losses and waste. India is the sixth largest food and grocery market in the world and food processing industry contributes 32% to this food market.

***Dr Harender Raj Gautam**

****Dr H.L. Sharma**

Food processing involves the intentional transformation of any food item from its raw or natural state into a consumable or more durable form. The ultimate objectives include preparing foods for consumption, preservation by slowing or stopping decay to extend shelf life, ensuring safety, and enhancing taste and nutritional profiles. India is the 2nd largest producer of fruits and vegetables in the world with a share of 11.7 and 17.8 per cent, respectively and had a record horticultural production of 355.48 million tonnes in 2022-23. Most

of the horticultural produce like fruits and vegetables are perishable due to short shelf life resulting in huge post-harvest losses. In a study conducted by Indian Council of Agricultural Research-Central Institute of Post-Harvest Engineering and Technology in 2015, 6.7-15.8 per cent of the fruits and 4.5 – 12.4 per cent of vegetables produced in the country are lost due to poor post-harvest handling. National Bank for Agriculture and Rural Development, in its report in 2020, also corroborated this fact that post-harvest handling is responsible for 20-30 per cent of losses, which amounts to Rs. 1,52,000 crores, across various stages, including

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storage, grading, packaging, shipping, and marketing, whether as fresh produce or in processed form. These losses primarily occur in the farmer's field (15-20 per cent), during packaging (15-20 per cent), transportation (30-40 per cent), and marketing (30-40 per cent). Thus, food processing has a critical role in achieving food and nutrition security. Fresh fruits and vegetables contain many vitamins, minerals, dietary fibre, and other nutrients and are an important part of the human diet. The World Health Organization recommends an average daily intake of at least 400 g of fruits and vegetables, significantly reducing the risk of chronic diseases, controlling body weight, and improving intestinal health. Food processing is required to increase the shelf life of foods and is of utmost importance for perishable commodities like fruits and vegetables to optimize nutrient availability and food quality, and reduce losses and waste.

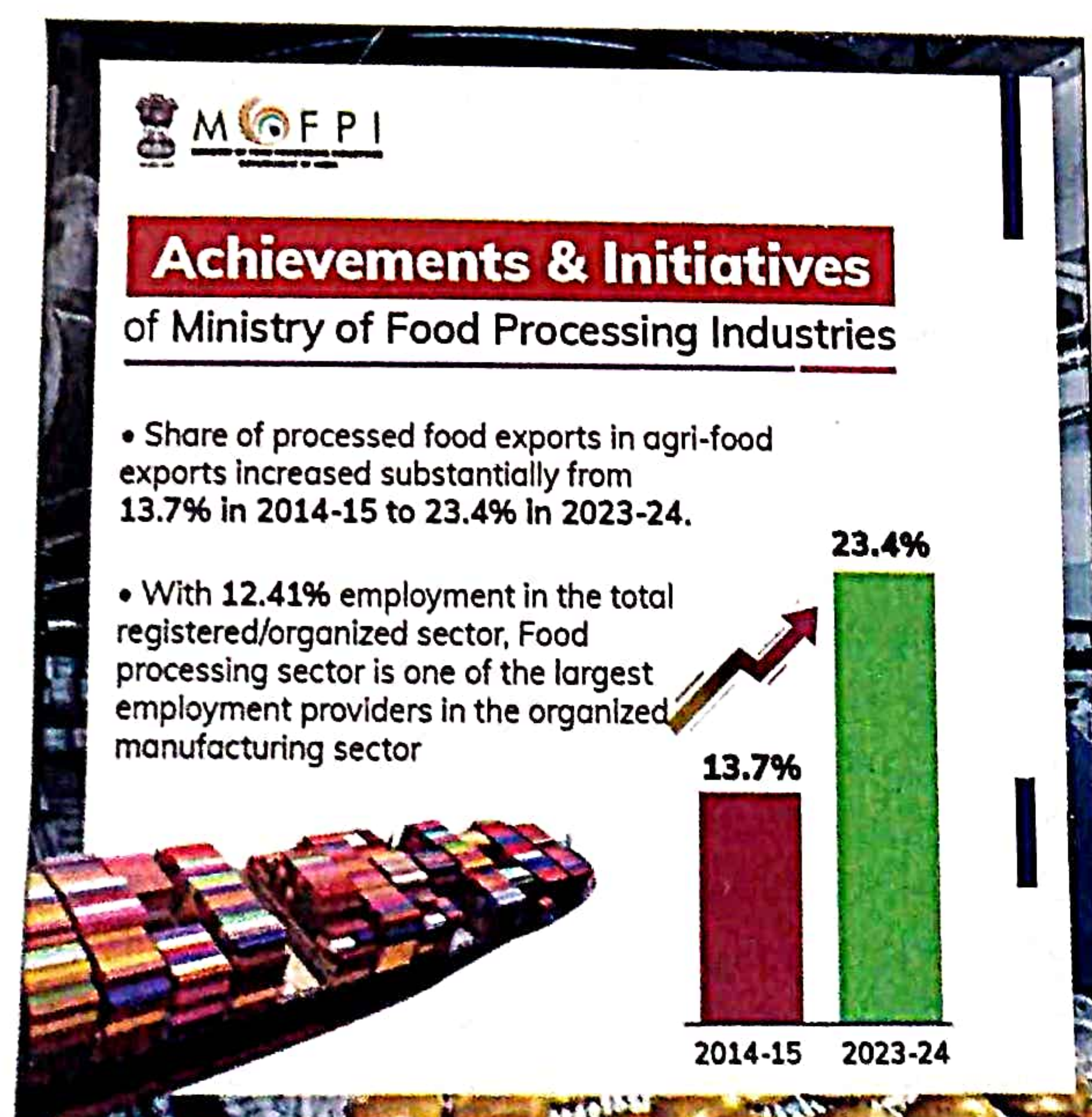
Importance and Scope

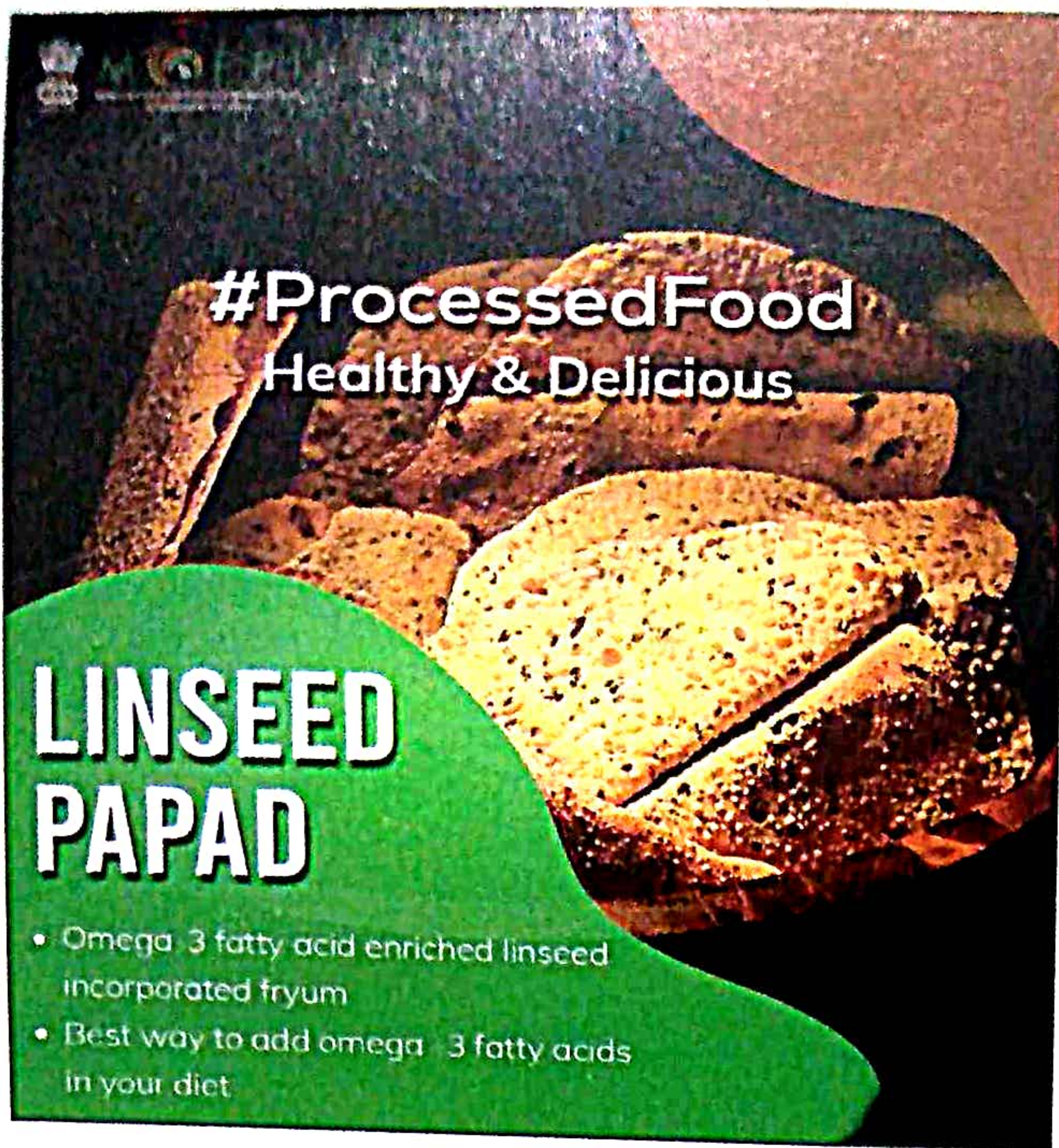
The global market for fruit and vegetable ingredients is estimated at US\$194.1 billion in 2023 and is projected to reach US\$286.8 billion by 2030 and expected to grow from compound annual growth rate (CAGR) of 5.7 per cent from 2023 to 2030. Further, there is an export potential as developed economies import a higher proportion of processed food, comprising about 48 per cent of their total food imports, compared to around 35 per cent for developing economies. The world demand for processed vegetables in the year 2022 was 28.3 million MT by volume and valued at 40 billion USD.



Major importing countries are the USA, Germany, UK, France, Japan, China, Belgium, Netherlands and Italy.

India is the 6th largest food and grocery market in the world and food processing industry contributes 32 per cent to this food market. The market size of the food processing sector in India is estimated to reach US\$1,274 billion in 2027 from US\$866 billion in 2022. Food processing industries also contributes 13 per cent to total export and 6 per cent to the industrial investment. The growing consumption of food is expected to reach US\$1.2 trillion by 2025-26, owing to urbanization and changing consumption patterns. However, food processing levels remain significantly lower in India in comparison to global standards. India currently processes less than 10 per cent of its agricultural output which comprises only around 2 per cent of fruits and vegetables, 6 per cent of poultry, 21 per cent of meat, 23 per cent of marine and 35 per cent of milk. Further, the share of India's high-value and value-added agricultural produce in its agriculture export basket is less than 15 per cent, compared to 25 per cent in the US and 49 per cent in China. The Indian Fruit Juice Market is expected to grow at a robust 7.76 per cent CAGR, reaching a market size of US\$537.172 million in 2030 from US\$369.703 million in 2025. Horticulture industry is one of the big resource and raw material for food processing. This sector constituted 10.54 and 11.57 per cent of Gross Value Added (GVA) in manufacturing and agriculture sector, respectively in





still a noticeable gap between the world's demand and supply from India. India exported processed vegetables worth USD \$526.93 million, equivalent to 409,699 MT in the year 2022. India's major export destinations for processed vegetables include the USA, UK, Germany, Spain, and the Netherlands.

Employment generation has been the significant outcome of the growth of this sector, directly employing about 20.05 lakh people across 40,579 registered food processing factories. Food processing sector is one of the largest employment providers in the organized manufacturing sector with 12.41 per cent employment in the total registered/organized sector as per the report of Annual Survey of Industries (ASI), 2022-23. The Southern region of India dominates the food processing sector with the highest 5348 registered factories in Andhra Pradesh which accounts for about 14.3 per cent of the total units in India, followed by 4764 in Tamil Nadu with share of 12.7 per cent, 3598 in Telangana with share of 9.6 per cent. Punjab has 3200 units with share of 9 per cent followed by Maharashtra having 2509 units with share of 7.0 per cent. Telangana, Tamil Nadu, Andhra Pradesh, Karnataka, and Kerala contribute significantly to the nation's exports accounting for 48 per cent by volume and 41 per cent by value of India's processed fruits, juices, and nuts exports.

New Technologies in Food Processing

Modern technologies are becoming a key element of food processing sector, introducing innovations that not only has potential to increase production efficiency but also shape new standards of food quality and safety. Many of these technologies are green food processing technologies which focus on using renewable resources, reducing waste, and cutting down on energy use. Green techniques such as freeze-drying, high-temperature short-time (HTST) processing, decaffeination, aseptic packaging, and food irradiation are revolutionizing the industry.

Non-Thermal Technologies

Among the new, unconventional food preservation technologies, the non-thermal high-pressure method seems to be promising. These non-thermal treatments reduce microbial load present in the food by destroying the cell membranes and genetic material thereby causing disorganization of catabolic and anabolic activities in the food spoiling microorganisms. All these non-thermal treatments can be employed in single or they can be

2020-21 which was ₹1.92 lakh crore in 2022-23. Food processing sector had 1.69 per cent share of GVA in the total GVA of the country in 2019-20. Share of processed food export in agri-food export has gone up to 23.4 per cent in 2023-24 from 13.7 per cent in 2014-15. The total FDI received in the food processing sector since April 2000 till March 2022 was US \$11.08 Billion. In 2023-2024, India's agricultural exports including processed food touched USD \$48.9 billion. India stands as one of the largest exporters of cucumber and gherkins globally, exporting 28 per cent by volume and 25 per cent by value of the global demand between 2020-2022. But there is

Achievements

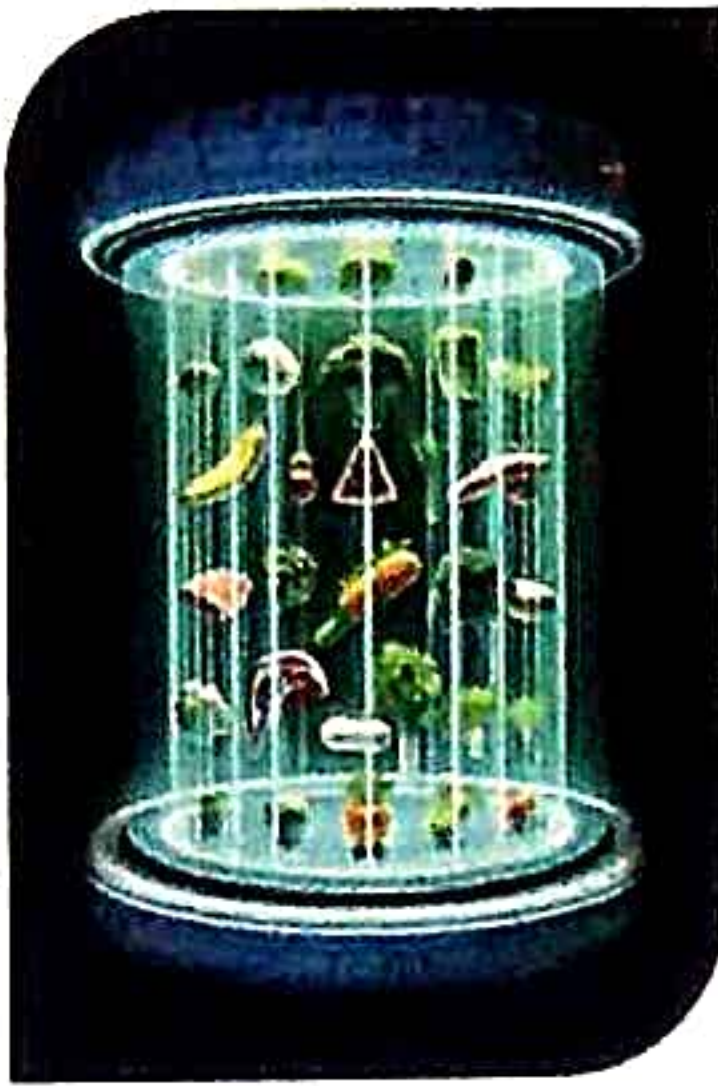
UNDER PRADHAN MANTRI FORMALISATION OF MICRO FOOD PROCESSING ENTERPRISES SCHEME (PMFME)

- A total of 46,643 Loans have been sanctioned under the credit linked subsidy component of the PMFME scheme, since January 2024.
- An amount of Rs. 254.87 crore has been sanctioned as seed capital assistance to 71,714 Self Help Group (SHGs) members.
- 2 Incubation Centres approved and 11 Incubation Centres have been completed/inaugurated/commissioned during the period providing product development support to grass-root Micro Enterprises.
- 4 proposals of Marketing & Branding have been approved to provide branding support to the micro enterprises

Year End Review 2024



NEW TECHNOLOGY IN FOOD PROCESSING INDUSTRIES #2



IRRADIATION

It is the process by which an object is exposed to radiation. An Irradiator is a device used to expose an object to radiation, notably gamma radiation, for a variety of purposes.

Uses:

1. Sterilisation of army rations and other shelf stable foods.
2. Extension of shelf life of various foods to be distributed and stored at refrigerated temperatures, eg. fresh fish, meats, milk, eggs.
3. Inhibition of sprouting in onions and potatoes, and delay in ripening of fruits.

used in a sequential approach or in amalgamation with each other to bring about maximum damage to food spoiling microorganism. These approaches will increase shelf life of food by utilizing energy efficiently for a fleeting time and keeping nutritional, textural, organoleptic qualities of food intact.

High-Pressure Processing (HPP): High-pressure processing (HPP) is a food pasteurization method where food is subjected to elevated pressures (up to 87,000 pounds per square inch, or 6,000 atmospheres, or 600 MPa), at ambient or chilled temperatures, to alter the food's attributes to achieve consumer-desired qualities. The use of high-pressure processing allows us to kill microorganisms that can cause diseases or spoil food. High-pressure processing method has been shown many advantages over the traditional methods as it reduces rennet coagulation time (RCT) and also improve the cheese yield. Cheeses made from milk treated by this method exhibited higher moisture, salt, and total free amino acid content compared to cheeses made from raw or pasteurized milk.

Cold Plasma Technology (CPT): Cold plasma is a recent technical intervention for maintaining food quality and safety. Cold plasma is generated by electric discharges implemented at various levels of pressure in high-moisture foods, as a vacuum boosts liquid conversion to gaseous phase. This novel method also results in microbial inactivation of foods. CPT is gaining prominence in the food processing industry for its

versatile applications in enhancing food safety and extending shelf life.

Pulse Electric Field Technology (PEF): PEF technology is increasingly used in food processing to deactivate microorganisms and enzymes, thereby extending the shelf life of various products without relying on traditional heat treatments. Pulsed electric fields are extensively used for fluid foods like processing of fruit juices, squash, milk etc. The treatment destroys cell membranes of microorganism in treatment time of less than one second. PEF technology has become a global standard for pretreatment before cutting in the production of French fries and chips, due to its numerous process and quality advantages. PEF softens the potato tissues by discharging cell fluid and reducing turgor pressure, effectively replacing the traditional pre-heater. This change reduces water and energy consumption by up to 90 per cent and avoids heating the product.

In other innovative non-thermal technologies, the use of ultrasound can lead to a shortening of the drying time and temperature, thereby improving product quality while preserving health-promoting compounds. Irradiations are usually preferred for the treatment on solid food material. The ionizing radiations used include high speed electrons, high power photons, X-rays which causes damage to the membranes of microbial cells and the disruption in genetic makeup of cells. Non thermal techniques like ultraviolet light treatment are used



NEW TECHNOLOGY IN FOOD PROCESSING INDUSTRIES #9

FREEZE DRYING

Also termed "lyophilization" it is a drying process where the wet product is first frozen to a solid phase and subsequently dried (typically to a final moisture content of 1-3%) by sublimation of the ice under reduced pressure.



PMFME
PM Formalisation of Micro
food processing
Enterprises Scheme



A SPECIAL INITIATIVE FOR THE DEVELOPMENT
OF MICRO FOOD PROCESSING ENTERPRISES.

**76 Incubation Centers with an
outlay of more than ₹200 crores
have been approved.**

for treating exterior surfaces of raw fruits, processed food, and packaging material. Cold chain logistics and preservation technologies are essential to cutting down on food waste and prolonging the shelf life of perishables. This holds particularly true for meat, dairy, fruits, and vegetables. In addition, ultraviolet light is also used for treating food processing equipment before and after food processing operations.

Food Fortification

Fortification is the addition of key vitamins and minerals such as Iron, Iodine, Zinc, and Vitamins A & D to various food articles such as rice, wheat, oil, milk, salt, etc. to improve their nutritional content. These nutrients may or may not have been originally present in the food before processing or may have been lost during processing. Various technologies aid this process, such as premixing to ensure even nutrient distribution, extrusion for cereals, spray drying for powdered products, encapsulation that helps protect nutrients, especially in fats and oils. Further, emerging nanotechnology techniques also offers potential for better nutrient absorption. World Health Organization (WHO) has recognized food fortification as a safe and cost-effective public health intervention in prevention, reduction and control of micronutrient deficiencies also known as hidden hunger. Globally, over 100 countries, including India, have implemented national salt iodisation programmes, 85 countries have mandated wheat flour fortification, and 32 countries have

mandatory guidelines for fortification of cooking oil.

Artificial Intelligence (AI)

Among the new strategies for maintaining the quality of fresh vegetables and fruits, AI is a potential technology in food processing. Algorithmic models such as artificial neural networks (ANN), convolutional neural networks (CNN), and support vector machines (SVM) have been developed in combination with image processing to detect and score apples, bananas, mangoes, etc. online. Machine learning is being applied to track quality changes in fruits and vegetables during storage and predict remaining shelf life, and provide timely product information to consumers. In addition, AI has also been introduced into the smart cold chain. AI could monitor and record cold chain environmental parameters in real-time. Based on this information, an algorithm model can be established to evaluate the freshness and maturity of fruits and vegetables in cold-chain transportation.


Automation and Robotics in Food Processing: The food processing sector in India is changing as a result of the use of automation and robots, which improves scalability, accuracy, and efficiency. Robotic fruit, vegetable, and grain grading systems minimize human error and guarantee consistency. Automated packaging machines can meet the growing need for both traditional and intelligent packaging solutions since they are fast and precise. Automation lowers labour costs and boosts throughput in a variety of processes, from pulping and juicing in the beverage industry to mixing dough in bakeries.

Advanced Food Packaging Technologies: Packaging is important for looks also but beyond that packaging is also crucial for food safety, sustainability, and preservation. Smart packaging solutions are gaining popularity because they use sensors to keep an eye on the quality and freshness of products. Indicator packaging is related to the quality of the food, indicating, for example, pH changes, which cause perceptible colour changes when the food is no longer suitable for consumption. Sensor packaging indicates the presence or level of certain substances or physical properties, such as monitoring gases, humidity, microorganisms, or temperature changes. Eco-friendly packaging materials manufactured from biodegradable and recyclable materials are gaining favour in response to the global effort toward minimizing plastic waste.

IoT and Blockchain for Traceability: Transparency and traceability are being improved in the food supply chain through the use of blockchain technology and Internet of Things (IoT) devices. Blockchain enables manufacturing monitoring from farm to fork, guaranteeing product safety and enhancing consumer confidence. Maintaining the authenticity of high-end products and tracking organic produce are two areas where this technology really shines.

Government Initiatives

Government of India has taken various policy and financial initiatives in recent years to strengthen the food processing sector. Central Government has approved the umbrella Central sector scheme, SAMPADA- Scheme for Argo-marine processing and Development of Agro-processing Clusters, subsequently renamed as 'Pradhan Mantri Kisan SAMPADA Yojana (PMKSY) with a total allocation of Rs.6000 crore in 2017. This scheme aims to create modern infrastructure with efficient supply chain management from farm gate to retail outlet for promotion, overall development and growth of Food Processing Industries, through creation of employment opportunities, reducing wastage of agricultural produce, increasing the processing level and enhancing export of the processed foods. Under this scheme, Ministry of Food Processing Industries has approved 41 Mega Food Parks, 399 Cold Chain projects, 76 Agro-processing Clusters, 588 Food Processing Units, 61 Creation of Backward & Forward Linkages Projects



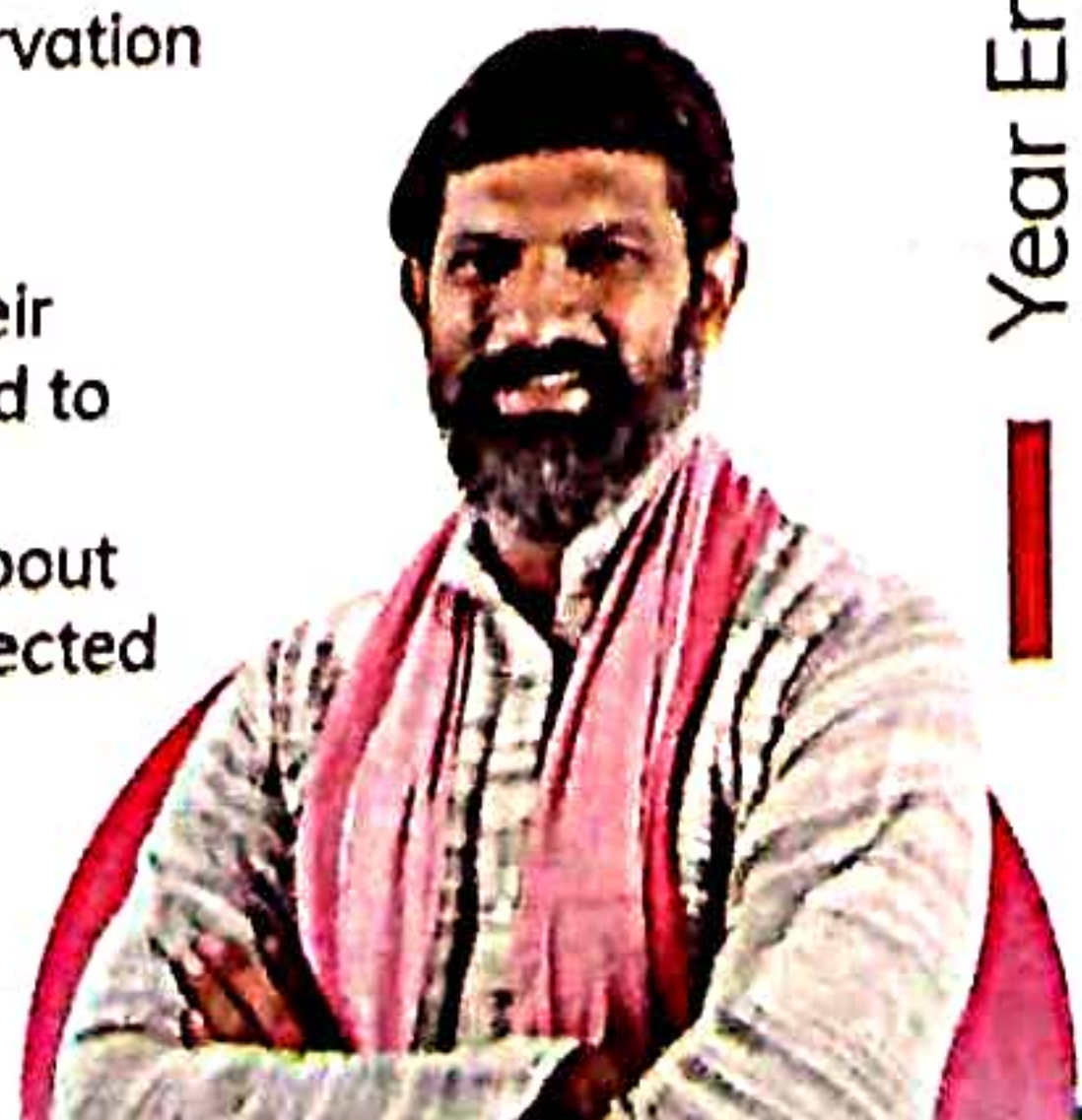
MOFPI
Ministry of Food Processing Industries


Year End Review 2024

Achievements


UNDER PRADHAN MANTRI KISAN SAMPADA YOJANA (PMKSY)

- 143 projects have been approved under various component schemes of PMKSY, since January 2024.
- 69 projects have been operational resulting in processing & preservation capacity of 14.41 Lakh MT.
- The approved projects, on their operationalization, are expected to leverage investment of Rs 2303.24 Crore benefiting about 3.53 lakh farmers and are expected to result in more than 0.57 lakh direct/indirect employment.





PMFME
PM Formalisation of Micro food processing Enterprises Scheme



A SPECIAL INITIATIVE FOR THE DEVELOPMENT OF MICRO FOOD PROCESSING ENTERPRISES.

Seed Capital @ ₹40,000/- per Self Help Group (SHG) member engaged in food processing for working capital and purchase of small tools.

and 52 Operation Green projects. PM Kisan SAMPADA Yojana is expected to leverage investment of Rs. 11,095.93 crore by the year 2025-26. In 2022, a Special Food Processing Fund of Rs. 2,000 crore was set up with National Bank for Agriculture and Rural Development to provide affordable credit for investments in setting up units under Mega Food Parks and Designated Food Parks.

The real challenge in the food processing sector is with the people engaged in food processing in unorganized sector. As per the report on Annual Survey of Unincorporated Sector Enterprises (ASUSE) for the year 2022-23, the unorganized food processing sector in the country comprises nearly 23 lakh food processing enterprises which are unregistered and informal. These units face challenges in access to credit; modern technology and machinery; branding and marketing; and food safety and hygiene. To address this problem, the PM Formalisation of Micro food processing Enterprises (PMFME) scheme was launched with the sole aim to enhance the competitiveness of existing micro-enterprises in the unorganized food processing sector and promote formalization of the sector. The main focus of the scheme was to support Farmer Producer Organizations, Self Help Groups and Producers Cooperatives along their entire value chain. The Scheme is being implemented for a period of five years from 2020-21 to 2024- 25 with an outlay of Rs. 10,000 Crore. The main theme of the Scheme is the One District One Product approach, a part of a broader

MoFPI
MINISTRY OF FOOD PROCESSING INDUSTRIES
GOVERNMENT OF INDIA

**FOR SETTING UP OF
MULTIPRODUCT
FOOD IRRADIATION UNITS**

**MINISTRY OF FOOD
PROCESSING INDUSTRIES**

**IS PROVIDING
FINANCIAL SUPPORT**

Grants-in-aid/ subsidy @ **35%** of eligible project cost for projects in General Areas

@ **50%** of eligible project cost for project in Difficult Areas and projects of SC/ST, FPOs and SHGs*

*subject to a maximum of Rs 10 crore per project



strategy of concentrated agricultural and industrial development focused on each district, offering an array of fiscal incentives, credit, marketing, and policy support. This scheme is approved for 713 districts in 35 States/UTs with 137 unique products. This sector has the potential to create millions of more jobs, particularly in rural areas, by connecting farmers with processing units and markets, thereby boosting farmer incomes and contributing to rural development.

Another key driver of growth is the Production-Linked Incentive (PLI) scheme, for the period 2021-22 to 2026-27 to create global food champions and improving the visibility of Indian food brands abroad. This scheme has been implemented with an outlay of Rs.10,900 crores and aims to boost domestic manufacturing, promote exports, and generate employment.

In addition, the Central Government has taken many decisions to make fiscal policies favourable to facilitate this sector. New food processing, preservation and packaging units are now qualifying for 100 per cent income tax exemption for the first 5 years of operation and thereafter these units will be charged at the rate of 25-30 per cent. Further, 100 per cent deduction is permitted on capital expenditure for cold chain or warehouse. In addition, loans to food and agro-based processing units and cold chain have been classified under agriculture activities for Priority Sector Lending (PSL). Central Government has also allowed 100 per cent FDI in the food processing sector under the automatic route, facilitating a straightforward and efficient investment process. The food processing sector has also been a magnet for foreign investment, attracting US \$12,955.90 million in FDI equity inflows from April 2000 to September 2024, accounting for 1.83 per cent of the country's total FDI inflows. In another initiative to the food processing sector, government has introduced lower GST slab rates for most of the basic food items. Of all food categories taken together under different chapter heads/subheads, almost 71.7 per cent of the food items fall under the lowest slab of GST, i.e. 0-5 per cent.

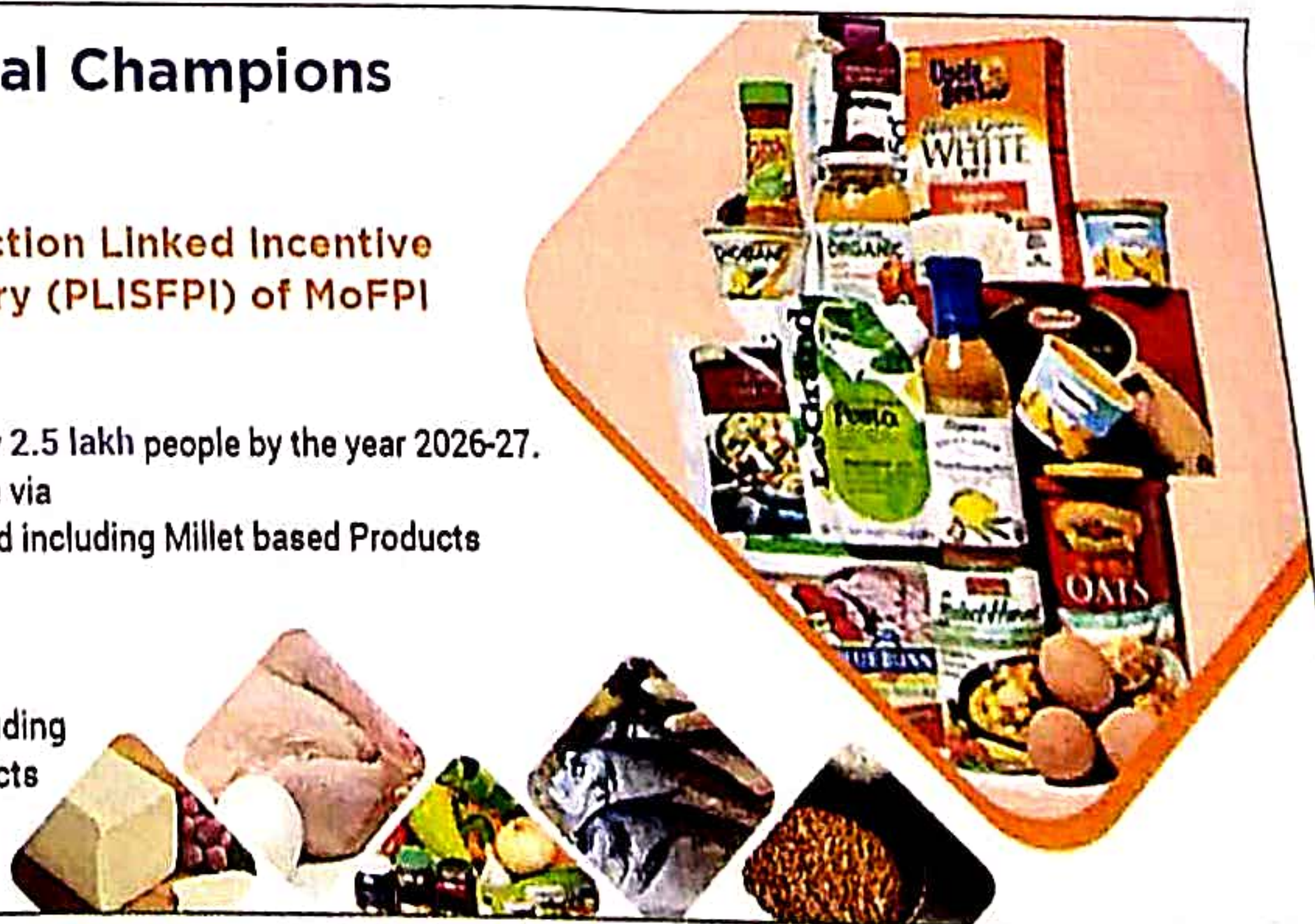
Commercial Success Stories

Amul is the leader in food processing in India having reached Rs 80,000 crore (\$10 billion) in 2023-24 from Rs 72,000 crore (\$9 billion) in 2022-23 and have just ventured into the sector of fruit and vegetable processing. PepsiCo is a leading commercial success story in food processing of fruits and vegetables in India with brands like Tropicana and Lay's potato chips. PepsiCo is a world leader in convenience foods

PLIS for developing Global Champions in Food Sector

The Central Sector Scheme - Production Linked Incentive Scheme for Food Processing Industry (PLISFPI) of MoFPI

- ◆ Has an outlay of Rs. 10900 crore.
- ◆ Will create employment opportunities for nearly 2.5 lakh people by the year 2026-27.
- ◆ Food Product Segments covered in the scheme via
 - Ready to Cook/Ready to Eat (RTC/RTE) food including Millet based Products
 - Processed Fruits & Vegetables
 - Marine Products
 - Mozzarella Cheese
 - Innovative/Organic products of SMEs including Free Range Eggs, Poultry Meat, Egg Products





PM FORMALISATION OF MICRO FOOD PROCESSING ENTERPRISES SCHEME (PMFME)



SALIENT FEATURES OF THE SCHEME

- Micro-enterprises to get **Credit-Linked Subsidy @35%** of the total project cost with ceiling of **Rs. 10 lakh** for upgradation of infrastructure and capacity addition
- **SHGs** to get **Seed Capital** for giving loans to members for working capital and small tools
- On site **Skill Training & Handholding**
- Special focus on **Women Entrepreneurs & Aspirational districts**.
- Transition from the **Unorganized sector** to the **Formal sector**

Helpline Number
☎+911302281089

and beverages working in 210 countries. PepsiCo in India directly employs more than 5,000 people and indirectly employs another 75,000 for its production and marketing of products across the country. Indian Tobacco Company (ITC) Ltd. is another important company with presence in the fruit and dairy foods with an array of beverages, such as juices like B Natural, Sunfeast and Bingo potato chips offering the goodness of fruit and fibre and milkshakes with real fruit bits in a variety of flavours. Britannia, Dabur India, Mondelez, Tetra Pak, Parle Agro Private Ltd., Tata Consumer Products, Amul, Patanjali Foods and Yu are some of the other leading brands dealing in food processing in India. In addition, Sahyadri Farms in Maharashtra, Sula Vineyards, Sil Food India Pvt. Ltd. in Maharashtra, Suguna Foods in Tamil Nadu, Agro Tech Foods Ltd. in Telangana, MTR Foods in Karnataka, Organic India in Uttar Pradesh, Unibic Foods in Karnataka, McCain in Gujarat, Flex Foods Ltd. in Uttarakhand and Tamil Nadu and Mother Dairy in Delhi are some other big names in food processing industry. In India, Himachal Pradesh being the fruit bowl of the country with strong horticulture annual economy of more than Rs 10000 crore is also emerging as a food processing hub to avoid the post-harvest losses in the tough terrains of the State. Horticultural Produce Marketing and Processing Corporation (HPMC) established in 1974 with the assistance of World Bank is an excellent example of fruit processing in Himachal Pradesh. This Corporation is a success story of 50 years because the vision to establish such an institution was the future outlook of the then Chief Minister of Himachal Pradesh- Dr Y.S. Parmar who visualized the future of Himachal Pradesh in horticulture and food processing. The Corporation has established a new fruit processing plant built at a cost of Rs 100.42 crore at Parala in Shimla district in 2024 and this corporation has

processed a record 2000 metric tons (MT) of apple juice concentrate across its three plants in 2024. In Himachal Pradesh, Cremica Mega Food Park is the first mega food park which has been set up in 52.40 acre of land at a cost of Rs. 107.34 crore with facilities like multi-crop pulping line with bulk aseptic packaging, frozen storage, deep freezing with dry warehouse and other processing facilities. There are some other big food processing units like Himalaya Food Company at Paonta Sahib in Sirmaur district, Shivambu International at Una, Hygeia Fruit and Vegetable Processors Private Limited and Gold Home in Mandi district and Shimla Hills Offerings Pvt Ltd. in Shimla district.

Way Forward

There is a need to make big cluster of food processing by putting research institutions and production houses at a single place to grow in a mutualistic environment. If we have to choose a global success story then Food Valley in Netherlands is a unique example where collaboration between food companies, research institutes, and local agribusinesses has given rise to an industry which is so innovative and important that it is frequently compared to California's Silicon Valley. It is also described as 'the golden triangle', which brings together the key stakeholders in business, government and science. This is a world capital of innovation in food and agriculture, where the whole chain of research is usually covered in-house by more than 6,500 scientists, specialists and experts. Food Valley is a global hotspot for the future of food.

As Food Valley in Netherlands is an excellent example promoting innovations in agriculture and food processing, there is need to further accelerate the momentum of development to make India a major exporting hub of food processing. □



Nutritional and Health Security through Horticulture

The term 'nutrition security' emerged in the mid-1990s and focused on food consumption by the household or the individual and on how that food is utilized by the body and thus in principle is more than food security. The horticultural crops are rich sources of nutritional bioactive compounds. They are important sources of protective nutrients like vitamins, minerals, antioxidants, folic acid, and dietary fibers hence strongly contribute in achieving the goal of nutritional and health security.

***Dr. Brij Bihari Sharma**

****Anjali Sharma**

Malnutrition remains a significant public health problem in India despite having several major programmes to address the issue. Data from the Global Hunger Index that measures malnutrition, stunting, and mortality rates of under-five shows that one in three children in India has stunted growth, whereas 15 per cent

of the country's population is undernourished. The concept of food security developed over the last 50 or more years addressed primarily the need for the production and access to adequate food grains to feed the world's increasing population. Nutrition security, a later development, was a much broader concept since nutritious and safe diets alongside adequate biological and proper social environments ensure appropriate

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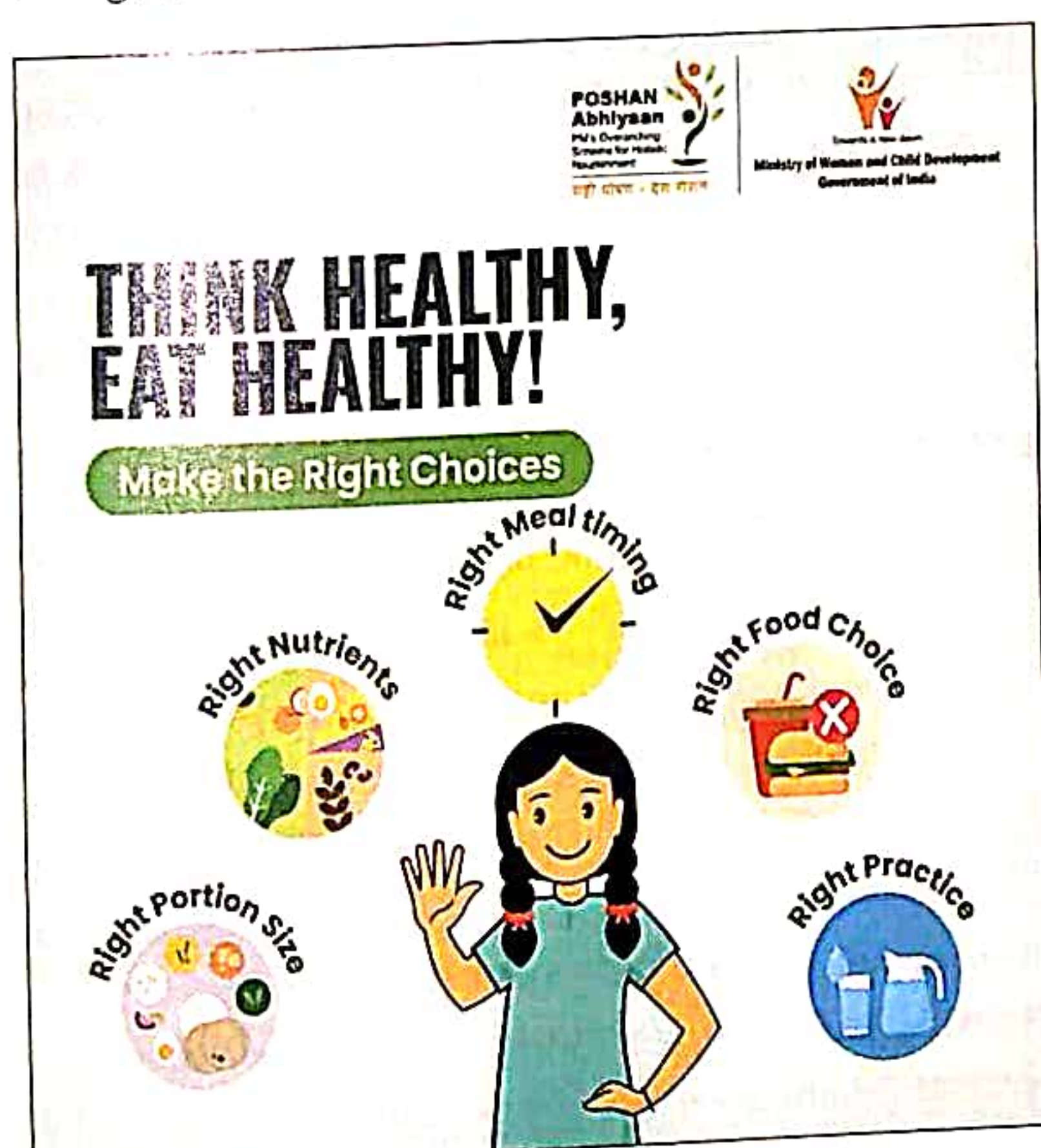
growth and development in childhood and help promote health and prevent disease in adulthood. The need for a paradigm shift in policy formulation from focusing on food security at the aggregate level to nutrition security at the level of each child and adult implied that the definition 'food and nutrition security' integrates both the conceptual frameworks of food security and nutrition security. This integrated approach aspires not merely to address the micronutrient malnutrition which is a bigger problem than food energy deficiency. Still, it is a food-based approach that tackles non-food factors such as water, sanitation, and care practices. Increasing (3.17% higher in the previous year) total horticulture production in India to 353.19 million tonnes during 2023-2024 (estimated) open a new ray of hope for ensuring nutritional and health security through horticulture.

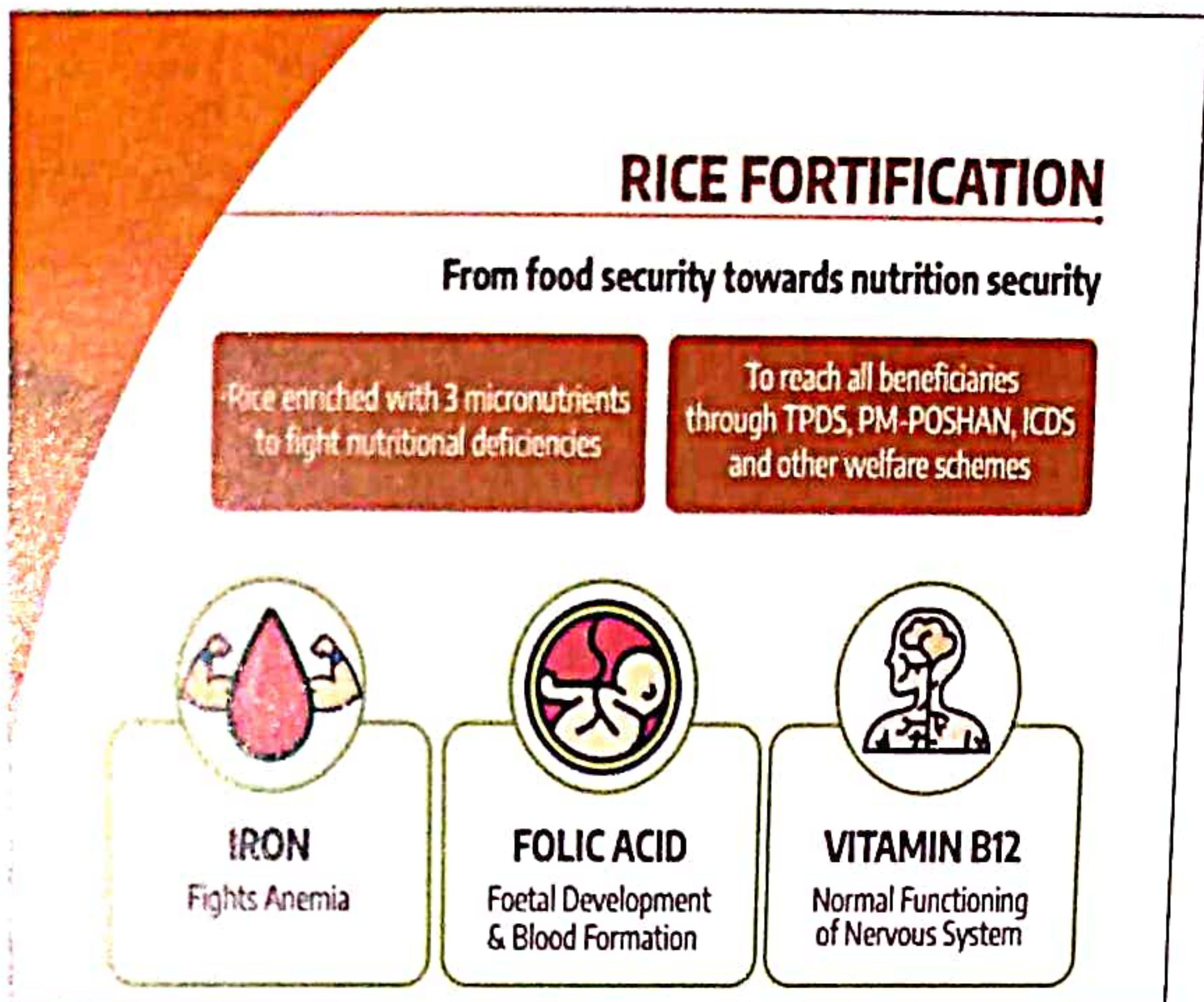
The term 'nutrition security', emerged in the mid-1990s and focused on food consumption by the household or the individual and on how that food is utilized by the body and thus in principle is more than food security. Building on UNICEF's conceptual framework of malnutrition, the International Food Policy Research Institute (IFPRI) in 1995 proposed that 'nutrition security' be defined as 'adequate nutritional status in terms of protein, energy, vitamins, and minerals for all household members at all times. The concept of nutrition security is hence broader than food security since the term utilization in nutrition also encompasses biological utilization.



Indian lifestyle has a predilection for fresh fruits and vegetables that are processed at home. On the contrary, surveys indicate a consistently low consumption of fruits and vegetables. Annual consumption (kg/person/annum) of fruits was 9.6 (rural), 15.6 (urban), and 11.8 (India), while it was 74.3 (rural), 79.1 (urban), and 76.1 (India) for vegetables. The latest National Sample Survey revealed that out of 1000 households in India, vegetable consumption was reported by 983 (rural) and 932 (urban) whereas fruits by 608 (rural) and 777 (urban) residents. The Expert Committee of the ICMR-NIN dietary guidelines 2024 recommended that every individual should consume at least 400 g of vegetables (Green Leafy Vegetables: 100 g; other vegetables: 200 g; Roots & Tubers: 100 g) in a day. In addition, fresh fruits (100 g), should be consumed regularly. Since requirements of iron and folic acid are higher for pregnant women they should consume 100g of leafy vegetables daily. High-calorie vegetables and fruits are to be restricted for overweight/ obese subjects.

The total horticulture production in India during 2023-2024 is estimated to be around 353.19 million tonnes, which is 3.17% higher than the previous year. The agriculture ministry released its third advance estimate for the production of horticulture crops, giving record estimates for fruits, vegetables, spices, and plantation crops like areca nut, cashew nut, cocoa, and coconut. Horticulture production will beat foodgrain yield fifth year in a row, continuing the rising trend since 2019-20. The increased horticultural production is, however,





not an indicator of the rise in income of cultivators. This was reflected again this year when farmers had to sell their produce, mainly onion, potato, and tomato, at throwaway prices in many parts of the country due to multiple reasons, including the absence of cold chain. Being perishable items, horticultural produce needs extra attention during storage and transportation. The government of India and farmers lack storage facilities in many parts of the country, leaving the farmers to struggle to get remunerative prices. Record production of fruits at 112.73 million tonnes, showing a positive trend with a projected increase of 2.29% compared to the previous year. This growth is primarily attributed to higher production of key fruits like mango, banana, lime/lemon, grapes, and custard apple. Similarly, the production of vegetables is estimated to be a record of 205.80 million tonnes. While the overall horticulture production saw a slight dip, vegetable production had mixed results across different crops.

Horticulture Crops for Nutritional Security

Horticultural crops are rich sources of nutritional bioactive compounds. They are important sources of

protective nutrients like vitamins, minerals, antioxidants, folic acid, and dietary fibers. The diversified and highly nutritive vegetables are affordable and cost-effective solutions to hidden hunger and malnutrition.

Dietary Fiber: Dietary fibers are mainly plant cell walls containing cellulose, pectins, xyloglucans, xylans, mannans, and free arabinans. They delay the absorption of glucose and fats after meals, increase fecal bulk, and speed up the passage through the digestive tract, thus preventing the risk of constipation, hemorrhoids, colon cancer, and diverticulitis. Leafy vegetables like celery, cabbage, spinach, lettuce, and amaranth are rich sources of dietary fiber. Fig, guava, almond, dry chili, peas, french beans, cluster beans, and okra are also good sources of fiber.

Source of energy and proteins: Vegetables are quite low in protein content when compared to dry pulses. Protein-rich vegetables are peas, lima beans, drumstick leaves, French beans, and celery. Potato, cauliflower, okra, cowpea, beat leaf (palak), fenugreek (methi) leaves, and onion are also sources of protein. Other sources of protein, fat, and carbohydrate are given in Table 1.

Growing Health: Horticulture in India

India faces a significant challenge with micronutrient deficiencies, largely due to insufficient intake of essential nutrients like calories, proteins, iron, iodine, vitamin A, and calcium. This has led to widespread health problems, including iron deficiency anemia (IDA) affecting over 75% of preschool children and sub-clinical vitamin A deficiency (VAD) affecting 57%. Iodine deficiency, often caused by a lack of iodized salt, is endemic in 85% of districts. The resulting child malnutrition affects 43% of children under five, contributing to 22% of India's disease burden. Even after 70 years of independence,

Table 1: Horticultural source of energy and proteins

Protein	Cashew nut, almond, walnut	Pea, cowpea, lima bean, broad bean, mustard, pumpkin, pointed gourd drumstick, celery, garlic, Brussels spout.
Fat	Walnut, almond, cashew nut, avocado	Bengal gram leaf, small bitter gourd, chili, brinjal, brussels sprout, snake gourd, pointed gourd, lettuce, pink radish, sweet corn hyacinth bean, cluster bean, spinach, globe artichoke
Carbohydrate	Dry apricot, date fig, dry karonda, banana, bael, custard apple, cashew nut, jamun, jack fruit	Tapioca, potato, sweet potato elephant foot yam, taro, garlic, pea, onion bitter gourd, brussels sprout, carrot

Table 2: Daily requirements of Vitamins & dietary fibers and their source in horticultural crops (per 100 grams)

Vitamins	Daily requirement / Adult/day*	Horticultural Sources
Vitamin C	40 mg	Gooseberry, Guava Parsley, Capsicum, green chilli, drumstick, cabbage, Mango ripe, Lemon juice, radish leaves, drumstick leaves
Thiamin	1.4 mg	Beans, Peas, Pistachio Nuts, Poppy seeds, Quinoa, Asafoetida, Cashew nuts
Riboflavin	1.6 mg	Red chillies, drumstick, chenopodium, Amaranthus, Palak, Curry leaves
Niacin	18 mg	Red chillies, beans, peas, capsicum, sweet potato, potato, Oyster mushroom, Almond
Pantothenic Acid	5 mg	Garlic, Rajma, Oyster Mushroom, Cowpea, Shitake, Bail fruit, Cashew nuts
Pyridoxine	2 mg	Muskmelon, Pak choi, Oyster Mushroom, Garlic (single clove), Watermelon, Walnuts, Pistachio Nuts
Biotin	30 µg	Knol-khol, Parsley, Scarlet beans, Colocasia leaves, Pistachio Nuts, Oyster Mushroom, Shitake mushroom
Folic Acid	100 µg	Spinach, Parsley, Asparagus, Legume vegetables
Cyanocobalamin	1 µg	Spinach, Broccoli, Asparagus
Vitamin 'A'	600 µg	Drumstick leaves, Fenugreek leaves, Amaranthus, Carrot, Sweet Potato, Mango ripe, Papaya ripe
Vitamin 'D'	5 µg	White button mushroom, Oyster mushroom, Shitake mushroom
Vitamin 'E'	15 µg	Pistachio Nuts, Almonds, Coconut dry, Mace, Parshnip, Spinach, Broccoli, Zucchini green, curry leaves, turmeric powder
Vitamin 'K'	120 µg	Spinach, Turnip green, Broccoli, drumstick Amaranthus, Parsley, Colocasia leaves, Knolkhol

*Recommended by NIN, Hyderabad

India's undernutrition rates remain among the highest in the world, with almost 50% of children under five being underweight and stunted, and over 30% of adults also affected. Crucially, fresh fruits, vegetables, and nuts—products of the horticulture sector—are vital sources of micronutrients like minerals and phytochemicals and offer a key solution to these deficiencies.

Vitamins and Minerals: A Hidden Treasure for Health

Food is composed of nutrients: macronutrients and micronutrients and, are classified according to the amount required for a healthy body. Fruits and vegetables are called 'Protective foods'. They are rich sources of sugars, vitamins, minerals, and bioactive compounds which help to maintain proper functioning of the body. Fruits, nuts, and vegetables play a significant role in human nutrition, especially as sources of vitamins (C, A, B6, thiamine, Niacin, E), minerals, and dietary fiber. Their contribution as a group is estimated at 91%

Anemia-Fighting Diet ADOLESCENT GIRLS & BOYS NEED TO CONSUME IRON RICH FOODS DAILY

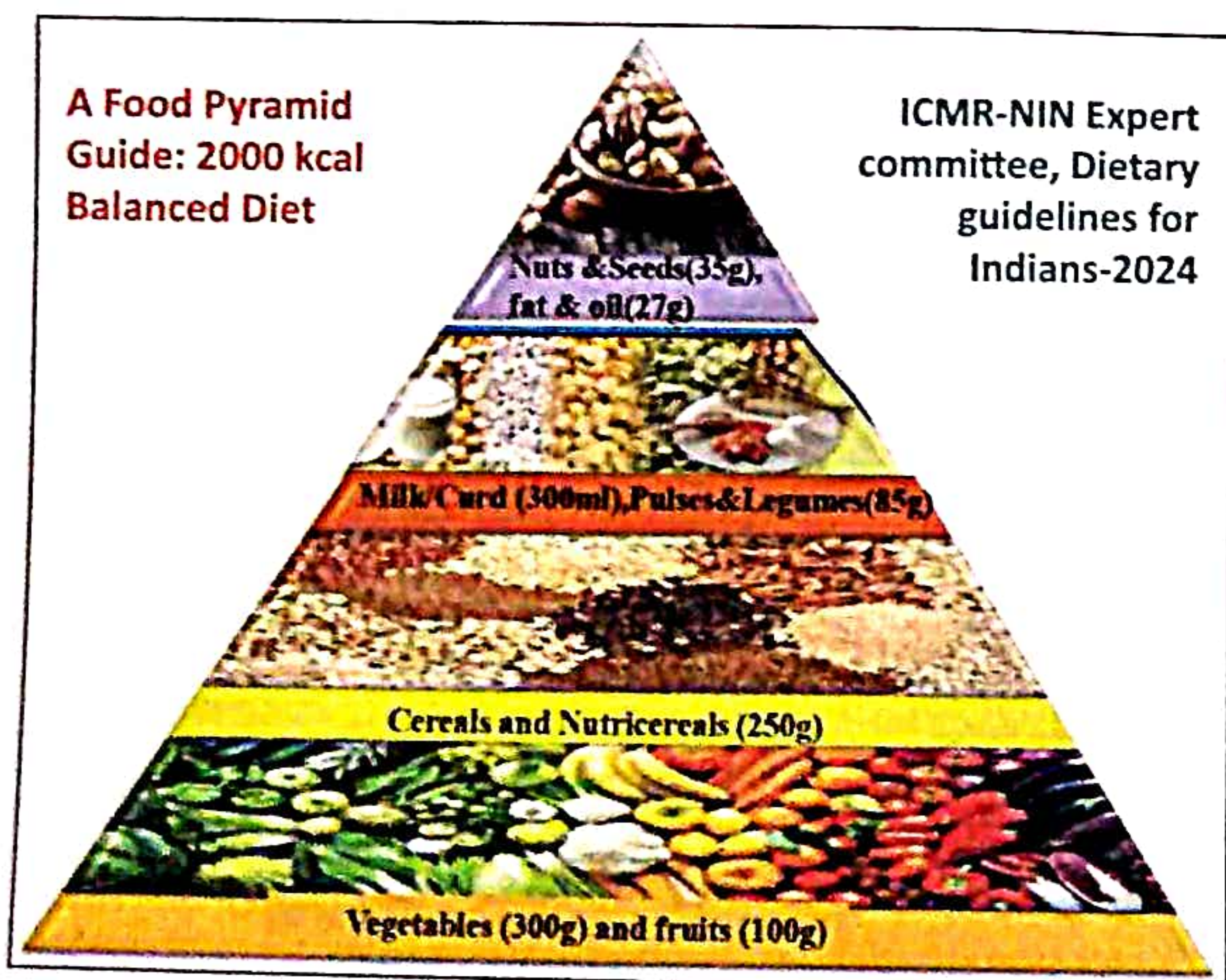


of vitamin C, 48% of vitamin A, 27% of vitamin B6, 17% of thiamine, and 15% of niacin in our diet. Fruits and vegetables also supply 16% of magnesium, 19% of iron,

Table 3: Daily requirements of minerals and their source in horticultural crops (per 100 grams)

Minerals	Daily requirement / Adult/day*	Horticultural Sources
Calcium	600 mg	Amaranthus, turnip green, Parsley, Palak, Radish leaves, Celery, Colocasia leaves, Hyacinth Beans, Knol-khol, Poppy seeds, Black pepper
Phosphorus	600 mg	Cowpea, Vegetable soybean, Peas, Celery, Parsley, Poppy seeds, Oyster mushroom dried, Almond
Chloride	2.3 gram	Lotus stem, drumstick leaves, curry leaves, fenugreek leaves, Amaranthus, Knol-khol, Spinach, Phalsa, Tamarind leaves
Magnesium	340 mg	Cowpea, Amaranthus, Curry leaves, Tomato, Cardamom, cumin seeds, poppy seeds, cloves, Almond, Cashew nuts
Iodine	150 µg	Seafood, Beans, Rhubarb, Watercress, Potato, Strawberry
Sodium	1.5 gram	Amaranthus, Carrot, beet leaves, fenugreek leaves, palak, spinach, cloves, cumin seeds
Potassium	3750 mg	Turmeric powder, Cowpea, sword bean, colocasia, muskmelon, celery, coriander leaves, drumstick, cumin seeds, Pippali, black pepper, Raisins dried black, Pistachio nuts
Iron	17 mg	Amaranthus, Radish, Parsley, <i>Sarson saag</i> , mint, Basella, watermelon, chenopodium, turmeric powder, cumin seeds, tamarind pulp, mint leaves, black pepper
Zinc	12 mg	Rye, cumin, potato, beans, pumpkins
Selenium	40 µg	Rye, garlic, broccoli
Copper	900 µg	Coriander, black pepper, Poppy, mace, Areca nut, Pippali, walnut
Magnees	2-5 mg	Cumin, coriander, okra, clove

*Recommended by NIN, Hyderabad



are of high quality as to their content of essential amino acids. Other important nutrients supplied by fruits and vegetables include folacin, riboflavin, zinc, calcium, potassium, and phosphorus. Daily requirements of vitamins & minerals and their source in horticultural crops (per 100 grams) are given in detail in Tables 2 & 3.

Nutraceuticals Value of Horticulture Crops

Fruits and vegetables have historically been considered rich sources of some essential dietary micronutrients and fibers, and more recently they have been recognized as important sources for a wide array of phytochemicals that individually, or in combination, may benefit health. Therefore, some people have conferred on fruits and vegetables the status of “functional foods.” Owing to their commercial value and source of many processed foods or secondary products, fruits play a key role in the economy of many developing countries.



Fruits, nuts, and vegetables in the daily diet have been strongly associated with reduced risk for some forms of cancer, heart disease, stroke, and other chronic diseases. Some components of fruits and vegetables are strong antioxidants and function to modify the metabolic activation and detoxification/disposition of carcinogens, or even influence processes that alter the course of the tumor cell. Although antioxidant capacity varies greatly among fruits and vegetables it is better to consume a variety of commodities rather than limiting consumption to a few with the highest antioxidant capacity. There is an increasing evidence that consumption of whole foods is better than isolated food components (such as dietary supplements and nutraceuticals). For example, increased consumption of carotenoid-rich fruits and vegetables was more effective than carotenoid supplements in increasing LDL oxidation resistance, lowering DNA damage, and inducing higher repair activity in human volunteers.

Antioxidants

There are numerous compounds in vegetables that function as antioxidants. Primary among them are α -carotene, vitamin 'C', vitamin 'E', selenium, and flavonoids. There is an evidence that antioxidants like carotene, ascorbic acid (vitamin C), β -tocopherols (vitamin E), flavonoids, and selenium are significantly associated with reduced cancer risks. Vegetables are rich sources of antioxidant nutrients viz., vitamin C, vitamin E, and carotenoids. Certain flavonoids like quercetin, kaempferol, myricetin, and luteolin are also present in vegetables.

Carotenoids

They are the pigments in fruits and vegetables that protect from damage to lipids, blood, and other fluids. Among 600 and more naturally occurring carotenoids, the majority have antioxidant properties. Beta carotene is present in dark green leafy vegetables, carrots, and pumpkins. It protects from coronary heart disease and lung cancer. Lycopene is a carotenoid present in tomato and watermelon which prevents oxidation of LDL cholesterol and reduces damages to arteries. It will also reduce the risk of bladder cancer and pancreatic cancer.

Natural pigments

This group includes anthocyanin, betalains, carotenoids, chlorophylls, etc. They are exploited as the source of nutraceuticals used against many human ailments. These pigments are useful to maintain human health, protect from chronic diseases, or restore wellness by repairing tissues. Anthocyanin pigment gives purple color to brinjal, amaranth, cowpea, dolichos bean, etc. It is an important and widely distributed group of water-soluble natural pigments that can prevent cardiovascular diseases, neurological diseases, and cancer. Recently, transgenic tomatoes, with purple color were developed in the U.S.A. by transferring genes from snapdragon flowers. Similarly, purple cauliflowers, purple capsicums, etc. are also catching the market.

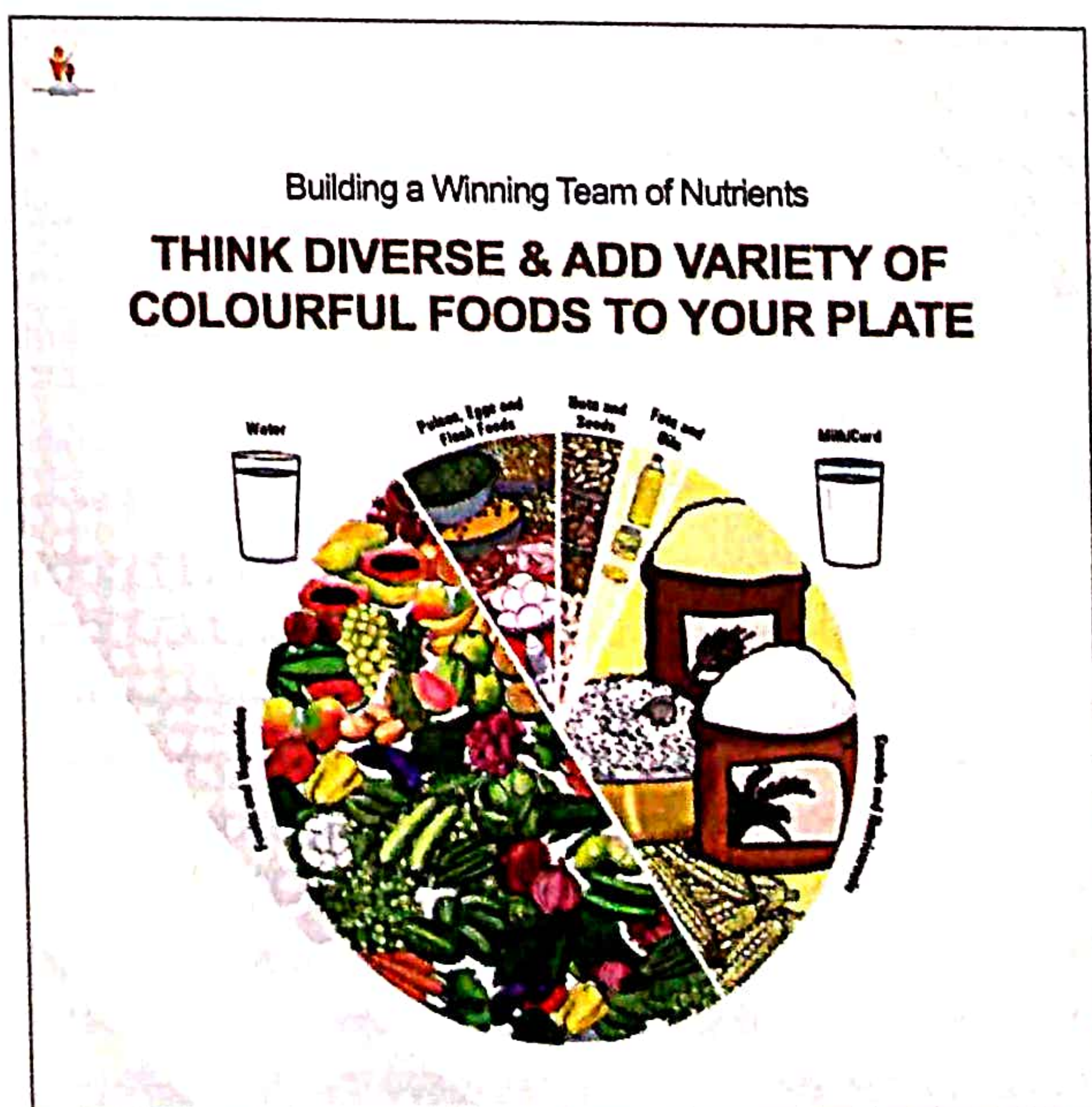


Table 4: Phenolic compounds in horticultural crops

Phenolic compounds	Sources	Effects on human wellness
Proanthocyanins	Apple, grape, cranberry, pomegranate	Help prevent cancer
Anthocyanidins	Apple, blackberry, blueberry, cranberry, grape, nectarine, peach, plum & prune, pomegranate, raspberry, and strawberry	Help prevent heart disease, cancer initiation, diabetes, cataracts, and allergies; help lower blood pressure.
Flavan-3-ols	Apples, apricots, blackberries, plums, raspberries, strawberries	Help prevent platelet aggregation and cancer
Flavanones	Oranges, grapefruit, lemons, limes, tangerines	Help prevent cancer
Flavones	Guava	Help prevent cancer, allergies, and heart disease
Flavonols	Cranberry	Help prevent heart disease and cancer initiation; are capillary protectants.
Phenolic acids	Blackberry, raspberry, strawberry, apple, peach, plum, cherry	Help prevent cancer; help lower cholesterol

Flavonoids

They are one of the most widely occurring groups of secondary metabolites or phytochemicals in plants. They induct enzymes that detoxify carcinogens. Flavonoids are a large family of lower molecular weight polyphenolic compounds found in plant tissues, which include flavones, flavonols, flavanones, anthocyanin anthocyanidins, catechins, and isoflavonoids. Other phenolics like p-coumaric, caffeic, ferrulic, and chlorogenic acids are reported in tomato. They are mostly present in the skin. Among cucurbits, flavonoids are present in genera *Cucumis*, *Lagenaria*, *Citrullus*, and *Luffa*. Quercetin and kaemferol are reported in French beans. Cheratin is a flavonoid isolated from bitter gourd having a hypoglycaemic effect. Onion and garlic contain several sulfur-containing compounds like allicin, garlicin, etc. which reduce blood cholesterol and help to prevent coronary heart diseases and heart attacks. (Table-4)

Improved Nutritional-Rich Varieties

A total of 1,596 high-yielding varieties and hybrids of horticultural crops (fruits – 134, vegetables – 485, ornamental plants – 115, plantation and spices – 467, medicinal and aromatic plants – 50, and mushrooms – 5) were developed by NARES System. As a result, the productivity of horticultural crops viz. banana, grapes, potato, onion, cassava, cardamom, ginger, turmeric, etc. have increased significantly. The varieties of quality standards for export purposes have been developed

in apple, mango, grape, banana, orange, guava, litchi, papaya, pineapple, sapota, onion, potato, tomato, pea, cauliflower, etc. Some of the varieties breed for higher nutritive value are given in table 5.

Mushroom: Emerging Industry for Nutritional Security

The production and consumption of mushrooms is increasing very fast throughout the world, mainly due to greater and greater awareness of their nutritive and medicinal attributes. India produces about 600 million tonnes of agricultural waste per annum and a major part of it is left out to decompose naturally or burnt *in situ*. This can effectively be utilized to produce high-quality food such as mushrooms followed by utilization of

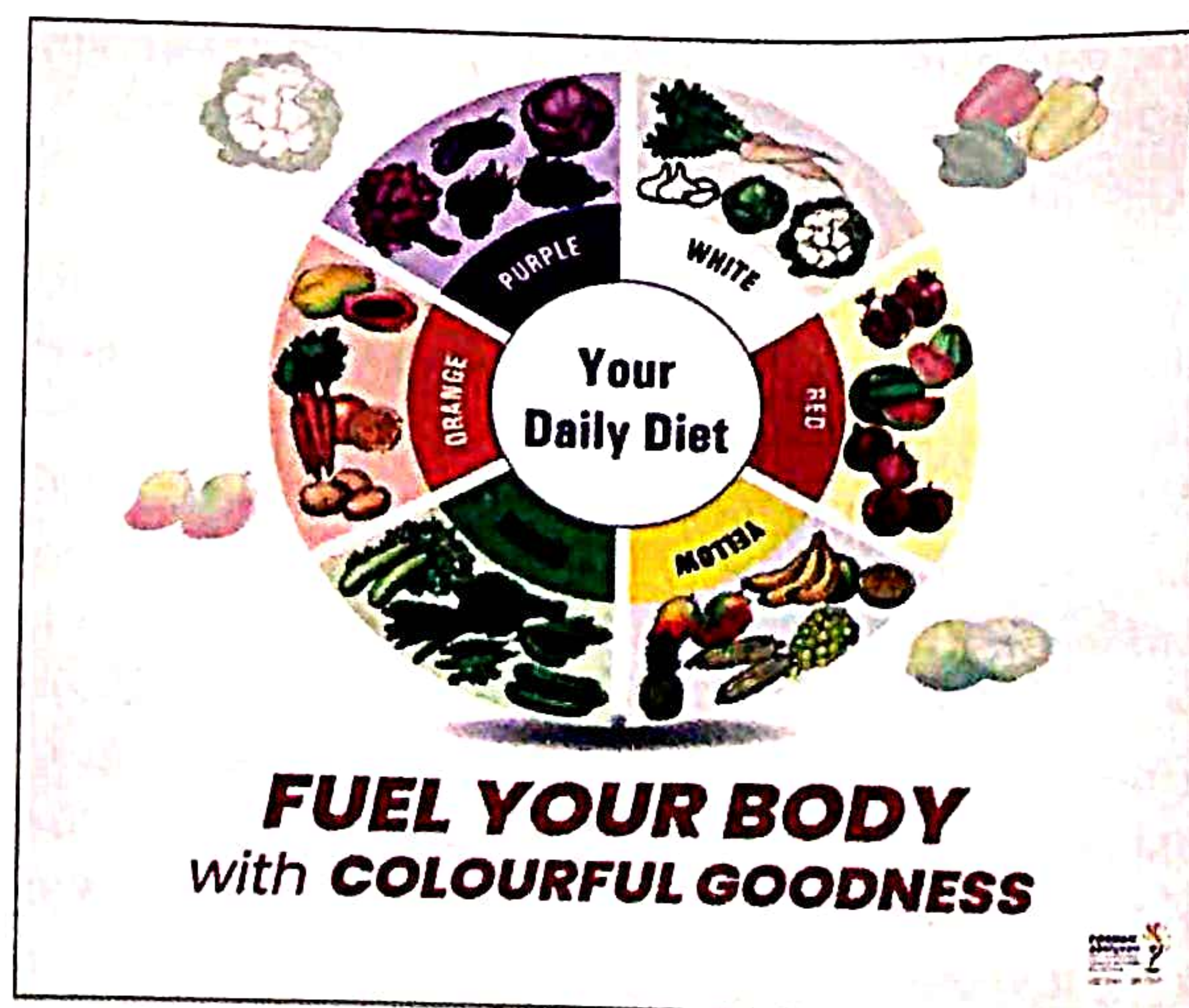


Table 5: Improvement for higher nutritive value

Crop	Varieties	Description
Papaya	Arka Surya	Fruits are medium in size about 600 – 800 g with a small fruit cavity. Pulp is about 3 – 3.5 cm thick, deep red, sweet with a T.S.S. of 13.5 – 15°brix, and rich in carotene.
Paprika	Arka Abir	Has better color (color value maximum 1, 65,541 c.u) and low pungency (0.05% Capsaicin) Suitable for oleoresin extraction, oleoresin yield from fruits without seed 5.78%.
	KTPL-19	Capsanthin pigments rich
Amaranthus	Arka Samraksha	with high antioxidant activity of 499mg (AEAC units) and minimum nitrate content of 27.3 mg and 1.34g of oxalates per 100g fresh weight of leaves.
	Arka Varna	high antioxidant activity of 417mg (AEAC units), nitrate content of 37.6mg, and 1.42g of oxalates per 100g fresh weight of leaves.
	Pusa Lal Chaulai	Anthocyanin rich
Muskmelon	Arka Jeet	Flesh white, medium texture, excellent flavor with high TSS(13-16%), and rich in vitamin C (41.6 mg/100 g)
Broccoli	Palam Vichitra	Anthocyanin rich
Pumpkin	Arka Chandan	Thick orange flesh, solid cavity. Fruit weight 2-3 kg. Rich in carotene (3331 IU of carotene/100g flesh)
Tomato	Arka Ahuti	Thick fleshed fruits have light green shoulders, ripen to dark attractive red, TSS 5.2% Bred for processing- tomato puree.
	Pusa Rohini	Lycopene rich

spent mushroom substrate by converting it into organic manure for crop plants. Today, commercially grown species are button and oyster mushrooms, followed by paddy straw, milky mushrooms, etc. The present production of white button mushrooms is about 85% of the total production of mushrooms in the country. The country is proud to have the biggest mushroom unit in the world producing 200 tonnes button mushroom per day and its export accounts for about 25 % of the US imports. India has tremendous potential for mushroom production and all commercial edible and medicinal mushrooms can be grown. There is increasing demand for quality products at competitive rates both in the domestic and export markets. Though the growth of mushrooms will depend on increasing and widening the domestic market in the coming years, the export market will be equally attractive. To be successful in both domestic and export markets, it is essential to produce quality fresh mushrooms and processed products devoid of pesticide residues and at a competitive rate. It is also important to commercially utilize the compost left after cultivation for making manure, vermicompost,

briquettes, etc. for additional income and total recycling of wastes. It can generate self-employment, alleviate poverty, and improve the socioeconomic status of women, youth, and unemployed in the rural areas. It can provide nutritional security, particularly to poor people by incorporating mushrooms in their diets.

Biofortification of Horticultural Crops

Biofortification efforts are underway in various horticultural crops, including banana, cassava, beans, potato, orange sweet potato (OSP), cowpea, and pumpkin, with several conventional and transgenic varieties already released and more in development. A nutritious diet, providing essential energy, protein, fats, vitamins, antioxidants, and minerals (many of which the human body cannot produce), is crucial for human health and well-being. Unbalanced diets, often containing anti-nutritional factors, contribute to global health problems and socio-economic hardship. While past agricultural efforts emphasized high-yielding varieties, organizations like the Indian Council of Agricultural Research (ICAR) have also prioritized nutritional quality improvement across cereals, pulses,



oilseeds, vegetables, and fruits. Although ICAR has released over 5,600 crop varieties, the number of biofortified varieties remains limited, underscoring the need for continued focus in this area. These biofortified varieties play a vital role in achieving nutritional security, particularly in India. Significant progress has been made in biofortifying horticultural crops such as cauliflower (var. Pusa Beta Kesari 1, rich in β -carotene), potato (var. Bhu Sona, rich in β -carotene), sweet potato (var. Bhu Krishna, rich in anthocyanin), and pomegranate (var. Solapur Lal, rich in iron and zinc).

Nutritional Garden for the Farming Community

The main purpose of a nutrition garden is to provide the family daily with fresh vegetables rich in nutrients and energy. A scientifically laid out nutrition garden helps to meet the entire requirements of fruits and vegetables for a family all year round. The establishment of a nutrition garden is advocated as a means of preventing malnutrition as it is a low-cost sustainable approach for reducing malnutrition, increasing awareness of vegetable production, increasing working hours, and achieving food, nutrition, and economic security for tribal families. The fruits and vegetables are consumed by purchasing them from the market but for each small and marginal family, it is not possible to include them in daily life. To ensure a healthy diet, fruits and vegetables are to be grown systematically in a small piece of land available in a home which is known as a nutrition garden. This

is important in rural areas where people have limited income and poor access to markets.

Horticulture Extension

Home gardens once used to be a cornerstone of traditional Indian farming systems, but over time, they have slowly begun to lose their importance in people's eyes as a relic of old-fashioned customs. But now, their importance is being recognized once again. Home gardens can take on many forms, from a few plants in containers to large garden plots in the backyard. Beyond the reward of homegrown produce, gardens provide easy access to fresh and nutritious vegetables, besides the health, environmental, and enjoyment advantages for the gardener. The benefits of a home garden make the physical exertion and costs of gardening worth the effort. The promotion of local plants is an appropriate strategy for increasing vegetable consumption in a particular region. Many local plants have antioxidative, antimutagenicity, and anti-inflammatory properties. Nutrition awareness programmes stress the need for the inclusion of locally available fruits and vegetables like papaya, mango, guava, and leaf vegetables in their daily diet. Hence every housewife or every citizen has a vital role in converting his surrounding vacant land into a live kitchen garden, where location-specific seasonal vegetables and fruits are grown. Hence, the consumption of vegetables may be increased gradually and consumption of green and green leafy vegetables also increased proportionately. □



Sustaining Rural Livelihoods Through Horticulture

Horticulture greatly contributes to nutrition and food security for a country. Diversification towards horticulture also helps in managing the risk and uncertainty associated with agriculture, thus making the rural areas more economically sustainable. This article explores how horticulture can greatly contribute towards creating rural livelihoods and help rural economies sustain their growth.

***Dr. Chetna Singh**

****Prof. Virendra Kumar Paul**

Rural areas are known for the quality of life centered around the nature. Prosperity being generally linked to economic prosperity, globally, majority of poor are considered to be living in rural areas. If quality of life is stressed by economic deprivation, then out-migration is inevitable. However, if livelihoods can be sustained, then the rural areas can serve the twin purpose of creating gross environmental wealth as well as inhibiting the increase of resource consumption due to exponential unabated urbanization. Improving sustainable livelihood opportunities for small and marginal farmers and forest communities is the most effective way to enhance incomes through natural resources. In rural India, unemployment and poverty has been a bane for self-sustaining economic development. India is still a country with a rural economy and most of the country's population still lives in rural areas and agriculture

continues to be the mainstay of the rural population. Agriculture alone is, however, becoming increasingly non-rewarding for the rural economy to sustain. Thus, there is a need to create an aspirational and supportive ecosystem for youth toward building an economically productive and sustainable livelihood which notionally emulates a template of an organised sector.

What can be done to reduce unemployment and poverty and improve livelihoods in rural areas is the question that needs to be answered. One of the first requirement of a strategy to reduce rural poverty should be to provide the enabling environment and resources for those in the rural sector who are engaged in the agricultural production and distribution system. Moreover, there is a need to diversify within agriculture to sub-sectors such as horticulture, which are high-value crops, with low gestation period, and can be profitably produced on small and marginal land-holdings.

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Trends in horticulture production and trade in India

Horticulture sector encompasses a wide range of crops such as fruit crops, vegetable crops, ornamental crops, spices, medicinal and aromatic crops etc. Horticulture got an impetus after the 1991 reforms, when the markets began to liberalize and small and marginal farmers took note of the business opportunity in cultivating fruits, flowers, vegetables, and spices. Unlike traditional agriculture, which primarily focuses on large-scale crop production, horticulture emphasizes the profitable cultivation of high-value crops in smaller-scale settings. Moreover, the productivity of horticulture crops is much higher compared to productivity of food grains.

Horticulture greatly contributes to nutrition and food security for a country. Diversification towards horticulture also helps in managing the risk and uncertainty associated with agriculture, thus making the rural areas more economically sustainable. Horticulture has been recognized as an important contributor in multiplying the income of farmers as well as playing a key role in ensuring essential nutritional security. According to some estimates, it constitutes 18% of the area under agriculture and contributes about 33% of the gross value to the agricultural GDP. Beyond the domestic market, horticulture also has great export potential, and in 2023 it was worth more than Rs. 4 lakh crores.

Potential of Horticulture in Rural Economy

Horticulture based rural tourism is an emerging area which can contribute greatly to sustainable economic development. This is more relevant for the Himalayan states and ecologically vulnerable geographical settings.

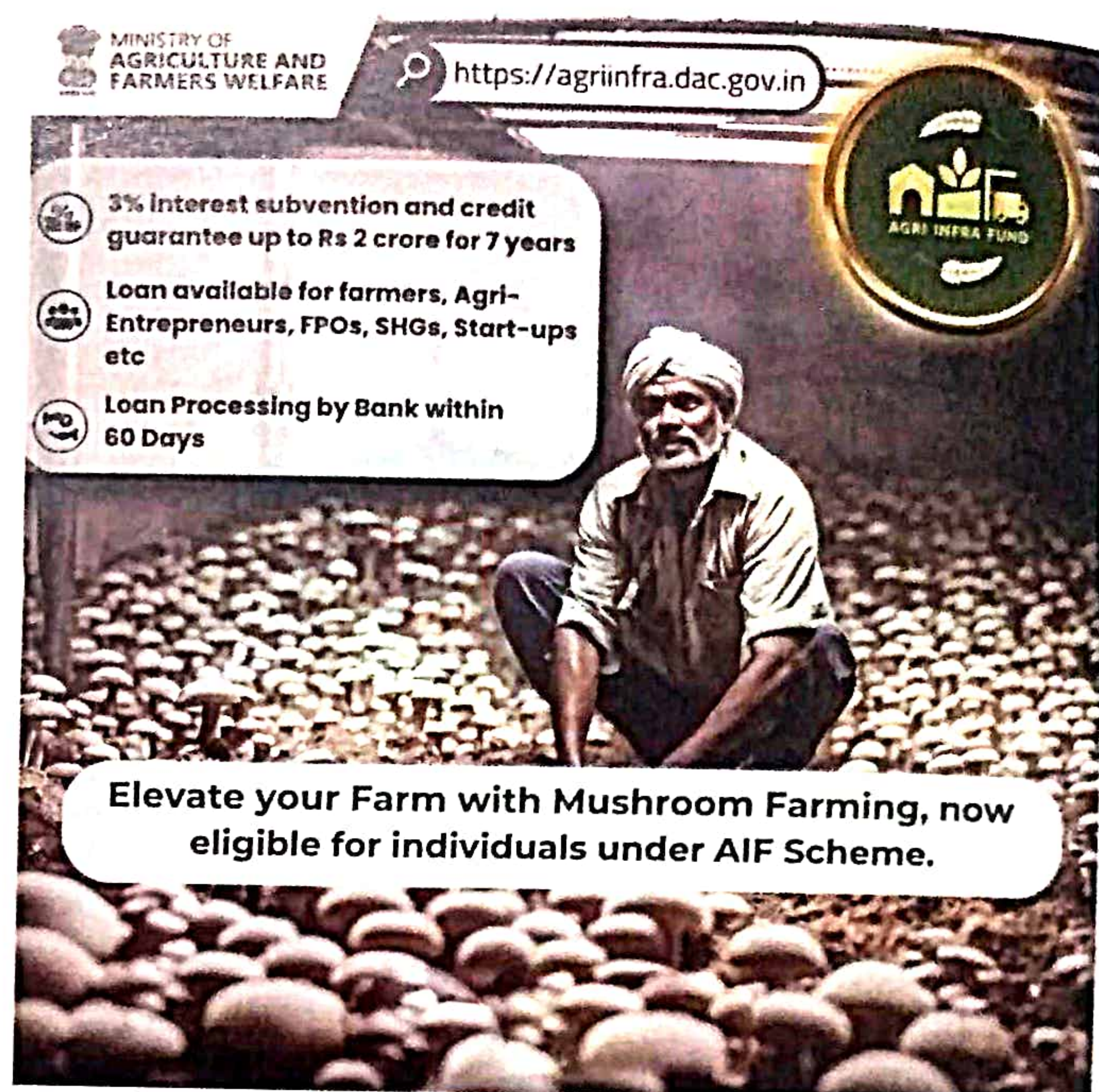
MINISTRY OF AGRICULTURE AND FARMERS WELFARE <https://agriinfra.dac.gov.in>

3% Interest subvention and credit guarantee up to Rs 2 crore for 7 years

Loan available for farmers, Agri-Entrepreneurs, FPOs, SHGs, Start-ups etc

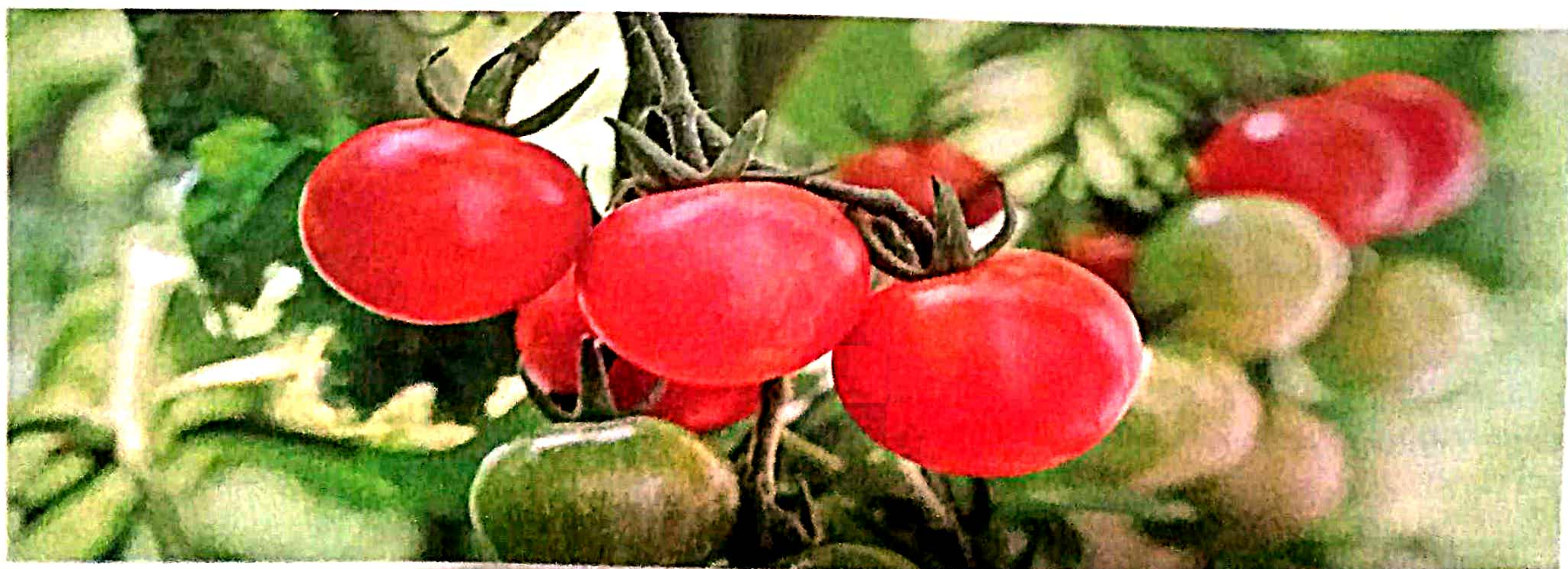
Loan Processing by Bank within 60 Days

Elevate your Farm with Mushroom Farming, now eligible for individuals under AIF Scheme.



Horticulture is socially sustainable too, as it gives more incomes in the hands of small and marginal farmers, who are subsistence farmers and majority of them grow fruits and vegetables and meet the demand of urban areas. Thus, developing the horticulture sector would contribute greatly to the country's and the rural area's development resulting in increased livelihood opportunities and income and reduced out migration to urban areas.

Of late, India has been performing very well in horticulture production. The value of horticulture crops is steadily increasing over the last several years. The total horticulture production has surpassed the total foodgrain production for the year 2022-23. At present, India is the second largest producer of vegetables and fruits in the world after China. It ranks first in



the production of a number of horticulture crops like banana, lime, lemon, papaya and okra. India's advantage lies in being a low-cost producer of fruits and vegetables because of a combination of factors such as favourable and diverse agro-climatic conditions, availability of cheap and surplus labour, and low input costs.

The productivity of horticulture has increased significantly over the last two decades, leading to a sharp increase in production and area. The production of horticulture crops has thus outpaced the production of food grain since 2012-2013. Vegetables constitute the highest proportion of horticulture crops. The percentage distribution of total horticulture crops in the country remains highest for vegetables followed by fruits and plantation crops over the last ten years.

The data of state-wise production of horticulture crops presents a promising picture as shown in Figure 1. Accordingly, Uttar Pradesh holds the first position with a total production of 462 lakh tonnes followed by Madhya Pradesh (373 lakh tonnes) and West Bengal (355 lakh tonnes). These states have a large share of vegetable production. However, in spite of having a favourable



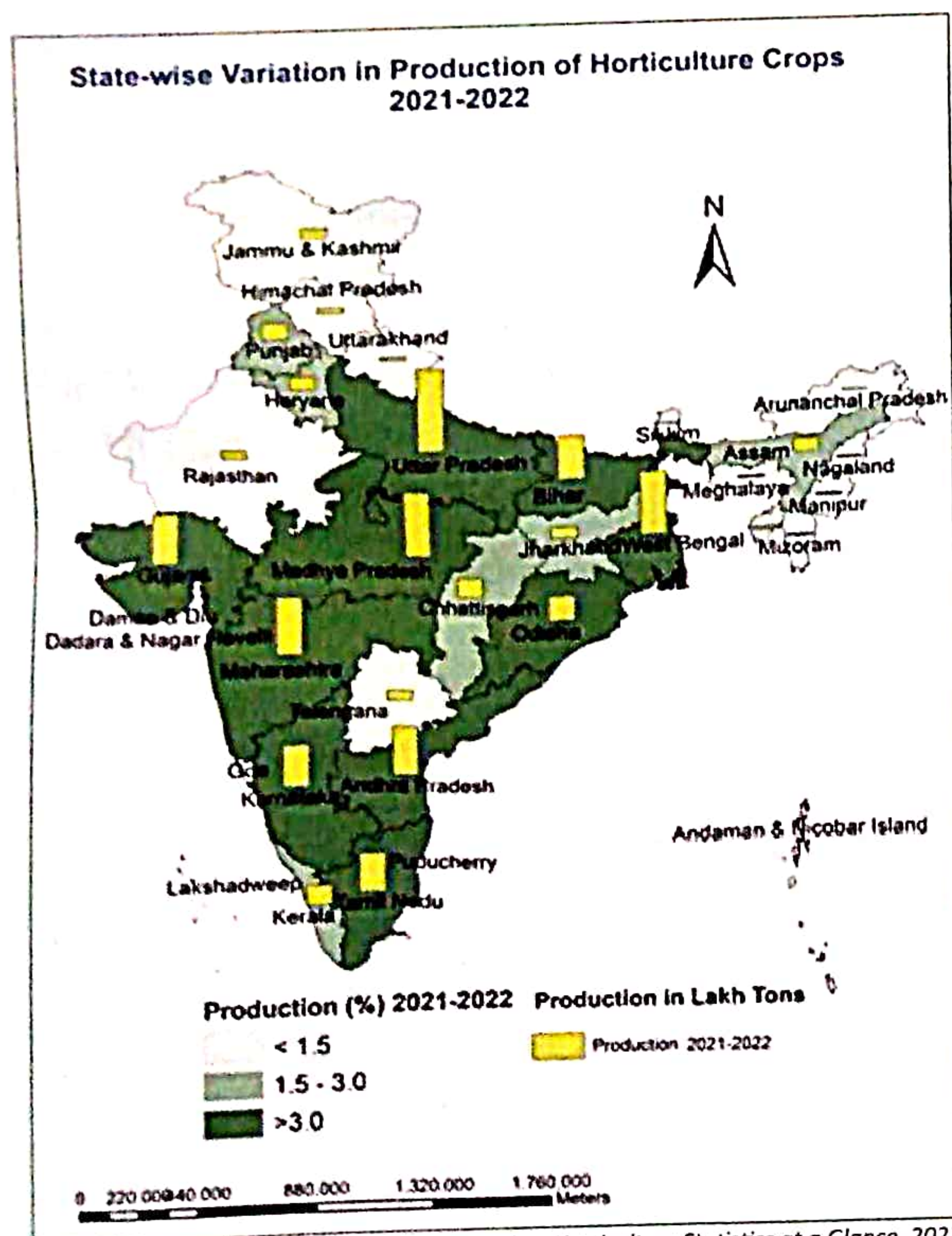
climatic condition, Himalayan states are lagging behind. There is a huge scope for rural livelihoods to prosper in these northern states to diversify into various kinds of high value horticulture crops such as medicinal plants, plantations, ornamental and aromatic crops.

Challenges for Livelihood Creation in the Horticulture Sector

Despite the fact that India's horticulture sector is growing, the country's share in global trade remains insignificant, accounting for around 1% of the global trade in vegetables and fruits. Export growth of the horticulture sector is being constrained by production and productivity issues, storage and marketing challenges, inadequate transport infrastructure, quality issues and disjointed supply chains.

The horticulture sector faces several challenges which need to be resolved. Some of the challenges that the sector faces are as follows:

- **Insufficient Post-harvest Infrastructure** – Because of the gap between production and supply, perishable nature of horticulture crops and seasonality, having a good network of warehouses and cold storage infrastructure is pertinent for better value realization of horticulture crops. In its absence there is a large scale wastage. Post-harvest infrastructure is still insufficient in case of India and varies widely over the different states. The central government has facilitated creation of a Warehouse Infrastructure Fund in NABARD. Other than the



Source: Adapted by Authors based on Horticulture Statistics at a Glance, 2022

Figure 1: State-wise Percentage of Production and Total Production of Horticulture Crops, 2021-22



government agencies, this fund is also available for Farmers' Producers' Organizations (FPOs), Federations of Farmers' Collectives, corporates, cooperatives, APMCs, SPVs set up under PPP mode, etc. to support creation of infrastructure for storage of agricultural commodities. However, the states which have the highest production of horticulture crops have less storage capacity created as compared to states with more production of cereals and other non-horticulture crops. Many of the hilly states have huge potential in the horticulture sector but lack post-harvest infrastructure.

- **Insufficient access to good quality seeds and reliable irrigation facility and poor soil management-** As the majority of farmers in the horticulture sector are small and marginal landowners, the access to good quality seeds and irrigation facilities is a challenge.
- **Limited availability of farm insurance and farm mechanisation, combined with lack of access to institutional credit** for small and marginal farmers, results in lower investment in the sector.
- **Small and marginal landholdings-** This results in low crop rotation potential leading to reduced yields and decreased soil fertility overtime. This impacts production and yield of horticulture crops.



- **Lack of effective research and extension in light of climate change scenario-** Climate change has impacted the entire primary/agriculture sector, and horticulture is no different. With an increase in extreme weather events and shift in seasons, more adaptive measures through focussed government extension programmes have to be initiated in all the states. This again becomes more relevant for the Himalayan states.
- **Meeting the consumption demand** - With increasing urbanization, purchasing power and population there is going to be an increase in demand for horticulture crops of all kinds to meet the consumption and nutritional requirements. Meeting the increased consumption demand its going to be a challenge given the limited and declining nature of land under cultivation.
- **Non-availability of timely and robust information-** This needs to be ensured to improve the marketing of horticulture crops and remove supply chain bottlenecks. This also hampers market intelligence of farmers which keeps them devoid of cashing in on export opportunities.
- **Lack of quality control at post-harvest stage;**
- **Insufficient processing facilities** make the horticultural produce highly perishable commodities resulting in high wastage.
- **High price fluctuations-** It is a daunting challenge for small and marginal farmers to cope with the high price fluctuations especially when the supply exceeds the demand in the market. These challenges result in fragmented backward and forward linkages and inefficient supply chain management for the horticulture sector.

Role of State in Supporting the Horticulture Sector

Government of India aptly recognized the potential of the sector and has thus initiated several programmes and schemes to effectively deal with these challenges.



The National Horticulture Board implements several programmes as a sub-scheme of Mission for Integrated Development of Horticulture (MIDH). These schemes lay focus on most of the challenges being faced by the horticulture sector. Mission for Integrated Development of Horticulture is a Centrally Sponsored Scheme, launched on 1st April 2014. It covers fruits, vegetables, root & tuber crops, mushrooms, spices, flowers, aromatic plants, coconut, cashew, cocoa and bamboo. While Government of India contributes 60 per cent of the total outlay for developmental programmes in all the states except the states in North East and Himalayas for which 90 per cent contribution is from Central Government. In case of Union Territories 100 per cent fund is contributed by the central government. There are five sub-missions/Boards under the mission. These are:

- **National Horticulture Mission (NHM)** – Under this mission, there are schemes pertaining to promotion of Commercial Horticulture, developing cold storage facilities, Technology Development Transfer Scheme, Market Information Service Scheme for Horticulture in addition to several training programmes.

GOVERNMENT OF INDIA
MINISTRY OF AGRICULTURE
AND FARMERS WELFARE

NATIONAL HORTICULTURE MISSION

Objectives

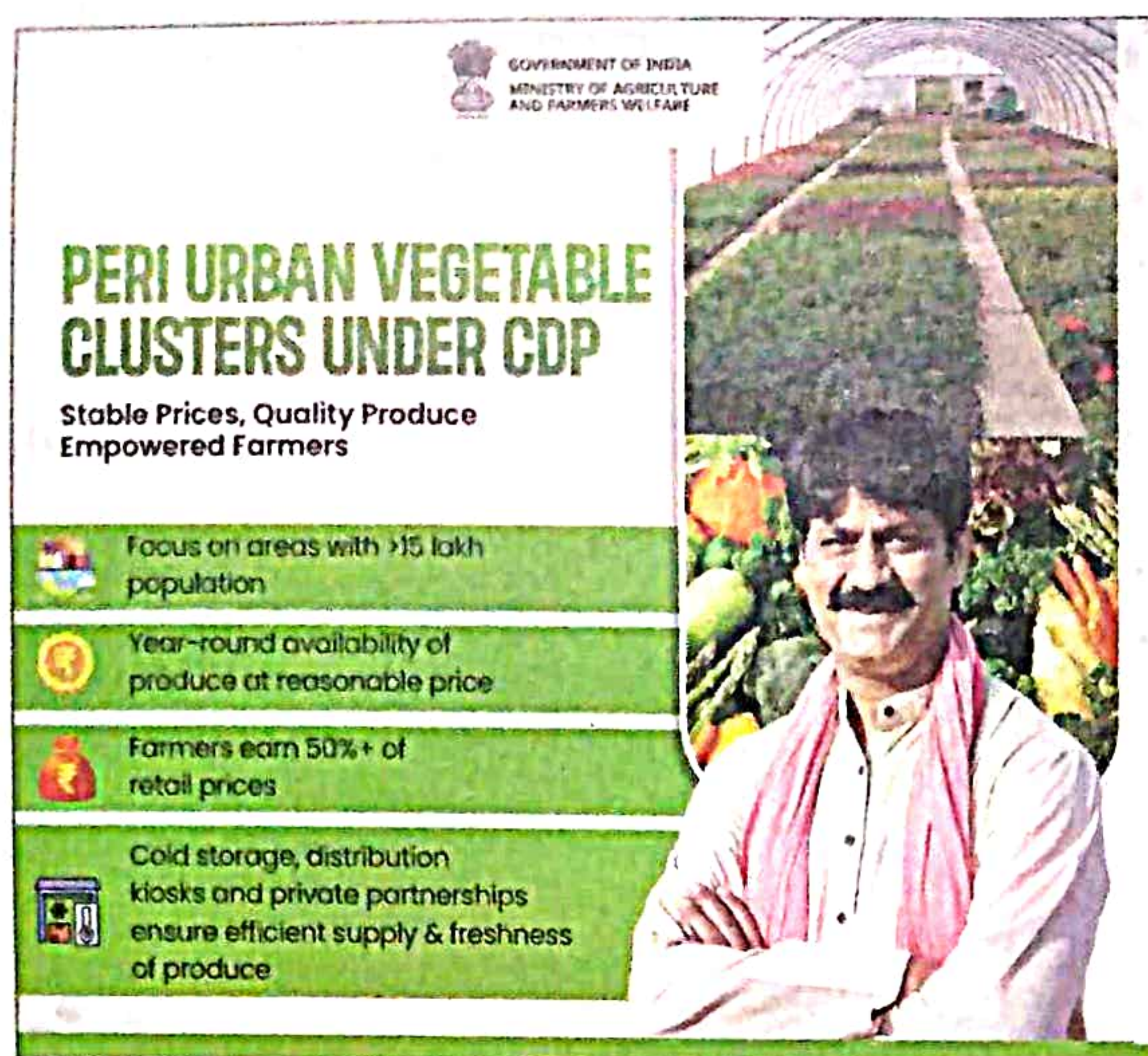
- Encouragement to **small & marginal farmers**
- Increase in **horticulture crop production**
- Support to increase the **farmers' income**
- Improve **nutritional Security**
- Strengthening position as a **leading global exporter** of horticulture products

राष्ट्रीय बागवानी बोर्ड
National Horticulture Board

Activities and Schemes of National Horticulture Board

- Commercial Horticulture in protected cover**
50% subsidy under protected cultivation scheme
- Cold Storage**
35-50% subsidy for Cold Storage
- Post Harvest Management**
35-50% subsidy in PHM
- Commercial Horticulture in open field**
40-60% subsidy under open field cultivation scheme

- **Horticulture Mission for North East and Himalayan States (HMNEH)**
- **National Horticulture Board (NHB)** - The Ministry of Agriculture and Farmers Welfare has launched a new programme for Horticulture Cluster Development to enhance the global competitiveness of the Indian horticulture sector. The NHB has been designated as the Nodal Agency for implementation of Cluster Development Programme as a component of Central Sector Scheme of NHB. The Cluster Development Programme (CDP) leverages the geographical specialisation of horticulture clusters and promotes integrated and market-led development of preproduction, production, post-harvest, logistics, branding, and marketing activities. Integrated Cold Chain Availability Platform (ICAP) has also been created by the ministry which is being maintained by NHB.
- **Coconut Development Board (CDB)**
- **Central Institute for Horticulture (CIH)** – It works in the domain of marketing and value chain development, awareness programme on marketing



and value addition, Entrepreneurship Development Programme cum Skill Development Training.

Launch of National Horticulture Mission has spurred the production and productivity of horticultural crops over the last decade. Government of India has also facilitated large scale disbursement of loans for construction of warehouses, cold storage and cold chain infrastructure through the Warehouse Infrastructure Fund (WIF) created under NABARD. Government of India has also established several Centres of Excellence for Fruits and Vegetables for promotion of research and development in the field of horticulture.

Way Forward

The government has taken note of the economic potential of the horticulture sector and how well it can contribute towards creating better livelihoods in the rural areas, thus curtailing rural to urban migrations. However, more needs to be done to effectively manage the supply chain and ensure more re-investment in the horticulture sector. Moreover, the enormous global trade potential yet remains untapped. To start with, it is required that a national level comprehensive horticulture policy be developed which mandates the initiatives to be taken by the respective state governments and the standards and qualities to be maintained. Only Himachal Pradesh has a Draft Himachal Pradesh Horticulture Policy 2022. The state also has a capacity building programme called "Kshamta se Samruddhi" for horticulture farmers. A bottom-up approach in developing a policy framework is required whereby, district, state and national level guidelines can be worked out. This is more so required

because there are regional variations in soil, climate elevation, skills, infrastructure, etc. which need to be considered for optimally exploring the potential of diverse regions. This would facilitate the increase in production and yield of horticulture crops, thereby increasing the income and surplus earnings which can be reaped back by way of developing cooperatives and Self-Help Groups (SHGs). This would also eliminate the intermediaries and lead to seamless integration of the backward and forward linkages, as shown in Figure 2. Further, industry support and involvement of the private sector has to be enhanced. For this certain incentives and PPP models can be developed so that integrated supply chain management can be worked out on the lines of contract farming. Forward linkage of the horticulture sector to the agro-processing industries and MSME would go a long way in generating greater profits and investable surpluses in the rural economy.

There is a need for special emphasis to be laid on quality of products at each stage of backward and forward linkage. It is important to empower and build the capacity of farmers and producers' associations, either in form of cooperatives, which strengthen backward and forward linkages and also formalise the currently unorganised agriculture sector; or in the form of SHGs, which can be supported initially and then can be transformed into self-sustaining enterprises. In the process, promotion of women led enterprises and youth led commercial activities in horticulture can be given preference. Mechanism for easy and timely access to credit for farmers, SHGs and cooperatives should also be worked out for the growth of the sector.

It is also required that use of *modern tools* such as GIS, AI and IoT be used for database creation and efficient management of supply chain in the horticulture sector. Greater awareness of government schemes, programmes and missions of horticulture in rural areas is also essential.

As far as regional strategies are concerned, the Himalayan states hold the key for harnessing the optimum potential of the horticulture sector. These states are dealing with several grave challenges of poverty, unemployment, backwardness, insufficient infrastructure and amenities and thus need more sustainable economic options in the long-run.

It is also necessary that the rural settlements are amenitized with supportive infrastructure such as

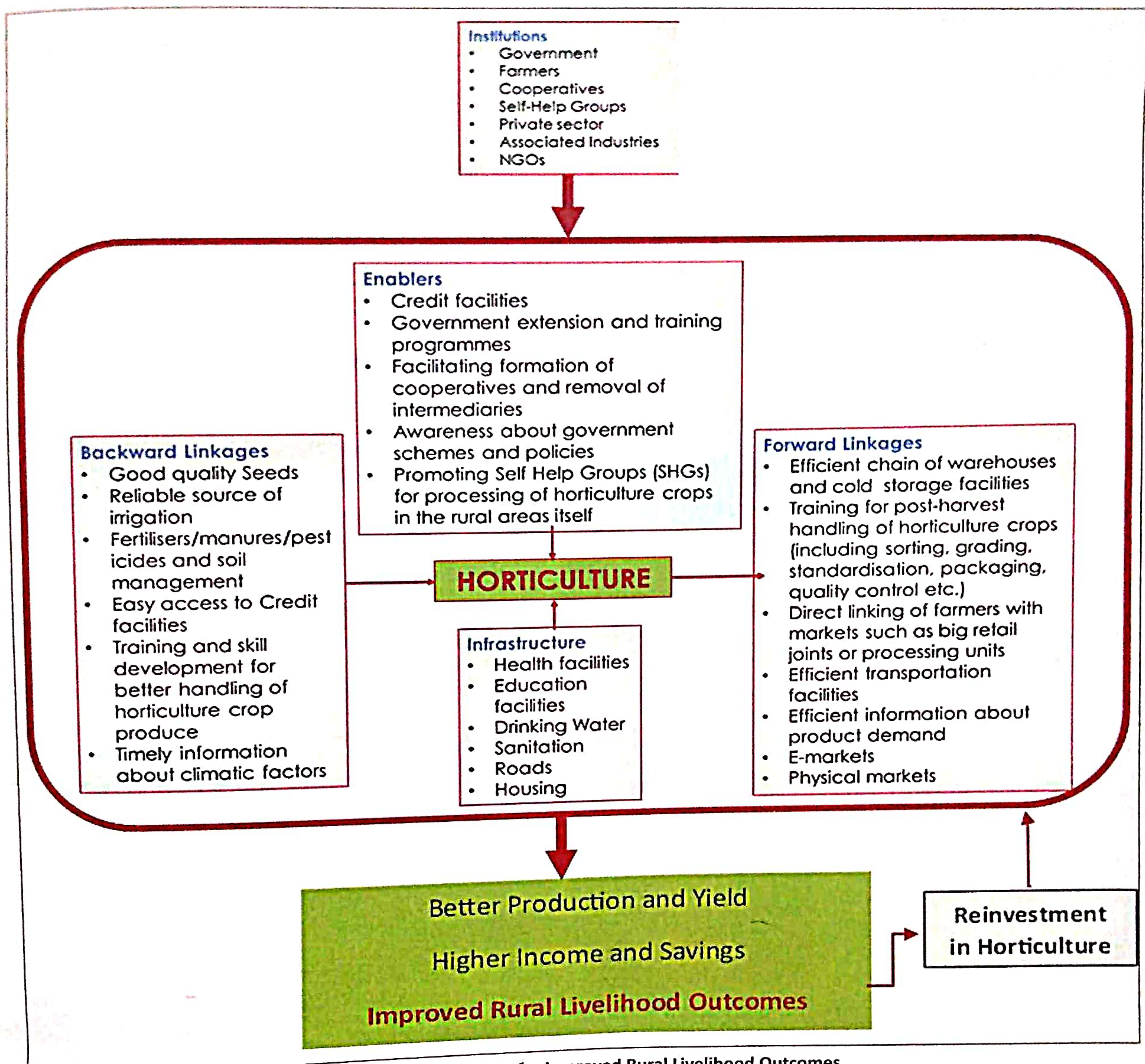


Figure 2: Interventions for Improved Rural Livelihood Outcomes

hygiene, safety, micro processing units for horticulture produce wherein the role of Planners is critical as they also need to shift their focus from routine Urban Planning. 'Nature-Centric Rural Contextual Planning' is the need of the hour with focus on creating an entire eco-system of for rural livelihoods and the enabling infrastructure. Thus, a paradigm shift in Planning approach must consider regional influences to bolster entire living structure in rural areas where 'Quality of Life', livelihoods lead to emergence of New India, shedding poverty tag of the past.

Prime Minister, Shri Narendra Modi released 109 varieties of field and horticulture crops in August 2024, which is a clear demonstration of proactive scientific interventions of the Central Government to strengthen horticulture with the underlying emphasis to create strong base for rural livelihoods.

With such interventions horticulture is bound to be promoted as a high value sub-sector of agriculture and can greatly contribute to high income and employment in the rural areas leading to the realisation of PM Modi's vision of "Gaon Badhe to Desh Badhe". □