

Sustainable Horticulture for Nutritional Security and Economic Prosperity

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ABSTRACT

Horticultural activities pave the way for integration of resource poor farmers to fight against the threats of hunger, malnourishment thereby contributing to better health. Not only better health horticulture creates better wealth by creating employment also as horticultural crops have been found to have much larger potential than field crops. Furthermore, Horticulture fosters market integration and creates new market opportunities *vis-a-vis* empower women, protects and enriches agrobiodiversity and making cities more liveable.

Keywords : Horticulture, Sustainable development, Health and wealth, Challenges and opportunities in West Bengal.

Introduction

Human society around the Globe today rely on agricultural systems to provide most of their food needs, as they have for thousands of years. Farming is the primary means of converting solar energy in to food, and no other approach is likely to replace it in the near future. Maintaining the integrity of the agriculture research base (e.g., land, water, biodiversity, etc.) is necessary for continued production. However, history is replete with examples of countries and cultures that allowed their resource base to degrade over time, undermining their ability to provide for the needs (Mitra, 2016). The desire to avoid this fate is a prime motivation for the emergence of the idea of “sustainable agriculture”. Sustainability was defined as “meeting the needs of today without compromising the ability of future generations to meet their

needs”. We now hear about sustainable forestry, sustainable buildings, and sustainable development along with sustainable agriculture, an indication that negative impacts of human activity on the global systems we rely upon are being recognized and addressed. Sustainability is commonly defined as being economically viable, environmentally sound and socially acceptable (or just). Put another way, sustainability depends on the 3 E’s- ecology, economics and equity. Sustainable agriculture should be considered a goal, a direction, or a concept, rather than a specific set of farming practices.

As the world population is predicted to reach 9.7 billion by the year 2050 and pressures such as changing weather patterns, increasing water scarcity, loss of soil fertility and productive land are limiting the options to increase food

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production in an environmentally and socially sustainable way, there are increasing calls for novel approaches to sustainable development. The UN Sustainable Development Goals (SDGs) are one approach to focus global efforts. Thanks to direct and indirect benefits of production, processing, marketing and consumption of horticultural crops. Horticulture can make a significant contribution to the achievement of several of the SDGs. These diverse benefits are captured in the concept of ‘*Horticulture for sustainable development-H4sD*’

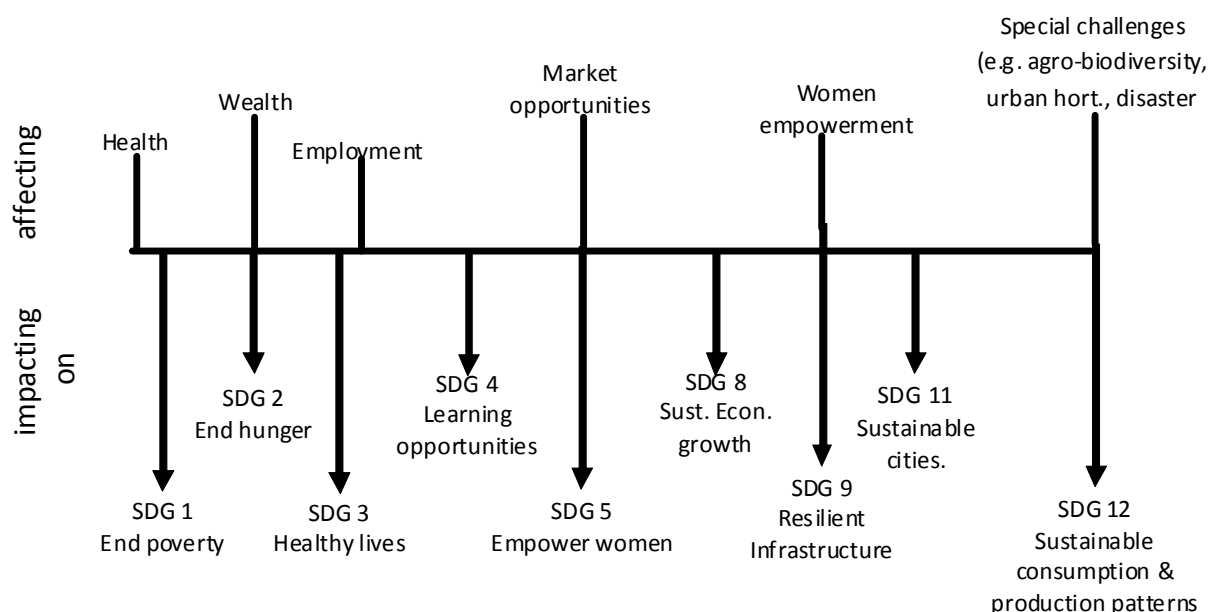
Horticultural activities pave the way for integration of subsistence farmers, the landless and other resource poor people once excluded from markets into broader

economic activities, and thus play a pivotal role in any approach to fight the threats of hunger, micronutrient deficiency and over nourishment and hence contribute to better **health**. Because horticultural products are generally high-value crops, they directly create **wealth** via higher incomes due to higher market prices compared to staples. In addition, processing, trading and other elements of the value chain for horticultural crops create comparatively more **employment** and open additional **new market opportunities** than can be realized with staple crops. Moreover, horticulture has positive impact on the **empowerment of women** and contributes to the protection and enrichment of **agro-biodiversity** and livable **cities**.

Horticulture for sustainable development-H4sD

Horticulture

vegetables, fruit, nuts, aromatic and medicinal crops
flowers and ornamentals, herbs and spices
as well as trees, shrubs and grasses



Horticulture guarantees health

There is a major cause of malnutrition and under-nutrition in our country, ill effects of which are manifested through low birth weights, high infant mortality, anemia due to iron deficiency, blindness in children due to vitamin A deficiency etc. (Mitra and Rajendran, 2018). An optimum energy requirement can be made with 2800 calories per capita per day, against which an average Indian hardly gets 1500-2000 calories. Fruits and vegetables play an important role in the balanced diet of a human being (Mitra *et al.*, 2014). These provide not only energy rich food, but also vital protective nutrients like vitamins and minerals. Comparatively, fruits and vegetables are one of the cheapest sources of natural nutritive foods. Vitamins like A and C and minerals like calcium, magnesium, iron and potassium are abundantly available from these crops, which help in building resistance against diseases. Substantial evidences and meta-analysis has clearly established the link between the intake of fruit and vegetables to a reduced risk of chronic disease, including cancer, cardiovascular, and neurodegenerative diseases. For example, fruit and vegetables have been shown to be beneficial for people suffering from chronic obstructive pulmonary disease by reducing oxidative stress and inflammation which, consequently, improves lung function. It is suggested, therefore, that incorporating fresh fruits and vegetables into diet of a person with chronic obstructive pulmonary disease should reduce their chances of serious illness or death infected with diseases such as COVID-19, as well as providing overall health benefits (Mitra, 2022). Fruits

provide a higher energy value per unit area as compared to cereals (Table 1).

At its 74th session, the United Nations (UN) General Assembly proclaimed 2021 to be the International Year of Fruits and Vegetables (IYFV). The IYFV2021 invites relevant stakeholders to strengthen the capacities of developing countries to adopt innovative approaches and technologies in combating loss and waste of fruits and vegetables. In addition, special attention is paid to the role of women, not only in the production of food, but also in assuring the food security of their families and communities. The fruit and vegetable sector has to drive not only food security but global nutritional security. The IYFV 2021 advocates for actions to strengthen the role of small-scale and family farmers in sustainable farming and production in order to reduce hunger and poverty, enhance food and nutrition security, improve livelihoods, and contribute to better natural resource management. Today the message is loud and clear “Grow and eat more fruits and vegetables to live a healthy life” (Mitra, 2022).

Horticulture creates wealth

The production and sale of fruit and vegetables, especially at a small scale, is a powerful tool for alleviating rural poverty and for enabling poor people to grow out of poverty (Mitra, 2014). Due to its high per unit productivity, horticulture is an effective tool in poverty alleviation for people with insecure land tenure and also in urban/peri-urban settings with limited land availability. Being of high value, fruits and vegetables not only enable small-scale farmers to escape poverty, they also open the door to farmers and others becoming

Table1: Energy value and productivity of different crops

	Calorific value/ 100g	Edible portion (%)	Yield (t/ha)	Total calorific value / ha
Wheat	341	100	1.87	6376700
Banana	153	71	17.42	26652600
Papaya	40	75	50.00	20000000
Guava	66	100	9.10	6006000
Peas	93	60	2.80	2604000
Onion	50	95	10.59	5295000
Potato	97	90	15.20	14744000
Total calorific value/ha in terms of yield is much higher for fruit crops				

agricultural entrepreneurs/ 'agripreneurs' throughout the whole food value chain. However, growing and selling perishable crops demands a high level of knowledge and pre-consideration regarding production, storage and transport as well as marketing and utilization.

Horticulture creates employment

According to the National Commission on Agriculture, the agricultural sector (horticulture in particular) has the most potential for generating employment, particularly for the rural masses as compared with non-agricultural sector. Horticultural crops have been found to have much larger potential than field crops. Due to its high labour intensity, horticulture has the potential to create employment throughout the value chain from production to processing. Besides utilizing family labour in an optimal way, the horticulture value chain creates employment for non-family labour.

Cultivation of fruits and vegetables creates more jobs than cereals (Table 2). By creating viable rural employment opportunities, horticulture has an important role in reducing the migration of young people from the rural areas into the urban centers. Internationally traded horticultural produce also has an important role to play and will increasingly create demand for skilled personnel, mainly in food processing and packaging.

Horticulture fosters market integration and creates new market opportunities

The majority of smallholders are aiming for a double purpose of consumption and sale of horticultural produce. In this way, these smallholders are integrated into local and national markets and are enabled to break away from subsistence farming. Furthermore, the diversification of the local markets creates business opportunities for new products based on horticulture. This includes novel products of primary

Table2 : Employment generation by cultivating different crops

	Labour required (mandays/ha)
Rice, wheat	140-150
Tomato	180
Bringal	200
Peas	275
Carrot	200
Onion	220
Chillies	200
Mango	800
Orange	760
Banana	1000
Pineapple	1095
Guava	460
Papaya	350
Sapota	460

processing such as juices, ice creams, biscuits etc. and the use of fruit and vegetable extracts in various health-related products, such as nutraceuticals, cosmetics, etc.

Horticulture empowers women

Horticultural production, marketing, processing and consumption not only leads to nutritional and economic benefits for those involved, but also behavioural changes are observed. The production, handling and marketing of horticultural crops can provide safe and rewarding work for women and girls. In most cases, their engagement in the production and sale of fruits and vegetables has enabled women to take up a more self-confident role in their families and communities. It is estimated

that women are responsible for 70% of actual farm work and constitute up to 60% of the farming population. Women are generally engaged in multiple occupations ranging from unpaid family labour to self-employed in their home or village or outside to generate income for themselves. However, women in rural areas have affinity towards farming and as high as 75% of the rural women are found participating in different farm and allied works. The involvement of women has increase in horticultural sector with the increase in area and production of these crops. With the increase movement of male population in other sector, the role of women in horticulture as well as in other sectors of agriculture has increased.

Horticulture protects and enriches agro-biodiversity

Horticultural production protects and enriches agro-biodiversity through the use of both modern varieties and even to an increasing extent indigenous and often neglected or underutilized horticultural crops. In addition, quite often indigenous vegetables are providing a high proportion of the nutrition needs of especially the poor in a country. Due to its high inter-species diversity, horticulture provides comparatively many options for diversifying smallholder agriculture to develop new markets, spread risk, and adapted to new realities associated with climate change. In addition, many indigenous species and land races have the potential to be new horticultural crops, but they are at risk of being lost. Their survival can best be secured by promoting their use, besides conserving them in the relevant conservation facilities.

Home gardens (a very common component in most household of rural Bengal) are the sites for on farm conservation of many indigenous crop species having unique food value and being strongly associated with cultural values. Most of the vegetables and medicinal plant species and some of the fruit crops in home gardens are traditional and have not been fully utilized. However, these crops are the major source of family nutrition (Mitra, 2014). Since the diverse mixture of crops are harvested at different times, a constant supply of food in some form or other is available from these home gardens at all times of the year. We (Mitra *et al.*, 2020) studied the importance and roles of home gardens in three districts (Hooghly,

Birbhum and Darjeeling) of West Bengal. We observed that the size of home gardens varied between 0.14 to 0.96 ha and in the gardens, we recorded 21 species of commercial and underutilized fruits, 26 species of vegetables, 9 species of spices, 12 species of medicinal plants, 16 species of ornamentals, 3 species of fodders and 35 species of different cereals, pulses, oil seeds and other cultural crops. The diversified species in homestead not only supply food but also provides potential food security to the household. Agro-biodiversity is clearly linked to dietary habits to the semi-subsistence feature of these farming systems. Besides, modern agricultural systems have succeeded in providing calories, but in the process, they have increased “hidden hunger” (micronutrient malnutrition) by displacing edible local plants.

Horticulture benefits liveable cities

The global population is estimated to reach 9.7 billion by 2050, 70% of which will be living in urban areas. This rapid process of urbanization and population growth can directly lead to increasing number of people to feed in cities, while indirectly relating to the rise of unhealthy diets and consequent health issues such as overweight, obesity and diet-related diseases. Urban and peri-urban agriculture (UPA) is increasingly recognized as a key component of the resilience of local food systems as it diversifies food value chains, improves the livelihood of city dwellers, and brings about multiple benefits to sustainable urban development through local food production and short supply chains. Horticulture has an increasingly important role in urban developments. This involves both the aspects

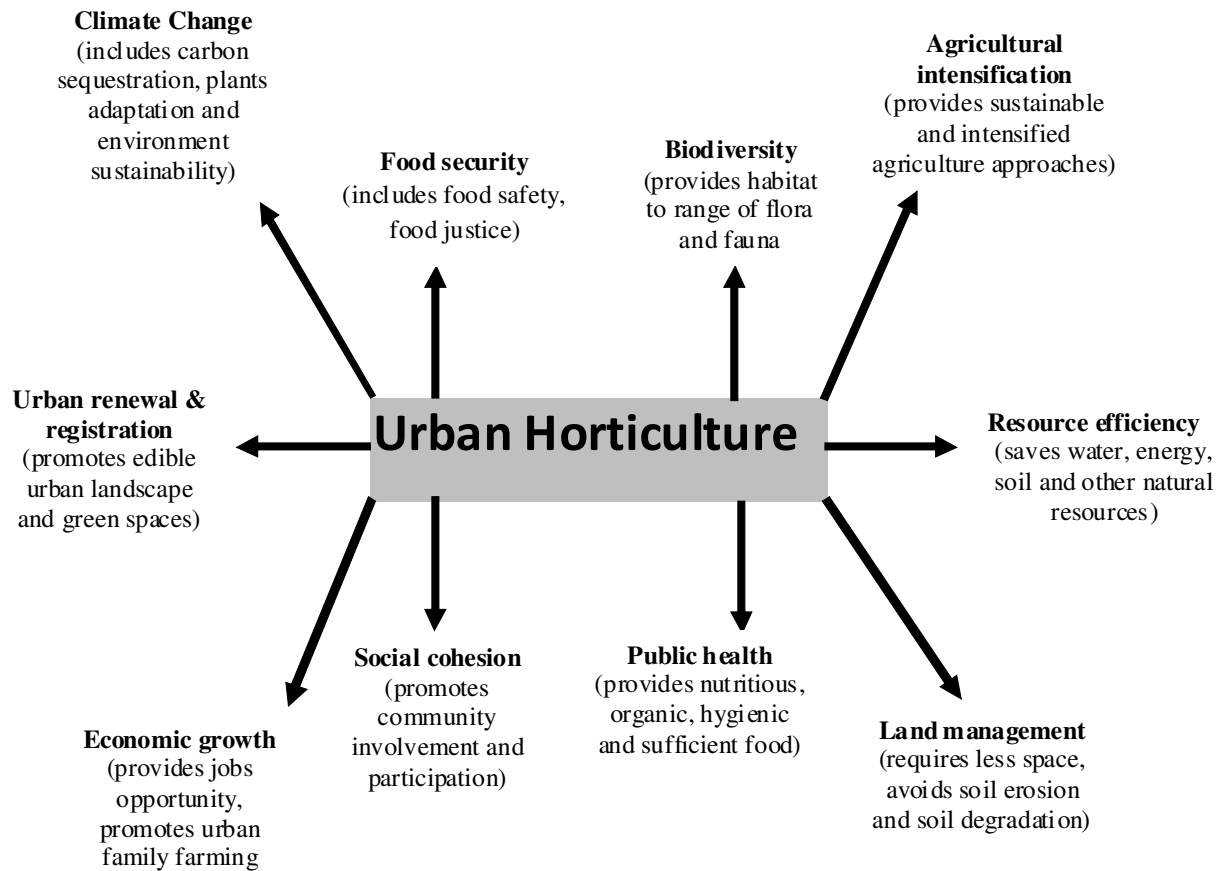


Figure. 2. Societa social challenges that can be mitigated through urban horticulture.

consumer and the role of horticulture in the creation of green spaces in cities which have dual recreational and environmental benefits. Urban container gardening benefits particularly the urban poor who are often landless and have limited access to healthy food.

Recently, the outbreak of novel coronavirus 2019 (COVID-19) has reached pandemic proportions and has disrupted the food chain in different ways. The lockdown strategies have increased transportation interruptions, labour shortages, and limited market access which resulted in food loss and wastage. The pandemic has emphasized the

importance of local food production. Under such situation 'Urban Horticulture' has emerged as a viable concept to provide sufficient fresh and safe food to cities. Peoples, planners, and governments all are rethinking ways to utilize vacant lands/ roof tops in cities for food production under this dynamic condition.

Water availability

Globally, water resources are shrinking mainly owing to rapid population growth, increased economic activities, degradation and overuse of water. Due to increasing demand for water gap between demand and supply is widening over the time. Water deficits are threatening sustainability of

agriculture in many parts of the world which demands efficient use of the limited water resource to avoid further expansion in water deficit areas. Currently Indian agricultural supports 17% of world population and 11% of livestock only from 2.4% of global land and 4.5% of water. Looking into population growth, declining land and water coupled with challenges of climate change, has created much greater concern to feed the growing population. Although India has the largest irrigation system in the world, its irrigation use efficiency has not been more than 40 per cent. If it continues like this, the water crisis would result in reduced production and productivity. This calls for more productive use of water and more crop yield per drop of water.

Micro-irrigation is an efficient method of water application for horticultural crops. This method is widely used because it not only conserves water but also allows efficient management of water and fertilizer. Another advantage of micro-irrigation is that it is capable of delivering precise amount of nutrients (fertigation) to the soil in measured quantities at any time at no additional cost. Fertigation ensures higher and quality yield along with savings in time and labour which makes fertigation economically profitable. The experiments have clearly demonstrated that through fertigation 40-50% of nutrients could be saved which otherwise wasted. Fertigation is ideally suited for hi-tech horticultural production systems since it involves not only the efficient use of the two most precious inputs, i.e. water and nutrients but also exploits the synergism of their simultaneous availability to plants.

Soil Salinity

The coastal zone represents the transition from terrestrial to marine influence and vice versa. It comprises not only shoreline ecosystem, but also the upland watersheds draining into coastal waters, and the near shore sub-littoral ecosystems influenced by land-based activities. West Bengal has a 158 km long coastline influencing 14,152 km² lands. The soil pH varies from 3.5 to 7.0. This ecosystem generally lags much behind the inland areas in terms of crop productivity, mainly because of unfavourable climate, poor soil and hydrological conditions. Among the existing abiotic stresses, salinity is mainly responsible for poor yield of crops in coastal areas. Besides, prolonged submergence due to sea water intrusion adversely affects crop growth and yield in coastal belts. Many fruit trees such as phalsa, date palm, guava, sapota, ber, jamun, Indian gooseberry, pomegranate, karonda, bael, tamarind, have potential for saline environment (Table 3). A number of varieties/lines of different vegetables have been suggested by the researchers to grow in salt-affected soil (Table 4)

Climate change

Global warming and climate change is the greatest concern of mankind in the 21st century. In August 2021, the Intergovernmental Panel on Climate Change (IPCC) prepared and delivered a comprehensive assessment report on global climate change (IPCC, 2021). They determined in clear terms, that a global warming of 1°C above pre-industrial levels has occurred. The global surface temperature in July 2021 was the highest for July since records begin in 1880 at

Table : 3 Sodicity and salinity tolerance of fruit trees

Ranking based on tolerance level	pH	ESP (%)	ECe (dS m ⁻¹)	Fruit trees
High	9.5-10.5	40-50	12-15	Ber, date palm, sapota, gular (<i>Ficus glomerata</i>), khirni (<i>Manilkara hexandra</i>)
Moderate	8.5-9.5	30-40	09-12	Gooseberry, pomegranate, ber, karonda, guava, date palm, bael, peach (<i>Prunus persica</i>), jamun, phalsa, mulberry (<i>Morus alba</i>), Kainth (<i>Feronia limonia</i>), custard apple (<i>Annona squamosa</i>), cherry (<i>Prunus</i> spp.) tamarind (<i>Tamarindus indica</i>)
Low	7.5-8.5	20-30	06-09	Fig (<i>Ficus carica</i>), guava, mango, olive, citrus
Sensitive	6.8-7.5	15-20	04-06	Banana, pineapple (<i>Ananas comosus</i>), jackfruit (<i>Artocarpus</i> spp.), litchi (<i>Litchi chinensis</i>), papaya (<i>Carica papaya</i>), passion fruit (<i>Passiflora edulis</i>), strawberry (<i>Fragaria</i> spp.), cashew (<i>Anacardium occidentale</i>), avocado (<i>Persea americana</i>), pear (<i>Prunus</i> sp.), grape (<i>Vitis vinifera</i>)

Table : 4 Promising vegetable varieties for salt-affected soils

S. No.	Crop	Variety/line	S. No.	Crop	Variety/line
1.	Brinjal	Black beauty, R-34	7.	Garlic	HG-6
2.	Cabbage	Golden acre	8.	Okra	Pusa Sawani, Kashi Kranti, VRO-112
3.	Muskmelon	Pusa Madhuras	9.	Peas	P-23, new line perfection market prize
4.	Kharif onion	Basant	10.	Potato	JE-808, Kufri Chamatkar, CP-2059, JE-303, Kufri Sindhuri
5.	Onion	Hisar-2, Punjab selection, Udaipur-102, Bombay red, Pusa Ratnar	11.	Tomato	EC-2791, DT-10, EC- 13904 and C-11-2, hybrid 14, NT-3, Marglobe, Kalyanpur, T-1, Sabour Suphala, at-69, Hisar Arun, Moneymaker
6.	Chili	C-4, Musalwadi, Jwala, Chaman			

0.93°C above the 20th century average (NCEI, 2021). Overall, global temperatures are now higher than at any other time in the past 125,000 years.

Anthropogenic warming has produced heat waves, heavy rainstorms, and violent cyclones. In coming decades, hotter heat waves and worse floods and storms are expected. We horticulturists have seen the devastation of these effects at hand. We have seen years of drought in Australia, throughout Africa, USA (Alaska, Oregon, and California), Canada, Russia, Greece and Italy (Sicily), causing issues with domestic water supplies, water stress issues for horticultural crops and horrific wildfires killing forests, wild life, and humans. In other areas flash floods are occurring in low elevations including in Belgium, Germany, India, Japan, Thailand, Vietnam, New Zealand, and China in association with hurricanes, cyclones, tornados, and other wind events. These floods have washed away entire crops in fields or protected structures. They have displaced millions of people from their homes.

Climate change is projected to cause increase in temperature, variations in rainfall, increase the frequency of extreme events such as heat, cold waves, frost days, droughts, floods etc. Various plant processes like vegetative growth, flowering, fruiting and fruit quality are highly vulnerable to climate changes. Two major parameters of climate changes that have far reaching implications on plant are more erratic rainfall patterns and unpredictable high temperature spells which will consequently expected to reduce crop productivity. Drought reduced fruit set and

increased fruit cracking in pomegranate and litchi. Increase in atmospheric temperature and change of rainfall pattern affected banana cultivation in some countries. In various fruit crops, moisture stress and high temperature during flowering strongly influences the pollen and ovule quality and consequently the fruit set and yield (Irenus and Mitra, 2014; Stern and Mitra, 2017; Mitra and Irenus, 2018; Mitra, 2018). The promotion of stigma and stamen sterility in papaya is mainly because of higher temperature which caused flower drops as well as sex changes in female and hermaphrodite flowers. Flower drop is quite common in mango, guava, litchi and other fruits, if low temperature prevails during flowering. Studies have clearly shown that the population abundance, geographic range and pollination activities of important pollinator species like bees, moths, and butterflies are declining considerably with changing climate. Higher temperature during fruit growth and development increased the incidence of several physiological disorders like spongy tissue and black tip in mango, cracking of fruits, granulation in citrus etc. Pest ecology of certain crops is changing due to climate change. Fruit fly in guava, carambola, citrus etc. is becoming alarming due to hot and humid condition. Warm and humid conditions are also favorable for pests like beetles, bugs and other sucking pests and diseases like mildew, blight etc.

Development of new varieties with higher yield potential and resistance to multiple stresses (drought, flood, salinity) should be the key to maintain yield. Improvement in germplasm of important tropical and subtropical fruit crops for heat

stress tolerance should be one of the targets of breeding programme. Location specific soil and water conservation models, protocol for organic farming, conservation horticulture, development of biotic and abiotic stress tolerance rootstocks etc are some of the strategies to mitigate the impact of climate change (Mitra, 2018).

Organic production

Organic farming is considered as holistic production management systems (for crops and livestock) emphasizing the use of management practices in preference to the use of off-farm inputs. It is based on international standards and guided by the principles of health (i.e. sustaining ecosystem health and human health), ecology (i.e. enhancing living ecological systems, ecological balances and cycles), fairness (i.e. ensuring equity, respect, justice and stewardship of the shared world) and care (i.e. taking precaution and responsibility). There is a growing realization and interest for organic foods in India and consumers' demand for organic fruits is booming. Fruits have greater potential for export and are valued much as organic food among horticultural crops. With the phenomenal growth in area under organic management and growing demand for wild harvest products, India has emerged as the single largest country with highest arable cultivated land under organic management. India has also achieved the status of single largest country in terms of total area under certified organic wild harvest collection. India ranks 10th position among the top ten countries in terms of cultivable land under organic certification. Global retail organic food sales are currently valued worth USD

31 billion and growing at over 20% per annum. Target for tropical and sub – tropical fruits and its products is 0.14 billion USD. Major organic fruit produced in India are mango, cashew, banana, pineapple, passion fruit and orange (Mitra, 2013, Mitra and Devi, 2016). Major problems in organic cultivation are: lack of marketability at a premium over the conventional produce, inadequate certifying agencies and inability of the farmers to reach the certifying agencies, marginal and fragmented land holdings, practice of *jhum* cultivation, lack of efficient quality control mechanism and organized marketing system etc. Development of organic agriculture is now being embraced by the mainstream and shows great promise commercially, socially and environmentally.

Horticulture after the pandemic

The COVID-19 pandemic has generated a serious economic crisis. Substantial changes have occurred in the food and ornamental production chains. The pandemic has affected agriculture to a great extent, causing significant economic losses and notable changes that are likely to persist over time. COVID-19 has prevented and modified the normal food supply chain. Infections, quarantine measures and restrictions have led to delayed delivery of agricultural inputs, the lack of arrival of seasonal labourers, the non-harvesting of crops, the accumulation of products, and the disruption of the distribution grid, thereby sometimes causing shortage of products in grocery stores. The agri-food sector has been closely connected internationally, but the COVID-19 crisis highlighted critical issues

in the system related to the flow of goods, thus encouraging some countries to adopt a more domestic 'food sovereignty' approach towards greater local food production and inevitably changing the logistics of the entire food system. Possibly the COVID-19 crisis will result in a new and lasting attention to the infrastructures and the workforce at the base of food supply chains. Potentially this focus may drive change, for example a reduction in intermediaries from the producer to the consumer and, possibly, a significant reduction in wasted food. The continuing labour crisis in agriculture is driving innovation and automation, leading to implementing more mechanical harvest systems. It has been appropriate to work toward increasing the resilience of a system during the pandemic. Research activities into food production in the urban context, e.g., to speed up its availability, are the key elements in the attempt to prevent multiple inconveniences that COVID-19 has caused. Food production, shortness of the supply chain, and speed of reaching the consumers are summed up in the concept of urban farming. Vegetable production is best suited to become more local, allowing the shortening the food chains (Mitra, 2021). For as unexpected as this pandemic was, horticulture is a living example of flexibility and change. The horticulture sector right now are being redesigned and adjusted to rise, face, and meet the needs of feeding and satisfying humanity.

Challenges and opportunities of fruit cultivation in West Bengal

The growth and prosperity of rural economy are closely linked with agriculture and allied agriculture sectors. With the

increasing population and inadequate employment generation, the pressure on land has increased considerably leading to fragmentation of land. West Bengal has the national advantage of diverse agro climatic conditions, which enables production of wide range of horticultural crops. About 70 thousand hectares of land (mostly in the western districts) is still remain unutilized in West Bengal, most of which is suitable for growing fruit crops without assured irrigation, provided a proper selection of crop is done and a marketing net work created. If this area is brought under such crops, it will provide huge employment opportunity for the tribal and other backward poor people living in this area in production stage alone. Additional employment will be generated on the industrial side using fruits as raw material.

A large variety of fruits are grown in West Bengal due to varied agro-climates available in the state. The major fruits are mango, banana, litchi, guava, papaya, coconut, pineapple etc. The laterite tracts of West Bengal consisting of Bankura, Purulia, Birbhum, part of Burdwan and west Midnapore where irrigation facilities are poor, and a sizeable area of land is still available we can grow successfully ber, pomegranate, mosambi, sweet orange, guava, mango, aonla, sapota, annona, jackfruit. Due to unique agro-climatic situation in West Bengal, one or another fruit/s is/are available round-the-year (Table 5)

The income generating capacity of fruit cultivation is much higher than any field crops; however the cost of cultivation is also higher in developing and maintaining orchards. Some of the tree fruit plants like mango, litchi, coconut, bael, jackfruit etc.

needs a gestation period before it starts bearing. In this period the farmers should take up growing of different vegetables, flowers and medicinal plants to meet their income for maintaining family. Once, the crops came into bearing and if managed scientifically, it is not difficult to earn 50-100 thousand rupees from a hectare of land. There are other fruit crops like banana, papaya, pineapple, strawberry etc. which start producing in less than one year to one and half years after planting. Growing fruits crops in a scientific manner is remunerative (Table 6)

Strength, Weakness, Opportunity and Challenges of Fruit Cultivation in West Bengal

Strength

- Varied agro climatic condition suitable for number of fruit crops for cultivation.
- Adoption of different crop cultivation in different agro-climatic condition making the availability of horticulture produce for prolonged period.
- Demand and choice of horticulture produce is increasing day to day necessitating more and more produce day by day.
- Increasing demand of fruit crops in drier lateritic tracts of West Bengal.

Weakness

- Lack of inadequate quality planting materials, improved hybrid seeds etc. and location specific technology adoption.
- Inadequate technical knowledge at various levels.
- Lack of awareness regarding pre- and post-harvest management practices, proper marketing infrastructure /

marketing system with forward and backward linkages.

- Slow promotion of processing, value addition and less availability of processing industries.
- Lack of technical personnel at block / grass root level.

Opportunities

- Scope in generation of quality planting material, improved / hybrid seeds etc.
- Increase in area, production & productivity of fruit crops in the alluvial and lateritic tracts of the state and strengthen nutritional security.
- Increase in soil health and production of safe and organic produce.
- Availability of raw material for processing industries and reduction in post harvest losses.
- Motivation or providing opportunity to the farmers, SHGs etc. in the farming sector for self employment.

Challenges

- Most of the farmers in the state are small and medium scale category.
- Large number of production constraints and lack of infrastructure.
- Inadequate manpower,
- Lack of reliable statistical information in area and production of fruit crops in different district on scientific basis.

Thrust areas

1. The major fruit crops cultivated in the state are mango, litchi, banana, guava, pineapple, citrus, coconut and cashewnut. The productivity of pineapple, papaya and coconut is higher than the national average. However, the overall productivity

of fruit crops in the state is 12.9 t/ha. The productivity should be increased up to 20 t/ha by 2030.

2. The higher productivity should be achieved through measures like production and distribution of improved planting materials, rejuvenation of senile orchards, judicious use of natural resources like land, water and light, integrated nutrient, pests and disease management, disease surveillance, plant health clinics, mechanization of farm operations, etc. Assistance for these activities should be extended to the public as well as private sector.

3. The western districts of West Bengal (Purulia, Bankura, Birbhum, parts of West Midnapore and Burdwan) have potential for quality fruit production, particularly mango, guava, sapota, pomegranate, ber, sweet orange, aonla, date palm, cashew, jackfruit, bael, jamun etc. Alphanso mango

has a good potential in this region. The mango varieties suitable for cultivation in the state are Langra, Himsagar, Fazli, Amrapali and Lakshman Bhog. It is recommended to give, further thrust on mango cultivation for next 5-10 years. The present area under mango being 109.5 thousand ha, it could be targeted to 130 thousand ha in next 10 years.

4. The old and new alluvial zones of West Bengal (Hooghly, Howrah, Nadia, 24-Parganas, Burdwan, Murshidabad, Malda) are suitable for cultivation of mango, litchi, banana, papaya, guava, coconut and several tropical and subtropical fruits. The potentiality of growing banana, litchi, guava and papaya should be utilized properly in this region. Availability of quality planting materials should be ensured. Present area, productivity in state and targeted for the next 10 years along with recommended varieties are presented below.

Crop	Present area (2020-21) (000 ha)	Productivity (2030)	Targeted		Suitable varieties
			Area	Product.	
Mango	109.5	8.1	130.0	12.0	Langra, Himsagar, Lakshman Bhog, Amrapali
Litchi	10.2	7.1	14.0	10.0	Bombai, Bedana, China
Banana	51.6	21.5	65.0	30.0	Martaman, Giant Governor, Kanthali
Guava	18.3	11.1	25.0	18.0	Khaja, Sardar, Allahabad Safeda
Papaya	13.1	23.3	18.0	36.0	Ranchi, Surya, Sunrise Solo
Citrus (all)	22.2	6.1	30.0	10.0	Promalin, Seedless, Mandarin

5. The foot hills of Darjeeling districts (Siliguri sub-division), Jalpaiguri and Dinajpur have tremendous potentiality for extending the area under pineapple, banana, guava, coconut and jackfruit. Suitable varieties for processing and export needs to be grown only.

6. Considering the soil and climatic conditions, the area under minor fruits in the state is increasing. Some of these crops like sapota, aonla, pomegranate, tamarind have very good export and/or processing potential, however, suitable varieties or clones need to be grown.

7. Future emphasis in the state should be on eco-friendly integrated pest and disease management for sustainable agriculture growth. This can be achieved through the use of various bio-control agents. In addition, plant-derived pesticides (botanicals), secondary metabolites from micro-organisms (antibiotics) and insect pheromones applied for mating disruption, monitoring or lure- and -kill strategies should be promoted in IPM programmes.

8. It is recommended that for promotion of organic farming, area and group based approach should be adopted by the State Government. To provide technical support, SAUs/KVKs/Central Agencies/reputed NGOs/Agro-clinics should act as service providers.

9. State Government should take up activities like publicity and creation of awareness among farmers to educate them, organizing them in groups, training the service providers in private sector and arranging their registration, promotion of local certification agencies and assistance in marketing.

10. Regulatory mechanism which state government may include : formation of organic farmers groups, registration of farmers group with district authorities, documentation of individual farm/farm records, service providers KVKs/SAUs/Agri-clinics/Private entrepreneurs, fixation of nominal fee, accreditation agencies, certification and inspection agencies.

11. Keeping in view the export potential of mango, the problem of quality management, mapping and control of fruit borer and fruit fly infestation, a complete protocol for post harvest handling of Lakshman Bhog, Langra, Himsagar and Amrapali, needs to be taken up. Recommendations about crop geometry and pruning techniques for high-density mango plantations need to be finalized.

12. Litchi has a great export potential from the state in near future. It is urgently necessary to introduce small seeded varieties, development of package for organic cultivation, scheduling irrigation for controlling fruit drop and cracking, alternative protocol for skin colour retention after harvest (other than sulphitation) and post harvest handling.

13. Wherever, feasible school *Nutrition Gardens* should be promoted. The aim of such garden is to generate awareness of the fact that for every major nutritional malady like Vitamin A deficiency induced blindness, iron-deficiency induced anaemia, there is a horticultural remedy. Every school a Fruit Garden (if land is not available, along the boundary wall) should become a statewide goal.

Table 5 : Availability of fruit crops round-the-year due to unique agro-climatic features.

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Pear												
Mango												
Litchi												
Orange												
Lime, Lemon												
Plum												
Guava												
Papaya												
Aonla												
Pineapple												
Watermelon												
Pomegranate												
Jackfruit												
Strawberry												
Coconut												

Table 6 : Net Income (from 1.0ha)

	(Rs)	Gestation Period (years) *
Mango (Amrapalli -4m x 4m HDP@)	60,000-80,000	4
Litchi (Bedana - 5m x 5m HDP)	40,000-50,000	5
Banana (Giant Governor -1.8m x 1.8m HDP)	50,000-60,000	1.5
Pineapple (Giant Kew -64,000plants/ha HDP)	40,000-50,000	1.5
Papaya (1.8m x 1.8m)	50,000-60,000	8 months
Ber (Umran, Kaithali)	20,000-25,000	4
Aonla (Banarasi, Chaikia)	25,000-30,000	4
Jamun	18,000-25,000	7
Bael	18,000-25,000	8
Sweetlime	30,000-35,000	2
Pomegranate (Ganesh)	25,000-35,000	3
Coconut based mixed farming (with banana, pineapple and pippa)	35,000-45,000	1,4

@HDP : high density of planting *During gestation period, the interspace should be utilized by cultivating different vegetable, flowers, medicinal plants, and spices. The farmers could make a sizeable income until the fruit plants started bearing.

CONCLUSION

Horticulture sector is an important component of today's farming system. Horticulture development has assumed an important position in the food and nutritional security an economic prosperity in both rural and urban areas. In the scenario of climate change and increasing population pressure, we need to focus more for sustainable development. The concept of "Horticulture for sustainable development " activities pave the way for the integration of subsistence farmers, the landless and other resource-poor people once excluded from markets into broader

economic activities. This will play a significant role in sustaining rural communities and improving the living conditions of the poor. Horticulture can have a positive impact on the empowerment of women and contribute to the protection and enrichment of biodiversity and more liveable societies.

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