SATSA Mukhapatra - Annual Technical Issue ***28*** *: 2024* ISSN 0971-975X ***Invited Paper***

Horticulture for Livelihood and Nutritional Security

Pranab Hazra

(Received : February 25, 2023; Revised : June 18, 2023; Accepted : January 15, 2024)

ABSTRACT

In the changing Global scenario, food, nutrition, healthcare and livelihood security are the matter of great concern to human, social and economic development. Horticultural crops (fruits, vegetables, root and tuber crops, plantation crops, medicinal and aromatic plants, spices and condiments and ornamental crops) have emerged as the best option not only to provide adequate food and nutrients but also to generate employment in rural sector and enhance the profitability from the farm. With increase in *per capita* income and accelerated growth of health conscious population, demand for horticultural produce is on increase which is expected to further accelerate, which will require enhancing both productivity and total production. Although, the country is the second largest production of fruits and vegetables in the world, availability of fruits and vegetables still continues to be much below the dietary requirements. Technology driven horticulture is expected to address the concern for nutritional and livelihood security, health care leading to ultimately economic development. School level nutrition education with multipronged collaboration based on nutrient potential of vegetables and fruits may be a viable option to improve food and nutritional security for the vulnerable section of the population.

Keywords : Horticulture, Livelihood security, Doubling farmers' income, SWOT analysis, Challenges in horticulture

Indian agriculture and food and nutritional security: an overview

The growth and prosperity of rural economy are closely linked with agriculture and allied agricultural sectors. Apart from meeting the food and fodder requirements, its importance also stems from the raw materials that it provides to industry. India is primarily an agrarian economy. Gross value added by agriculture, forestry, and fishing was estimated at Rs. 19.48 lakh crore (US$ 276.37 billion) in 2020. Share of agriculture and allied sectors in gross value added (GVA) of India at current prices stood at 17.8 % in 2020. However, this sector provides employment for over 60 percent of the population. For this reason, agricultural sector indeed plays a vital role in Indian economics, politics and society. India is among the highest-ranking countries in production volume for various commodities like rice, cotton, dairy, fruits, vegetables, meat and seafood, but the nation has access to only 60 % of the

Professor, Department of Vegetable Science , Former Dean, Faculty of Horticulture and Dean, Post Graduate Studies, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, West Bengal, Email: hazra.pranab05@gmail.com, Mobile : 9433259721; 8910782815

produce due to lack of storage infrastructure. With policy interventions, faster mechanization, adoption of innovative technologies and smarter farming solutions, the agriculture sector is expected to witness its next wave of growth, thus helping the Indian economy to achieve the recent World Bank's Global Economic Prospects report of projected growth of 7.5 % in the next two fiscal years.

Explosion of population, degraded ecosystem services and climate change have posed a major threat to food and nutritional security. Global population may reach 10 billion by 2050, requiring an increase in agricultural production by 70% in order to sustain the supply chain towards food security. More than 1.0 billion people globally are hungry and about 3.0 billion people are malnourished. 70% of malnourished people live in South and Southeast Asia and 53% of children of the world are malnourished and underweight and 40% of them live in India. COVID-19 pandemic pushed over 130 million more people into chronic hunger across the globe because of increase in food price and widespread food insecurity.

It has been assessed that Globally 60 % of ecosystem services *viz.*, Agricultural production, Supply of water, Control of climate and Nutrient cycles are degraded (Millennium Ecosystem Assessment, 2005) and 24% of the arable land suffers soil degradation which are the major causes of widespread subsistence production with low levels of technology leaving little, if any, surplus production for sale or trade. This degraded ecosystem and climate change condition have resulted in increase in food price and widespread food insecurity particularly in the developing countries which has been aggravated due to COVID 19 pandemic and Russia – Ukraine war.

Agricultural production scenario in India has worsen further because of the apathy of the rural youth to take agriculture as profession because of lack of assurance of crop as well as the market and lack of employment opportunity in the rural sector resulting wide spread migration of population to urban areas accounting around 30%. In this situation, crop diversification and smarter and more modern approaches are therefore necessary in production system so that farming practices may achieve sustainability and climate resilience in our cropping systems.

Horticulture : the best option for livelihood security

Horticulture is an important allied sector of agriculture, which provides supplementary income, alternative livelihood especially to the landless, employment opportunities during non-agricultural seasons. Besides this, it contributes immensely in value added services and food processing industries. This sector has an ability to create man hours and entrepreneurship among the youth. Demand for fresh and processed products of all types of agricultural diversifications *viz.*, horticulture, aquaculture, poultry, dairy production and organic produce is increasing due to rapid urbanization, rise in income particularly of the middle class population and changing consumption habits of the population. Consumer demand of horticultural crops is increasing day by day as the quality of life has increased in urban

and peri-urban areas. The Economic Survey 2015-16 presented in the Parliament by the Union Finance Minister emphasized that the scenario of horticulture crops in India has become very encouraging. Horticulture and livestock sectors have emerged as major drivers of growth in the agricultural and allied sector. In the last 60 years, cereal production enhanced by 4 times, milk by 6 times, fish by 9 times and horticultural crops by 10 times. Over the last decade, this sector has grown at the growth rate of 3.6 percent. The year 2021-22 has become the nine straight year when total horticulture production (333.25 million tonnes) out-performed total food grain production (315.72 million tonnes). The increase in production has been registered in vegetables, spices, medicinal and aromatic crops. The Floriculture sector has been the hardest hit by the pandemic as production declined by 7.17%.

Between 2004-05 and 2020-21, increase in the production of horticultural output has come from an increase in acreage and even larger increase in productivity. While the area under horticulture crops grew by about 2.7 % per annum, productivity increased by 37 % between 2004-05 and 2020-21.

Different Horticulture crops (fruits including nuts, vegetables including potato, tuber crops, mushroom, ornamental plants including cut flowers, spices, plantation crops and medicinal and aromatic plants) has become a key drivers for economic development in many of the states in the country. Present production of different horticultural crops (NHB Data Base, 2021-2022) is 333.25 million tonnes from 27.56 million hectare land (Table 1). Total production of different horticultural crops viz., Vegetables: 199.88 million tonnes; Fruits: 102.92 million tonnes; Flowers: 2.88 million tonnes (0.791 million tonnes cut flower and 2.095 million tonnes loose flower); Plantation crops: 15.85 million tonnes; Spices: 10.81 million tonnes, Aromatic and Medicinal crops: 0.78 million tonnes and Honey: 0.125 million tonnes contributes more than 30.4 % of agricultural GDP and 54% of agricultural exports only from 8.5% of cropped area. Horticultural crops also stipulate five times higher per capita income than the cereals worldwide.

Pivotal role of horticulture in doubling farmers' income

In India, the early agricultural development strategies focused primarily on raising agricultural output for attaining food security. The announcement for doubling farmers' income (DFI) by the Prime Minister of India on 28 February 2016, and its subsequent inclusion in the budget speech of the Union Finance Minister on 29 February 2016, propelled the momentum towards enhancing farmers' income. Since then, doubling farmers' income has been at the centre stage in the debates on agriculture. The premise of the strategy for doubling farmers' income is based on the following primary principles: a) increasing total output across the agricultural sub-sectors through realising higher productivity b) rationalizing / reducing the cost of production, c) ensuring remunerative prices in the agricultural produce, d) effective risk management and e) adoption of sustainable technologies. The Inter-

Table 1. Area and production of different horticultural crops in India

Crop	Area and Production of different Horticultural crops in India (NHB Data base, 2021-22)	
	Area (,000 ha)	Production (,000 tonnes)
Fruits	6967	102924
Vegetables	11065	199882
Cut flower	267	2095
Loose flower		791
Plantation crops	4271	15852
Spices	4344	10816
Honey		125
Total	27563	333251

Ministerial Committee examined issues related to farmers' income, and suggested a 7-point strategy :

- Enhancing production of crops and livestock through intensification
- Raising productivity through better management and irrigation
- Reducing cost of production through adoption of technologies and conventional practices
- Higher realization of net income through modern/ electronic marketing
- Processing and value addition to farm produce
- Diversification into high-value crops
- Adoption of supplementary agricultural/ non-agricultural enterprises backed by skill development programs

As per the strategy, Government has adopted and implemented several policies, reforms, developmental programmes and schemes for achieving higher incomes for the farmers directly or indirectly which include :

- **Unprecedented enhancement in budget allocation :** In the year 2015-16, the Budget allocation for Ministry of Agriculture & FW (including DARE, DAH&F) was only Rs. 25460.51 crore which has been increased by more than 5.44 times to Rs. 1,38,550.93 crore in 2022-23.
- **Fixing of minimum support price (MSP) at one-and-a half times the cost of production :** Government has increased the MSP for all mandated Kharif, Rabi and other commercial crops with a return of at least 50 per cent over all India weighted average cost of production from 2018-19. MSP for Paddy (common) has increased to Rs. 2040 per quintal in 2022-23 from Rs. 1310 per quintal in 2013-14. MSP

for Wheat increased from Rs. 1400 per quintal in 2013-14 to Rs. 2125 per quintal in 2022-23.

- **Promotion of organic farming in the country :** Paramparagat Krishi Vikas Yojana (PKVY) was initiated in 2015-16 to promote organic farming in the country. Altogether, 32384 clusters have been formed and an area of 6.53 lakh hectare has been covered benefitting 16.19 lakh farmers. In addition, Under Namami Gange Programme123620 hectare area and under natural farming 4.09 lakh hectare area was covered. Government also proposes to promote sustainable natural farming systems through the scheme Bhartiya Prakratik Krishi Padhati (BPKP). Mission Organic Value Chain Development in North East Region (MOVCDNER) has been launched. 379 Farmer Producer Companies have been formed comprising of 189039 farmers and covering 172966 hectare area.
- **Per drop more crop :** Per Drop More Crop (PDMC) scheme was launched in the year 2015-16 which aims to increase water use efficiency, reducing cost of inputs and increasing productivity at the farm level through Micro Irrigation technologies i.e. drip and sprinkler irrigation systems. So far, an area of 69.55 lakh hectare has been covered under Micro irrigation through the PDMC scheme from the year 2015-16.
- **Promotion of farmer producer organizations (FPOs):** To bring scales of economy to agricultural operations a new Central Sector Scheme for Formation & Promotion of new 10,000 FPOs was launched by Hon'ble Prime Minister on 29th February, 2020 with budget outlay of Rs 6865 crore till 2027-28.As on 31.10.2022, 3855 no. of FPOs have been registered under new FPO scheme.
- **National beekeeping and honey mission (NBHM) :** This mission has been launched in 2020 as part of the Atma Nirbhar Bharat Abhiyan to increase productivity of crops through pollination and increase in honey production as an additional source of income. Rs. 500 crore for the period 2020-2021 to 2022-2023 has been allocated for beekeeping sector.
- **Agricultural mechanization :** Mechanization is an extremely vital to modernize agriculture and reduce drudgery of farming operations. During the period from 2014-15 to March, 2022 an amount of Rs.5490.82 crore have been allocated for agricultural mechanization. During 2022-23, an amount of Rs. 504.43 crores has been released for distribution of around 65302 machines on subsidy.
- **Providing soil health cards to farmers :** Soil Health Card Scheme was introduced in the year 2014-15 to optimize usage of nutrients.
- **Setting up of national agriculture market (e-NAM) extension platform :** 1260 mandis of 22 States and 03 UTs have been integrated to e-NAM platform. As on 31.10.2022, more than 1.74 crore Farmers and 2.36 Lakh traders have been registered on e-NAM portal.

- **Launch of the national mission for edible oils –oil palm :** This mission has been approved with a total outlay of Rs 11,040 crore.
- **Agri infrastructure fund (AIF) :** Since inception of AIF in the year 2020, the scheme has sanctioned an amount of Rs.13681 crore worth agriculture infrastructure in the country for more than 18133 projects. These infrastructures include 8076 warehouses, 2788 primary processing units, 1860 custom hiring centres, 937 sorting & grading units, 696 cold store projects, 163 assaying units and around 3613 other kinds of post-harvest management projects and community farming assets.
- **Improvement in farm produce logistics, introduction of Kisan Rail :** Kisan Rail has been launched by Ministry of Railways to exclusively cater the movement of perishable agri-horti commodities. First Kisan Rail was started in July 2020. Till 31st October, 2022, 2359 services on 167 routes have been operated.
- **MIDH - cluster development programme :** The cluster development programme (CDP) is designed to leverage geographical specialization of horticulture clusters and promote integrated and market-led development of pre-production, production, post-harvest, logistics, branding, and marketing activities.
- **Creation of a start-up eco system in agriculture and allied sector :** So far, 1055 startups during 2019-20 to 2022-23 period have been finally selected by different knowledge partners and agribusiness incubators of DA&FW. A total of Rs. 6317.91 lakhs grants-in-aid have been released for funding to these Startups to the respective knowledge partners (KPs) & RKVY RAFTAAR Agri business incubator (R-ABIs) as grants-in-aid support by DA&FW.

The government initiated several steps in this direction with a focus on intensification, diversification, shift from subsistence to commercialization and business orientation towards agro-based small-scale enterprises. ICAR has come out with collection and compilation of experiences of 75000 successful farmers who have doubled their income during 2016-17 and 2020-21 (Doubling Farmers Income, State wise Synthesis, ICAR, 2022).

Salient outcome of the strategies of doubling farmers' income

- Increase in income was evident across all the sectors of agriculture including field crops, horticulture, livestock, fisheries and farm/non-farm enterprises.
- The overall increase in income ranged from 125.44% in Ladakh to 271.69% in Andaman and Nicobar Islands.
- Uttarakhand, West Bengal, Chhattisgarh and Puducherry recorded more than 200 per cent increase in income however, most of the other states recorded overall increase in income in the range of 150 to 200 per cent.
- Horticulture had the dominant share in total income during 2016-17 as well as 2020-21 in 14 states like Jammu and Kashmir, Himachal Pradesh,

Ladakh, Jharkhand, Sikkim, Meghalaya, Mizoram, Tripura, Goa, Gujarat, Maharashtra, Tamil Nadu, Karnataka and Kerala.

- Himachal Pradesh, Kerala and Goa are the top three states with a share of more than 60 per cent in total income from Horticulture.
- In terms of additional income generated during the intervention period, horticulture was the dominant component in 17 states, including the three north-eastern states of Sikkim, Meghalaya and Mizoram. The percentage share in additional income from horticulture was as high as 67.72% in Himachal Pradesh followed by 61.11 % in Ladakh, 60.15% in Delhi, 59.15% in Kerala, 58.06% in Karnataka, 57.33% in Goa and 55.89% in Gujarat.
- Field crops, although the share in total income is declining from 2016-17 to 2020-21, it still remained as the dominant source of income in 11 states *viz.*, Punjab, Uttarakhand, Haryana, Rajasthan, Uttar Pradesh, Bihar, Chhattisgarh, Madhya Pradesh, Andhra Pradesh, Puducherry and Telengana.
- Madhya Pradesh, Chhattisgarh and Haryana are the top three states where field crops have high share in total income of the farmers.

Horticulture holds the key for prosperity of rural economy in West Bengal

West Bengal is predominantly an agrarian State comprising of only 2.7% of India's geographical area. It supports nearly 8% of its population. There are 71.23 lakh farm families of whom 96% are small and marginal farmers. The average size of land holding is only 0.77 ha. However, the State is bestowed with diverse natural resources and varied agro-climatic conditions which support cultivation of a wide range of crops. The net cropped area is 52.05 lakh ha which comprises 68% of the geographical area and 92% of arable land with cropping intensity of 184%. West Bengal is located at the centre of the Eastern region of India. The state is basically riparian, situated as it is, in the heart of extremely fertile Gangetic delta and bestowed with six agro-climatic zones (northern hill, northern terai, old alluvial, new alluvial, western red and lateritic, and costal zones) ranging from tropical to arctic. Exhibiting a wide range of flora and fauna, this state has the potential to produce wide range of horticultural products. Allied sector is now equally important for the development of the state especially it's rural economy and all round development of any country. The state of West Bengal has immense potentiality to meet these demands on account of its diverse climatic conditions.

The state of West Bengal extends from the Himalayas to the Bay of Bengal. It has a varied climate and forestry ranging from temperate on the Himalayas to hot in the mangrove swamps at the estuaries providing habitat for an equally varied flora and fauna. West Bengal bestowed with different natural agro-climatic zones, has been taking leading role in cultivation of various types of horticultural crops. West Bengal is the largest producers of horticultural crops in India due to diverse agro-climatic conditions and rich biodiversity. Diverse agro-climatic regions,

wide variety of soils supplemented with substantial rainfall has made West Bengal a forerunner in vegetable production in our country. With a production of 32.82 million tonnes of horticulture produce from an area of 1.94 million ha (Table 2), West Bengal is the largest producer of horticultural crops accounting for 14.12% vegetables, 10.15% cut and loose flower and 3.61% fruits production and 9.84% of total horticultural production in the country. West Bengal ranks top for total production of vegetable including potato, cut flower and pineapple in the country. Fruits and vegetables accounted for about 459 billion Indian rupees (Rupees 45900 crore) from West Bengal to the Indian economy in fiscal year 2019 but it has slightly reduced to 457 billion Indian rupees (Rupees 45700 crore) in 2020. The state made up nearly 12 percent of a nationwide share within this sector.

Table 2. Area and production of different Horticultural crops in West Bengal

Crop	Area and Production of different Horticultural crops in West Bengal (NHB Data base, 2021-22)	
	Area (,000 ha)	Production (,000 tonnes)
Fruits	283.56	3717.98
Vegetables	1511.19	28229.16
Cut flower	29.73	218.71
Loose flower		74.53
Plantation crops	55.70	313.51
Spices	61.17	250.67
Honey		20.00
Total	1941.35	32824.55

SWOT analysis of the State for horticultural development

Strength Weakness Opportunity Threat (SWOT) analysis has been conceded to conceptualize the synoptic profile of the production of horticultural crops in West Bengal. SWOT analysis has widened the scope for formulation of a full proof strategy for sector development. Planning would be made keeping in mind the strengths in each sector as a whole has, weaknesses analysed and tried to be overcome, opportunities fully explored and taking safe guards to withstand possible/ potential threats. This analysis has also brought out a comparative perspective of sectors.

Strength

- The State is endowed with varied agro-climatic conditions and abundance of natural resources for diversified production of different horticultural crops including fruits, vegetables,

plantation, flower and ornamentals and spice crops.

- Strong consumption base due to sprawling urbanization with huge middle-class population having adequate income support which creates huge domestic demand for different horticultural crops and wide market opportunities
- Strong production base for different horticultural crops particularly, vegetables, fruits and flowers with scope for further development, processing and value addition.
- Excellent potential for production of high value vegetables and flowers in the plains as well as in the hill situation under low and medium cost poly houses
- Good trans-state and export demand for different horticultural crops particularly vegetables , flowers and different fruits like, mandarin orange, pineapple, mango, etc.
- The net cropped area of the state is 52.05 lakh ha which comprises 68% of the geographical area and 92% of arable land with cropping intensity of 184%. Most of the soils are fertile alluviums which are highly productive
- Well-developed irrigation infrastructure in different parts of the state facilitating higher cropping intensity with potential for further development especially of ground water resources.
- Conceptualization of "Agri Export Zones" in different districts by Central Government for different horticultural crops has brought about a paradigm shift in the approach-from "production oriented" to "market driven" farming.
- Major production centres across the state are linked with city markets by effective rail and road transport facilities
- Large pool of skilled and enthusiastic small and marginal farmers

Weakness

- Inadequate availability of quality seeds/planting materials of improved varieties
- Preponderance of small and marginal farmers (more than 96%) with low average holding size (0.77 ha) which limits the scope for the adoption of capital intensive modern horticultural technologies
- Predominance of rice based mono-cropping and /or with potato /jute in sequence and less adoption of crop rotation and diversification.
- The state has a coastline of 210 km mainly in Medinipur and Sunderbans in the South-24 Parganas districts. The beaches and inlets, creeks, and mangrove swamps, mudflats, coastal dunes and sand flats are the characteristics of these areas which are problematic for growing successful crops.
- Red lateritic zone of West Bengal is comprised about one third of the cultivated area in the districts of Purulia, Bankura, Jhargram, parts of Paschim Medinipur, Bardhaman and Birbhum. Average cropping intensity of this zone is very low due to less fertile, dry and predominantly acidic soil and inadequate distribution of rainfall.

- Several areas of the state are flood prone with persisting drainage problem which poses huge problem to successful crop production.
- Adverse impact on soil health and productivity due to imbalances in fertilizer application particularly to vegetables including potato coupled with very low application of organic manure.
- Inadequate postharvest handling and multi-purpose cold storage facilities particularly for vegetables and flowers which results in seasonal gluts and distress sales besides huge postharvest losses.
- Low level of awareness among majority of the farmers regarding the importance of soil fertility, ecosystem services, natural resource management, integrated nutrient and pest and disease management which are the main stay for sustainable production as well as the quality requirement for export.
- Inadequate bank financing in the horticulture sector as a whole

Opportunities

- Harnessing both public and private funding support to establish efficient domestic market / export- oriented value chain
- Linking production chain with marketing and processing chain
- Technological commercialization, scaling up of innovations and area expansion with hardy fruit and plantation crops particularly in waste land and culturable waste land of coastal and red and lateritic zone
- Adoption of modern horticultural technologies in the production system *viz.*, use of specific variety/ hybrid, micro-irrigation, micro-propagation, high-tech and certified nursery, protected farming, etc.
- Establishment of multi-rich, bio-fortified and specialized horticulture hub in red and lateritic zone through adoption of improved technologies
  - Vegetables (high lycopene tomato, watermelon, high â carotene carrot, orange coloured cauliflower, orange fleshed sweet potato, drumstick, etc)
  - Fruits (mango, guava, aonla, pomegranate, bael, ber, custard apple, sapota, sweet orange, etc)
  - Flowers (commercial floriculture hub of rose, gerbera, chrysan-themum)
  - Promotion of rain water harvesting structures especially in irrigation water constraint areas of red laterite zones covering Purulia, Bankura, parts of West Medinipur, Jhargram, Birbhum, etc. for utilization of the harvested water for supplemental / life-saving irrigation in the difficult season.
- Rational utilization of ground water resources through adoption of micro irrigation system
- Establishment of seed production venture of vegetable crops and seed tuber production of potato through promotion of seed villages for production of certified / truthfully labelled seed with centralized

processing/quality control facilities at block /district level in the red and lateritic zone

- Promotion of the production of quality planting materials and development of accredited nurseries in different districts for different horticultural crops
- Boosting mandarin orange production in Darjeeling district through establishment of new orchards with healthy and disease-free planting materials and judicious management of plant nutrients (macro & micro) and irrigation
- Establishment of commercial floriculture hub in Darjeeling and Jalpaiguri district with different commercial flowers including orchids
- Improvement of cropping intensity through better management of surface and ground water resources; crop diversification with less water intensive and remunerative crops like vegetable, flowers and seed spices like, coriander and black cumin
- Soil health management through comprehensive survey and introduction of Soil Health Cards
- Better organic input supply to the farmers through development of 'Organic Inputs Production Hubs', promotion of FYM, vermicompost and botanicals among the farmers
- Strengthening extension mechanism with the focus on active involvement of informal channels for technology dissemination through Farmers' Clubs, FPOs, FPCs promoted by NABARD, NCDC, SFAC, and pro-active NGOs
- Policy interventions favouring contract farming to facilitate exclusive production of specific varieties of particularly vegetable crops suitable for export and processing with user industry tie-up for buyback
- Wide opportunities for export of fresh and processed forms of different horticultural products
- Keeping in view of the majority of small and marginal farmers in the production of agriculture and horticulture crops, where individual ownership of farm equipment is not a feasible and viable proposition, the concept of "Farm Machinery Hub" has wide opportunities in the state to promote mechanization in farming of different horticultural crops
- Establishment of multipurpose cold storage facilities and food processing units either through private/ corporate sector investment or Public-Private Partnership (PPP) mode with Government providing the basic infrastructure in the potential production zones.
- Promoting the concept of organic farming, Good Agriculture practices (GAP), Good Handling practices (GHP), Sanitary & Phyto-sanitary measures (SPS), CODEX, etc. among the horticultural farmers and development of Frontline demonstration centres for organic farming, GAP & GHP.
- Modernization of existing processing units and adoption of hazard analysis and critical control points (HACCP), a systematic preventive approach to food safety in the processing units

- Development of Agripreneurs' hub for sustainable agri-business for fresh produce and processed products.
- Use of IT technology *viz.*, software, GIS, satellite data & predictions about diseases, pests, etc. and strengthening of export cell (international market data, promotion of produce, etc.) for promotion of export of horticultural produce.

Threats

- Apathy of the rural youth to take agriculture as a profession because of wide spread migration to the proximate cities and other state because agriculture is considered as un-remunerative profession resulting shortage of man power in agriculture/ horticulture and widespread subsistence production.
- The pressure on land has increased considerably leading to fragmentation of land with increasing population and inadequate employment opportunity in the rural sector. As the pressure on the land increased, the farmers are forced to exploit their land for livelihood support which again leads to degradation of environment and soil health that would lead to food and nutritional insecurity.
- As the State is located in the humid tropic and the Bay of Bengal is close by, it has to often face vagaries of nature like flood, cyclone, hailstorm, etc. Occurrence of other climatic vagaries like high temperature, untiely rainfall, excess rainfall exert adverse effect on production and cause transport and storage losses.
- Indiscriminate use of ground water which may lead to several blocks falling under over-exploited category limiting the scope for further development of irrigation facilities.
- Smaller land holdings due to preponderance of small and marginal farmers (96%) limiting the scope for adoption of capital intensive modern horticultural technologies.
- Lack of awareness regarding the concept of organic farming, Good Agriculture practices (GAP), Good Handling practices (GHP), integrated nutrient and pest and disease management, Sanitary & Phyto-sanitary measures (SPS), CODEX, etc. among the horticultural farmers limiting the scope for adherence to quality standards with special reference to exports.
- Declining organic matter levels and mining of nutrients causing deficiencies of certain secondary and micronutrients particularly in the areas of high cropping intensity which necessitated bringing up the packages of integrated nutrient management strategy.
- Some of the disease and pest problems like, bacterial wilt of Solanaceous vegetables, downy mildew in bitter gourd and cucumber, *Phytophthora* rot in pointed gourd, fruit and shoot borer in brinjal, bhendi yellow vein mosaic virus in okra, leaf curl virus in tomato and chilli, root knot nematodes in different vegetable crops, fruit fly in mango and guava, guava wilt, powdery mildew of rose, *Phytophthora* leaf rot in betel vine, etc. still assume serious proportion.

- Lack of region specific research back up for organic farming package, lack of availability of organic inputs and at the same time lack of assured market for the organically grown produce is the main hindrance of implementing this ecology based agricultural system.

Agri-Export zones for Horticultural crops in West Bengal

The concept of Agri Export Zone (AEZ) was introduced by Central Government in 2001 through EXIM Policy 1997-2001 to take a comprehensive look at a particular produce/product located in a contiguous area for the purpose of developing and sourcing the raw materials, their processing/packaging, leading to final exports (Table 3). The concept hinged primarily on convergence of existing Central and State Government schemes to take care of financial interventions required at various stages of value chain; partnership among various stakeholders *viz.*, Central Government, State Government, farmer, processor, exporter etc. and focus on targeted products and areas to identify required policy interventions.

Table 3 : Agri-Export zones for horticultural crops in West Bengal

AEZ for Horticultural crops	Districts
Pineapple	Jalpaiguri, Darjeeling, Cooch-Behar,
Mango	Malda, Murshidabad
Litchi	Malda,Murshidabad, Nadia, North 24 Parganas
Potato	Hooghly, Burdwan, Howrah, Purba-Medinipur
Vegetables	Murshidabad, Nadia, North 24 Parganas, South 24Parganas
Flowers	Purba Medinipur, Darjeeling,

Horticulture : opportunity for investment, entrepreneurship and business

Horticulture, one of the main agricultural diversifications in the country involves increasing the area and productivity of farming lands, bringing technological aspect in agriculture, raising the farmers' incomes and their standard of living, being a source of employment opportunities. There exists huge business opportunities in the horticulture sector of India. Investors and entrepreneurs from India and abroad are making greater investments into the sector and are actively involved in trading of India's horticulture crops.

Emerging opportunities of horticulture

Retail business

India's food and grocery retail business is estimated at Rs. 24,70,000.00 crores / $380 billion and this sector is dominated by traditional trade formats like neighbourhood shops, which hold about 98 % of the total market share. The market share held by modern trade formats such

as supermarkets and hypermarkets is expected to double from 2.0 to 4.0% by 2020, which will boost the venture for retail chain management.

Export of horticultural produce

Over the years, India has developed export competitiveness in certain specialized products, making it the world's 14th largest exporter of agricultural including horticultural, fishery and forestry product. It exported fresh produce worth Rs. 11,412.50 crore (US$ 1,527.60 million) over 2021-22, with fruits valued at Rs. 5,593 crore (US$ 750.7 million) and vegetables at Rs. 5,745.54 crore (US$ 767.01 million). During this period, processed fruits and vegetables (including pulses) were exported for a total of Rs. 12,858.66 crore (US$ 1,724.88 million), of which Rs. 8,308.04 crore (US$ 1,114.19 million) and Rs. 4,550.62 crore (US$ 610.69 million) were processed vegetables, including pulses.

Leading agricultural / horticultural exports consisted of Basmati rice, different vegetables, fruits and nuts, buffalo meat / meat of bovine animals, frozen shrimp and prawns, cotton and refined sugar.

Onions, okra, bottle gourd, mixed vegetables, potatoes, tomatoes, and green chilli contribute largely to the vegetable export basket while, grapes, pomegranates, mangoes, bananas, oranges account for larger portion of fruits exported from the country. The major destinations for Indian fruits and vegetables are Bangladesh, UAE, Iran, Netherland, Nepal, Malaysia, UK, Sri Lanka, Oman and Qatar.

Sustainable mechanization

Sustainable mechanization plays an increasingly important role to ensure sustainable agricultural and food production particularly, in view of continued migration of people from rural to urban areas. This implies that power sources (human, animal or motor-based) need to be adapted from the ergonomic, social, cultural and economic point of view. FAO is working with private sector partners, Governments and farmers to create and promote sustainable mechanization opportunities. Reduction of drudgery to the farm labour, particularly woman is a key element of sustainable mechanization and contributes to reducing women's hard workload by taking into consideration technologies apt to their needs and improving their access to appropriate forms of farm power.

India is the largest tractor market in the world and is estimated to grow at 10 % annually for the near future. The agriculture and farm equipment including micro-irrigation equipment market in India is currently estimated at Rs. 58,500 crores / $ 9 billion and is expected to reach over Rs. 71,500 crores / $ 11 billion in the next five years.

Irrigation management

Agriculture in India is vulnerable to the vagaries of weather because an estimated 52 % of farmland is un-irrigated and still dependent on rainfall in one hand and wastage of precious water due to flooding of field in the other. This situation warrants efficient irrigation management through drip and fertigation system. The Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)', launched in 2015, brought together various schemes regarding irrigation, micro-irrigation, command area development and watershed development

under the ambit of a single umbrella. The overreaching vision of this scheme is to ensure access to some means of protective irrigation to all agricultural farms in the country, to produce 'per drop more crop', thus bringing much desired rural prosperity.

Farming-as-a-service

Farming-as-a-Service is a concept which was spawned a few years ago in India by offering farming services, machinery, and implement rentals on a pay-per-use basis. Farming services such as land preparation, soil-health data, supply of planting materials, sowing, poly house and micro-irrigation management, crop management, machinery rental, harvesting and post-harvest management and will be relevant to most of the farmers as they own small farmlands (average size 0.77 hectares in West Bengal) which are affordable and reduce the need for capital expenditure. This service sector will not only attract the youth in the farming sector but also generate job opportunity in the rural areas.

Food processing sector

The food-processing sector in India is one of the largest sectors, accounting for 32 % of the country's total food market. To reduce wastage of fresh fruits and vegetables, and to add value to them, processes like canning, dehydration, pickling, provisional preservation and bottling have been introduced. The sector is the sixth largest and ranks fifth in terms of production, consumption, exports and growth. The sector contributes 9 % and 11 % of GDP in manufacturing and agriculture including horticulture, respectively, and makes up for 13 % of India's exports and 6 % of total industrial investment. As per the latest Annual Survey of Industries, 39,319 registered food-processing units in the country employ approximately 1.7 million people in food and beverage manufacturing. However, percentage of processing of fruits and vegetables in India is currently less than 3% as compared to countries like China (23%), the United States (65%) and Philippines (78%). In 2019 period, ~8.31 million tons of fruits and vegetables were processed in India, which is expected to reach 16.39 million tons by 2024, expanding at a compound annual growth rate (CAGR) of ~14.84% during the 2020-2024 period. This feature amply suggests huge possibility of expanding fruit and vegetable processing sector in the state in particular and country as a whole.

Cold chain sector

Traditionally, Indian consumers prefer fresh meat, vegetables, fruit, dairy products and produce. With the evolving middle class, an increase in demand for fresh produce, meat and perishable packaged foods is on the rise, thus leading to potential opportunities for sustainable cold chain networks.

Horticulture: the best option to alleviate hunger and malnutrition

Hunger, malnutrition and hidden hunger continues to persist as a pressing Global phenomenon. Food, at the fundamental level, is viewed as a source of nutrition to meet daily requirements at a minimum in order to survive but with an ever greater focus on the desire to thrive. Hunger and malnutrition refers to the lack of macronutrients like carbohydrates and protein in the diet. "Hidden hunger" or

micronutrient deficiency is a pernicious problem around the world particularly in the under-developed and developing countries that is caused by a lack of vitamins and minerals and affects the health of about 300 crore (3 billion) people worldwide. Vegetables and fruits are the important source of food containing essential micro-nutrients (vitamins, minerals) and phyto-chemicals as a vital accompaniment for the staple cereal based diet and hold the key in assuring nutritional security. With high income elasticity, the demand for vegetables and fruits and perception of diversified diet has been growing steadily. In India, both access and consumption of vegetables has been increasing in the urban and peri-urban population group. People are beginning to consume more healthful foods that can alleviate problems related to "diseases of overabundance" and diet-related chronic diseases, such as some types of obesity, heart disease, and certain types of cancer. However, meeting the requirements for macro and micronutrients for most of the population groups in rural households and communities of India and most of the South Asian countries seems far-off because of meagre presence of vegetables and fruits in the diet.

Addressing the challenge of feeding the 21st century

The most critical challenge to crop production is the attainment of enhanced productivities in farmers' fields, especially in developing countries. The Food and Agriculture Organization of the United Nations (FAO) estimated that 70% more food is needed to feed adequately the over nine billion people expected to inhabit planet earth by 2050 (FAO, 2009). FAO (2011) recommended that, for realizing the imperative of the low-input agriculture being preferred for the 21st Century, farmers require suitable improved varieties of different crop that are genetically diverse, climate change resilient, input use-efficient, high yielding, have enhanced nutritional and other quality attributes and have been bred for adaptation to a range of agro-ecosystems and farming practices. The extremely narrow genetic base of the available varieties of crops and the parental lines for breeding new ones nullify efforts to enhance productivities in farmers' fields, increase vulnerabilities and thereby imperil food security.

Mba *et al.* (2012) suggested increased incorporation of traits from non-adapted genetic resources including landraces, mutants and crop wild relatives in crop improvement programme to develop "smart" crop varieties of the 21st Century. Spontaneous and induced mutations facilitate plant-breeding programmes through enhancing the genetic resources.

3-A concept

Vegetables and fruits cannot support the nutrition security in the population if their 3-A concept is not fulfilled which includes: (i) accessibility or availability, (ii) affordability and (iii) acceptability (Chavasit and Chareonkiatkul, 2014). The basic challenge is to make vegetables and fruits accessible to the huge poorer sections who are by default starved and malnourished. This 3-A concept plus nutrition education should be a powerful strategy in increasing a population's consumption of vegetables

and fruits. Establishment of nutritional garden in the backyards creates opportunities to improve nutritional status of the farm families.

Informal education in nutrition and biodiversity : need of the hour

- **School-level nutrition education**

At the beginning of this new millennium, we are still facing an alarming challenge. One billion poor people still suffer from hunger and malnutrition while about 3 billion show under-nutrition and micronutrient deficiencies (FAO, 2011). At the same time, about 2 billion are overweight and/or obese, a steadily increasing number in all countries in the world (WHO, 2011). This double burden is found in both poor developing countries as well as in Brazil, Russia, India and China.

Food and nutritional insecurity often originates in poverty and low socio-economic status and has serious consequences on health and nutritional status of people. However, interventions aiming at increasing income or supplementary foods have not eliminated food insecurity because this problem is not resulted from economic poverty alone. Instead, the focus must be on raising awareness, cultivating attitudes and skills conducive to healthy eating, improving access to healthy food, and providing healthy options when choosing food especially with limited budget. School level nutrition education with multipronged collaboration based on nutrient potential of vegetables and fruits may be a viable option to improve food and nutritional security for the vulnerable section of the population.

- **Farmers' level education for community-based management of crop biodiversity**

FAO and Bioversity International in 2010 for the first time linked the concept of "biodiversity" with the emerging issue of "sustainable diets". Their joint study revealed that a total 1,097 vegetable species, with a great variety of uses and growth forms, are cultivated worldwide. But, we only seem to be familiar with 80 species (less than 7% of the total species). However, from the point of view of major share in the market and variety/hybrid development hardly 25 vegetable crops are important in the world. Conservation and utilization of plant genetic resources for food and nutrition are inextricably linked. Plant genetic resources should be made more easily available and useful to plant breeders and farmers for further improvement**.** Modern plant breeders and biotechnologists rely on genetic variation in landraces, primitive cultivars and wild forms to produce better adapted and higher yielding crop varieties. Therefore, it is vital that a wider range of germplasm is conserved, both *ex-situ* and *in-situ*, so that it will be available in the future as a resource for adapting crops to new and changing environmental conditions and to sustain agricultural production and development. Farmers' level education for conservation of diversity of wide range of important and under-utilized vegetable crops should be based on Government sponsored village workshop, social and resource mapping, rural diversity drama, rural poetry journey, folk song competition, traditional food fair and diversity fair.

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