"Livelihood Opportunities in Horticulture: Promoting Women Hortipreneurs"

Edition
2023

Edited by

Ramya H R
V.K. Jayaraghavendra Rao
K. Sai Maheshwari
Sushrirekha Das
Uday Kumar G

Jointly Published By
ICAR-IIHR Bengaluru & MANAGE, Hyderabad

“Livelihood Opportunities in Horticulture: Promoting Women Hortipreneurs”

Editors: Ramya H R, V.K. Jayaraghavendra Rao, K. Sai Maheshwari, Sushrirekha Das and Uday Kumar G

Edition: 2023

ISBN: 978-93-91668-78-5

Citation: Ramya H R, V.K. Jayaraghavendra Rao, K. Sai Maheshwari, Sushrirekha Das and Uday Kumar G (2023). Livelihood Opportunities in Horticulture: Promoting Women Hortipreneurs [E-book] Hyderabad: IIHR, Bengaluru & National Institute of Agricultural Extension Management, Hyderabad, India

---

Published for Dr. P. Chandra Shekara, Director General, National Institute of Agricultural Extension Management (MANAGE), Hyderabad, India by Dr. Srinivasacharyulu Attaluri, Program Officer, MANAGE and printed at MANAGE, Hyderabad as e-publication.

MESSAGE

National Institute of Agricultural Extension Management (MANAGE), Hyderabad is an autonomous organization under the Ministry of Agriculture & Farmers Welfare, Government of India. The policies of liberalization and globalization of the economy and the level of agricultural technology becoming more sophisticated and complex, called for major initiatives towards reorientation and modernization of the agricultural extension system. Effective ways of managing the extension system needed to be evolved and extension organizations enabled to transform the existing set up through professional guidance and training of critical manpower. MANAGE is the response to this imperative need. Agricultural extension to be effective, demands sound technological knowledge to the extension functionaries and therefore MANAGE has focused on training program on technological aspect in collaboration with ICAR institutions and State Agriculture/Horticulture Universities, who has expertise and facilities to organize technical training program for extension functionaries of State Horticulture Department.

In India, Horticulture sector contributes to the nutritional security of farmers through steady income, the export earnings from different horticulture products and their value addition are also noticeably contributing to the National income. On the other hand farm women through their involvement in farming, post-harvest management, horticultural crop production, livestock management, fisheries, natural resource management, and homestead resources, have made significant contributions to the expansion of the agricultural sector but the persistent gender disparity in resource access and control is a significant issue that has raised concerns about the sector's inclusive and sustainable growth in addition to keeping women trapped in a cycle of poor productivity. In this context Scoping livelihood opportunities for women in horticulture, Developing Horti-preneurship for Sustainable Rural Livelihood among women, promoting role of women in Nutrition Sensitive Horticulture and value addition in Horticulture ensures profitability and sustainability among women farmers in the society.

It is a pleasure to note that, Indian Institute of Horticultural Research, Bengaluru and MANAGE, Hyderabad is organizing a collaborative training program entitled "Livelihood Opportunities in Horticulture: Promoting Women Hortipreneurs" from 23-25 January, 2023 and coming up a joint publication as *e*- book as immediate outcome of the training program.

I wish the program be very purposeful and meaningful to the participants and also the *e*- book will be useful for stakeholders across the country. I extend my best wishes for success of the program and also I wish Indian Institute of Horticultural Research, Bengaluru many more glorious years in service of Indian agriculture and allied sector ultimately benefitting the farmers. I would like compliment the efforts of Program Coordinators of MANAGE, Hyderabad and ICAR-IIHR (Indian Institute of Horticultural Research), Bengaluru for this valuable publication.

(P. CHANDRA SHEKARA)
Director General, MANAGE

FORWARD

India is one of the fastest growing economies in the world. Agriculture though contributes less than one sixth to the national economy, agriculture employs about half of the population directly or indirectly. Horticulture expansion can make a significant contribution to agricultural growth. To enhance the farmer's income, ensure nutritional security, and reduce the post-harvest losses of horticultural produce, mainly fruits, and vegetables, it is essential to promote horticulture based entrepreneurial development. Horticulture presents numerous avenues available for entrepreneurship activities. In this regard ICAR-Indian Institute of Horticultural Research, Hesaraghatta, Bengaluru has commercialised more than 300 technologies through technology transfer, horti-preneurship, development of value-added products for domestic and export through training, business incubation and acceleration.

Women are known for delivering multiple roles effortlessly throughout the year and thus, they are considered the backbone of every society. Women produce over 50 percent of the world's food and comprise about 43 percent of the agricultural labor force, both globally and in developing countries. Additionally, studies indicate that women invest as much as 10 times more of their earnings than men do in their family's well-being, in areas including child health, education and nutrition. Women's empowerment, thus has a direct impact on agricultural productivity and household food security and as a result it remains at the core of agricultural research and outreach practices in developing countries. Women's empowerment is considered a 'pre-requisite' to achieving global food security. 'Gender inequality in agriculture' reveal that women lack access to and control over resources such as land and capital as well as agricultural inputs and technology such as improved crop varieties, training, information and marketing services, no decision making power over credit, and are poorly represented in agricultural and non-agricultural groups and organizations. Hence women empowerment though entrepreneurship is the need of the hour and also women need to empower themselves by bringing a major change in their attitude.

ICAR-IIHR has designed dynamic and transformation-oriented technologies and programs in such a manner that the grooming of impoverished women will uplift the condition of their livelihood. In this context, ICAR-IIHR is conducting a free online training program entitled "Livelihood Opportunities in Horticulture: Promoting Women Hortipreneurs" from 23-25 January, 2023 sponsored by the National Institute of Agricultural Extension Management (MANAGE), Hyderabad for the Extension officials of State / Central Horticulture departments, Horticulturists, faculty of SAUs/KVKs/ICAR institutes etc. Also tapping opportunities in post-harvest technologies, nutrition sensitive agriculture, etc., can play a great role in increasing income and participation of women in agriculture / horticulture. Role enrichment of women in FPOs, horti-preneurship, and start-up promotion has been given special emphasis. It also enhances their vision and skills in developing horticulture business plans and pitch fund them, thereby empowering women. I hope that the participants from different parts of the country would be immensely benefitted from this online training. I have no doubt that the course will be intellectually rewarding to the participants. I take this opportunity to congratulate MANAGE and ICAR-IIHR for their fruitful collaboration towards benefits of farmer community and stakeholders in Horticulture. I also congratulate course directors and course coordinators for their untiring work, and high level of enthusiasm.

(Sanjay Kumar Singh)
Director, ICAR-IIHR, Bengaluru

PREFACE

This *e*-book is an outcome of collaborative online training program on "Livelihood Opportunities in Horticulture: Promoting Women Hortipreneurs" from 23-25 January, 2023. The editors' main aim is to provide insights to all extension workers, faculties, researchers and students about developing hortipreneurship for Sustainable Rural Livelihood among women and to introduce horticultural technology and their transfer to the stake holder's right from production to value addition and export focusing women perspective. Empowerment in agriculture is generally defined as one's ability to make decisions on matters related to agriculture as well as one's access to the material and social resources needed to carry out those decisions. Opportunity structure is measured by the rules, laws, regulatory frameworks, culture, norms and behavior of the formal and informal institutions of a society. Thus women need to be empowered in tapping the opportunities around them and in taking right decisions to become entrepreneurs.

The editors felt that all the experience of resource persons of this training should be integrated together to form a unique proposition on horti-preneurship. Horticultural science is subjects which have different magnitudes, scale and direction coordinating both subjects from a common point was indeed a challenging job. The experts and resource persons in Horticultural science contributed immensely and tirelessly to develop various chapters of this e-book in very short span of time. They all deserve applaud. The editors extend their sincere thanks to all the experts who have contributed valuable time and put sincere efforts to produce this *e*-book.

The editors also thank MANAGE, Hyderabad for the financial support to the training program. The editor's express gratitude towards the director, ICAR-IIHR for the constant encouragement for this training and *e*-book creation for the participants. The editors hope that this *e*-book will help participants as well as other extension people across the country to gain valuable information on horticultural production, handling, storage, processing and value addition for domestic and export markets.

Editors

Ramya H R
V.K. Jayaraghavendra Rao
K. Sai Maheshwari
Sushrirekha Das
Uday Kumar G

CONTENTS

Chapter: 1

Indian Horticulture scenario and Livelihood Opportunities in horticulture: Emphasis to women

Ramya H.R

ICAR-Indian Institute of Horticultural Research
Hesaraghatta, Bengaluru -560089

A horticulture revolution is currently taking place in the Indian agricultural sector. Even though it uses only 13.1% of the total gross cropped land, horticulture makes up 30.4% of the agricultural GDP. Every year since last decade, the nation's total horticulture production has topped its total food grain production, setting a new record. Despite all of these successes, the horticulture industry is still plagued by post-harvest losses, a shortage of storage facilities, seasonality in prices, and market volatility. Integrating and overhauling the horticulture production and value chain system urgently is required to boost the development of healthier and more nutrient-dense vegetables and increase farmer income.

India at 75th 'Azaadi Ka Amrit Mahotsav' promulgates mission of warranting women as **"Empowered women- Empowered Nation".** India is an agrarian economy with about 54.6 percent of total workforce engaged in agricultural and allied sector activities. Globally Share of women in agriculture, forestry and fishing employment (percent) is 36.7% whereas in India the share is 26.1%. (FAO. 2021). The percentage of female operational holdings in the country has increased from 12.78 percent during 2010-11 to 13.78 percent during 2015-16 (Ministry of Agriculture and Farmers Welfare, 2019). Less than 20 per cent of landholders worldwide are women. In rural areas the gender pay gap is as high as 40 per cent. Rural women shoulder a disproportionate amount of unpaid care and household work, which is neither recognized nor remunerated. Rural women are at high risk of abuse, sexual harassment and other forms of gender-based violence. Climate change threatens to exacerbate rural women's vulnerability to discrimination, exclusion and exploitation.

Disadvantaged by gender asymmetries in rights, they face widespread constraints in access to productive resources (e.g. land, water) and productivity-enhancing inputs, (credit, fertilizer, seeds, veterinary drugs) as well as access to research, education and extension. (FAO, 2011). All too often, women's needs, priorities, and voices are missing from the policy process, even when women may be disproportionately affected by shocks or have distinct policy preferences. The first ever Global Conference on Women in Agriculture (GCWA) held in March 2012 at NASC complex, New Delhi also recommended gender sensitization and integration of gender in agricultural research to generate evidences on gender based outcomes of R&D interventions. Women make significant contributions to the rural economy while there are cross-country differences in women's participation in agriculture, recent literature across contexts suggests that the involvement of women in agriculture is increasing over time (Khatri-Chhetri et al., 2020; Paudel et al., 2019). Vemireddy and Pingali (2021) reported in their study that women not only shoulder most of the domestic household work but also spend similar time in agriculture

across all seasons as men. Though extension services enhance adoption, literature shows that men have more access to extension services than women (Croppenstedt et al., 2013; C. R. Doss, 2001). It has been identified that men have access to information through NGOs, extension agents, and participation in field demonstrations, but women's knowledge is never updated and limited due to social immobility (Paris et al., 2011; Theis et al., 2019).

Their roles differ across regions, yet they consistently have less access than men to the resources and opportunities they need to be more productive. Too often, these kinds of crises, increasingly intensified by climate change, disproportionately affect women (FAO 2020; Kumar and Quisumbing 2013) and reveal the disconnect between the essential roles women play in Agri Farming System (AFS) and their relative absence in governance processes that design and implement AFS-related policy solutions. Research also suggests that women lag behind men in agricultural technology adoption (Rola-Rubzen et al., 2020). The use of labor-saving technologies are widespread, but there is a significant gap in their adoption by women due to barriers in access to capital, access to inputs and services (information, extension, credit, fertilizer), physical accessibility, and cultural norms (Achandi et al., 2018; Croppenstedt et al., 2013). Women are in 'a low input, low output equilibrium', without having access to appropriate technologies that can relieve their time on activities like weeding, transplanting, harvesting, grinding, transport, water, fuel collection (Alkire et al., 2013; Wodon and Blackden, 2006).

Tackling both problems head on effectively governing systems increasingly subject to shocks and a changing climate, while empowering women within governance processes will be essential to securing resilient, sustainable, and inclusive food systems. Other periods of shock or stress, such as during the Ebola outbreak or COVID-19 pandemic, can expose women and girls to higher risk of GBV compared to men, which, in addition to the physical and psychological impacts, can limit women's freedom of movement to participate in community-based activities or decision-making processes (FAO 2020; Onyango et al. 2019). During periods of political or physical conflicts, fears of physical violence, attacks, or kidnapping can deter women from participating in community groups or local activities, or from engaging in income-generating activities beyond the household (Bello and Abdullahi 2021).

The importance to reduce women's time constraints in agriculture to maximize overall welfare is also echoed in several recent time use studies (Johnston et al., 2018; Padmaja et al., 2019). The Women's Empowerment in Agri-food Systems Governance (WEAGov) is an assessment framework to help countries and stakeholders measure the extent of inclusion and leadership of women in agrifood systems governance and to identify gaps and opportunities. WEAGov looks across three stages of the policy cycle: policy design, policy implementation, and policy evaluation. At each stage of the policy cycle, WEAGov asks three questions central to women's empowerment in governance: Are women considered? Are women included? And are women influencing? (Ragasa, Catherine, 2022).

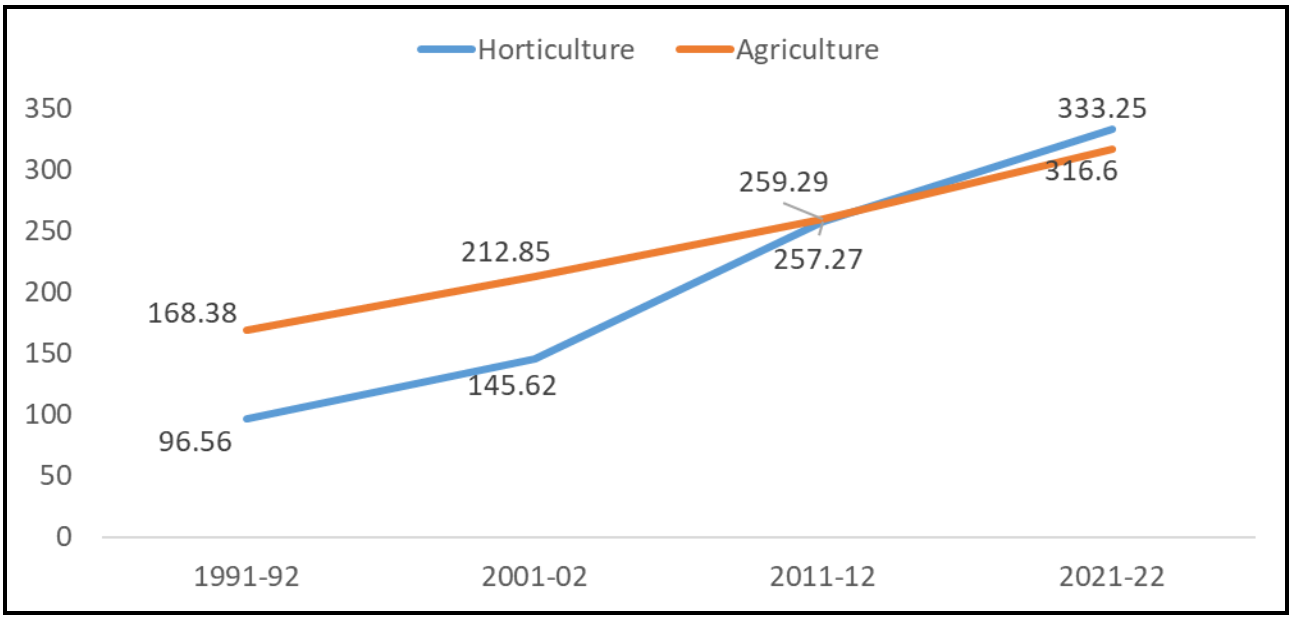
Increasing women's access to land, livestock, education, financial services, extension, technology and rural employment would boost their productivity and generate gains in terms of agricultural production, food security, economic growth and social welfare. Closing the gender gap in agricultural inputs alone could lift 100-150 million people out of hunger. Governments, the international community and civil society should work together to eliminate discrimination under the law, to promote equal access to resources and opportunities, to ensure that agricultural policies and programmes are gender-aware, and to make women's voices heard as equal partners for sustainable development. Achieving gender equality and empowering women in agriculture is not only the right thing to do. It is also crucial for agricultural development and food security. (FAO, 2011).

Rural women are left to use traditional tools and procedures resulting in low efficiency, drudgery, occupational health risks, and low income. Their contributions fall under indirect material income and go unacknowledged even in decision making. (Majumdar, 2017). Women in many cultures face social restrictions on their mobility and ability to interact freely in public institutions and markets. Groups are found to help overcome such restrictions (Agarwal, 2010). In South Asia, for instance, over 85% of farmers are small and increasingly female. Potentially, group farming could provide them economies of scale, a dependable labour force, more investible funds and skills, and greater bargaining power with governments and markets. (Bina Agarwal, 2020). These extended advantages could prove especially important for agricultural development, given a growing feminisation of agriculture (Agarwal, 2014). Some of these ideas came from practitioners, especially those who had formed women's groups initially for other purposes, or who saw enormous potential in adapting the self-help group (SHG) model, which originated to promote savings and credit (Tankha, 2002) but has diversified since (NCAER, 2008), and is widespread in India today. Other ideas stemmed from academics that emphasised the need for resource pooling and cooperation among women, including by leasing in land, since they typically lack adequate access to land or other resources on an individual basis (e.g. Agarwal, 1994, 2003). Added to this has been the success of group approaches in managing common pool resources (Agarwal, 2010; Ostrom, 1990). Organising Mahila gosthis, Farm women Days, Melas, Exhibitions for sharing information and getting direct feedback and communicating modern technologies and concepts through various traditional media specific to a region which are appealing to farm women by working with the traditional artists for the treatment of the knowledge base. Following Participatory approach in appraisal, technology development and transfer. Emphasising on action research and demonstration oriented technology transfer programmes. (Singh, 2020). Existence of appropriate technology and understanding perception of technological attributes is critical in enabling the process of adoption among farm women (Vidhya, 2021).

Today, how to bridge the gender gap and empower women with new knowledge and technology is a great challenge. Hence conceptualizing women's empowerment in agri-food systems needs a new framework and strategy to encourage them into entrepreneurship. Thus linking horticulture business avenues also helps in improving women livelihood status.

Status of Horticulture in India

Horticulture production in India has more than doubled from 146 MT in 2001-02 to 333.25MT in 2021-22 whereas the production of food grains increased from 213 MT to 316.6 MT during the same period (Figure 1).



(Source:3rd Advance Estimates of area and production of horticultural crops for the year 2021-22. https://agricoop.nic.in/en/StatHortEst#gsc.tab=0)

Figure 1: Production of Horticulture vis-a-vis Agriculture

Horticulture has registered a sharp rebound in production and acreage, far outpacing the foodgrains production since 2012-13. The most notable factor behind this is that the productivity of horticulture has increased from 8.8 tonnes per hectare (TPH) in 2001-02 to 12.1 TPH in 2020-21. The productivity of total food grains increased from 1.7 TPH to 2.5 TPH during the same period.

Indian Horticulture Export Trends

Promoting farm exports is crucial not only for generating valuable foreign currency for the nation but also for achieving the objective of an "Aatmanirbhar Bharat," which necessitates self-reliant agriculture. India's agri-exports increased by 13.99% in 2020-21, from Rs.6012.76 crore in 1990-91 to Rs.305469 crore in 2020-21. This is an increase of nearly 50% in 30 years. However, agri-exports experienced a slight decrease of approximately 8% in 2019-20. While India's agri-exports surged and reached all-time highs in 2020 and 2021, this was made possible by a slew of initiatives initiated by the Indian government and institutions, including Farmers Producer Organizations (FPOs).

Despite leading in production of fruits and vegetables, India’s exports of these products have not replicated the same success. During 2010-20, there has been an increase of US$ 2.8 million in the exports of India’s horticulture products, with export value of US$ 3.19 billion in

2020. Some of the major destinations for country's exports are UAE, Netherlands, US and Saudi Arabia. There are some products that have performed better than the average horticulture product's export performance. Onions, potatoes, frozen or fresh vegetables not already cooked, grapes, etc. Exports of these goods have increased as a result of a number of factors. Fresh grape exports, for instance, have grown from US$ 102.5 million in 2010 to US$ 307.9 million in 2020. GrapeNet and other initiatives like agri-export zones (AEZs) have aided in accelerating this expansion. Similarly, exports of fresh potatoes increased from 26.9 million US dollars in 2010 to 70.7 million US dollars in 2020. Exports of potatoes have increased alongside significant production increases. However, India accounts for less than 2% of all horticultural exports worldwide. India imports less than 1.5% of fruits and vegetables from the top markets like the United States, Germany, the United Kingdom, China, and France. The nation has the potential to export horticultural products to these nations due to its substantial base of production.

Figure 2 depicts that there is 15% increase in value of fresh fruit & vegetable export trends in the year 2021 compare to 8% in 2020 and Figure 3 explains the Floriculture export trends wherein there is 7% increase in value of fresh fruit & vegetable export trends in the year 2021 compare to 4% in 2020. Figure 4 depicts that there is an increasing trend in production of processed horticultural products.

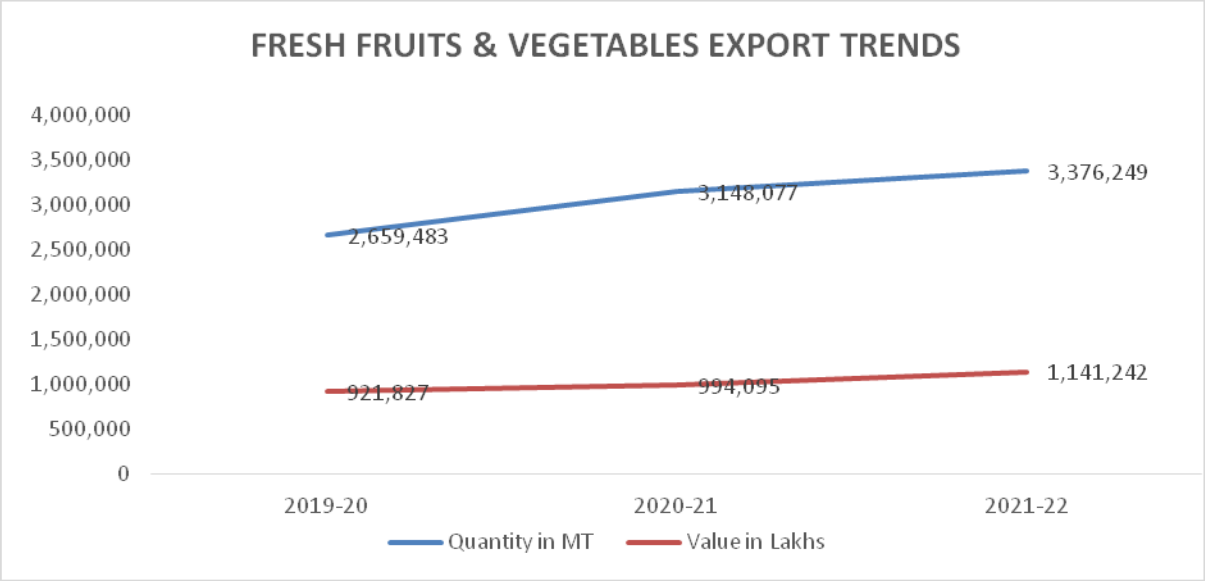


Figure 2: Fresh fruit & vegetable export trends

Year on Year Export growth		
Product	**2020-21**	**2021-22**
Quantity in MT	**18%**	**7%**
Value in Lakhs	**8%**	**15%**

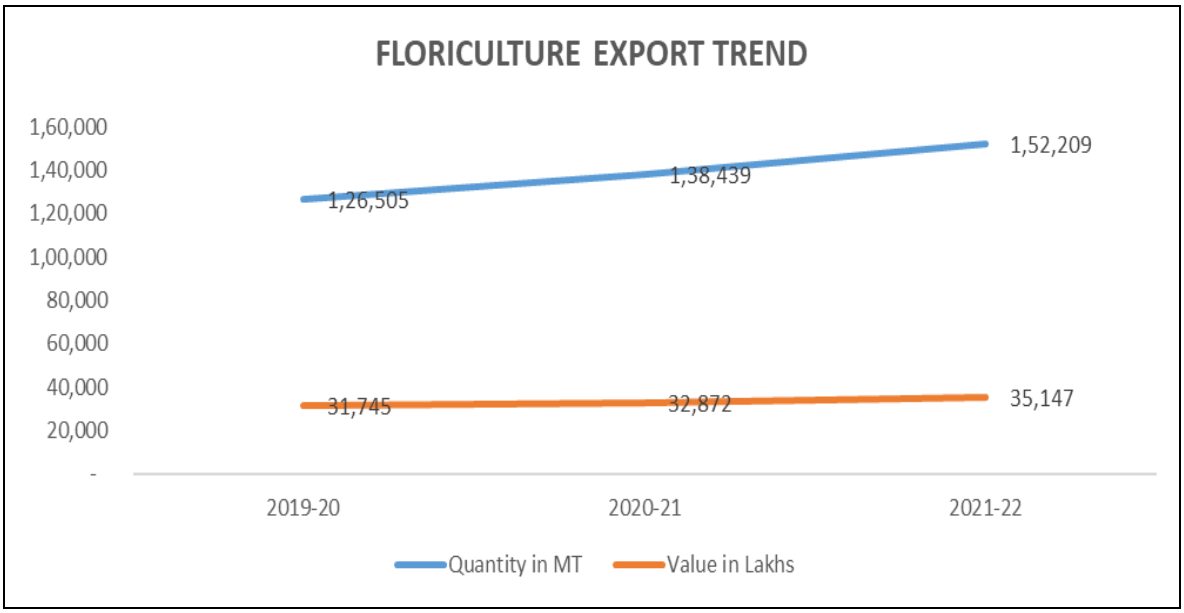


Figure 3: Floriculture export trends

Year on Year Export growth		
Product	**2020-21**	**2021-22**
Quantity in MT	**9%**	**10%**
Value in Lakhs	**4%**	**7%**

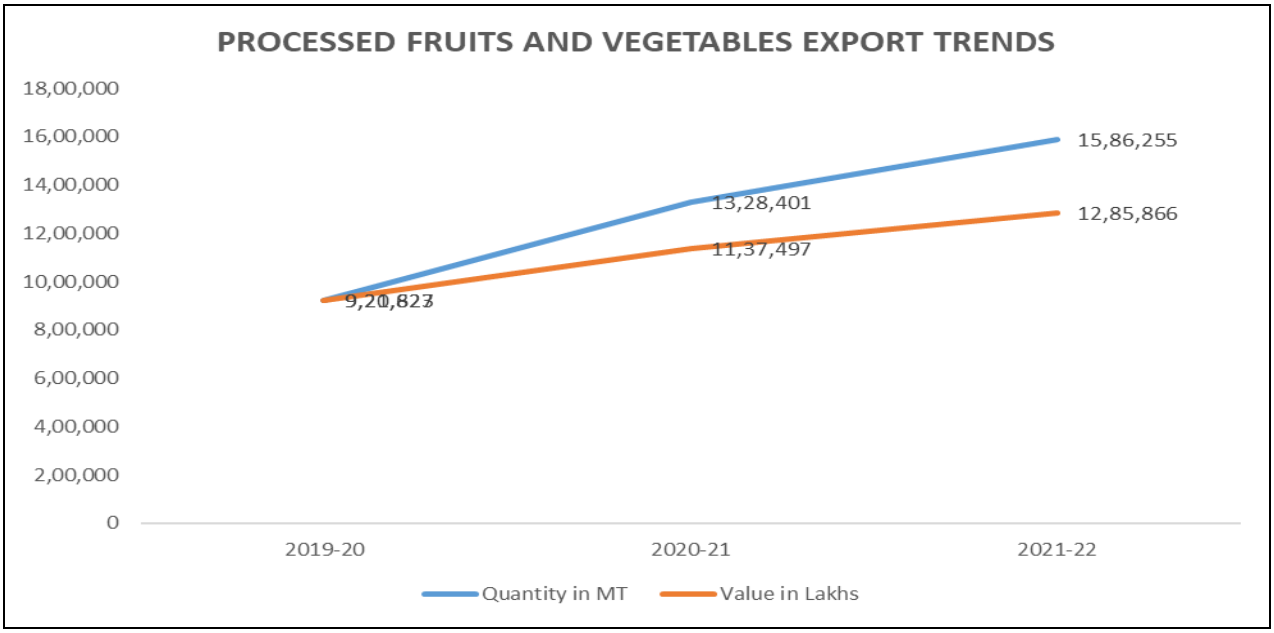


Figure 4: Processed Fruits and Vegetables Export Trends

(Source:3rd Advance Estimates of area and production of horticultural crops for the year 2021-22. https://agricoop.nic.in/en/StatHortEst#gsc.tab=0)

Opportunities in Export of Horticulture Products

A research paper on Market Expansion of Indian Horticulture Products was written by the Centre for Advanced Trade Research. It used Revealed Competitive Advantage analysis to identify some of the horticultural products that India could use to boost its exports in the short term.

Product Name	Importing countries
Cucumbers and gherkins provisionally preserved	France, Japan, Belgium, Russian Federation, Spain
Dried onions, whole, cut, sliced, broken or in powder	Germany, Japan, UK, Indonesia, Canada
Cucumbers and gherkins, prepared or preserved	Canada, Germany, USA, Netherlands, France
Fresh coconuts, whether or not shelled or peeled	Thailand, USA, Malaysia, UAE, Hong Kong
Fresh or dried cashew nuts, shelled	USA, Netherlands, UK, China
Dried, shelled pigeon peas "Cajanus cajan"	USA, UAE, Nepal
Fresh or chilled onions and shallots	China, Bangladesh, USA, Pakistan
Dried, shelled chickpeas "garbanzos"	Pakistan, Bangladesh, UAE
Dried, shelled leguminous vegetables	China, Pakistan, UAE, Saudi Arabia, Bangladesh

Source: CATR Analysis and UN Comtrade

These products can be focused while improving the exports of the horticulture products. Also, the importing countries are the markets that should be focused to expand the exports of these products.

To increase its horticulture exports to its intended markets, India ought to concentrate on the following actions:

Economies have been able to significantly improve their horticulture sector and establish themselves in the global market by participating in the Global Value Chains (GVCs). Kenya is a great illustration of how a small group of players significantly increased a nation's export of horticultural goods. At the Kenyan International Airport complex, large packaging and storage facilities are owned by Kenya's major exporters and producers. India must build the necessary infrastructure to reduce losses throughout the value chain. The cooperative company "MAHAGRAPES," which was established in January 1991 by the Maharashtra State Grape Growers' Association with the intention of increasing grape exports from Maharashtra, serves as an instructive case study. Facilities for pre-cooling and cold storage have been provided by MAHAGRAPES. The sector would require government support in the long run. The EU's use of

CAP as a model is a good one that can serve as a model for looking for evidence of growth over the long term.

The horticulture industry's productivity and skills will also benefit from technology imports. For instance, Israeli technology known as "plastic mulching" has previously increased tomato farms' yields in Tamil Nadu through the Indo-Israel project. In a similar vein, India ought to adopt Israel's drip irrigation system because it has been demonstrated to be effective at preventing water waste. In order to increase demand for horticultural products, it is thought that the consolidation of farm holdings is a very important step. According to Azhar Tambuwala, Director of Sahyadri Farms, farmers in India typically cultivate their land for food production rather than for profit. Back-end integration must be used to support marketing. As a result, consolidation is essential because farmers are unable to accumulate large land holdings because of the law and how property is divided when passed down through generations. When farmers work together, they can make bolder and bigger decisions because standardization and fair management can enter the production process. The Centre's Horticulture Cluster Development Programme has the potential to change the game in terms of the value chain's scale and sophistication. According to official estimates, farmers will gain access to a common pool of resources and build last-mile connectivity, bringing their incomes closer to doubling.

Share of Top 10 Imported Agricultural Commodities in 2020-21

Figure 5 signifies that there is 61% increase in value of floriculture import trends in the year 2021 also Figure 6 depicts that Vegetable oils accounted for 52% of the total agri-imports in 2020-21, making them the single largest product in terms of agricultural imports (Figure 4). With a ten percent share, fresh fruits are the second most imported agricultural product, followed by pulses (7.6 percent), spices (5.1%), and cashews (4.7%). It is noteworthy that India imported 90.8 percent more sugar in 2020-21 than in the previous year, as well as 19.8 percent more vegetable oils, among the major commodities it imported. The import trend gives the inference that there are plenty of opportunities to tap with respect to vegetable oils and fresh fruits in India which provides the root for many employment avenues.

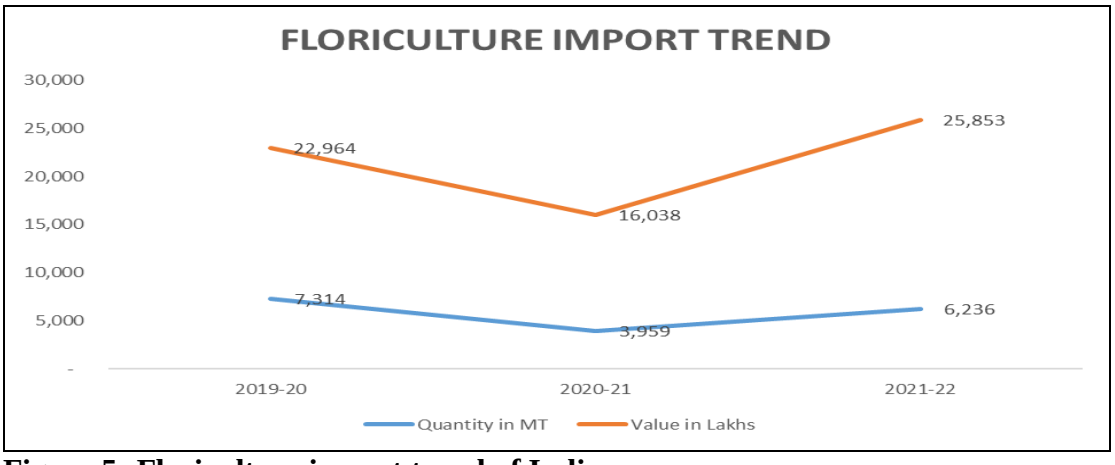
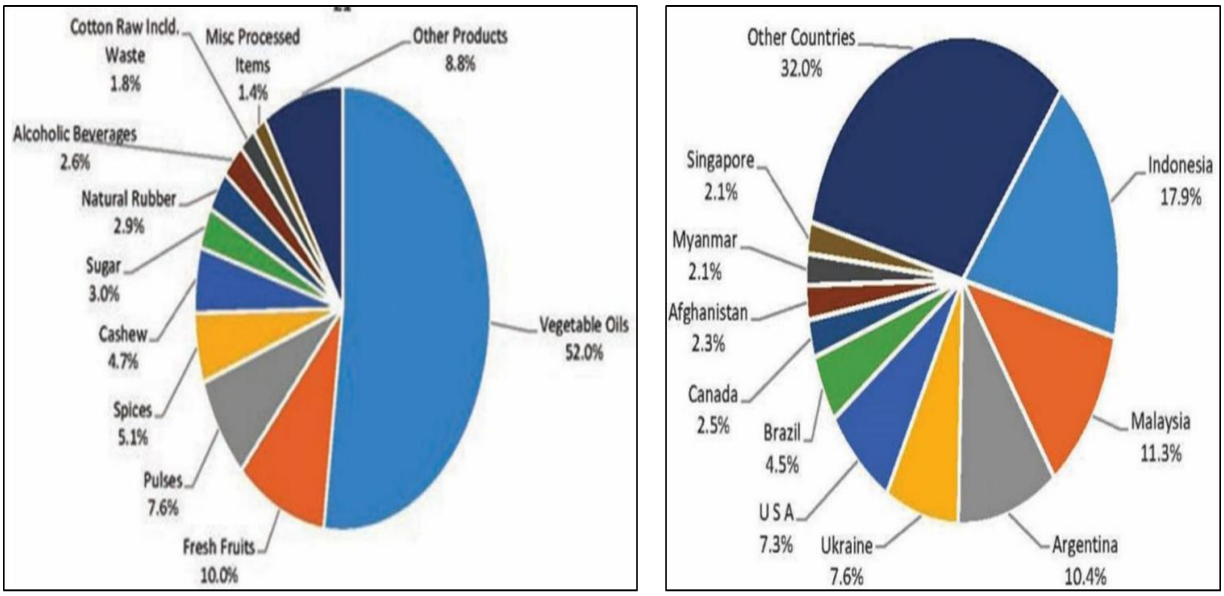


Figure 5: Floriculture import trend of India
(https://agriexchange.apeda.gov.in/importtoindia/PrdGrp_prdwise.aspx?gcode=0101&val=1/100000)

Product	2020-21	2021-22
Quantity in MT	-46%	58%
Value in Lakhs	-30%	61%



Source: Directorate General of Commercial Intelligence & Statistics, Department of Commerce.

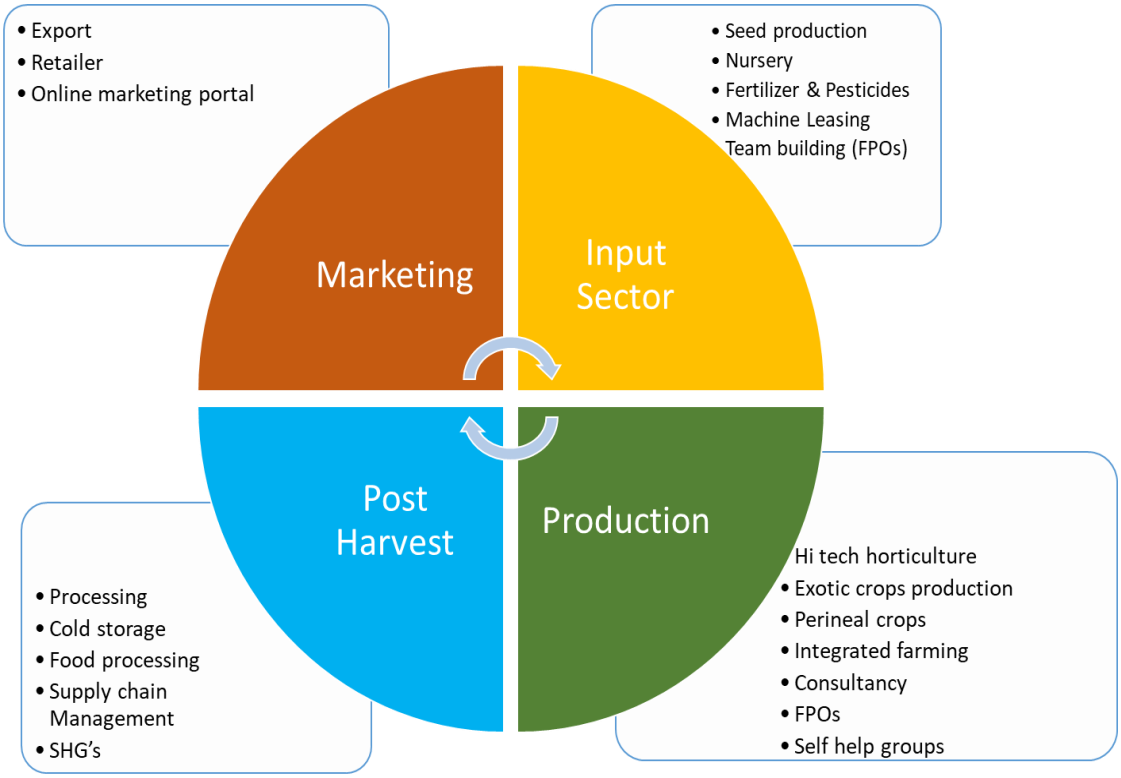
Fig 6: Share of Top 10 Imported Agricultural Commodities in 2020-21

<u>Creating new opportunities through Promotion of Exotic and Indigenous Crops</u>

Government of India had identified 10 globally popular exotic fruit crops of commercial importance and Indigenous fruit crops with high nutritional and nutraceutical properties. Also 10 important State Horticulture Missions have been given targets for area expansion during 2021-22 through which new marketing avenues open up for the entrepreneurs in the market.

S. No.	Exotic Fruit crops	Niche Fruit crops
1.	Avocado	Aonla
2.	Blue berry	Karonda
3.	Dragonfruit	Seabuckthorn
4.	Fig	Garcinia
5.	Kiwi	Jamun
6.	Mangosteen	Hanuman Phal (Soursop)
7.	Persimmon	Bael
8.	Passion fruit	Tamrind
9.	Rambutan	Phalsa
10.	Strawberry	Jack fruit

Areas of opportunities for women hortipreneurs: Due to Raise in Demand there are opportunities in all the phases of horticulture



Women Specific opportunities in horticulture

- Household food security by kitchen gardening and nutrition gardening
- Storage infrastructure and adjusting for spatial inconsistencies :Kisan Rail and Krishi Udaan
- Contract farming, and Farmer Producer Organizations (FPOs)
- Agritech start-ups
- Value addition
- Location specific drudgery reduction technologies
- Rural Crafts
- Adoption of artificial intelligence, Internet of Things, drone technology
- Processing and Storage
- Gender mainstreaming through SHGs
- Storage loss minimization techniques

ICAR-IIHR interventions to support the livelihood of rural women

More than 170 varieties and hybrids have been released and a number of sustainable production, protection, and post-harvest management technologies have been developed as a result of research conducted over the past five decades. The institute has released three varieties of papaya, five hybrids of mango, three varieties of guava, five hybrids of grapes, and one variety of pomegranate, annona, ber, and passion fruit, respectively, in the field of fruit crops. Arka Sahan, a annona hybrid with large globules and fewer seeds, Arka Kiran, a red-fleshed hybrid guava, and Arka Prabhat, a high-yielding pink-fleshed papaya hybrid, hold better promise and are gaining more popularity.

The Institute has developed and released 60 high-yielding open pollinated varieties and 15 F1 hybrids for commercial cultivation of 24 pest- and disease-resistant vegetable crops. These include Arka Manik for watermelon, which is triple pest- and disease-resistant, Arka Anamika for okra, which is resistant to Yellow Vein Mosaic Virus, and Arka Komal for French bean, which is resistant to rust. Arka Vikas, Arka Kalyan, and Arka Niketan, onion-specific tomato varieties with high yields, have had a significant impact. The Institute has released tomato hybrids Arka Ananya and Arka Meghana that are resistant to thrips and viruses, chilli hybrids Arka Harita and Arka Suphal of chilli that are resistant to powdery mildew, high yielding male sterility base chilli hybrid Arka Swetha, bacterial wilt brinjal hybrid Arka Anand, and high yielding onion hybrids based on male sterility Arka Lalima and Arka Kirthima. The Institute has developed improved varieties of gladiolus, chrysanthemum, bougainvillea, hibiscus, tube rose, rose, China aster, carnation, gerbera, and crossandra in the field of ornamental crops. The China aster cultivars Poornima, Kamini, Vilet cushion, and Shashank, the tube rose cultivars Shringar, Suvasini, Prajwal, and Vibahv, and the crossandra variety Arka Ambara have gained a significant amount of popularity among farmers. A spore-less oyster, milky and medicinal mushroom with potential for export have all been developed in the mushroom industry. In the field of production technologies, the Institute has standardized the high density planting of bananas and pineapples, which is used by most fruit growers. The Institute's discovery and introduction of the grape rootstock Dog ridge has revolutionized grape cultivation in dry land and challenging soils. Schedules for integrated water and nutrient management like drip irrigation, fertigation, and fertilization in the active root feeding zone, among other things, for various vegetables, ornamental crops, and the best possible use of resources, a standard has been established. Additionally, the Institute has developed standard diagnostics for leaf and petiole in order to provide the most effective fertilizer recommendations for each crop. The institute has released mango special, banana special, citrus special, and vegetable special for higher and better yields and has standardized technology for foliar nutrition of micro nutrients in recent years. Because these technologies have already been made commercially available, a wide range of farmers now have access to them. Spongy tissue, a major issue in mango, has been identified as a result of the findings of the causative factors, and solutions have been proposed. Additionally, the Institute has produced biofertilizers like PSB, azospirallium, VAM, and others.

The Institute has standardized the technology of pest management in the field of plant protection, using botanicals and plant products like neem soap and pongamia soap to control major pests and

trap crops like African marigold to control tomato fruit borer and mustard to control DBM in Cole crops. Microorganisms and biocontrol agents such as Trichoderma, Pseudonomous fluoroscence, and Paecilomyces lilacinus, among others nematodes and soil-borne diseases have been standardized for control. The Institute has commercialized a pheromone trap that has been standardized to eliminate the mango fruit fly, which has become the primary export restriction. Integrated disease management protocols and virus diagnostic kits were developed simultaneously. The Institute has standardized MOP protocol, shrink wrapping technology, and technology to extend storage life at various temperatures in the field of post harvest technology. The Institute has established protocols for the preparation of osmo-dehydrated products, fruit-based beverages like mango squash, passion fruit squash, and aonla squash, passion fruit banana blends, various culinary pastes and purees, lactic acid fermentation of vegetables, and standardized protocols for minimally processed foods as a priority area for value addition through product development. The Institute has standardized technology for producing protected tomato, colored capsicum, cucumber, and melons in the frontier areas and precision technology. The process by which nursery seedlings can be produced using pro trays has undergone further development. Macro propagation protocols for various crops and nucleic acid probes for numerous viruses have been developed in the field of biotechnology. Additionally, methods for DNA finger printing have been developed to characterize and record germplasm.

Horticulture Marketing Challenges

Despite the horticulture industry's fast growth, growers are not overly optimistic. As a result of their over production, they are turning to distress sales, burning their harvest, or dumping it on the road. The current state of the market begs the question of why, despite record output levels, we have not been able to treat our farmers fairly. The market for horticulture crops in India is characterized by fragmentation, high price volatility, significant quality and quantity losses, and low levels of processing. In contrast to cereals and dairy, where marketing and procurement are well advanced, a respectable value chain for fruits and vegetables is lacking. The perishable nature of the crops, regional and seasonal concentration, accompanying losses, and lack of storage facilities are to blame for this.

Due to the bulkiness, seasonal production, and perishable character of horticulture products, marketing them is quite risky and complex. For fruits and vegetables, there is also a distinct range of prices from producer to consumer, which results from interactions between different intermediaries at various levels of the marketing chain. Additionally, the marketing plans made at various points, from the farm gate to the end consumer, also have a big impact on pricing levels. Fruits and vegetables have a different marketing system than other agricultural products because of these characteristics.

- **Large Post-Harvest Losses**

According to a comparative study conducted in 2015 by the Central Institute of Post-Harvest Engineering and Technology (CIPHET), Ludhiana, approximately 16% of fruits and vegetables are lost after harvest. This huge gap emphasizes the necessity of focusing on reducing wastage in

the fruits and vegetables sector, despite the fact that it is essential to concentrate on reducing food loss across various commodities. The TOP crops, which account for 51% of the total vegetable production, have the highest post-harvest losses among all vegetable crops. Tomato has the highest post-harvest losses among the TOP crops, at 12.44 percent, followed by onion at 8.20 percent and potato at 7.32 percent.

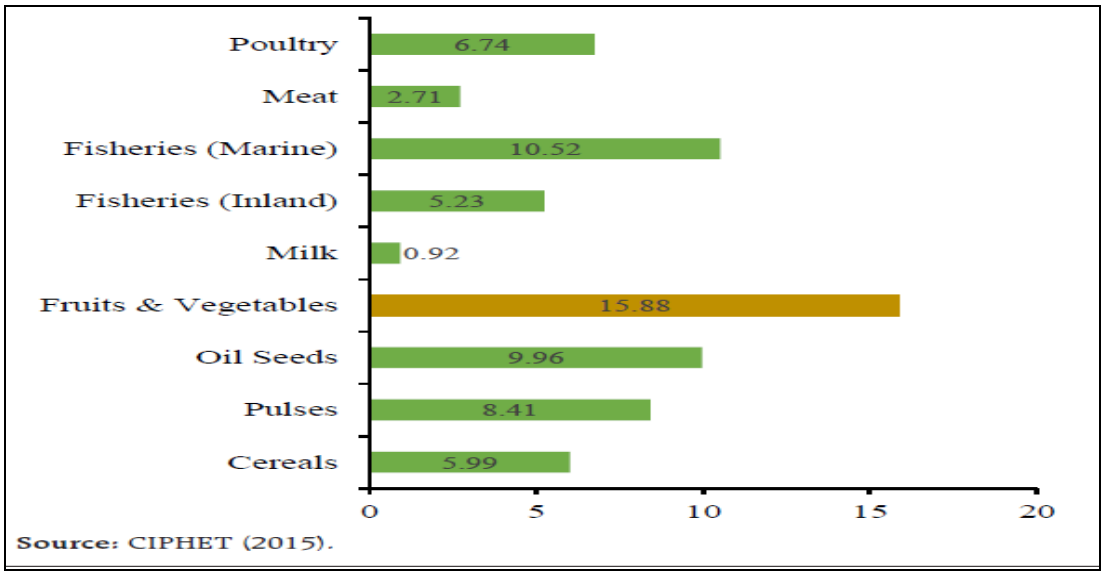


Figure 7: Estimated loss of major agricultural produce-wastage (%)

- **Infrastructure Availability**

In India, storage infrastructure plays a crucial role in marketing due to seasonality, perishable horticulture crops, and a lack of coordination between supply and demand. Because it is where the commodity is most of its life, cold storage infrastructure is one of the most important parts of the post-harvest process. There are approximately 7600 cold storage facilities in India with a capacity of 34.9 million metric tons (MMT), but their distribution among the states is uneven. Only the four states of Uttar Pradesh, West Bengal, Gujarat, and Punjab contain approximately 59% of the storage capacity (21 MMT). In addition, 75% of the cold storages are devoted solely to potatoes, indicating that other products are unavailable and highlighting the significance of potatoes for Indians.

- **Prices Seasonality and Market Volatility**

Tomato, Onion, Potato crops (TOP crops) have a short shelf life because there aren't enough facilities for storage and warehousing, so we see price increases in the same months every year. This is especially evident in the case of onion, which experiences an annual sharp price increase in October due to a lack of supply in spite of constant demand. All vegetable and fruit crops experience seasonality and market volatility, although TOP crops are more susceptible. If we address post-harvest losses, develop the necessary storage and warehousing infrastructure, and establish a supply chain that is fully integrated, this problem can once more be substantially resolved.

Realizing Potential: Way Forward

The value chain for fruits and vegetables must be made market demand-driven so that growers do not experience the problem of surplus. It is essential that different sorts of losses, wastages, and inefficiencies along the value chain be reduced in order to achieve this. The first step in this direction would be to reduce harvest and post-harvest losses by filling the gap in the storage infrastructure and adjusting for spatial inconsistencies using programmes like Kisan Rail and Krishi Udaan, etc. Second, we must think of alternative marketing strategies and channels to address the inefficiencies in the marketing chain. In a typical value chain for fruits and vegetables, significant margins appropriated by middlemen result in a low share of the rupee going to the farmer.

Innovative solutions have been developed, including farmer-consumer markets, contract farming, and Farmer Producer Organizations (FPOs), which connect organised retail with farmers directly. Today, there is also an urgent need to strengthen agricultural extension and speed up the transfer of technology from the lab to the ground. Agri start-ups will undoubtedly be essential in this area in the future. Agritech start-ups are offering pertinent and cutting-edge answers to a variety of problems that are being encountered along the entire agricultural value chain. These start-ups have established connections between farmers, input dealers, wholesalers, retailers, and consumers, establishing strong marketing ties and delivering high-quality produce on schedule, increasing the producer's share of the consumer's rupee. Additionally, horticulture crop cultivation must keep up with emerging technology. Adoption of blockchain technology, artificial intelligence, Internet of Things, drone technology, etc. in this context would unavoidably occur. As a result, skill development must keep up with these new technologies to ensure that the necessary technology moves from the lab to the real world. It is anticipated that agribusiness startups will play a crucial role in this regard. Horticulture must also be prioritized as an investment sector, with a focus on nature smart horticulture. This will significantly reshape horticulture as an engine of economic growth that generates employment, food and nutritional security, environmental services, and, most importantly, produce that meets the requirements of domestic and export markets. States play a crucial role in bringing about these reforms because agriculture is a subject of the state. Last but not least, establishing farmers' access to new markets is essential to ensuring a steady and profitable income. In order to achieve this, serious efforts must be made to expand both our export market for fresh and processed fruits and vegetables and our processing capacity.

CONCLUSION: Women in the countryside play a significant role in the expansion of the New India's agricultural sector. Through guaranteed access to resources, technology, education, health facilities, ownership rights, and skill development, rural women will be recognized and mainstreamed, enhancing agriculture productivity and contributing to the development of an empowered nation.

REFERENCES

- Achandi, E.L., Mujawamariya, G., Agboh-Noameshie, A.R., Gebremariam, S., Rahalivavololona, N., Rodenburg, J. (2018). Women's access to agricultural technologies in rice production and processing hubs: a comparative analysis of Ethiopia, Madagascar and Tanzania. J. Rural Stud. 60, 188–198. https://doi.org/ 10.1016/j.jrurstud.2018.03.011.
- Agarwal, B. (1994). A field of one's own: Gender and land rights in South Asia. Cambridge: Cambridge University Press.
- Agarwal, B. (2003). Gender and land rights revisited: Exploring new prospects via the state, family and market. Journal of Agrarian Change, 3(1&2), 184–224.
- Agarwal, B. (2010). Gender and green governance: The political economy of women's presence within and beyond community forestry. Oxford: Oxford University Press.
- Agarwal, B. (2014). Food Security, productivity and gender inequality. In R. Herring (Ed.), The Oxford handbook of food, politics and Society. New York: Oxford University Press.
- Alkire, S., Meinzen-Dick, R., Peterman, A., Quisumbing, A., Seymour, G., Vaz, A. (2013). The women's empowerment in agriculture index. World Dev. 52, 71–91.
- Bello, B., & Abdullahi, M. (2021). Farmers-herdsmen conflict, cattle rustling, and banditry: the dialectics of insecurity in Anka and Maradun local government area of Zamfara State, Nigeria. https://doi.org/10.1177/21582440211040117
- Bina Agarwal (2020) Does group farming empower rural women? Lessons from India's experiments, The Journal of Peasant Studies, 47:4, 841-72, DOI: 10.1080/03066150.2019.1628020
- Croppenstedt, A., Goldstein, M., Rosas, N. (2013). Gender and agriculture: inefficiencies, segregation, and low productivity traps. World Bank Res. Obs. 28 (1), 79–109 (JSTOR).
- CIPHET (2015). Annual report. Ludhiana. ISBN: 978-81-931450-2-9
- Doss, C.R., 2001. Designing agricultural technology for African women farmers: lessons from 25 Years of experience. World Dev. 29 (12), 2075–2092. https://doi.org/ 10.1016/S0305-750X(01)00088-2.
- FAO. (2011). The State of Food and Agriculture: Women in Agriculture. FAO, pp147
- FAO. (2020). Gendered impacts of COVID-19 and equitable policy responses in agriculture, food security, and nutrition. Accessed: https://www.fao.org/3/ca9198en/CA9198EN.pdf.
- FAO. 2021. World Food and Agriculture – Statistical Yearbook 2021. Rome. https://doi.org/10.4060/cb4477en
- Johnston, D., Stevano, S., Malapit, H.J., Hull, E., Kadiyala, S. (2018). Review: time use as an explanation for the agri-nutrition disconnect: evidence from rural areas in low and middle-income countries. Food Pol. 76, 8–18. https://doi.org/10.1016/j. foodpol.2017.12.011. February.
- Khatri-Chhetri, A., Regmi, P.P., Chanana, N., Aggarwal, P.K. (2020). Potential of climate-smart agriculture in reducing women farmers' drudgery in high climatic risk areas. Climatic Change 158 (1), 29–42. Kivlin, J.E., Fliegel, F.C., 1967.

- Kumar, N. and Quisumbing, A. (2013). Gendered impacts of the 2007-2008 food price crisis: data from rural Ethiopia. Food Policy, 38: 11-22.
- Majumdar, Joydeep and Shah, Priyanka. (2017). Mapping the role of women in Indian Agriculture. Annals of Anthropological Practices 4(2):: 46-54
- NCAER (2008). Impact and sustainability of SHG bank linkage programme. New Delhi: National Council of Applied Economic Research.
- Onyango, M., Resnick, K., Davis, A., & Shah, R. (2019). Gender-based violence among adolescent girls and young women: a neglected consequence of the West African Ebola outbreak. In: Schwartz, D., Anoko, J., & Abramowitz, S. (eds) Pregnant in the Time of Ebola. Global Maternal and Child Health. Springer, Cham. https://doi.org/10.1007/978-3-319-97637-2_8
- Ostrom, E. (1990). Governing the commons. The evolution of institutions for collective action. Cambridge: Cambridge University Press.
- Padmaja, R., Pramanik, S., Pingali, P., Bantilan, C., Kavitha, K. (2019). Understanding nutritional outcomes through gendered analysis of time-use patterns in semi-arid India. Glob. Food Secur. 23, 49–63. https://doi.org/10.1016/j.gfs.2019.04.001.
- Paris, T., Diaz, C., Hossain, I., 2011. Participatory evaluation of a rice flour mill by poor rural women: lessons from Bangladesh. Gend. Technol. Dev. 15 (2), 275–299.
- Paudel, G.P., KC, D.B., Rahut, D.B., Khanal, N.P., Justice, S.E., McDonald, A.J. (2019). Smallholder farmers' willingness to pay for scale-appropriate farm mechanization: evidence from the mid-hills of Nepal. Technol. Soc. 59, 101196.
- Ragasa, Catherine; Kyle, Jordan; Kristjanson, Patricia; and Eissler, Sarah. 2022. Conceptualizing women's empowerment in agrifood systems governance: A new framework. IFPRI Discussion Paper 2153. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.136489
- Rola-Rubzen, M.F., Paris, T., Hawkins, J., Sapkota, B. (2020). Improving gender participation in agricultural technology adoption in Asia: from rhetoric to practical action. Appl. Econ. Perspect. Pol. 42 (1), 113–125.
- Singh, Krishna M. and Kumari, Priyanka and Ahmad, Nasim and Shekhar, Dibyanshu (2020). Role of Women in Agriculture: Technology-led, Gender Sensitive Policy Options. http://dx.doi.org/10.2139/ssrn.3517148
- Tankha, A. (2002). Self-Help Groups as financial intermediaries in India: Cost of promotion, sustainability and impact. A study prepared for ICCO and Cordaid, the Netherlands.
- Theis, S., Krupnik, T.J., Sultana, N., Rahman, S.-U., Seymour, G., Abedin, N., 2019. Gender and agricultural mechanization: a mixed-methods exploration of the impacts of multi-crop reaper-harvester service provision in Bangladesh. Int. Food Pol. Res.Inst. 1837.
- Vemireddy, V., Pingali, P.L. (2021). Seasonal time trade-offs and nutrition outcomes for women in agriculture: evidence from rural India. Food Pol. 102074. https://doi.org/ 10.1016/j.foodpol.2021.102074.

- Vidya Vemireddy, Anjali Choudhary. (2021). A systematic review of labor-saving technologies: Implications for women in agriculture. Global Food Security, Volume 29, 100541, ISSN 2211-9124, https://doi.org/10.1016/j.gfs.2021.100541.
- Wodon, Q., Blackden, C.M. (2006). Gender, Time Use, and Poverty in Sub-saharan Africa.
- Yi, Q., Chen, M., Sheng, Y., Huang, J.,(2019). Mechanization services, farm productivity and institutional innovation in China. China Agric. Econ. Rev.
- DATA extracted from : 3rd Advance Estimates of area and production of horticultural crops for the year 2021-22. https://agricoop.nic.in/en/StatHortEst#gsc.tab=0
- DATA extracted from the APEDA WEBSITE: https://agriexchange.apeda.gov.in/importtoindia/PrdGrp_prdwise.aspx?gcode=0101&val=1/100000
- DATA extracted from the APEDA WEBSITE: https://agriexchange.apeda.gov.in/importtoindia/MainheadPrdGrp_prdwise.aspx?gcode=%270201%27,%270202%27,%270203%27,%270204%27,%270205%27,%270206%27,%270207%27

Chapter: 2

Biofortified Foods for Nutritional Security of Women

Pushpa Chethan Kumar

Division of Postharvest Technology & Agri.Engg
ICAR-Indian Institute of Horticultural Research
Hesaraghatta, Bengaluru -560089

Introduction

Currently, a larger percentage of women in India are still categorized under malnutrition. As per the recent report by National Family Health Survey (2015-16), nearly 22.9% women are underweight who are aged between 15-49 years. The highest percentage of malnutrition was observed in the states of Jharkhand (31.5%) followed by Bihar (30.4%), Dadra and Nagar Haveli (28.7%), Madhya Pradesh (28.4%), Gujarat (27.2%) and Rajasthan (27%). Annually, India loses over USD 12 billion in GDP due to vitamin and/or mineral deficiencies (Yadava *et al*, 2017). A recent report published in the Journal Nature is an alarming because it states that India has the highest global prevalence of anemia among women of reproductive age which is accounted to 53%. Prevalence of anemia among reproductive women will lead to underweight babies which in turn lead to malnourished individuals. The major reason for undernourished children is due to inadequate nutrition in a mother before and after the mother hood. This vicious cycle continues for generations if the chain is not broken by the proper nutrition education and availability of healthy diet. Since decades the government is trying to reduce the under nutrition especially among women and children through various programmes. However, the existence of under nutrition has led to the development of biofortified foods. The biofortified foods can act as a direct channel for providing micronutrients to the vulnerable group. Hence, many staple crops such as rice, wheat, maize, pearl millet, sweet potato and other crops have been biofortified with iron, β-carotene, zinc and amino acids to reduce this micronutrient malnourishment.

Biofortified crops for mitigating malnutrition

Major nutrients that are required for human nutrition are obtaining from plant based foods. However, the major staple crops of the world such as rice, wheat and maize are often deficient in some of these nutrients. Besides, it is difficult to enhance the nutritional value of foods through

processing and by traditional agricultural approaches. But the advances in molecular biology are rapidly growing so the crops can be engineered with molecular tools to develop crops with enhanced key nutrients. In this context, the nutritional targets include elevated mineral content, improved fatty acid composition, increased amino acids and antioxidant levels in staple crops. Therefore, biofortification was identified as a suitable method for delivering micronutrients. The term biofortification can be defined as a process of increasing the density of vitamins and minerals in a crop through plant breeding, transgenic techniques, or agronomic practices (Khush *et al*, 2012).

- Conventional breeding: In this technique of biofortification, seeds are selected which are the source of rich nutrient and are bred with varieties which are high yielding. The result will be the production of crop with high yield and high in targeted nutrient. HarvestPlus, is an organization which is working for developing biofortified crops through conventional breeding method.

- Transgenic approaches: This approach of biofortification involves identification and characterization of gene function, and then utilization of gene to engineer the plant metabolism to produce high nutrient content. In addition, the genetic modifications can be targeted to the edible portions of commercial crops. This technique facilitates the simultaneous incorporation of genetic systems to enhance micronutrient concentration, decrease antinutrients and increase promoters for bioavailability of targeted micronutrient. Eg. rice, cassava, maize and wheat.

- Fertilizer application: It involves application of fertilizers containing mineral micronutrients. This technique is simple and inexpensive. But, increase in micronutrient in the edible portion depends on several factors such as the application method, soil composition, mineral mobility in the plant, and its accumulation site. Micronutrient feritilizers can increase the levels of Zn, Ni, I, Cu, Mo and Se.

Globally, micronutrient malnutrition (MNM) exists in majority of under developed and in developing countries. Micronutrient malnutrition is also known as hidden hunger as the deficiency symptoms are not immediately visible. Even though MNM exists since many decades only during 1980s, its affect on health of vulnerable group has been emphasized.

Elimination of deficiency of iron, vitamin A and iodine by the year 2000 was addressed during 1990 World Summit for Children, which is facilitated by the UN with support from UNICEF, the World Bank, WHO, FAO, UNDP, CIDA and USAID (Mayer *et al*, 2008). Even though many activities were framed to overcome this micronutrient deficiency but it could not be achieved. It was suggested that only public health intervention strategies were not enough to reduce the MNM, there should be sustainable approach for this. Hence, biofortification of staple crops has emerged as a better solution to overcome MNM burden. Biofortification of staple crops offers low cost and long term solution for underdeveloped and developing countries to mitigate the MNM.

Table 1: Biofortified crops released from Indian Council of Agricultural Research, New Delhi

Crop	**Variety name**	**Biofortified for**
Rice	CR Dhan 310	Protein
	DRR Dhan 45	Zinc

Wheat	WB 02	Zinc & iron
	HPBW 01	Iron & Zinc
Maize	Pusa Vivek QPM9 Improved	Provitamin-A, Lysine & Tryptophan
	Pusa HM4 Improved	Lysine & Tryptophan
	Pusa HM8 Improved	Lysine & Tryptophan
	Pusa HM9 Improved	Lysine & Tryptophan
Pearl millet	HHB 299	Iron & Zinc
	AHB 1200	Iron
Lentil	Pusa Ageti Masoor	Iron
Mustard	Pusa Mustard 30	Low erucic acid
	Pusa Double Zero Mustard 31	Low erucic acid & low glucosinolate
Cauliflower	Pusa Beta Kesari 1	β-carotene rich
Sweet Potato	Bhu Sona	β-carotene
	Bhu Krishna	Anthocyanin
Pomegranate	Solapur Lal	Iron, Zinc & vitamin-C

Strategies for popularization of biofortified crops

Nearly 821 million people would be undernourished as per the United Nations estimates in 2018 worldwide, but still shockingly the number has not come down. It has been reported that around 2 billion of individuals are suffering from each iron and iodine deficiency, whereas 3 and 150 million people are suffering from vitamin A and zinc insufficiency, respectively. (Srivastav *et al* , 2022). This data reveals the vulnerability of micronutrient deficiency in the world. To

overcome this burden, few biofortified crops have been released to the market in countries such as Bangladesh and China who has released zinc-enriched rice and wheat, respectively; β-carotene rich sweet potato has been released in Mozambique and Uganda where sweet potato is one of their main staple foods; and Zambia and Nigeria has got β -carotene rich maize (Diaz-Gomez *et al*, 2017). The first transgenic biofortified crop, Golden Rice, with provitamin A carotenoids has got nod to utilize in Philippines in 2018. In India, various Central Institutes and State Agricultural Universities under Indian Council of Agricultural Research, New Delhi, have developed biofortified rice, wheat, maize, pearl millet, mustard, lentil, sweet potato, cauliflower and pomegranate with high content of protein, tryptophan, iron, zinc, beta-carotene, anthocyanin etc. However, even though many varieties have been available but the adoptability by farmers should be increased. By increasing the production of biofortified crops, its availability can also be made through public distribution system. Initially, consumers may not accept some of the biofortified crops such as carotene rich sweet potato because of the orange color but the consumers should be educated about the importance of micronutrients to our body. Apart from supplying through public distribution system, instant food formulations for children should be made available from these biofortified crops through Anganwadi. Public should be made aware of importance of consumption of biofortified crops. Child bearing women and mothers should be educated about the biofortified crops and its inclusion in their diet. School going children should be educated about the malnutrition and importance of usage of biofortified foods. Food processers should be encouraged to utilize the biofortified crops in processed foods. Most importantly farmers should be encouraged to grow biofortified crops by providing true seed materials. Thus, the regular consumption of micronutrient rich food will lead to decreased vulnerability to MNM.

Conclusion

Prevalence of micronutrient malnutrition is always a burden for the government. It directly or indirectly affects the growth of any country. Once the micronutrient occurs in an individual, it will continue for generations if it is not intervened. Therefore there is a need to break this vicious cycle of burden to produce a healthy individual. There is a need of sustainable approach to overcome this chain of burden and biofortificaion is one such approach. The biofortified crops are an easy way to mitigate the micronutrient deficiency as the crop itself is rich in micro nutrients. The public distribution system will play a major role in making available

the micronutrient rich biofortified staple foods to the poor population who shares the major percentage of micronutrient malnutrition.

References:

- Díaz-Gómez, J., Twyman, R. M., Zhu, C., Farré, G., Serrano, J. C., Portero-Otin, M., and Christou, P. 2017. Biofortification of crops with nutrients: factors affecting utilization and storage. Current opinion in biotechnology. 44, 115-123.
- Khush, G.S., Lee, S., Cho, JI. *et al.* 2012. Biofortification of crops for reducing malnutrition. *Plant Biotechnol Rep* **6**, 195–202. https://doi.org/10.1007/s11816-012-0216-5
- Mayer, J. E., Pfeiffer, W. H., & Beyer, P. 2008. Biofortified crops to alleviate micronutrient malnutrition. *Current opinion in plant biology*, *11*(2), 166-170.
- Srivastav, P., Vutukuru, M., Ravindran, G., Awad, M.M. 2022. Biofortification—Present Scenario, Possibilities and Challenges: A Scientometric Approach. Sustainability. 14, 11632. https://doi.org/10.3390/ su141811632
- Yadava D.K., P.R. Choudhury, Firoz Hossain and Dinesh Kumar. 2017. Biofortified Varieties: Sustainable Way to Alleviate Malnutrition. Indian Council of Agricultural Research, New Delhi.

Chapter: 3

Horticulture Network through FPOs: Success Stories

R. Venkattakumar
ICAR-Indian Institute of Horticultural Research (IIHR)
Bengaluru-560 089, Karnataka

Abstract

The concept of Farmers Producers Organizations (FPOs) has been promoted to solve the problems faced by majority of small and marginal farmers of the country, through collectivizing themselves as business performing organizations across various stages of agriculture related supply and value chain activities. From 2002 onwards, such organizations were promoted by various development departments, by making them to register under Companies Act. Through a research study, the best practices of such FPOs were documented during 2016-2020. These FPOs started serving the broad-based needs of their producer members such as input supply, output procurement, custom hiring facilitation and overall technological backstopping. But performance of many of these organizations were not so successful on a long run due to many emerging challenges. Through focus group discussions and telephonic survey with the office bearers of the FPOs, some of the emerging challenges of the FPOs were delineated such as failure to strike business partnership with input companies, failure to initiate market tie-up with big companies, managing operational costs during the initial years, non-adoption of innovative marketing strategies, lack of experience in branding and profit making business process, lack of adequate technical manpower, failure to arrange credit and crop insurance facilities for the producer members etc. This paper discusses about best practices of FPOs in creating horticulture networks and emerging challenges and derive implicative strategies to be recommended for practicing towards effective management of FPOs.

Key words: *FPOs; horticulture networks; emerging challenges; implicative strategies*

The Context

The majority small and marginal farmers of the country are deprived of quality input supply, credit facilities, financial assistance, crop insurance support, marketing facility etc., mainly due to their poor socio-economic background. Further, lack of awareness towards improved productions technologies and below-par adoption behaviour of these farmers resulted in low productivity, no surplus for processing and value addition, thus, contributing towards less profit from agriculture. As a result, the small and marginal farmers of the country are in distress situation. Amidst such scenario, the concept of Farmers Producers Organizations (FPOs) emerged (Venkattakumar et al, 2011; Venkattakumar and Sontakki, 2012; Venkattakumar et al 2018; Venkattakumar et al 2019 and Venkattakumar et al 2020). The FPOs are the organizations established through collectivizing small and marginal farmers to perform agriculture in a business mode at all stages of agriculture related supply and value chain activities. They are the structures made as hybrid between cooperatives and private limited companies, so that vibrancy

of private limited companies may be brought in, while safeguarding the welfare of producer members. They are the organizations made by the farmers, for the farmers, registered under Companies ACT. There are more than 5000 FPOs being promoted all over the country through various implementing and facilitating development departments. However, only a few FPOs are successful in achieving the main motto of performing agriculture in a business mode for a long run. This fact needs to be prosecuted and the emerging challenges that favour poor performance of FPOs need to be deliberated.

Brief Methodology

A research study was carried out by the Division of Social Sciences and Training, ICAR-Indian Institute of Horticultural Research (IIHR) to document the best practices followed by the FPOs promoted by development departments, research organizations, non-governmental organizations (NGOs) in Karnataka, Tamil Nadu and Telangana in India. Now, to delineate the challenges faced by these FPOs, the opinion of office bearers of FPOs operating in Karnataka such as Puthari Horticulture Framers Producers Company Limited, Kodagu; Palamner Horticulture Framers Producers Company Limited, Palamner; Rajaghatta Horticulture Farmers Producers Company Limited, Rajaghatta; Sadalamma Horticulture Farmers Producers Company Limited, Sadli; Cheluru Horticulture Farmers Producers Company Limited, Cheluru Horticulture Farmers Producers Company Limited, Cheluru and Venugopalaswamy Horticultural Farmers Producers Company Limited, Hosekote were collected through either focus group discussions or through telephonic survey. The general services offered by the FPOs in creating horticulture networks and the emerging challenges faced by them while running the business operations are presented in this paper, based on the previous study and opinion survey through focus group discussion/telephonic survey.

Results and Discussion

Puthari FPO, Kodagu, Karnataka

Puthari Farmers Producers Organization, Kodagu is an FPO functioning in Kodagu district of Karnataka to extend diversified services to the farmer-members from the district. This FPO is being promoted by *Krishi Vigyan Kendra* (KVK), Gonikoppa, Kodagu, Karnataka, which is functioning under the administrative control of ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru. The KVK extends technological backstopping to the FPO for its services to the farmer-members and also provides space for doing business activities in agriculture.

During the lock down period, the supply chain was disrupted and the consumers of Kodagu district were suffering from lack of supply of fruits and vegetables. Understanding this situation, the FPO utilized the already existing tie-up with horticulturists of 8 taluks in Karnataka, who could supply their produces to FPO, procured the produce and supplied to the consumers at the premises of KVK. Based on this experience, KVK gave a regular space for the FPO to operate a Rural Mart. Also, the FPO initiated contract farming of vegetables through farmers who had tie-up during the lock down period. Table 1 gives the details of the additional benefits realized by the farmers by selling their produce through FPO during the lockdown period. Such benefits ranged from Rs.2/kg for chilli and yard long bean to Rs.26/kg for mango. Entering agreement

with farmers for contract farming and establishing an exclusive Rural Mart at KVK were the innovations that emanated from this model.

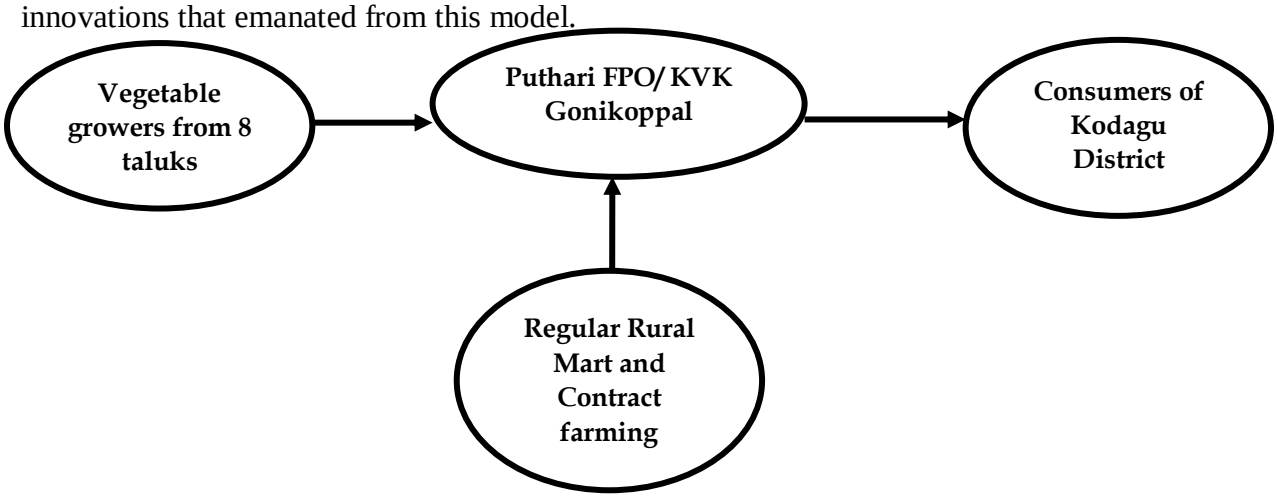


Table 1. Benefits realized by farmers through Puthari FPO model

Crops	Net Price realized*		Additional benefits realized FPO farmers (Rs. /kg)
	Non FPO farmers (Rs. /kg)	FPO farmers (Rs. /kg)	
Grapes	60	80	20
Papaya	3	7	4
Banana	3	9	6
Pineapple	4	12	8
Cabbage	3	7	4
Chilli	5	7	2
Pumpkin	3	9	6
Watermelon	4	9	5
Tomato	5	12	7
Mango	61	87	26
Sweet potato	6	9	3
Elephant foot yam	6	12	6
Yard long bean	25	27	2

* Arrived at after accounting for transportation charges

Palamner Farmers Producers Organization (FPO), Andhra Pradesh

Palamner FPO is serving its producer-members of Palamner taluk of Andhra Pradesh through different kinds of extension services like supply of inputs (seeds, planting material, fertilizers, plant protection chemicals, farm tools and implements) and procurement and marketing of produces etc. The farmer-members (350-400) of this FPO had a tough time to market their produces, especially vegetables during the lock down 1 period of COVID 19 pandemic. The FPO helped these farmers through direct marketing.

Demand for vegetables was identified to supply to three companies situated in Palamner with about 7000 workers. The indent from companies were collected by the FPO and, in turn, informed to vegetable growers. The growers supplied vegetables to FPO. The FPO procured, graded, packed with the brand name of FPO and supplied to the identified companies. Better price than the market price was given to the farmers and with Rs.1/kg profit for the FPO, vegetables were distributed to the companies. Farmers were benefitted by no commission cost. As a result, farmers started diversifying cultivation of new vegetable crops such as green chilli, ladies' finger, ridge gourd, bottle gourd, bitter gourd from instead of growing tomato, cauliflower and cabbage. This happened due to the tie-up with the companies. Every day, around 3 tonnes of vegetables were supplied to the companies. Remaining vegetables were distributed to apartments in Bengaluru and also sold through road side stalls arranged by FPO.

Vegetable growers were also benefitted through the interest free COVID loans arranged by FPO from financial organizations. Further, the FPO was planning to establish primary processing centre and buy air-conditioned vegetable vending vans under Operation Green project of the Government of India (GoI). Table 2 shows the additional benefits realized by farmers by participating in this model, which ranged from Rs. -1/kg for palak and bottle gourd to Rs.9/kg for *Gongura*, a green vegetable. Though, there was observed less price for a couple of crops than the market price, assured buy back and immediate price realization was provided by the FPO. The innovations that can be learnt from this model are sale of vegetables through the brand name of FPO and plans to establish primary processing centre; purchase of AC vegetable vending van through Operations Green project.

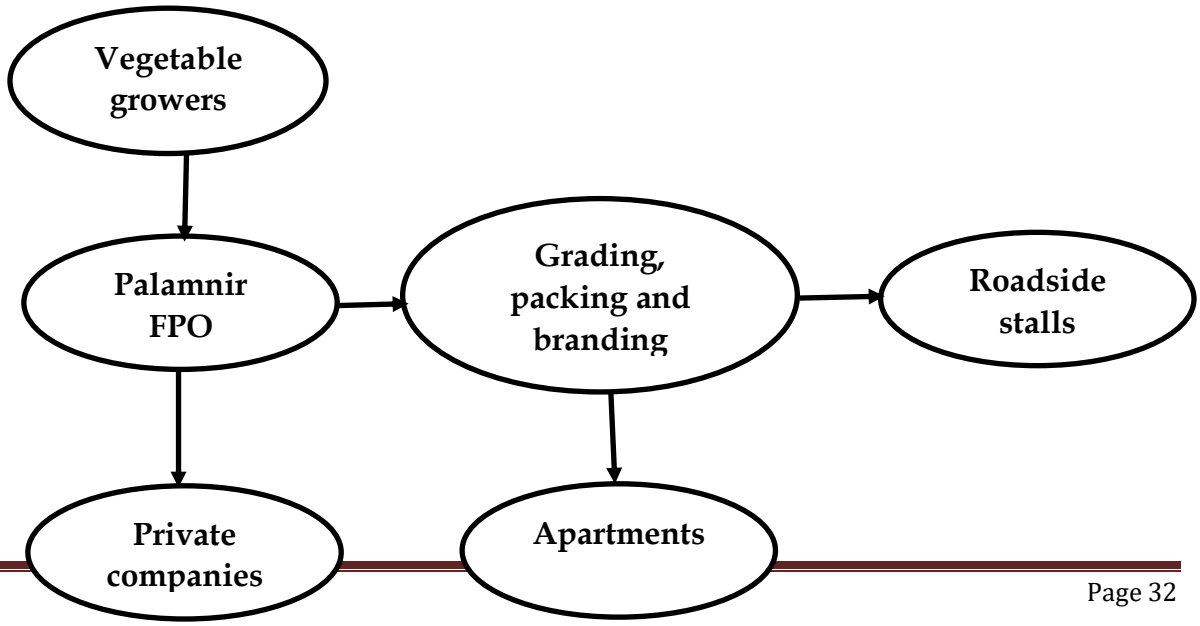


Table 2. Benefits realized by farmers through Palamner FPO model

Crops	Net Price realized*		Additional benefits realized by the FPO farmers (Rs./kg)
	Non FPO farmers (Rs. /kg)	FPO farmers (Rs. /kg)	
Mango	6	12	6
Ridge gourd	12	20	8
Tomato	3	8	5
Cabbage	3	9	6
Gongura (a green vegetable)	18	27	9
Palak	13	12	-1
Bottle gourd	8	7	-1
Raw banana	22	31	9
Chilli	15	22	7
Brinjal	13	15	2

* Arrived at after accounting for transportation charges

Sadalamma Horticultural Farmers Producers Company Limited, Sadli, Karnataka

Majority of the producer-members of Sadalamma Horticulture Farmers Producers Company Limited, Sadali, Karnataka are growers of rose onion. The FPO provides broad-based services to the producer members through input sale on wholesale price, output procurement, custom hiring service, introduction of technologies through research organizations and arranging technology backstopping through research organizations like ICAR-IIHR, DoH Karnataka, KVK and other organizations. They cultivate the variety Arka Bindu released by ICAR-IIHR. The FPO supports the producer - members by procuring the produce. The FPO grades and packs the produce. The FPO has tie-up with a company viz., MP Allium Seepa. The company buys the rose onion from the FPO and does direct exporting of rose onion or distributes to the exporters of the rose onion. Thus, the FPO supports the rose onion grower-members of the FPO through produce procurement at higher sale price, grading packing and providing tie-up with exporters. Similar benefits were realized by the onion growers even during the covid-19 pandemic lockdown period also. The additional benefits realized by the FPO members through the model of FPO was ranging from Rs. 1/ kg for capsicum to Rs. 3/ kg for tomato (Table 3).

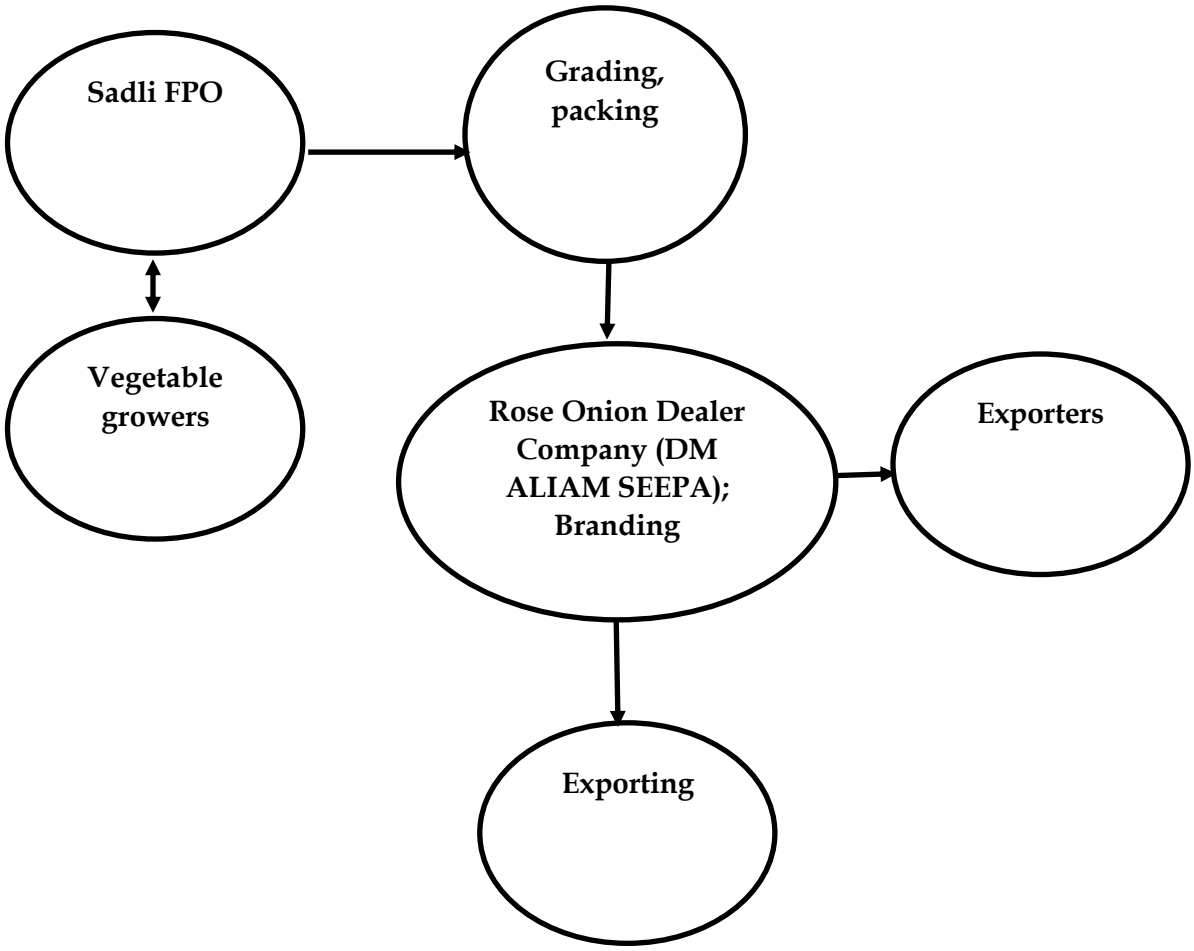


Table 3: Additional benefits realized by the producer members (n=8)

Crops	Net Price realized		Additional benefits realized by the FPO members (Rs./kg)
	Non- FPO farmers (Rs. Kg)	FPO farmers (Rs. Kg)	
Onion	16.75	19	2.25
Capsicum	26	27	1
Potato	22	24	2
Tomato	11	14	3

Rajaghatta Horticultural Farmers Producers Company Limited, Rajaghatta, Karnataka

The Rajaghatta Horticulture Farmers Producers Company Limited, Rajaghatta, Karnataka serves its producer members through supply of inputs needed for agriculture such as fertilizers, pesticides, weedicides, fungicides, organic manures, drip systems, sprayers and mulch materials, etc., at whole sale price through tie-up with various input companies/ dealers; establishing custom hiring center for hiring of agricultural tools, implements and machineries; arranging

technological inputs such as seeds and packing material in association with research institutes like ICAR-IIHR and UAS, Bengaluru and technical backstopping through research institutes; DoH Karnataka and KVKs. This FPO started supporting the member-farmers through output procurement also. This FPO, by having tie-up with companies such as Waycool, Zomato, MORE, Aditya Birla and other local retailers involved in direct purchase of vegetables. Apart from such procurement, through collaboration with KVK, Doddaballapur, Karnataka, this FPO arranges sales of the produce of the producer members at **rural mart** available at the KVK. The KVK in turn supply the vegetables through tie-up with canteens/ food messes available in the district. They also support producer members through having direct tie-up with apartments in Bengaluru for sale of vegetables produced from the producer members. The additional benefit realized by the FPO members was observed to the tune of Rs.25/kg for French beans (Table 4).

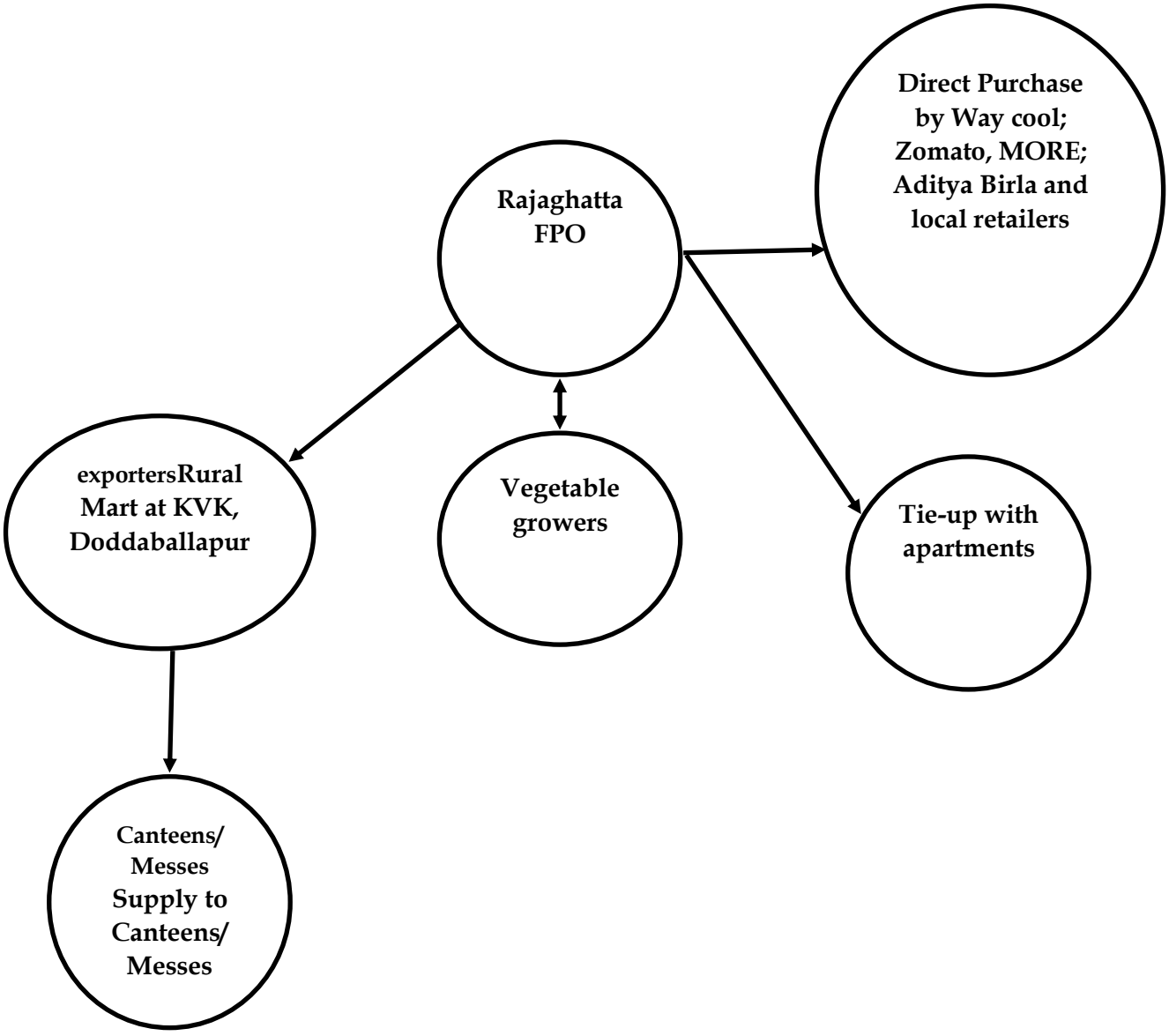


Table 4: Additional benefits realized by the producer members (n=5)

Crops	Net Price realized		Additional benefits realized by the FPO members (Rs./kg)
	Non- FPO farmers (Rs. Kg)	FPO farmers (Rs. Kg)	
Ridge gourd	16	17	1
Brinjal	13	18	5
Tomato	13	17	4
French bean	18	47	29
Carrot	3	2	-1
Beetroot	1	5	4
Cabbage	3	5	2
Dolichos bean	33	37	4
Chilli	33	37	4
Grapes	15.5	37	21.5

Venugopalaswamy Horticultural Farmers Producers Company Limited, Hoskote, Karnataka

Venugopalaswamy Horticultural Farmers Producers Company Limited, Hoskote, Karnataka is supported by the Department of Horticulture, Government of Karnataka. This FPO supports its producer - members through input supply at whole sale price by having tie-up with input companies/ dealers for procurement of fertilizers, chemicals, drip systems, mulch materials, sprayers and other equipments. This FPO also established a custom hiring centre to let hiring of farm tools, implements and machinery at marginal rates. This FPO supports its members, mostly, vegetable growers through output marketing facilitation. This FPO procures vegetables from members, grades and packs. Then, distributes to the retailers such as MORE, Reliance Fresh, Ninja Kart etc., by its own brand name. It also has a tie-up with Waycool Company which in turn enters into contract with producer members of the FPO for contract farming on a procurement price which is mutually agreed. In turn, the company procures, grades, packs and distributes in their own brand name to malls and apartments. Thus, the producer members are getting additional monetary benefits than, the fellow farmers. The additional benefits realized by the FPO members was ranging from Rs. 5/kg for capsicum/cabbage to Rs. 10/kg for tomato/ French beans (Table 5).

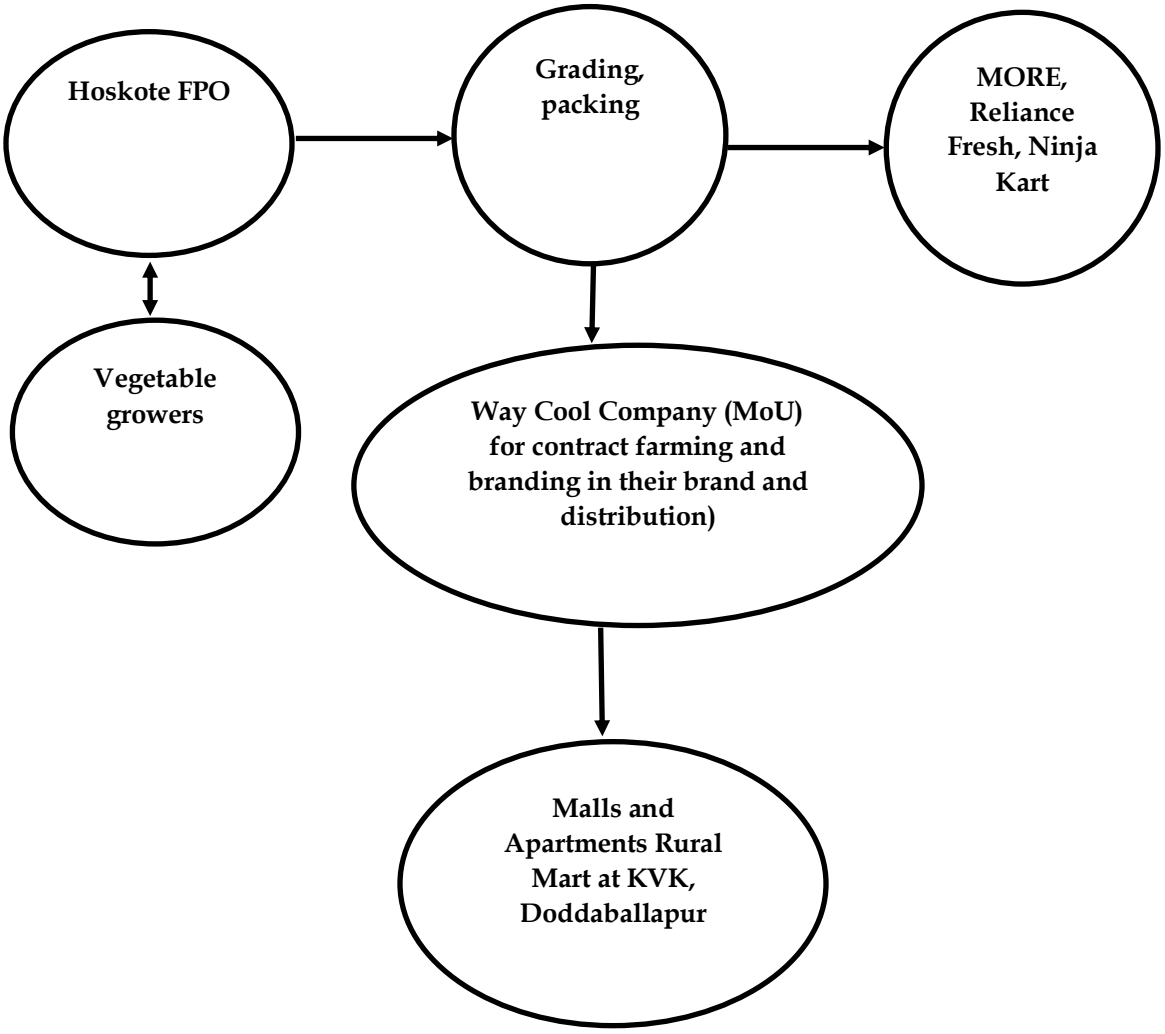


Table 5: Additional benefits realized by the producer members (n=4)

Crops	Net Price realized		Additional benefits realized by the FPO members (Rs./kg)
	Non- FPO farmers (Rs. Kg)	FPO farmers (Rs. Kg)	
Capsicum	23	28	5
Cabbage	5	10	5
French bean	28	38	10
Tomato	8	18	10

Cheluru Horticultural Farmers Producers Company Limited, Cheluru, Karnataka

The Cheluru Horticultural Framers Producers Company Limited, Cheluru, Karnataka is one of the FPOs promoted by Department of Horticulture, Government of Karnataka. Most of the members of this FPO are onion growers. This FPO supports its producer members through various broad-based extension services. Such services include arranging input supply at whole sale price by having tie-up with about three fertilizers company/ dealers; ten pesticides

companies/ dealers and companies that distribute seeds, drip systems and mulching material. The company has established a custom hiring centre with the help of Department of Horticulture, (DoH), Karnataka, through-which involved in hiring business of farm tools, implements and machinery at minimal rates. For output procurement, especially, the onion, the FPO has tie-up with companies and exporters such as DM Allium Seepa and Natural Rhizomes Pvt. Ltd. These retailers/ exporters grade and pack and distribute/ export in their own brand. Here, the onion growers get more procurement price than the market, thus get benefitted through the FPO. The additional benefits realized by the FPO members was ranging from Rs. 2/kg for Chilli to Rs. 10/kg for ridge gourd/ drumstick/ French bean (Table 6).

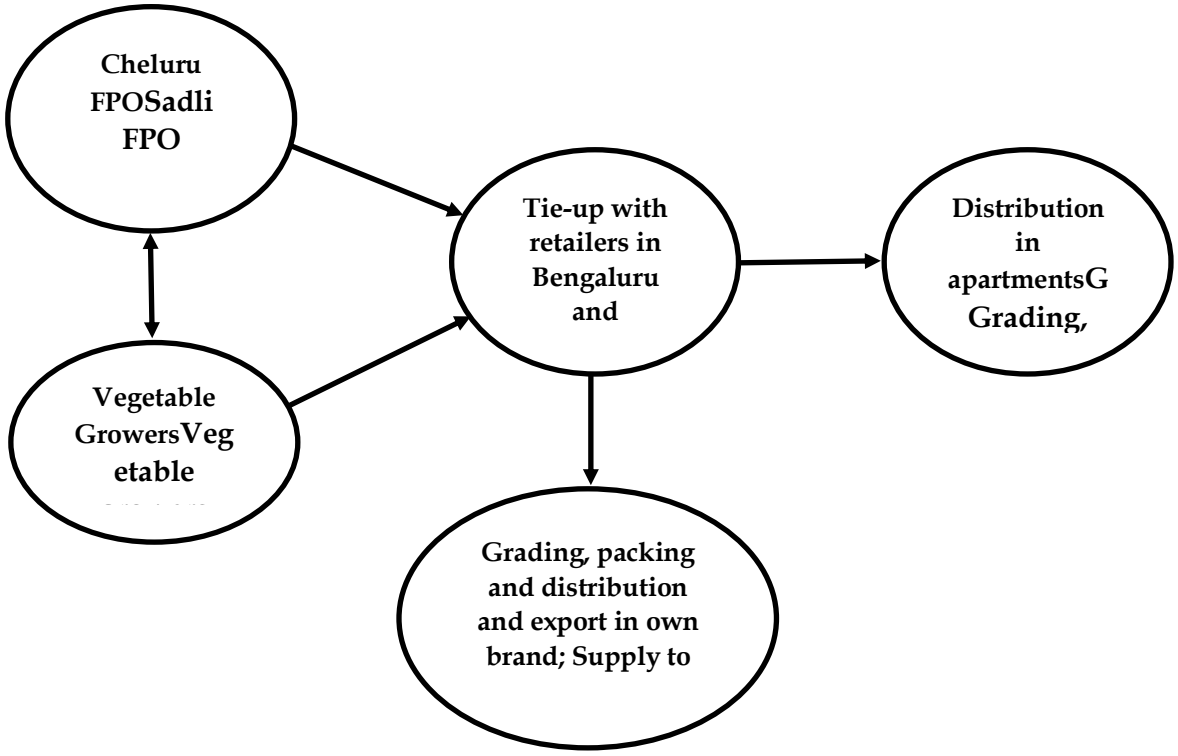


Table 6: Additional benefits realized by the producer members (n=3)

Crops	Net Price realized		Additional benefits realized by the FPO members (Rs./kg)
	Non- FPO farmers (Rs. Kg)	FPO farmers (Rs. Kg)	
Beetroot	8	13	5
Ridge gourd	18	28	10
Drumstick	28	38	10
Chilli	8	10	2
French bean	38	48	10
Bhendi	23	28	5

Emerging challenges and implicative strategies

Challenges	Implicative strategies
Lack of Business Partnership Recognition from Input Companies	Input companies may recognize FPOs as their business partners through their corporate social responsibility activities. The development departments which facilitate FPOs, ought to ensure that the FPOs are recognized as the business partners of input companies on priority basis through certain policy guidelines that bind the input companies.
Burden of Owning Immovable Properties for Establishing Infrastructure	There is a need to relax the requirement of immovable property to be owned by FPOs to have assistance towards infrastructure such as rural marts.
Market tie-up with Retail Operators-Not a Successful Venture	There is a need to create unique brand for marketing products of FPOs located in a same region. The development departments, who facilitate FPOs may think of creating a unique brand and franchise through which, products of FPOs in a particular region can be marketed.
Operational Cost in the Initial Years	Assistance for meeting out operational cost requirements of FPOs may be arranged in the initial years. All the FPOs promoted by various development departments should get such support against no criteria.
Lack of Innovative Marketing Strategies	The development departments and the state governments may come out with specific support programmes, so that FPOs can get adequate financial and license support towards innovative marketing strategies such as establishing road side stalls.
Need for Tax Holiday during the Initial Years	The FPOs may be given tax holiday in the initial years (first five years), by considering the need for meeting the operational costs and establishment cost of various infrastructure.
No Uniform Criteria Across Commodities for Matching Grants	Differential criteria must be fixed towards the limits for small and marginal holdings of plain and hill regions, for uniform provision of equity matching grants to all FPOs.
Lack of Social Engineering to Eliminate Ideology and Socio-economic Clashes	Adequate social engineering towards eliminating ideology and socio-economic clashes among the produce members may be arranged through collaboration with NGOs may be facilitated.
Motivating active participation of office	Provision of honorarium towards the President and Board of Directors positions is strongly recommended, in order to bring-

bearers	in motivation towards active participation of office bearers.
Lack of Experience in Branding and Profit-making Business Process	Business consultants may be appointed for a cluster of FPOs to guide them towards innovative business strategies.
Lack of Adequate Technical Manpower for Facilitating Business Process at Grass-root Level	Providing technical manpower support through NGOs towards agro-advisory and business process promotion at different levels (village, mandal/ taluk. District and FPO levels) may be encouraged.
Lack of Patronage Loyalty towards FPOs	Stringent guidelines should be formulated towards breaking patronage loyalty by producer members, so that the members will be bound to support the FPOs for the benefit of all members of FPOs.
Failure in Arranging Credit Facilities and Crop Insurance	Identification of financial organizations and arranging their collaboration with FPOs should be made on priority basis for extending credit and insurance facilities on cluster basis.

REFERENCES

- Venkattakumar, R., Sudha Mysore., Venugopalan, R., Nita Khandekar., Narayanaswamy, B., Balakrishna, B., Achala Paripurna and Reddy, T.M. (2020). Structural and Functional Interventions needed for Effective Functioning of Farmers' Producers Companies. International Journal of Development Extension. 11 (1): 23-27.
- Venkattakumar, R., Sudha Mysore, Venugopalan, R., Balakrishna, B., Narayanaswamy, B., Atheequlla, G.A., Achala Paripurna and Reddy, T.M. (2019). Performance of Farmers Producers Organizations (FPOs) and Associated Factors in Karnataka: Producers' Perspectives. Indian Research Journal of Extension Education. 19 (2&3): 7-12.
- Venkattakumar, R. and Sudha Mysore. (2018). Need for a Vibrant Promoter for Enhancing the Performance of Farmers Producer Company (FPC): A Case Study of an FPC from Medak District, Telangana. Journal of Community Mobilization and Sustainable Development. 13 (3): 600-605; Print ISSN: 2230-4047; Online ISSN:2231-6736.
- Venkattakumar, R., Sudha Mysore., Venugopalan, R., Nita Khandekar., Narayanaswamy, B., Balakrishna, B. (2017). Farmers Producers Company and Broad-based Extension Services: A Case of Ayakudi Guava Producers in Dindigul District of Tamil Nadu. Indian Res. J. Ext. Edu. 17 (3), July, 2017.
- Venkattakumar, R. and Sontakki, B.S. (2012). Producer Companies in India-Experiences and Implications. Indian Research Journal of Extension Education. Special Issue (1): 154-160. January 2012.
- Venkattakumar, R. Sontakki, B.S., Rasheed Sulaiman and Sriram, N. (2011). Success Stories on Producer Company Model in Andhra Pradesh. Journal of Extension Education. 23 (3): 4658-4662.

Chapter: 4

Role of Value chain opportunities in horticulture for women

R.B Tiwari

ICAR-Indian Institute of Horticultural Research
E-mail: rb.tiwari@icar.gov.in

Introduction

Fruit and vegetables keep us healthy and add variety, taste and texture to our diets. In human nutrition, fruits and vegetables play an important role towards making of a balanced diet and prevention of several chronic diseases. The World Health Organization (WHO) recommends consuming at least 400 g each day to reap their health and nutrition benefits. Fruits and vegetables provide 90% of the vitamin C and 60% vitamin A in the world. Fruits are a natural source of energy, vitamins, minerals, and dietary fiber. They provide essential vitamins, minerals, as well as various phytochemicals that confer significant health benefits other than basic nutrition. Further, healthy eating has become one of the most important factors in food choice among governments and cultured consumers. They were conscious that more frequent consumption of fruit and vegetables should be a part of a healthy diet (Margetts et al., 1997).

Fruit and vegetables are grown by small-scale producers around the world, either for their own use or for sale. Fruit and vegetable production is central to the livelihoods of many small-scale farmers. High levels of food loss and waste result from poor handling and the perishability of fresh produce. Ensuring that fruit and vegetables contribute more to nutrition and health requires more comprehensive and holistic approaches. **The supply of fresh produce must be made more efficient, inclusive and resilient.** The diverse range and characteristics of fresh fruit and vegetables and their inherently perishable nature warrants specific attention to their conditions of production, agronomic management, pest and disease control, harvesting techniques and postharvest handling systems. Transforming the fruit and vegetable sector requires a holistic and comprehensive approach that looks at the interconnectivity between demand, supply, socio-economic development and fruit and vegetable prices – a major determinant of consumer behaviour. Factors to consider toward delivering on better nutrition while also creating a better environment, better production and better livelihoods include facilitating access by small-scale producers and agricultural enterprises to viable markets, assuring the safety and quality of fruit and vegetables along supply chains, applying innovation, reducing loss and waste, and reducing the energy intensity and ecological footprint of supply chains (FAO, 2021, https://www.fao.org/3/cb2395en/cb2395en.pdf).

The Food processing Industry is pressurized to improve the quality and pace of its innovation processes. These all can be tackled by entrepreneurship in food processing (Negi, 2013). Traditionally fruits and vegetables are processed by various techniques into jam, ketchup, puree, pulp, juice, beverages and dehydrated products. The aim is that people should have access to a broad choice of technologies that are competitive and comply with food safety and quality standards which can be suitable employed for entrepreneurship developmental activities.

Diversified range of non-traditional products such as dehydrated slices/ fruit bar/ powder, vacuum fried, fortified, de hydro frozen, or ready-to- eat, ready to use, nutrient- dense diet are some of the new development in processed food sector. A detailed account of processes / technologies involved in development of novel kind of fruit and vegetables has been presented.

https://www.fao.org/3/cb2395en/online/src/html/fruit-and-vegetables.html

Women Employment and work conditions in horticulture value chain:

Policymakers are increasingly looking to high-value food chains, such as fruit and vegetable value chains, to create off-farm employment In normal farming or agriculture sector women work as uneducated and unskilled labourer. Women are more likely to be concentrated in

precarious jobs characterized by unequal remuneration, poor working conditions, no social security. In agricultural supply chains, women are often affected by multiple forms of gender discrimination including limited ownership and control over land and natural resources, barriers to financial services.

In contrast, horticulture and food processing and marketing, including quality assurance adopt a very dynamic and technology oriented approach to deal with the challenges associated with these high value commodities and can offer more satisfying and good employment opportunities to women and youth with having several types of qualification such as engineering, management, quality and safety expert to even highly educated and skilled human force. There is tremendous scope of employment to address problems in relation to production, quality, safety, traceability, handling, processing, packaging, storage and marketing of fruits, vegetables and their products. Agricultural enterprises demands highly skilled work force to support assurance of the safety and quality of fruit and vegetables along supply chains, to apply innovation, reduce loss and waste, and reduce the energy intensity and ecological footprint of supply chains.

Fresh fruits and vegetables value chain/ supply chain:

Horticulture value chains: Horticulture value chains are facing growing consumer expectations for variety, food safety and security. Most horticulture supply chains operate in a push based approach rather than demand driven or pull based, which leads to a mismatch between demand expectations and supply side capabilities. Emerging market challenges are more related to:

- Supply shortage,
- Lack of product variety,
- Safety and quality of the produce

FOOD LOSS: is an "unintended result of agricultural processes or technical limitations in storage, infrastructure, packaging, and marketing" (Johnson et al. 2019). With fresh fruit and vegetable crops, food is lost in the field due to economic reasons or weather constraints.

FOOD WASTE: It's lost elsewhere in the supply chain because of culling, slicing, dicing, and chopping during processing and reaching the expiration date while still on grocery shelves

Technologies: Technology and innovation are required at all stages in the fruit and vegetable supply chain, from production to consumption, to improve both quality and output. Improvements can range from simple farm-level technologies and practices to more sophisticated digital innovations that help assure the safety and quality of fresh produce as it moves along the supply chain. Innovative approaches such as public–private partnerships can help generate growth and development in the sector.

Supply chain of perishable food products or fresh fruits and vegetables constitute the processes from production to delivery of the agri-fresh produce (farmer to customer). The supply chain of fresh fruits and vegetables is complex compared to other supply chains due to the perishable nature of the produce, high fluctuations in demand and prices, increasing consumer concerns for safety and quality and dependence on climate conditions. The supply chain involves different people such as farmers /producers /importers, local traders/ wholesalers/

commission agents, transporters, processors, retailers, exporters etc. The fruit and vegetables reach the consumer through a chain of intermediaries who carry out different functions such as transfer of ownership of commodities, movement, maintenance or preservation of quality and quantity, payments and delivery to consumer. All these links or intermediaries constitute the supply chain of the fruits and vegetables. There are enormous opportunities for skilling, training and capacity building of the women and youth for horticulture and agro-processing related business opportunities in supply chain management of fruits, vegetables and their products

Being perishable in nature, quality of fruits and vegetables deteriorates after harvest wich requires to be addressed during the entire supply chain. The issue of quality and safety is very important but variable with respect to various actor in the chain.

Food quality describes the attributes of a food that influence its value and that make it acceptable or desirable for the consumer. The ideal of food quality therefore differs across countries and cultures.

Food safety is the assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use (CXC, 1969).

Unlike food quality, food safety is non-negotiable.

Value addition

Value addition for fresh fruit and vegetables includes sorting, grading, packaging, transport, wholesaling and retailing, as well as processing activities. It is done by enterprises of various sizes, from micro to large. Even traditional retail sector, which includes local wet markets and roadside stalls, is still central for fruit and vegetable retail and food security many countries. In addition, these mid-stream **agri-food enterprises** also create the biggest market opportunities for farmers domestically.

Access to finance is a longstanding problem for women as well as small farmers and agrifood enterprises. The lack of reliable, affordable finance inhibits innovation, growth and employment generation, and constrains the agri-food sector's capacity to reduce poverty.

However, several **Government schemes are addressing this issue.**

Infrastructure and utilities such as cold chains, appropriate storage and processing technologies, reliable energy and clean water supplies are often inadequate. Governments can support the sector by providing institutional frameworks for public– private collaboration, investing in infrastructure such as storage facilities and laboratories, stimulating linkages with research to generate innovations in postharvest operations (e.g., packaging and cold chains), encouraging finance for the sector, and building the competence of producers and managers

Box 7. Quality attributes based on consumer perceptions

Search attributes

Can be checked directly before purchase.

- Colour, size, firmness, blemishes

Experience attributes

Evident only after purchase, but influence whether someone buys the same produce item again.

- Taste, texture, cooking quality

Credence attributes

Cannot be assessed before or after purchase; depend on credibility of supplier. Often given on labels.

- (Sometimes) food safety
- Organic, fair trade, local origin, pesticide residues

Adapted from Rezare Systems (2020)

Further Stakeholders along the value chain emphasize different aspects of quality

Producers value factors such as yield, resistance to pests and diseases, and ease of harvesting.

Wholesalers and retailers place a premium on size, form, colour and safety. They often require the produce to comply with in-house or industry standards.

Consumers are more interested in the visual appearance, texture, firmness, sensory and nutritional properties.

Factors affecting quality: Fruit and vegetable quality is influenced by extrinsic and intrinsic factors.

Extrinsic factors include the production environment, how the produce is handled during harvest and at various stages of the supply chain, and how it is packaged and presented for sale to consumers.

Intrinsic factors relate to the food itself: its visual appearance (size, form, and colour), texture, firmness, sensory and nutritional properties, and food safety. All these attributes are of interest and value to consumers. The best type of handling and packaging depends on the type of produce. Bananas, for example, should be kept at a temperature of 12–15°C. Cauliflower needs cooler temperatures (0–5°C).

Importance of fruit & vegetable value chain/ supply chain

Gender and youth: Women produce much of the world's fresh produce, and they are often responsible for the harvesting, marketing and processing. As consumers, they often choose what items to buy and how to cook them. They are required to be supported as consumers in terms of education about food and nutrition including minimizing food losses and waste. The high value of fruit and vegetables and the potential for innovation open exciting opportunities for young people to become involved in production and other aspects of the value chain.

Fresh fruits and vegetable value chain:

Fresh fruits & vegetable quality, quality production- However, they may also require more labour than for many other types of food. This offers opportunities for actors throughout the chain to generate employment and income.**,** Harvesting, precooling Handling, grading, packaging, storage, transportation, marketing & consumption.

Issue of food losses and food waste:

Traceability of F&V value chain: Traceability The ability to follow the movement of a food through specified stages of production, processing and distribution.

Innovations in traceability: Traceability is a must-have in fruit and vegetable supply chains to mitigate and manage risks associated with food safety recalls. New traceability practices that use digital technology help ensure food safety and quality, optimize supply chains and reduce loss. Block chain is an increasingly popular method of traceability because it connects all the stakeholders' digital records and events in a tamper-resistant format. The information can be accessed at any point from anywhere, yet it cannot be edited or deleted.

Implementation of common traceability tools used for fruits and vegetables (F&Vs), as well as the latest developments and advances in digital innovations and other emerging technologies. F&Vs are an essential part of a healthy diet, but the quality of fresh produce deteriorates rapidly after the harvest. Moreover, the complex supply chain of these foodstuffs makes it difficult to trace them reliably from farm to fork. In the horticulture industry, fraud and adulteration practices could occur at any stage of food production, processing, or shipping, resulting in not only a lower quality, but more importantly a potential risk to food safety and authenticity, hence the importance of implementing an effective traceability system.

Developing entrepreneurs in agriculture can immensely benefit Indian economy by

- ✓ Reducing the burden on agriculture
- ✓ Generating employment opportunities for rural youth
- ✓ Reducing the need for migration from rural to urban areas, thereby reducing pressure on urban cities etc.
- ✓ Increasing individual and national income
- ✓ Food Processing Sectors where entrepreneurship can help the agribusiness

Enterpreunership in processing and value addition of fruits & vegetables:

Entrepreneurship and Food processing sector

Various processing technologies: processed forms of fruit and vegetables are important for farmers' livelihoods and incomes, trade, food security and nutrition. Some varieties are grown specifically to be sold as fresh produce; others are destined from the start for the processing plant. Still others may go either way: they are sorted and graded before sale: the best items are sold fresh (which typically fetches the highest prices), while the rest goes for processing. Growth of Food processing sector will lead to employment opportunities, raising agricultural yields, increased productivity, and enhance the standard of living of the people across the country, especially those who are in rural areas. India is the second largest producer of food after china in the world and has the potential to become a leader. The processed food and ready to eat packaged food is a new and evolving sector which needs emphasis and focus of entrepreneurship. It plays a vital role in diversification and commercialization, ensures value addition, enhance shelf life of the of agri produce, creates market for export of processed food, generates employment, enhance the income of farmers and overall development of the rural areas. There are many opportunities for entrepreneurship in food processing.

Food processing sector has the potential to be a major driver in the growth of India as well as Entrepreneurship in coming years. Without growing number of entrepreneurs and entrepreneurship, an economy is certain to become sluggish in growth. Entrepreneurship plays a very vital role in the growth of rural areas as well as an economy of the whole country. If economic growth is the effect, entrepreneurship is the cause. India has access to several natural resources and provides a competitive advantage to food processing sector. Some the drivers for improved food processing activities are Increasing consumers spend on ready-to-eat item and processed food as well as various Government support.

Food Processing Systems

Major aims of food processing:

- Extend the shelf-life of food and serve as the surge capacity in nature's seasonal cycle. (Supply-Demand)
- Enhance the acceptability (flavor, color, texture) and safety of food. (Tasty and safe)
- Provide nutritious foods enhancing good health, strengthening bodies and empowering mind. (*Healthful diet*)

- Help build communities and generate income for the farmers and manufacturers. (*Business*)

Processing: Processing of perishable has been a prime protector of food. The vegetables are processed into more stable products, that can be stored for extended period of time by canning, drying, freezing or through chemical preservation. Actually processing includes all the steps begins after harvest and ends before consumption of food. Normally handling, transportation, reception, temporary storage, washing, sorting, skin removal/peeling, size reduction i.e., dicing/slicing, blanching followed by either canning, freezing or drying.

Blanching - exposing vegetable to hot (>85^{o}C) or boiling water - as a pre-treatment followed by cooling. It is a must step before drying or freezing of vegetables to inactivate peroxidase enzymes. It helps clean the material and reduce the amount of micro-organisms present on the surface; preserves the natural colour in the dried products; it shortens the soaking and/or cooking time during reconstitution.

Dehydration: Drying or dehydration is an age old technology. The removal of moisture prevents the growth and reproduction of micro-organisms causing decay and minimizes many of the moisture mediated deterioration reactions. Drying brings about substantial reduction in weight and volume minimizing packing, storage and transportation costs and enables storability of the product under ambient temperatures, features especially important for developing countries. As per requirements prepared fruits and vegetables are given different pre-treatments followed by drying using cross-flow air drier at temperature range of 55-60°C. Different dehydration method are sun drying, solar drying, cabinet drying, vacuum drying, drum drying, spray drying, osmotic dehydration and freeze drying.

As per requirements prepared, vegetables are given different pre-treatments before they are subjected for dehydration. Vegetables are dried using cross-flow air drier at temperature range of 55-60°C. Examples of dehydrated products are dried onion flakes/onion powder, dried carrot slices, dried bean, cauliflower and dehydrated mushroom.

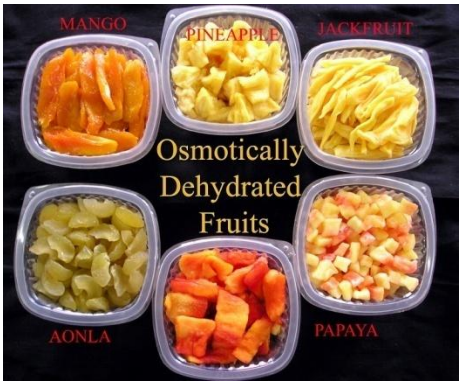
Dried fruits:

Dried fruits, which serve as important healthful snacks worldwide, provide a concentrated form of fresh fruits. They are nutritionally equivalent to fresh fruits in smaller serving sizes, ranging from 30 to 43 g depending on the fruit, in current dietary recommendation in different countries. Fresh fruits are processed by various techniques to become dried fruits to prolong their shelf life. Dried fruits are a concentrated form of fresh fruits, albeit with lower moisture content than that of their fresh counterparts since a large proportion of their moisture content has been removed through sun-drying or various modern drying techniques, such as mechanical devices, solar drying, vacuum drying, spray drying etc. Fruits can be dried whole (e.g., grapes, berries, apricots, and plums), in halves, or as slices (e.g., mangoes, papayas, and kiwis). Dried fruits are important healthy snacks worldwide. They also have the advantage of being easy to store and distribute, available throughout the year, and healthier alternative to salty or sugary snacks. Apples, apricots, dates, figs, peaches, pears, prunes, and raisins are referred to as ‘'conventional’'

or ‘’traditional'' dried fruits. Meanwhile, some fruits, such as blueberries, cranberries, cherries, strawberries, and mangoes are usually infused with sugar solutions or fruit juice concentrate before drying the process is popularly known as osmotic dehydration through which various products have been standerdised as well as reported (Tiwari, 2005) in fruit like guava (Anitha et al. 2014) banana (Thippanna and Tiwari, 2015), aonla (Sumitha at al. 2015) as well as vegetables such as carrot(Selvakumar and Tiwari, 2018ab)

Osmotically dehydrated fruits and vegetable Products:

Demand for healthy, natural and tasty processed fruits is continuously increasing not only for finished product but also for ingredients to be included in complex foods such as ice creams, cereals, dairy, confectionary and bakery products. Osmo-air dried fruits are the dehydrated fruit products based on the novel approach towards dehydration. By using osmotic dehydration process, at ICAR-IIHR, Bangalore different fruits such as mango, pineapple, papaya, banana, *aonla*, jackfruit, guava, sapota and vegetables viz. carrot, pumpkin, beetroot, muskmelon has been successfully dehydrated in to shelf stable slices which can be stored at room temperature for one year. The quality of osmotically dehydrated product is near to the fresh fruit in terms of colour, flavour and texture. It can be consumed as a snack. Such product can be used in ready to eat type of foods, ice creams, fruit salad, kheer, cakes, bakery products etc.



Osmotic dehydration process: Osmotic dehydration has received greater attention in recent years as intermediate step in drying of several fruits and vegetables. Being a simple process, it has potential advantages for the processing industry for dehydration of tropical fruits with longer shelf-life. Osmotic dehydration process involves water –rich solid products being soaked in concentrated aqueous solutions (mainly sugar or salt solutions) which creates three types of counter current mass transfer:

- an important water out flow from product to solution;
- a solute transfer, from the solution to the product; it is thus possible to introduce the desired amount of an active principal, a preservative agent, any solute of nutritional interest, or a sensory quality improvement in the product;
- a leaching out of the product’s own solutes (sugars, organic acids, minerals, vitamins etc.) in negligible quantity affecting composition of the final product.

Therefore, compared to single drying process, osmotic dehydration achieves a twofold transformation of the food items, by both a decrease in water content and a solute incorporation which may result in a subsequent weight reduction. Solute uptake during osmotic dehydration modifies the composition and taste of the final product. In many cases, however, extensive solute uptake is undesirable, because of its negative impact on the taste and nutritional profile of the product. Leaching of natural acids out of osmotically dehydrated fruit also affects the taste due to change in sugar acid ratio. Further partial dehydration and solute uptake protect fruit slices against structural collapse during terminal drying.

The process is simple and involves operations like selection of fruits, cleaning, washing, peeling, curing and slicing/dicing. The prepared fruit slices are soaked in sugar solution to remove water by osmotic pressures. Then the slices are drained and dried in hot air drier. The dried fruit is packed in flexible pouches.

Advantages of Osmotic dehydration: Though many advantages have been attributed for osmotic dehydration, important ones are as follows:

1. Minimum lose of colour and flavour.
2. Flavour retention is more when sugar or sugar syrup is used as an osmotic agent.
3. Enzymatic and oxidative browning is presented.
4. Sweetening of the product.
5. Reduces the water removal lead at the dryer
6. Increases the solid density of the product, which can be subsequently freeze dried.
7. Textural quality will be better After seen situation.
8. Simple facility and equipments are required
9. Energy consumption is very less.
10. The process is less expensive.

Fruit Bar:

Fruits serve as a source of energy, vitamins, minerals, and dietary fiber. One of the barriers in increasing fruit and vegetables consumption is time required to prepare them and the high perishability. Processing these high value food into fruit bars or fruit leather can be a good, convenient and better alternative. Fruit bar is the product prepared by blending fruit purees or pulp extracted from ripe pulpy fruit, sugar or other nutritive sweeteners and other ingredients and additives desired for product and dehydrated to form sheet which can be cut to desired shape and size. Fruit bars can also be nutritionally improved through fortification such as concentrated protein sources to improve its food value. Further, fruit bars can also act as suitable matrix for incorporation of prebiotics as well as probiotics. Sugar is an important ingredient in traditional fruit bar preparation. There is possibilities of use of alternate sweeteners and other sugar substitutes for preparation of fruit bar to meet the increasing demands of low calorie snack food. There is also great potential for use of solar energy as well as alternate drying techniques for popularization of fruit bar processing in rural areas (Tiwari, 2019, Singh et al.2020). As mentioned before, mango fruit bar is traditionally prepared by adding cane sugar to ripe mango puree, spreading the puree on bamboo mats and drying the pulp in the sun (Gujral and Brar, 2003). At ICAR- IIHR Bangalore technologies for making different types of fruit bar such as mango bar, papaya bar, guava bar and their blend have been developed (Singh and Tiwari, 2019 and Tiwari, 2019) as well as commercialized. An alternate way of using raw mango fruit for bar making has also been developed using combined processing technology. Singh and Tiwari, 2019 reported that,

blended guava-papaya (40:60) leather was found best among other treatments in terms of quality and acceptability. It had a good yield of 26.78 % with 15.75 % moisture content and 0.59 water acidity which promises a good storability and safety. It was highly acceptable with maximum sensory acceptability in terms of colour, flavor and texture (total 80.78 out of 100) with acidity 1.22 %, reducing sugar 39.44 %, non-reducing sugar 29.41 % and total sugar 68.85 %. It improved the nutritional value with 137.3 mg per 100g ascorbic acid and 1367.3 µg carotenoids per 100 g of prepared leather.

Fruit bar preparations commercial method for the manufacture of bar making involves fruit pulp mixed with sugar paste to form sheets that are dehydrated in a tray dryer (50–60◦C, 18—24 h) thereby obtaining a food microbiological attributes, color, and flavor acceptable (

Conclusion:

It is very clear that there are various technologies and concept available for value addition of fruits and vegetables such as dehydration and osmotic dehydration, fruit bar , vacuum frying etc which can play a very significant role for entrepreneurship development specially for small and medium-sized enterprises which may not be able to afford inhouse R & D and this may also open an avenue for various food and agri based institutions to harness their potential of the scientific and research capabilities resulting in an improved business environment in food processing sector. Improved food processing activities will result in more and more availability of convenient F&V products resulting in increased consumption of fruits and vegetables is one of the essential nutritional recommendations to prevent Non Communicable Diseases. (NCDs)s. In order to develop convenient options of fruits and vegetables with enhanced functional attributed a diversified range of non-traditional products such as dehydrated slices/ fruit bar/ powder, vacuum fried, fortified, dehydrofrozen, or ready-to- eat, ready to use, nutrient- dense diet are some of the new development in processed food sector. By using osmotic dehydration process, at ICAR-IIHR, Bangalore different fruits such as mango, pineapple, papaya, jackfruit, guava aonla etc has been successfully, developed and commercialized. Osmotically dehydrated fruit and vegetable slices and fruit bars are highly nutritious and suitable for using as snacks. Besides this, process for dehydration of other vegetables viz. onion, carrot, cauliflower, French bean, okra, pumpkin mushroom has also been developed. Dehydrated vegetables can be used in place of fresh vegetables in off season and also for making vegetable soup etc.

References:

- Anitha P, Tiwari R.B. and Singh A.K. (2014) Effect of different osmotic pretreatments on sensory quality of osmotically dehydrated guava slices. HortFlora Research Spectrum, 3(1): 21-28.
- Jacob JK and Paliyath G (2012) Infusion of fruits with nutraceuticals and health regulatory components for enhanced functionality Food Research International 45 (2012) 93–102**.**
- Singh, J.L. and Tiwari, R.B. 2019. Development of Nutritious Fruit Leather by Blending Guava and Papaya. Int.J.Curr.Microbiol.App.Sci. 8(07): 813-820. doi: https://doi.org/10.20546/ijcmas.2019.807.098.
- Singh, J.L., R.B. Tiwari and Ranjitha, K. 2019. Storage Stability of Guava Leather in Two Type of Packaging. Int. J.Curr.Microbiol.App.Sci. 8(07): 2465-2472. doi: https://doi.org/10.20546/ijcmas.2019.807.303**.**
- Singh, J L., R. B. Tiwari and K. Ranjitha (2020) Studies on Effect of Different Packaging Materials on Shelf-Life of Blended Guava-Papaya Fruit Leather European Journal of Nutrition & Food Safety 12(8): 22-32.
- Negi, S. (2013). Food Processing Entrepreneurship for Rural Development: Drivers and Challenges. In IIM, SUSCON III *Third International Conference on Sustainability: Ecology, Economy & Ethics* (pp. 186-197). New Delhi: Tata McGraw Hill Education, ISBN-13978-1-25-905869-1.
- Selvakumar, R and Tiwari, RB (2018) Effect of Osmotic Treatments on Weight Reduction, Water Loss,Solid Gain, Moisture, Total Solids, Yield and Drying ratio of Carrot (Daucus carota L.) slices Chem Sci Rev Lett 2018, 7(28), 959-965
- Selvakumar, R and Tiwari, RB (2018) Physico-chemical changes in osmotically dehydrated carrot slices during storage. International Journal of Chemical Studies, 6(5):1685-90**.**
- Sumitha N, Tiwari RB, Patil RA (2015) Suitability of packaging and storage conditions for Osmo-air dried aonla segments. Proceedings of National Academy of Science, India, Section B. Biological Sciences, 85: 203-209 (NAAS id: P134, IF: 6.00)**.**
- Thippanna, KS and Tiwari, RB (2015) Quality changes in osmotically dehydrated banana var. 'Robusta' and 'Ney Poovan' as affected by syrup concentration and immersion time J. Food Sci & Technol, 51(1):399:406**.**
- Tiwari, R.B. (2005).Application of osmo-air dehydration for processing of tropical fruits in rural areas. Indian Food Industry 24(6):62-69.
- Tiwari, RB (2019). Advances in Technology for Production of Fruit Bar: A Review. Pantnagar Journal of Research, 17(1): 11-18.

Chapter: 5

Creating Business opportunities for women entrepreneurship

V.K. Jayaraghavendra Rao

ICAR-Indian Institute of Horticultural Research
Hesaraghatta, Bengaluru -560089

Introduction:

Women entrepreneurship has been getting growing recognition over the past two decades across the world. Women entrepreneurs not only generate new jobs for themselves but also for others. They provide society with different solutions to management, organisation and business problems. Women owned businesses are playing a pivotal role in the upsurge of entrepreneurial activity in the United States. It is reported that the highest number of self-employed women are in Sweden followed by England, France and USA. In general, women are attracted to retail trade, restaurants, hotels, education, insurance and manufacturing. In our country, women constitute only 5.2 per cent of the total self-employed persons in India. Majority of them opted for agriculture, agro based industries, handicrafts, handlooms, cottage industries but in 2011 (2011 census) it has improved to 25 percent.

Women entrepreneurship is gaining importance in India in the wake of economic liberalisation and globalisation. The policy and institutional framework for nurturing entrepreneurial skills, imparting vocation education and training has widened the horizon for economic empowerment of the women. However, women constitute one third of the economic enterprise. There are scores of successful women entrepreneurs both in economic and social fields in India.

Thus, a stage has been already set for social take-off of women from a low development path to an accelerated pace in achieving higher level of self-sustaining economic growth in the wake of new economic policy 1991.

Definition

According to Schumpeter's concept, "Women who innovate, imitate or adopt a business activity are known as women entrepreneurs".

Government of India based on women participation in equity and employment of business enterprise has defined women entrepreneurs as "An enterprise owned and controlled by a women having a minimum financial interest of 51% of the capital and giving at least 51% of the employment generated in the enterprise to women"

(i) Opportunities Based on Business

Women entrepreneurs are bestowed with numerous business opportunities depending upon their area, choice of industry, capacity to invest, technical and non-technical skills etc.,

When a woman decides to become an entrepreneur she has extensive opportunities to tap into. The following are the opportunities unfolding in different spheres of commerce.

i. In the sphere of manufacturing women can start ventures like Agarbathi manufacturing, papad making, bedspread making, embroidery, export of handicrafts, apparel manufacturing, sweet stalls, manufacturing soft drinks, pickle making , manufacturing garments, handicrafts, printing press etc.

ii. In the sphere of service industries, women entrepreneurs may try their hand in ventures like catering service, computer centres, tutorial centres, Typewriting institutes, beauty parlours, dry cleaning, small restaurants, tailoring, crèche, florist shops, event management etc.,
iii. In the realm of trading ventures, women can enter the ventures like fancy stores, diagnostic centres, milk distribution, sweet stalls, drug stores, grocery stores, textile retailing, cool drinks parlour, coffee parlour, cell phone repairs, photo studios, photocopier firms, working women's hostel etc.,
iv. Highly educated, experienced and broadly exposed women technocrats can start larger venture like running hospitals, coaching centres, diagnostic laboratories, manufacturing activities, suited to their field of specialisation, advertisement and media firms, call centres, hotels etc.,

(ii) Financial Opportunities

All Banks in India provide financial support to the women Entrepreneur, in the form of micro small loans to buy Raw Materials and Equipment.

(iii) Non-Financial support

Women entrepreneurs are provided with the following non-financial support in the form of:
i. Putting in Policies, regulations and legal structures suitable to women entrepreneurs
ii. Financial counselling and training
iii. Business advisory service
iv. Handling legal barriers
v. Establishing Commercial linkages
vi. Client research
vii. Profitability and Efficiency analysis
viii. Offering and designing the products based on their needs
ix. Lower rate of interest
x. Collateral free loans
xi. Simplified processing system
xii. Flexible repayment system based on business nature

Opportunities for Women Entrepreneurs

(iv) Opportunities Created by Associations

There are various associations like Self Help Groups (SHG), Federation of Indian Women Entrepreneurs (FIWE), Women's India Trust (WIT), Small Industries Development organisation (SIDO), National Bank for Agriculture and Rural Development(NABARD), Self Employed Women's Association (SEWA), Association of Women Entrepreneurs of Karnataka (AWAKE), The International Centre for Entrepreneurship and Career Development, TiEStree Shakti (TSS), Tamilnadu Corporation for Development of Women Ltd. (TNCDW), Marketing Organisation of Women Enterprises (MOOWES), Women Entrepreneurs Promotion Association (WEPA), Women Entrepreneurs Association of Tamil Nadu (WEAT)andWeoW by Google are aggressively promoting women entrepreneurship in India.

Similarly, MSE cluster development programme bear a substantial portion of the project cost in respect of ventures owned and managed by women entrepreneurs. The percentage of guarantee given by Credit Guarantee Fund Scheme for Micro and Small Enterprises extend up to 80% for MSEs owned and operated by women.

(v) Opportunities Created by Government

Government both Union and Central have put in a number of schemes exclusively for promotion of women entrepreneurship namely:

i. Stand-Up India Scheme for Women Entrepreneurs
ii. Trade related Entrepreneurship Assistance and Development (TREAD) Scheme for Women
iii. Mahila Coir Yojana
iv. Mahila E-haat
v. Magalir Udavi Scheme
vi. Prime Minister's RozgarYojana (PMRY)
vii. Development of Women and Children in Rural India (DWCRA)
viii. Mudra Yojana Scheme for Women
ix. Udyogini Scheme
x. TRYCEM

(vi) Opportunities Created through Training Programme

Government of India has introduced National Skill Development Policy and National Skill Development Mission in 2009 in order to provide skill training, vocational education and entrepreneurship development to the emerging work force. This has been catalysing the emergence of women entrepreneurs in India. The following training schemes are being implemented for promoting self-employment of women by Government of India.

1. Support for Training and Employment Programme of Women (STEP)
2. Development of Women and Children in Rural Areas (DWCRA)
3. Small Industry Service Institutes
4. State Financial Corporations
5. National Small Industries Corporations
6. District Industrial Centres

(vii) Consortium of Women Entrepreneurs of India (CWEI)

Consortium of Women Entrepreneurs of India (CWEI) was registered as a civil society in the year 1996 which is a non-profit organisation in New Delhi. It is accredited by Government of

India. It is a member of National Board, Ministry of MSME and is working closely with Ministry of Rural Development in the Public Private Partnership to support below poverty line families in India. They are rendering the following functions:

i. They are acting as a springboard for enterprises started by the women.
ii. It is helping women achieve high economic empowerment.
iii. It is acting as a catalyst to improve the access of womenfolk to natural resources.
iv. It is providing technological support in the sphere of product design and development in the case of women owned enterprises.
v. It is providing quality control, marketing and technological supports to women owned enterprises.
vi. It is spreading knowledge to women entrepreneurs about various government schemes.

In sum, it can be stated that women consortium is an agency providing a comprehensive service of various types to women owned enterprises.

Challenges of Women Entrepreneurs

Though there is a tremendous growth in the women entrepreneurship in India, a number of research studies conducted in India have brought out the following problems and challenges encountered by women entrepreneurs during the course of their entrepreneurial journey.

1. Problem of Finance

The access of women to external sources of funds is limited as they do not generally own properties in their own name. Financial institutions too do not consider women in general creditworthy as they are sceptical of their entrepreneurial capabilities of women. They impose stringent condition which discourages women to avail themselves of loan assistance from banks. In this context, they are pushed to rely on their own savings and small loans from friends and relatives. Because of the limited funds, women entrepreneurs are not able to effectively and efficiently run and expand their business.

2. Limited Mobility

Indian women cannot afford to shed their household responsibilities towards their family even after they plunge into the venture started by them. This restricts the mobility of women entrepreneur significantly. The domestic responsibilities do not allow women entrepreneurs to freely move out of business enterprises in connection with business activities.

3. Lack of Education

Illiterate and semi -literate women entrepreneurs encounter a lot of challenges in their entrepreneurial journey with respect to maintaining accounts, understanding money matters, day-to-day operations of the company, marketing the products, applying technology etc., This reduces the efficiency of operating the business successfully.

4. Lack of Network Support

The successful operation of any venture irrespective of the size depends upon the network of support extended by various constituencies like family members, friends, relatives, acquaintances, neighbours, institutions and so on. Women entrepreneurs need much needed psychological support and wiser counselling especially during the time they actually encounter challenges. But it is reported that women entrepreneurs get very limited support in times of crisis from most of these constituencies.

5. Stiff Competition

Women entrepreneurs have to face acute competition for their goods from organised sector and from their male counterparts. Since they are not able to spend liberally due to financial constraints, they are not able to compete effectively and efficiently in the market.

6. Sensitivity

Women are more prone to a variety of emotions. Being mother, women are vulnerable to many emotions. They tend to have sympathy and empathy for others. This trait does not allow women entrepreneurs to take objective decisions in many contexts during the course of running the entrepreneurial venture. Besides, the weak emotions do not allow them to tolerate failures and disappointments arising during the normal course of their entrepreneurial journey. This inherently tone downs the effectiveness of their functioning.

7. Lack of Information

Women entrepreneurs are reported not to be generally aware of subsidies and incentives available for them due to their poor literacy levels or due to their pre occupation with household responsibilities. This lack of knowledge or limited knowledge about subsidies prevents them from availing themselves of special concessions, benefits and incentives awarded by Government and other agencies.

8. Dependent culture

In India, women however educated and talented are groomed to be dependent on their parents, life partners and children during the various phases of their life cycle. They could not take decisions on their own in many contexts due to this dependency factor. They have to take permission from their support groups to engage in any purposeful and gainful activity. They are not treated as equals unlike women in western countries. This cultural barrier does not allow them to start and manage their ventures according to their free will and pleasure.

The increasing presence of women as entrepreneurs has led to significant business and economic growth in the country. Women-owned business enterprises are playing a prominent role in society by generating employment opportunities in the country, bringing in demographic shifts and inspiring the next generation of women founders.

With a vision to promote the sustainable development of women entrepreneurs for balanced growth in the country, Start-up India is committed towards strengthening women entrepreneurship in India through initiatives, schemes, creation of enabling networks and communities and activating partnerships among diverse stakeholders in the start-up ecosystem.

Women's entrepreneurship needs to be studied separately for two main reasons. The first reason is that women's entrepreneurship has been recognized during the last decade as an important untapped source of economic growth. Women entrepreneurs create new jobs for themselves and others and by being different also provide society with different solutions to management, organization and business problems as well as to the exploitation of entrepreneurial opportunities. However, they still represent a minority of all entrepreneurs. Thus there exists a market failure discriminating against women's possibility to become entrepreneurs and their possibility to become successful entrepreneurs. This market failure needs to be addressed by policy makers so that the economic potential of this group can be fully utilized. The purpose of the paper to examine the constraints and opportunities facing female entrepreneurship in developing countries at micro- and macro-level perspectives and seeks to provide a detailed account of opportunities and constraints bought by entrepreneurship. According to Kamala

Singh," A women entrepreneur is a confident, innovative and creative woman capable of achieving economic independence individually or in collaboration generates employment opportunities for others through initiating establishing and running an enterprise by keeping pace with her personal, family and social life. According to Government of India—An enterprise owned and controlled by a women having a minimum financial interest of 51 per cent of the capital and giving at least 51 per cent of the employment generated by the enterprise to women. According to APJ Abdul Kalam "Empowering women is a prerequisite for creating a good nation, when women are empowered, society with stability is assured. Empowerment of women is essential as their thoughts and their value systems lead to the development of a good family, good society and ultimately a good nation." According to the recent reports and studies female entrepreneurship has attracted a lot of attention in recent years in light of concrete evidence that it supports economic growth and development. When women move forward, the family moves, the village moves and then ultimately the Nation moves forward.

Women are one of the most relevant untapped resources if you talk about entrepreneurship. Female entrepreneurship is gaining attention and importance in light of the evidence of the importance of new business creation for economic growth and development. Entrepreneurship refers to the act of setting up a new business so as to take advantages from new opportunities. Entrepreneurs are responsible for shaping the economy and they help in creation of new wealth and new jobs by inventing new products, process and services. We all understand that economic development of the today's woman is crucial for economic development of any country specially a country like India. The dependency on service sector has created many entrepreneurial opportunities for women that they can utilize to enhance their social standing and reputation. In this paper, an attempt has been made to study the opportunities and challenges related with entrepreneurship that the woman of our country faces in the present times. Much knowledge is not found about the economic relevance of women in entrepreneurship programs and the effect of these programs on society and economy.Opportunities for Financial Inclusivity: The Government of India and many state governments are running schemes to improve financial inclusivity for women. Pradhan Mantri Mudra Yojana is one such high-potential scheme for women because it offers collateral free loans.

Measures to Improve Women Entrepreneurship

Women entrepreneurship in India faces many challenges and requires a radical change in attitudes and mindsets of society. Therefore, programs should be designed to address changes in attitude and mindset of the people. Women of the present times should be made aware regarding her unique identity and her contribution towards the economic growth and development of the country. Course Curriculum should be designed in a manner that will impart the basic theoretical knowledge along with its practical implication and help impart skills required to be an entrepreneur. At the same time, there are various schemes like the World Bank sponsored programmes that can be undertaken for such purposes. Programmes can be conducted in which established and successful women entrepreneurs can advise and warn for the coming women entrepreneurs against the challenges they will face against being entrepreneur to boost the morale and confidence level of the upcoming entrepreneurs. Government should also play an important role by setting up policies and plan that supports entrepreneurship opportunities. Setting up good infrastructure is also required to build entrepreneurship

opportunities. It is not easy to promote women entrepreneurship in India as it requires elimination of various obstacles that includes changing the traditional attitudes and mindsets of people in society towards women. To provide opportunities of women entrepreneurship in India one needs to make aware the women regarding her position towards the value she can add towards economic growth and development of country. Education can play a crucial role in promoting women entrepreneurship and promotion of women entrepreneurship can be achieved by designing course curriculum that will impart the basic knowledge along with its practical implication regarding setting up of your own enterprise. Vocational training can also help by training, motivating and assisting the upcoming women entrepreneurs in setting up & managing of a new enterprise. Apart from vocational training sessions women can be trained on Information Technology to take the advantage of new technology in running their start-ups. Education has been instrumental in increasing the participation of women in entrepreneurial activities. Proper education not only helps in acquisition of requires knowledge but also imparts knowledge about the different opportunities available in different sectors. Good education makes women confident in dealing with problems in business in an effective manner. Also women entrepreneurs who have successfully set up their enterprises can act as advisors for the upcoming women entrepreneurs. The advices taken from these successful entrepreneurs can prove beneficial for the upcoming women entrepreneurs by resulting in better involvement of women entrepreneurs in their enterprises.

T**heir various problems are as follows:**

- Lack focus on Career Obligations
- Economic Instability of women
- Lack of Risk taking ability
- Arrangement of Finance& Raw Material
- Cut-throat Competition
- Low levels of literacy amongst women
- Problems in getting financial assistance by banks & Financial Institutions
- Marketing Problems

Facts & Figures about Women Entrepreneurship

The results of the survey conducted by IIT, Delhi are: 1) Women own one-third of small business in USA and Canada and the number is likely to be 50% in the coming century. 2) Women account for 40% of the total work force in Asian countries. 3) Women outnumber men by at least two lines in China. 4) The percentage of women entrepreneurs has increased from 7.69% in 1992-93 to 10% in year 2000-01, but the number still is significantly low as compared to overall work participation rate i.e. 25.7%. 5) The number of women in technical courses, professional courses and in engineering stream has shown a tremendous rise. Polytechnics and IITs have only 15% girls out of total enrolled students and very less join and set their own enterprises. 6) Around 8% of women have an interest in starting an enterprise or are giving it serious thought, compared with 13% of men. 7) Around one in five women come into self-employment from unemployment compared with around one in fifteen for men.

8) Only 2% of men cite family commitments as a reason for becoming self-employed, compared with 21% of women.

Conclusion

Women entrepreneurship in India faces many challenges and requires a radical change in attitudes and mindsets of society. Therefore, programs should be designed to address changes in attitude and mindset of the people. It is important to promote entrepreneurship among women to improve the economic situation of the women. This can be made possible with the help of education as education is a powerful tool in bringing out the entrepreneurship qualities in a human being. Moreover, attempts to motivate inspire and assist women entrepreneurs should be made at all possible levels. Proper training should be given to the women by establishing training institutes that can enhance their level of work-knowledge, risk-taking abilities, enhancing their capabilities. After setting up training institutes, there should be continuous monitoring, improvement of training programs so that they can improve upon the quality of the entrepreneurs being produced in the country. Undoubtedly the women participation rate in the field of entrepreneurship is increasing rapidly. However, efforts need to be taken at larger scale to give the position in the field of entrepreneurship that they deserve. The actions & steps that has been taken by the government sponsored development activities have benefited only a small strata of society and more needs to be done in this area. Effective steps need to be taken to have entrepreneurial awareness and skill development to women. The economic development of a country depends upon the involvement of women into the entrepreneurship activities. India is known to be male dominant country where women are facing considerable hurdles while operating the venture. In spite of this, women entrepreneurship in India is still growing steadily and is providing job opportunities and income generating avenues for different segments of society. The role of Women entrepreneur in economic development is also being recognized and steps are being taken to promote women entrepreneurship. The Indian society is shifting from conservative attitude to progressive attitude. So, women are getting more opportunities not only in entrepreneurial work but also in other domains of human life. Government and other agencies are taking various steps for the upliftment of women entrepreneurs by making the women entrepreneur a part of mainstream of national economy. Therefore, the skills enhancement through encouraging entrepreneurship results in economic development of women and country.

References

- Anil Kumar, ―Women Entrepreneurs Profile of the Ground relatives‖, SEDME Vol. 30 No. 4 December 2003 P – 1.
- Anil Kumar, Financing Pattern of Enterprises owned by women Entrepreneurs. The Indian journal of Commerce, Vol. 57 No.2, April – June. 2004. P-73.
- Bowen, Donald D. & Hirsch Robert D. (1986), The Female Entrepreneur: A career Development Perspective, Academy of Management Review, Vol. 11 no. 2, Page No. 393-407.
- Cohoon, J. McGrath, Wadhwa, Vivek& Mitchell Lesa, (2010), The Anatomy of an Entrepreneur- Are Successful Women Entrepreneurs Different From Men? Kauffman, The foundation of entrepreneurship.

- Carter, N. 1997. Entrepreneurial processes and outcomes: The influence of gender. In P. D. Reynolds, & S. B. White (Eds.), The entrepreneurial process: Economic growth, men, women, and minorities. Westport, Connecticut: Quorum Books.
- Cohoon, J. McGrath, Wadhwa, Vivek& Mitchell Lesa, (2010), The Anatomy of an Entrepreneur- Are Successful Women Entrepreneurs Different From Men? Kauffman, The foundation of entrepreneurship.
- Greene, Patricia G., Hart, Myra M, Brush, Candida G, & Carter, Nancy M, (2003), Women Entrepreneurs: Moving Front and Center: An Overview of Research and Theory, white paper at United States Association for Small Business and Entrepreneurship.
- Handbook on Women-owned SMEs, Challenges and Opportunities in Policies and programmes, International Organization for Knowledge Economy and Enterprise Development.
- Kubeczko, K., Rametsteiner, E. (2002). Innovation and entrepreneurship — a new topic for forest related research? Discussion Paper P/2002-1, Institute of Forest Sector Policy and Economics, BOKU Vienna.
- Lall, Madhurima, &SahaiShikha, 2008, Women in Family Business, presented at first Asian invitational conference on family business at Indian School of Business, Hyderabad.
- Murmann, J. P., &Tushman, M. L. 2001.From the technology cycle to the entrepreneurial dynamic. In C. Bird Schoonhoven, & E. Romanelli (Eds.), The Entrepreneurship Dynamic. Stanford, California: Stanford University Press.
- Myers, S. C. 1984. The Capital Structure Puzzle. The Journal of Finance, 39(3): 575-592.
- Singh, Surinder Pal, (2008), An Insight Into The Emergence Of Women-owned Businesses As An Economic Force In India, presented at Special Conference of the Strategic Management Society, December 12-14, 2008, Indian School of Business, Hyderabad
- S.K. Dhameja, ―Women Entrepreneurs: Opportunities, Performance, Problems Deep Publications Pvt., Ltd., New Delhi, P – 9.
- Tambunan, Tulus, (2009), Women entrepreneurship in Asian developing countries: Their development and main constraints, Journal of Development and Agricultural Economics Vol. 1(2), Page No. 027-040.the glass ceiling. Thousand Oaks, CA: Sag

Chapter: 6

BESST HORT in providing way to create livelihood opportunities through Horticultural technologies for women

C.K. Narayana
Business Entrepreneurship and Startup Support through
Technologies in Horticulture (BESST-HORT), A TBI of ICAR-IIHR
Hessaraghatta Lake Post, Bengaluru- 560 089

Sustainable Development calls for a sustainable economic growth, achieving sustainable livelihood, living in harmony with nature and using appropriate technology are important for sustainable development.

- **Three** core elements of sustainable development are **economic growth, social inclusion and environmental protection.**

What is Livelihood?

The deployment of capabilities, assets/resources (material and non-material) and activities required for a means of living. livelihood generally refers to "people's capacity to maintain a living" (Chambers & Conway, 1991). Though women's livelihoods vary from those of men in their control of income, resource use and production, and land rights, most frameworks used for poverty alleviation and community development are heavily based on capital assets, neglecting the "gendered nature of livelihoods". Entrepreneurship: A means to a Sustainable Livelihood. The number of women-led farms in the U.S. nearly tripled between 1982 and 2007, according to a 2013 USDA report.

In the agricultural food technology subsector ("agrifoodtech"), the number of startups has risen considerably. This space spans everything from automatic sensors, robotics, and drones for mapping farms and spraying them with fertilizer, to soil testing kits. Among the number of startups for which gender data is available, just 9% of the 259 agrifoodtech companies launched in 2002 had a woman founder or co-founder. In 2020, 22% of 1,061 agrifoodtech startups had a woman founder.

Role of Technology in Gender Mainstreaming

The ownership and use of digital technologies have substantial potential for economic empowerment of women and increasing gender equality. Access to the internet and ownership of and access to digital devices can offer additional employment opportunities, income and knowledge.

Impact of Technology on lives and Livelihoods

The continuous march of technology has had an immense impact on human culture and society. Technology has transformed our environment and sculpted our lives into what they are now,

from your automobile and computers to TV screens, airplanes, and beyond. The use and need for technology is not limited, and this is the world that man has created for his own use, to save time and energy in order to create more.

Today, technology has changed every individual's life and made the entire globe a small area by the way we communicate with others. Now, through different social media platforms like Facebook, Instagram, etc., we have more exposure to the rest of the world.

When it comes to how technology has affected our lives, advances in technology have put everything at our ease by making modern living more convenient. It has also made it possible to locate the nearest restaurant, dining area, hotel, and so on. We can even book movie tickets and shop for groceries and other necessities online. You can now access anything from anywhere on the globe thanks to the Internet of Things.

Various applications made possible by technological tools have made it simple to purchase online aeroplane tickets, cinema tickets, hotels, restaurants, and so on. A user can also check the availability of seats, their positions, and so on, and make a reservation based on their preferences. We may purchase groceries, food, medicine, books, and other items online and have them delivered to our homes without leaving our homes. For convenience, we can also call and reserve online cab services. Wherever a person is in the world, he can follow various courses and learn things such as dancing, cooking, yoga, and so on.

The availability of these services at home has increased people's reliance on technology. They are no longer interested in going out to eat and meeting new people. Modern farms and agricultural operations work far differently than those a few decades ago, primarily because of advancements in technology, including sensors, devices, machines, and information technology. Today's agriculture routinely uses sophisticated technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These advanced devices allow businesses to be more profitable, efficient, safer, and more environmentally friendly.

In addition, robotic technologies enable more reliable monitoring and management of natural resources, such as air and water quality. It also gives producers greater control over plant and animal production, processing, distribution, and storage, which results in:

- Greater efficiencies and lower prices
- Safer growing conditions and safer foods
- Reduced environmental and ecological impact

The Covid-19 pandemic and the war in Ukraine has massively disrupted the global food system, putting huge pressure on agriculture-focussed countries like India to provide more sustainable options. The combination of an influx of investments, AgriTech startups and innovation have the potential of changing the dynamics of Indian agriculture and paving the way for a futuristic model.

Role of Agri-Startups in Agriculture

Increasing Income: The state of small and marginal farmers in India has been dismal, struggling with low incomes, mounting debts and dependency on mono-crop culture, informal lenders and fluctuating output prices. Farmers who seek to venture into aquaculture or animal husbandry don't have appropriate investments, marketing channels and knowledge. With the advent of AgriTech startups and digital tools, many Indian farmers are supplementing their income with farm diversification.

Farm Diversification: The AgriTech Startups are empowering farmers to integrate livestock rearing and aquaculture into their existing operations with micro-farm installation requiring minimum space and labour. Non-crop diversification is helping farmers increase and earn round-the-year income, improve productivity and profitability and adopt sustainable farming systems.

Awareness Creation: AgriTech startups with the ever-increasing internet are increasing awareness among the farming communities and connecting them to a network of traders, retailers and exporters willing to buy their produce at higher prices.

Technological Advances: Technological advances in supply chain platforms have also resulted in the supply of high-quality live input materials to farmers engaged in livestock rearing and aquaculture.

Reforms in Lending Culture: With the emergence of Fintech and AgriTech startups, the lending landscape of the country is changing. Previously underserved small and marginal farmers can now secure loans from formal institutions at low-interest rates.

What are Initiatives Launched for Agri-Startups?

In 2020, the Reserve Bank of India directed banks to treat loans up to ₹50 crore to agri-startups under priority sector lending. In the Budget 2022, the Finance Minister of India also announced a fund for agri-startups and rural enterprises. The exclusive fund is launched through NABARD in order to give a fillip to the farm produce value chain. Agri-tech start-ups under the NIDHI-Seed Support Scheme (NIDHI-SSS) will receive funding up to ₹50 lakh. The seed fund will enable them to accelerate their commercialisation activities.

Incubators and its Role in development of Small Business and Start-ups

An incubator's main goal is to produce successful firms that will leave the program financially viable and freestanding. These incubator graduates have the potential to create jobs, revitalize neighbourhoods, commercialize new technologies, and strengthen local and national economies. As a part of their services, incubators usually also provide clients/incubatees access

to appropriate rental space and flexible leases, shared basic business services and equipment, technology support services and assistance in obtaining the finances necessary for company's growth along with mentors to guide the company through its initial steps.

Business Entrepreneurship and Start-up Support through Technologies in Horticulture (BESST-HORT), is a NIDHI-Technology Business Incubator of ICAR-Indian Institute of Horticultural Research, Bengaluru, Catalyzed and Supported by National Science and Technology Entrepreneurship Development Board (NSTEDB) of Department of Science and Technology, Government of India. NSTEDB was established by Government of India in 1982 with a broad objective of promoting gainful self-employment amongst the Science & Technology manpower to setup knowledge based and innovation driven enterprises. BESST-HORT was sanctioned to promote knowledge and innovation driven business enterprises and start-ups in the area of horticulture & allied fields. The major objectives of BESST-HORT are:

1. Attract the youth to horticulture through capacity building and entrepreneurship development.
2. Arrange for transfer of technology from ICAR-IIHR and other ICAR institutes in the domain of horticulture and allied fields.
3. Provide On-site and Off-site Technology incubation facility to scale up productions.
4. Provide mentorship (technical and business) and hand holding to the budding entrepreneurs.
5. Help the enterprise building through acceleration, investment, and market linkage.

Opportunities for women in Horticulture based Enterprises (including start-ups).

1. **Improved Supply chain of fresh fruits and vegetables:** is complex due to the perishable nature of the produce, high fluctuations in demand and prices, increasing consumer concerns for safety and quality and dependence on climate conditions.
   - Production & Processing Machinery Manufacturer
   - Packhouse Service Provider
   - Ripening Service Provider
   - Fresh Logistics Provider (Refrigerated Vans / Trucks / Wagons / Containers, etc)
   - Fresh F& V Exporters (Farmer / Merchant)
   - Vending Vehicles Manufacturer (IIHR Vending Van / Vending Tri-Cycle)
   - Packhouse Machinery Manufacturer

2. Opportunities in Processed fruit and vegetable products

Primary Processing:

- ❖ Pack houses can be used by producers, importers, co-operatives or clusters, traders, exporters and processors.
- ❖ Operations involve:

- ✓ Receiving, maturity assessment, trimming, sorting and grading, sizing, delatexing/desapping, cleaning/washing, surface drying, waxing, ripening/degreening, curing, packaging, precooling, storage, treatments for disease control, quarantine treatments and labelling.

Secondary Processing:

- ❖ Minimal Processing of Fruits & Vegetables – Fresh cut fruits & Vegetables
  Processing into Intermediary Products – Pulp, Puree, Paste, Concentrates

Tertiary Processing:

- ❖ Ready-to-Drink Juices (Fruits alone, Vegetable alone, Mixed juices/Punches)
- ❖ Ready-to Eat Products- Dried and Dehydrated Fruits & Vegetables; BF Cereals with fruits & nuts
- ❖ Ready-to-Cook Products- Retort Packed products (Tomato crush, Vegetable Gravies, Soup Powders, etc

Chapter: 7

Packages for processed products

S. Bhuvaneswari
Division of PHT & AE, ICAR-IIHR, Bengaluru

Packaging

The aim of packaging is to protect the product during handling, transportation and storage until the customer finally uses it. The type of packaging is determined by the nature of the product. It is function of the product, the package and environment through which the product is transported, stored and sold. The shelf life of a product is based on the protection required for the product under ideal packing and storage conditions.

Attributes of good package:

(1) It must attract attention

(2) It must tell the product story- what it is , what size , how much

(3) It must build confidence

(4) It must look clean and hygienic

(5) It must be convenient to handle and to carry

(6) It must look like good value

(7) It must deserve a preferred display

(8) It must prevent spoilage during the selling period

(9) It must resist soiling

Different forms of packages:

Food packages may be divided according to the primary constituent material into four groups such as 1) Paper and paper based packages

2) Glass packages

3) Metal packages

4) Plastic packages

Paper and Paper Based package

The raw material of paper is mainly cellulose. Wood which is about 50% cellulose is the major raw material for paper.

Papers are broadly divided into coarse grade used in packaging and fine grades used for writing and books.

Natural or unbleached craft is a light brown paper available in four grades such as grocer's bag, shipping sack, wrapping paper and gumming paper. These are strongest paper, relatively low cost and efficient production. By using special additives or treatments natural kraft can be given smooth surface, water repellency, higher tensile strength, lower transmission.

When good appearance features like whiteness, brightness and printability are needed bleached papers are used. They have a smooth surface, but their mechanical properties are not as good as unbleached papers. They are used for special wrapping and labelling. Common denotation for finished bleached papers are MG (machine-glazed) glazed on one side and rough on other side and MF(machine- finished) where both sides are smooth.

Glassine is a transparent paper with high grease, air resistance and a glass like smooth surface. Waxed glassines, excellent moisture barriers are used for wrapping and for bags were transparency and barrier properties are important. Grease papers are similar to glassine but without smooth surface. Parchment paper is translucent, sterile when made, grease proof, strong when wet and printable. It is used for greasy foods such as butter.

Chip board is a paperboard made from recycled materials, mostly old paper with some scrap added for strength. It is often used for cereal boxes.

Paper bags:

There are 4 basic types of paper bags namely flat, square, sachet bottom and automatic or SOS (self opening style). The square and SOS bags have gussets which are reverse folds in their edges. Flat and square bags are similar in that they both are made from a tube with a single or double fold on the bottom. Automatic and sachet type paper bags are able to stand up or lie flat for shelf display. They are used for consumer foods, flour, and pet foods

The basic material for paper bags is kraft, but kit is often combined with other materials, coatings, laminations or plies of reinforcing or barrier materials to obtain the properties required by the product and the packaging operations.

Corrugated Fibre Board (CFB):

CFB are mainly used for shipping containers. CFB consists of a sheet of corrugated paper, commonly called medium which is glued to one or two flat sheets of paperboard, called liners. Based on the number of mediums, there are single, double and triple walled corrugated board. Single wall board is known as single or double faced corrugated board, depending on the number of liners. The thickness of the corrugated medium is nearly constant; By varying the thickness of the liner different strength of corrugated board can be obtained. Based on the height of the corrugations and the number of corrugations per foot, there are 4 different flute styles designated as A,B,Cand E. Different types of boards are used for different purposes. A-flute gives good cushioning against shock and good compression resistance while B-flute has maximum crush resistance. The property of C-flute is in between. E-Flute corrugated board has a very good printing surface.

Advantages:

Low Cost to strength and Weight Ratio

Smooth non abrasive surface

Good cushioning properties

Easy to set up and collapsible for storage

Reusable and recyclable

Easy handling and stacking

Can be turned quickly into highly precise and accurate sizes and can be punched for ventilation.

Disadvantages:

Stacking strength decreases with duration of load and high humidity. Corrugated board sometimes is coated for special purposes like water resistance, higher stacking strength under high humidity condition. Considering the sales value and volume corrugated fiberboard is the most commonly used packaging material.

Folding cartons:

The folding carton is one of the most important rigid packaging forms. It is a container which is made from bending paperboard. It is the cheapest type of rigid packages especially in large quantities. Folding cartons are shipped and stored in collapsed form. They are erected immediately before the filling operation. This results in very low shipping and storage costs. Using the right printing method an excellent appearance on the retail shelf is possible. With the use of adequate paperboard material and design features, the folding carton has relatively good strength properties.

Metal Containers:

Metal containers are one of the most important forms of food packaging. Rigid metal containers include cans, drum and pails. Semi rigid metal containers the collapsible tubes have become more common in food packaging.

Advantages of metal containers:

1) They are hermetically sealed so they are able to prevent any material transfer (microorganism, insects, moisture, oxygen and flavour) between environment and the packaged product.

2) Their strength provides easy stacking material handling and transportation

3) They can be stored on the retail shelf easily.

4) They are convenient for customer use.

Their use is well adapted to thermal processing of food products.

The most commonly used material for metal cans is called tinplate which is really steelplate with a layer of tin coated to it by electrolytic process. The conventional 3-piece can consist of a body and two ends. The body is made from blank plate, which is bent into a cylindrical shape. Then the two ends pf the plate are joined to each other, making the seam. Based on the plate and the expected product in the can, the seam can be made by 3 methods, soldering cementing and welding. The ends may be made of idfferfent materials, as when the bottom is steel and the top is aluminium with an easy open pull tab. Inside the can, protective

organic coatings called enamels are used to prevent corrosion. The enamel must be formulated to suit the needs of each particular product.

Glass containers:

Glass as a packaging material is very popular in the food industry.

Advantages:

1) It is completely inert and its permeability to gases vapour and liquids is zero.

2) It can be produced at low cost.

3) They have a very high resistance to compression or internal pressure.

Disadvantages:

1) High weight and fragility.
2) If transparent, it is disadvantageous to the product which is sensitive to light.

Most commonly used glass containers in food industries are jars, mugs and tumblers.

Rigid Plastic Containers:

Plastic containers have replaced conventional glass, paper and metal containers in many areas of food packaging.

Advantages of using plastic containers over glass, metal and paper containers are as follows:

1) Weight and chances for breakage of plastic containers are less than for glass containers.

2) They show better corrosion resistance than metal containers.

3) The mechanical properties of plastic containers are not as affected by humidity as

paper and their permeability to gases, vapour and liquids is much lower also.

Disadvantages:

1)Plastic containers are more temperature and time sensitive than other packaging materials.

Many different polymeric materials are introduced and used but there are really only four significant resins: Polyethylene(low and high), Polypropylene, PolyVinylchloride and Polystyrene

Flexible packages:

Flexible packages includeds plastic films and combinations of plastic films with paper other plastics or foil, known as laminates. These containers include bags,pouches,skin,blister and shrink packages. The flexible packages are among the least expensive packaging forms. The difference between bag and pouches is that bags are made first and later they are filled and closed at another plant. But pouches are made, filled and closed in one operation generally on a form fill and seal machine. Bags and pouches may be made of simple plastic films or they may be coated or used in laminations. In many cases there exists no single film which is able to satisfy all the requirements of clarity, sealability barrier properties, price, machinability compatibility.

To obtain a plastic film which is nearly ideal for such situations, different properties of different films are combined by coating or lamination. The coating is applied on one or both sides of the film and is very thin. Coatings are able to modify heat sealing behaviour,barrier properties, handling characteristics, scratch resistance etc. One of the best example is cellophane, which is not heat-sealable and is a very poor moisture barrier. With various coatings it is one of the most important packaging films.

Any combination of different plastic films or plastic and non plastic(aluminium,

paper)layers,where each ply is thicker than 0.25 micron is called laminate. The laminate should be designed for a given need. For example, a plastic with good printability may be used as an outside layer, the next layer can be a good barrier while another can give strength to the laminate and the inner one with no interaction with the product.Many times plastic films are laminated with paper where the paper gives strength or with aluminium foil where the foil gives excellent barrier properties and some strength.

Aseptic packaging:

New development of worldwide significance has been the composite paper carton which is capable of being sterilized and then aseptically filled with sterile liquid products. This process is called aseptic packaging even though it is both a packaging and processing technology. This technology allows foods such as milk to be packaged in relatively inexpensive flexible containers and which do not require refrigeration. This means that milk and juices can be distributed in parts of the world where refrigeration is not common. The packaging material is made from laminated roll stock consisting (from the outside inward) of polyethylene, paper, polyethylene, aluminium foil, polyethylene and a coating of ionomer resin. The roll stock enclosed in a cabinet at floor level is drawn upward as a continueous sheet through a hydrogen peroxide bath near the top of the machine. The sheet is passed through squeeze rollers to remove excess peroxide and the descending sheet is formed into a tube that is exposed to radiant heat to complete the sterilization and remove traces of peroxide. Next, the tube is further formed into a rectangular shape, end sealed at package-size intervals, filled with presterilized liquid food, top-sealed and separated into individual package units in a continueous operation. Commercially sterile liquids have a shelf life of several months at room temperature in the exceptionally light weight form-fill-seal package. Several form-fill-seal systems have been developed to take advantage of the rapidly growing aseptic package market.

Different packages for different processed products

The packaging should match the characteristics of the food which the package contained.

Poly propylene containers

For Vegetable salads dressing with mayonnaise

PP film and laminated bags,

For dried candied fruits, dried and fried mixed vegetables,

Easy-open cans for fruit and vegetable juices

Long-neck glass bottles for fruit juice concentrates

PP bags and metallized film-laminated bags for snacks, dried cut flowers, potpourri, etc.

Filter paper, waxed paper and paper/foil/transparent film: For tea, herbal teas and coffee

Packaging of Processed Beverages

Plastic flexible film and semirigid packaging products are the major materials used. Lighter and more compact packaging is being improved, with Polyethylene Terephthalate (PET) and High Density Polyethylene (HDPE) replacing other plastics, aluminum replacing steel and tinplate Glass, tinplate, aluminium playing a lesser role generally.

Rigid Containers

Rigid containers are made of plastic, glass, aluminum and heavily waxed cardboard and are suitable for all packs. These are often reusable. Straight or tapered sides on rigid containers make it much easier to remove frozen foods.

Glass jars used for freezing should be made for the purpose. Regular glass jars may not withstand the extremes in temperature. Do not use regular, narrow-mouth canning jars for freezing foods packed in liquid. Expansion of the liquid could cause the jar to break at the neck.

Cans, such as shortening and coffee cans, are good for packaging delicate foods. Line the can with a food-storage bag and seal the lid with freezer tape because they are not airtight.

Packaging not sufficiently moisture/vapor-resistant for long-time freezer storage includes ordinary waxed paper and paper cartons from ice cream and milk

Chapter: 8

Establishment of Food Processing Unit and preparation of DPR

Vijay Rakesh Reddy S
Division of PHT&AE, ICAR-IIHR, Bengaluru

Introduction

Food processing is the transformation of agricultural products into food, or conversion of foods of one form into other forms. Food processing includes various operations *viz*. grinding grain to make raw flour to home cooking to complex industrial methods used to make convenience foods. The processes and procedures used to transform one or more raw ingredients into a consumable product are all included in food processing units. Animal husbandry, horticulture, plantations, agriculture, and fisheries include the use of food processing facilities. It also includes other sectors that produce finished food goods using agricultural inputs. This food processing sector has turned out to be one of the options for investments and earnings. The food processing industry's net worth is estimated to be over $1100 billion, and it is growing quickly, at a pace of 10-15 per cent annually. Depending on the primary raw materials utilised, there are nine different kinds of food processing plants. Regardless of how seasonal or perishable the foods are, processing them assures that we have access to them all year round. Contrary to those produced by an individual, mass production of these processed foods can be quite profitable.

Market survey and analysis

The most important step in beginning any business is identifying the product to be created and understanding the market. Investors are required to consider a product's marketability while selecting a product. In order to estimate the market size, identify rivals, and understand their trends, it is crucial to do research on the economic and industrial consequences of the current food processing businesses.

The business must be built in accordance with the requirements to make it legally stable after the initial market research is completed. Options include limited liability partnerships, partnership firms, private limited companies, and public limited companies, each with advantages and disadvantages of their own. These decisions might be made based on the manufacturing scale.

Choosing location of processing unit

Finding a good site for the plant requires determining the size of the market. Finding a location with workable and convenient access to resources like labour, raw materials, electricity, transportation infrastructure, *etc*. is advised. The government-provided subsidies and tax exemptions in several Indian states *viz*. North-Eastern states and Himalayan states for promoting industrialisation which also should be taken into account. By examining these elements as well as the accessibility of raw materials in a certain area, an optimum location can be determined. To

keep high-quality product all year long, one must take into account the perishable nature of food and duration.

Business planning and strategies

The initial research and analysis must then be streamlined to meet the needs of the processing units. For the business to create an outline for how it should operate, new policies and strategies must be developed, and the company's future goals must be generally determined. When it comes to food processing facilities, it's important to consider both the industry's expanding tendencies and potential future results.

Funding

As the food sector develops, funding is required for each company to import components and maintain the value chain. The size and makeup of the industry have a tendency to influence the funds as well. Therefore, it's crucial to have stockholders and establish a reliable source of money for the business. For beginners, it’s appropriate to use the incubation facilities developed through public funding for gaining confidence over the product they are trying and its marketability.

Legal implications

Before starting a business, a newly created company must be registered with the appropriate authorities. According to the Companies Act of 2013, in order to be registered as a business in India, a corporation must submit the necessary paperwork and supporting documentation. The business must also register for several taxes, including PAN, Sales Tax, Excise & Customs Registration, Service Tax, and others. Additionally, the trademark must be shielded from infringement by third parties, therefore an IPR registration with patents, copyrights, and other rights is required. Additionally, all the food processing units should comply with food laws *viz*. Food Safety and Standards Act, 2006 and the Legal Metrology Act, 2009.

To commence a food business in India, an FSSAI license is mandatory. FSSAI is the body that administers food safety laws and issues Food licenses to eligible entities. At present, FSSAI license is available under a 3-tier system i.e. Basic, State, and Central depending on the annual turnover of the applicants. Nonetheless, there are certain guidelines that one has to follow to legally protect the company.

Implementation

Implementation is inherently the trickiest part of any business formation. In this phase, there are major chances for making mistakes. The beginners must seek Subject Matter Experts (SMEs) to ensure seamless deployment of pre-established plans. The proper segmentation of the department and recruitment of the right candidates are also a part of the implementation stage, which indeed requires a certain level of expertise.

Role of Government

The Indian government had supported establishment of food processing facilities through several programmes and policies. The Ministry of Food Processing Industries (MoFPI), GOI also funds very generously in this sector for modernisation of this industry in our country. The government is supporting the food processing industry through implementation of various schemes viz. Pradhan Mantri Kisan SAMPADA Yojana (PMKSY), Pradhan Mantri Formalisation of Micro Food Processing Enterprise (PMFME), Production Linked Incentive Scheme for Food Processing Industry (PLISFPI), Operation Greens Scheme *etc*.

Preparation of Detailed Project Report (DPR)

A Detailed Project Report (DPR) is a final, detailed appraisal report on the project and a blue print for its execution and eventual operation. It provides information on the fundamental programme, the roles and responsibilities, all the tasks to be completed, the resources needed, potential risks, and suggested measures to mitigate them.

The success of project is measured on the basis of:-

- Whether the project was completed on time.
- Whether actual cost of project was within reasonable limits of escalation.
- Whether after completion of the project it was able to deliver the products of desired quality and in adequate quantity to clients satisfaction at profitable costs.
- Whether the project gestation period was within planned duration.

The DPR is a blue print, which on paper gives a great length and detail what has to be done to convert the corporate investment into a feasible project idea and ultimately a profit making enterprise. The top management policy guidelines, its impact on the project life, appraisal in terms of financial viability are dealt in great detail. The DPR is the basic of specification, contract drawings, detailed technical feasibility, financial feasibility, execution of project from practical point of view. The DPR will also highlight the nature of inherent risks in the project & potential external risks that will influence the outcome of the project. Also the DPR gives the measures for risk management and risk mitigation.

The main sub-division in a DPR is: -

- General Information of the project.
- Background and the experience of the project promoters.
- Details and working result of industrial concerns already owned and promoted by the project promoters.
- Details of the proposed project: -
    - ✓ Plant capacity
    - ✓ Manufacturing procedure adopted
    - ✓ Technical knowhow/ tie-ups.
    - ✓ Management teams for the project.
    - ✓ Details of land, buildings and plant and machinery.
    - ✓ Details of infrastructural facilities (power, water supply, transport facilities etc.)

- ✓ Raw material requirement/ availability.
- ✓ Effluents produced by the project & treatment procedures adopted.
- ✓ Labour requirement and availability.

- Schedule of implement of the project.
- Project cost.
- Means of financial projects.
- Working capital requirement/arrangements made.
- Marketing and selling arrangement made.
- Profitability and cash flow estimates.
- Mode of repayment of loans.
- Government approvals. Local body consents and statutory permissions.
- Details of collaterals security that can be offered to the financial institutions.

Steps of preparation of DPR:

1. Client interacts with consultant.
2. Consultant takes all required inputs from client & do necessary first phase studies.
- Client evaluates it & makes all necessary changes & requests consultant to do the necessary modifications.
1. Consultant submits the revised draft for approval.
2. Consultant submits the final DPR after getting approval from client.

Evaluation of DPR:

The final responsibility of the project lies with the owners. Therefore, the owner's organisation must have an appropriate mechanism for project evaluation of a DPR submitted by the consultant. Apart from care in selecting the most suitable consultant in the first place the owner's must pose the following questions.

- What are the sources of critical data & information that have form the basic premises of the DPR, like demand, capital cost, input cost etc?
- The extent to which the strategic plan of top management have been reflected in the design and the repair?
- What were the various alternatives considered, and the methodology followed for choosing one among them?
- The extent to which the design fulfils all applicable statutory requirements and regulations, both currently in force and those may be foreseen?
- Identification of potential problems, bottlenecks and/or major risks involved in the project.
- Degree of detailing.
- Influence of complementary/ completing projects.

- Scope for future expansion/modification/adaptation to new technologies and so on.

The above list is a simple of the types of question that the owner's may pose to the consultant during the process of selection, appraisal of the first draft and before giving the approval.

Model Project profile for Pineapple Osmodehydration Unit (with a production capacity of 500 kg/ day)

- Assumptions made
- Unit is established at owned land of the owner
- Cost of pineapple at farm gate @ 40/kg
- Recovery of pineapple after peeling @ 45 %
- Osmo-dehydrated product recovery @ 20 %

SL. No.	Particulars	Cost (Rs.)
I	Non-Recurring Cost	
	(i) Land (Own land establishment)	0
	(ii) Building Cost (1000 sq.ft) @ Rs.1000/sq.ft	10,00,000
	(iii) Machinery & Equipment	10,00,000
	a. SS Working tables (2' x 5')- 5 Nos 50,000 b. Fruit washing trough (500 liter cap) 3,00,000 c. Sugar Syrup tank (500 liter cap) 2,50,000 d. Cabinet drier (24 trays) 3,00,000 e. Pedastal heat sealing machine-1 No 15,000 f. Label coding machine - 1No 5,000 g. Food grade 200 kg cap plastic drums 5,000 h. Misc. Items 1,75,000	
	(iv) Electrical and other fittings	50,000
	(v) Furnitures & fixtures (fans, lights etc.)	50,000
	Sub Total of Non-Recurring Cost	21,00,000
II	Recurring Cost (Per day)	
	(i) Pineapple 500 kg @ Rs.40/kg	20000

	(ii) Sugar 250 kg @ Rs.35/kg	8750
	(iii) other Ingredients	1000
	(iv) Packaging material (pouches)	10000
	(v) Electricity (20 units @ Rs.7.80/unit)	156
	(vi) Labour (3 mandays @ Rs.300/day)	900
	Sub Total Recurring Cost I	40806
	Overheads @ ~ 10%	4080
	Sub Total of Recurring Cost II	44886
	Recurring Cost Per month of 25 days	11,22,165
	Working Capital Per Year	134,65,980
III	i. Total Working Capital	134,65,980
	ii. Depreciation on Non-recur@10%	2,10,000
	iii. Interest on working capital	16,15,918
	Total of III	152,91,898
IV	Total Capital Investment	
	Non – Recurring Expenditure	21,00000
	Working Capital Including depreciation and Interest	152,91,898
	Total Project Cost	173,91,898
V	Returns	
	Total Sales per year (30,000 kg) (assumed sales price of Rs.700/- per kg OD slices)	210,00,000
	Profitability per annum	36,08,102
VI	Percentage Return on sales (ROS)	17.18%
VII	ROI (Return on Investment)	20.74%

Return on sales (ROS) is a ratio used to evaluate a company's operational efficiency. This measure provides insight into how much profit is being produced per dollar of sales. An increasing ROS indicates that a company is growing more efficiently, while a decreasing ROS could signal impending financial troubles.

Return on Investment (ROI) is the ratio used to measure the efficiency of an investment. Higher ROI indicates investors gain in relation to their cost.

Chapter: 9

Nutrition sensitive Horticulture for livelihood security-Role of women

RB Tiwari
ICAR-Indian Institute of Horticultural Research

Introduction:

Historically, the focus of agricultural development has been on enhancing productivity and rural income (including the new emphasis on doubling farmers' income) and the strategies primarily revolve around the distribution of subsidies and subsidized inputs. In the 2022 Global Hunger Index, India ranks 107th out of the 121 countries.

Today, roughly three billion people are unable to afford even the cheapest, locally available, healthy diets. This represents a crisis, not just in terms of health, but also the mental and physical development of children, and the prosperity of families and growth of countries. Executive Summary - Foresight Report (glopan.org) the 2022 Global Hunger Index, India ranks 107th out of the 121 countries with sufficient data to calculate 2022 GHI scores. With a score of 29.1, India has a level of hunger that is serious. The Global Hunger Index (GHI) is a tool for comprehensively measuring and tracking hunger. Malnutrition in all its forms (undernutrition, micronutrient deficiency, overweight and obesity) is a major global challenge, and improving nutrition is a key priority for global development, as recognized in the UN Decade of Action on Nutrition (2016–2025) and the 2030 Agenda for Sustainable Development.

Food systems provide for all people's nutritional needs, while at the same time contributing to economic growth. The food and agriculture sector has the primary role in feeding people well by *increasing availability, affordability, and consumption of diverse, safe, nutritious foods and diets*, aligned with dietary recommendations and environmental sustainability. Applying these principles helps strengthen resilience and contributes to sustainable development (https://www.fao.org/3/i4922e/i4922e.pdf).

"A food system gathers all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socioeconomic and environmental outcomes." (HLPE 2014, p29)

Agriculture and nutrition impact each other, and many now recognize nutrition-sensitive approaches to agriculture as a key to achieving food security and good nutrition. To promote nutrition-sensitive agriculture (NSA), extension and advisory services (EAS) need strengthened competencies in nutrition and NSA promotion skills ((FAO and GFRAS,2022). Needs assessment to understand the gaps in learning and capacity among EAS provider is a must to support NSA.

Nutrition-sensitive agriculture is an approach that seeks to ensure the production of a variety of affordable, nutritious, culturally appropriate and safe foods in adequate quantity and quality to meet the dietary requirements of populations in a sustainable manner. The recognition that addressing nutrition requires taking action at all stages of the food chain - from production, processing, retail to consumption – has led to a broader focus which encompasses the entire food system. Making agriculture and food systems nutrition-sensitive necessitates taking action to address input quality, production, post-harvest handling, processing, retailing and consumption, in order to deliver safe and nutritious foods all year round to the consumer.

Nutrition-sensitive agriculture and food systems contribute to improving health outcomes, through for example, production of diverse, safe and nutrient-rich food, income generation that can facilitate access to health services, through reducing contamination of water sources, and through the application of labour-saving technologies.

Improving gender equality and increasing women's empowerment in food systems will result in better food security and nutrition, and more just, resilient, and sustainable food systems for all. Women have fewer adaptation options than men, as social norms restrict women's mobility, freedom of movement, and access to transportation, as do time burdens associated with domestic and care responsibilities. Another important theme is ensuring equitable access to markets where nutritious foods can be purchased. Nutrient-dense foods, such as fruit, milk, and vegetables, are hard to transport and store, and therefore must be purchased locally, particularly in remote and rural areas. There is cross-contextual evidence showing positive effects of nutrition counselling, nutrition education, and maternal education for nutrition, dietary diversity, and health outcomes for women and children. Existing literature shows that women face social, cultural, and institutional barriers to accessing and adopting agricultural technologies, information, and services (Njuki, et al. 2022).

Achieving gender equality and women's empowerment in food systems can result in greater food security and better nutrition, and in more just, resilient, and sustainable food systems for all. Women have differing access to resources compared with men, such as essential services, knowledge and information, technology dissemination, land, credit options, time, and markets. This differing level of access is shaped and reinforced by contextual social gender norms.

Globally, the need for agriculture to support better nutrition and health has been recognized dynamic and multifaceted linkages between agriculture, health, and nutrition. Ruel and Alderman (2013) identified six pathways through which agricultural interventions can impact nutrition:

(1) Food access from own-production;

(2) Income from the sale of commodities produced;

(3) Food prices from changes in supply and demand;

(4) Women's social status and empowerment through increased access to and control over resources;

(5) Women's time through participation in agriculture, which can be either positive or negative for their own nutrition and that of their children; and

(6) Women's health and nutrition through engagement in agriculture, which also can have either positive or negative impacts, depending on exposure to toxic agents and the balance between energy intake and expenditure.

Women's empowerment boosts the gains in dietary diversity from agricultural technology adoption in rural KenyaWe find that women's empowerment has a positive and significant effect on the women's dietary diversity score regardless of technology adoption status. We further show that women's empowerment enhances the positive effects of technology adoption on women's dietary diversity. NSA interventions lead to nutrition outcomes through 5 key pathways: food production, nutrition-related knowledge, agricultural income, women's empowerment, and strengthening of local institutions. The agriculture sector can potentially play a crucial role in responding to the problem of undernutrition by directly addressing inadequate access to nutrient-rich food, which is a key underlying determinant of malnutrition. Past studies highlight the contribution of agriculture to nutrition outcomes through 4 key pathways:

1) Agricultural production improving availability of and access to nutrient-rich foods

(2) Agricultural income increasing purchasing power

3) Agricultural policies affecting food price and

4) Agricultural interventions empowering women to improve their nutrition outcomes and those of their children.

While agriculture and food systems obviously play a key role in nutrition, experience shows that policies and programmes are more likely to have a positive impact on nutrition, and avoid negative impacts, if the following principles are applied:

1. Incorporate explicit nutrition objectives and indicators into their design, and track and mitigate potential harms.

2. Assess the context at the local level, to design appropriate activities to address the types and causes of malnutrition.

3. Target the vulnerable and improve equity through participation, access to resources and decent employment.

4. Collaborate with other sectors and programmes.

5. Maintain or improve the natural resource base.

6. Empower women.

7. Facilitate production diversification, and increase production of nutrient-dense crops and small-scale livestock.

8. Improve processing, storage and preservation to retain nutritional value and food safety, to reduce seasonality and post-harvest losses, and to make healthy foods convenient to prepare.

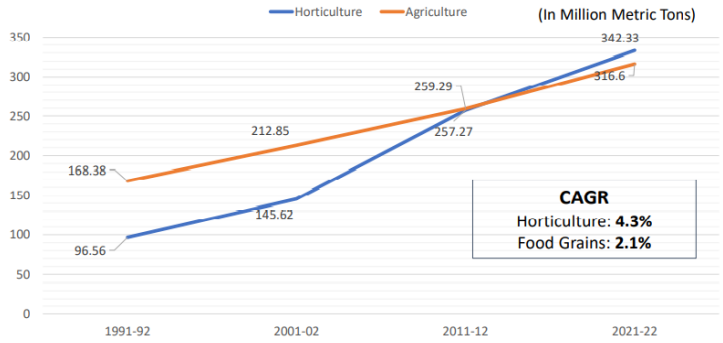
9. Expand market access for vulnerable groups, particularly for marketing nutritious foods.

10. Incorporate nutrition promotion and education.

The diversification of agriculture towards fruits and vegetables and integrated agriculture-aquaculture can potentially promote dietary diversity and improve nutritional outcomes. With more favourable nutrition-sensitive agricultural policies and empowerment of women, it is possible to improve nutritional status.

Horticulture Growth

In last 7 years the area under horticulture has increased from 23.4 Million Ha to 28.08 Million Ha **(20% growth)** while the production has increased from 280.9 Million MT to 342.33 Million Ha **(21.86% growth)** with the support of **Mission for Integrated Development of Horticulture.**



Production of horticulture has surpassed the production of the food grains in India.

Nutrition-sensitive post-harvest handling, storage and processing

Post-harvest handling includes all the steps that a harvested crop has to go through to get from the producer to the market – i.e. handling and treatment of the harvested produce, bulk packaging, transportation, storage, distribution and marketing. The processing phase includes both primary and secondary processing.

Crops must be harvested at an appropriate stage of maturity if their quality is to be maintained throughout their post-harvest life. Good post-harvest handling, supported by appropriate transport and logistical operations, including efficient cold chain infrastructure, is critical to maintaining the quality of food as it moves from the producer to the fresh produce market. Good quality raw material is also an important input for primary and secondary processing operations. Strengthening the capacity of smallholders and small entrepreneurs, in particular women, to store, preserve, process and package foods can help secure a year-round food supply that can improve nutrition and income generation. This can be done through – for example –trainings on techniques to optimize the shelf-life and nutritional quality of foods. In addition to training, provision and maintenance of necessary equipment for storage (e.g. small silos), processing and packaging as well as sustainable supply of inputs, are key.

Processing: Primary processing is used to prepare food for consumption or for further processing; it includes basic cleaning, peeling, slicing, dicing, drying, milling and packaging.

Food preservation involves treating and handling food in such a way as to stop or greatly slow down spoilage to prevent food-borne illness and extend shelf-life; it includes refrigeration, freezing, fermentation, pickling, canning and pasteurization. Secondary processing is the process whereby fresh foods or the products of primary processing are converted into other food products, often in a way that substantially alters their physical form. Methods include, for example, juicing, dicing, canning, cooking and drying. A balanced diet is needed throughout the year to maintain good health and nutrition. Post-harvest handling, processing and storage contribute to: maintaining a secure supply of food (and thus of nutrients) throughout the year; preserving the quality of harvested raw material as it moves along the food supply chain from the producer to the market; reducing losses; and making fresh produce available in local markets as well as in distant locations.

Diversified value-added products in horticulture

Osmotically dehydrated fruits -pineapple, mango,aonla, sapota, guava, papaya banana, Jackfruit, carrot, muskmelon, beetroot, pumpkin etc.

Dehydrated fruits: raisin, fig, anardana from pomegranate, fruit bars from mango, papaya and guava.

Dehydrated vegetables: cabbage, onion, carrot, cauliflower, French bean, okra and leafy vegetables.

Tomato products: tomato juice, whole concentrate, ketchup

Mushroom products: dehydrated mushrooms pickle and chutney frozen mushrooms**.**

Ready-to serves: Juice and beverages from various fruits and vegetables**.**

Nutrition-sensitive value chains

Nutrition-sensitive value chain approaches aim at maximising the nutrition benefits delivered by value chains. This entails promoting value chains for nutritious food products (e.g. fruits and vegetables) and identifying entry points to increase nutritional value at any step of the value chain. Market linkages and value chains play a critical role in determining availability, affordability and quality of food. In this context, nutrition-sensitive value chain approaches offer a useful framework to navigate the complexity of the food system and to unleash its potential to deliver healthy foods, by maximizing nutrition opportunities at any step of the value chain enhance the supply of nutritious food (e.g. increasing production, improving processing, storage and transport capacities); enhance the demand for nutritious food with social marketing and behaviour change campaigns; - add nutritional value (e.g. ensuring food safety, minimizing food and nutrient loss and waste, applying nutrition-sensitive processing methods such as reformulation and fortification.

Women's empowerment and gender equality

Women's empowerment refers to improving the social, economic, political and legal strength of women so that they gain power and control over their own lives. Women's

empowerment is the precondition to achieving gender equality, which refers to women and men having equal rights, opportunities and entitlements in civil and political life. The pathway from women's empowerment to improved nutrition consists of three interrelated components: women's use of income for food and non-food expenditures; women's ability to care for themselves and their families; and women's energy expenditure. Since there is

Women's empowerment and gender equality are at the nexus of the agriculture, nutrition and health sectors. Research shows that resources and income flows that women control have positive impacts on nutrition because they are more likely to be directed towards food, education, health and care. Designing and implementing gender-sensitive interventions in agricultural and rural development and the food system, which address unequal gender relations and empower women, are major factors contributing to the success of programmes to improve nutrition. Hence by promoting the adoption of labour-saving technologies and practices can reduce women's workloads and free up valuable time for child care, food preparation and women's health and leisure. For example: - Higher-yielding and pest-resistant crops, use of draft animals, conservation agriculture and no-tillage methods, and transport facilities to and from fields can all decrease labour needs for agriculture production. - Women are usually in charge of primary processing; therefore, women's work can be facilitated by the introduction of appropriate post-harvest technology, such as small pounding and dehusking machines. - Women in rural communities also spend significant time on tasks such as collecting water and firewood; water-source construction and rehabilitation is thus a labour-saving investment, as are programmes to widen the use of fuel-saving technologies and fuel-efficient stoves for food preparation.

Developing entrepreneurs in agriculture can immensely benefit Indian economy by

- ✓ Reducing the burden on agriculture
- ✓ Generating employment opportunities for rural youth
- ✓ Reducing the need for migration from rural to urban areas, thereby reducing pressure on urban cities etc.

Time for Agricultural Start-ups

- ✓ India today is emerging as a major startup hub with new entrepreneurial energy in various sector in urban localities.
- ✓ Agricultural sector has remained out-of-ideas and out-of-mind.
- ✓ The government has already initiated to offer attractive incentives including easy loans, insurance schemes and tax benefits to farmers-cum-entrepreneurs.
- ✓ Increasing individual and national income

Conclusion:

Women play a key role in all phases of the value chain including reducing food loss and waste at the production, post-harvest and processing stages. Interventions that focus on enhancing women's knowledge and capacities are therefore important to ensure that an adequate quantity of food is available and that the nutritional value of food is

preserved. The agricultural interventions have the potential to influence nutritional outcomes in the South Asia. However, the findings clearly indicate the importance of the home production of nutrient-rich food crops for improving the nutritional outcomes. Bio-fortification of staples and homestead gardens can influence the intake of a micronutrient-rich diet and consequently nutritional outcomes. The diversification of agriculture towards fruits and vegetables and integrated agriculture-aquaculture can potentially promote dietary diversity and improve nutritional outcomes. With more favourable nutrition-sensitive agricultural policies and empowerment of women, it is possible to improve nutritional status (Pandey, 2016). Targeting women for income-generating opportunities through various post harvest and value chain approaches can ensuring equitable access to decent employment. Empowering women is in itself an essential element of the enabling environment for nutrition. Further, training and capacity building on post harvest management and value addition, promoting and facilitating women's access to education will become fundamental foundation for women's empowerment which can also help in reducing food loss and waste: prevention, reduction and management.

References:

- Indu K Sharma, Sabina Di Prima, Dirk Essink, Jacqueline E W Broerse,Nutrition-Sensitive Agriculture: A Systematic Review of Impact Pathways to Nutrition Outcomes,Advances in Nutrition,Volume 12, Issue 1,2021,Pages 251-275,https://doi.org/10.1093/advances/nmaa103

- Jemimah Njuki, et al. (2022) A review of evidence on gender equality, women's empowerment, and food systems,Global Food Security,Volume 33,2022,100622,ISSN2211-9124, https://doi.org/10.1016/j.gfs.2022.100622.

- Marie T. Ruel, Agnes R. Quisumbing, Mysbah Balagamwala,(2018) Nutrition-sensitive agriculture: What have we learned so far?,Global Food Security,Volume 17,2018,Pages 128-153, https://doi.org/10.1016/j.gfs.2018.01.002.

- Pandey VL, Dev SM, Jayachandran U. (2016). Impact of agricultural interventions on the nutritional status in South Asia: A review. Food Policy, 62:28-40.

- Ruel MT, Alderman H. (2013). Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? Lancet, 382 (9891) (2013), pp. 536-551

Chapter: 10

Innovative Marketing Models in Horticulture

D. Sreenivasa Murthy and T.M. Gajanana

The production of fruits and vegetables has been increasing over the years as a result of recent technological breakthroughs - improved varieties/hybrids, production and protection technologies, sometimes even resulting in glut in the market. Efforts are on to put in place institutional arrangements to manage the surplus production. Despite these, producers' share in consumer rupee is still not so encouraging mainly due to non-remunerative prices and enormous post harvest losses at different stages of handling and the resultant deterioration of marketing efficiency and lower returns to the producers (Gajanana *et al*. 2018). Keeping the above in view, the paper discusses the present marketing arrangements, emergence of supply/value chains and innovative marketing models to link farmers to market. Besides the traditional supply chains involving pre-harvest contractors, Commission agents/Wholesalers, processors, Cooperatives, retailers etc, the recent Innovations in marketing intend to make a difference in the returns realized by the producers.

Innovations in marketing of horticultural crops

Model Market Act, 2003: Due to anomalies in trade, the farmers were not getting the benefits of regulation and amendments to APMC Act were made in September 2003 to pave the way for establishment of private markets, contract farming, direct purchase centres and Special Markets for perishables. The Act provided freedom to the farmers to sell directly to the contract-sponsors/private markets, consumers or producers but this was not enough for setting a common agriculture market even at state level. The buyers have to pay APMC charges even when the produce is sold outside the APMC area. In some states, minimum limit of setting up a private market was too high (Rs. 10Crore).

APLM Act, 2017: During 2017, the Agricultural Produce and Livestock Marketing Act was passed which provides for 1) Recognition of a State/UT as a single market, 2) Geographically restriction-free trade transaction of crops, livestock, fisheries and poultry, 3)Disintermediation of food supply chain by integration of farmers, processors, exporters, bulk retailers and consumers, 4) Clear demarcation of the powers and functions between the Director of Agricultural Marketing (regulatory functions) and Managing Director of State/UT Agricultural Marketing Board (developmental responsibilities), 5) Creation of a conducive environment for setting up and operating private wholesale market yards and farmer-consumer market yards, 6) Promotion of direct interface between farmers and processors/exporters/bulk-buyers/end users, 7)Declaration of warehouses/silos/cold storages and other structures as market sub–yard to provide better market access/ linkages to the farmers, 8) freedom to sell to the buyers at the place and time of their choice, 9) Promotion of e-trading to enhance transparency and integration of markets, 10) Provisions for single point levy of market fee across the State and unified single

trading license to realise cost-effective transactions, 11) Promotion of the national market through inter-state trading license, grading and standardization and quality certification, 12) Rationalization of market fee and commission charges, 13) Provision for Special Commodity Market yard(s) and Market yard(s) of National Importance (MNI), 14) Full democratization of Market Committee and State/UT Marketing Board.

Distant market sale model: In order to take advantage of the higher price prevalent in the far off markets, sale of produce in the distant markets has been in vogue for a long time. Pink flesh guava produced in Karnataka is transported to Kochi in Kerala and Chennai in Tamil Nadu with a transit loss of 3.6 to 4.62 per cent and retail level loss of 4.59-6.09 per cent. However, the wholesaler's margin of 21-23 per cent and retailers' margin of 35-46 per cent [Gajanana *et al. (*2019)] more than offset the marketing cost and the losses. Such evidences may motivate the farmers of Karnataka to transport their guava to distant market places and take advantage of the higher price in the distant markets. Besides, the sale of Nagpur mandarins during 2016 in Bengaluru is another case of taking advantage of the higher price in the distant market. The Maharashtra Orange Growers' Association (MOGA) managed to sell oranges @ Rs.25-30/kg in Bengaluru which fetched only Rs.7-8/kg in the production area of Amravati.

Markets for safe and nutritious horticultural produce

Domestic markets: Health and quality conscious consumers now look for safe and nutritious horticultural produce and markets, though on a small scale, have emerged in the form of outlets for organic produce, fresh and dried horticultural produce markets, carbide free produce etc,. The recent experience of HOPCOMS selling carbide free mangoes is a case in point. Enterprises like Era Organic, Phalada Agro Research Foundation, ISKON, Bengaluru, Parisara Organic Junction, The Organic World, Gramarajya etc. produce and market organically grown commodities in their own retail outlets in metropolitan cities.

International markets: Since the overseas importers insist on Global GAP, SPS and MRL, the exporters of these commodities procure them after meeting the required standards which ensure safe horticultural produce. Further, products with 'Certified Organic' label have an overseas market. International importers like the Netherlands based Eosta, Thailand based Swift are showing interest in organically grown fruits and vegetables.The Karnataka Agricultural and Processed Products Export Corporation (**KAPPEC)** in Karnataka has been in existence for over a decade and this Institution can make efforts to export the organically certified produce and ensure premium prices to the producers.

Farmer producers' organizations/companies (FPO/FPC) model

Co-operatives were once considered the only option for marketing. But, looking in to their inadequacies, a committee was constituted under the chairmanship of eminent economist Dr. Y. K. Alagh which recommended for the formation of Producer Company (PC) in 2002. Producer Company is a form of co-operative entity that was introduced in the Indian economy by virtue of Amendment IX A of the Companies Act, 2002 which became effective from February 6, 2003. A PC combines the benefits of a cooperative and the vibrancy and efficiency of a private company. Two examples of high performing PCs outside Karnataka may infuse confidence among the recently formed FPO/PC of Karnataka.

Indian Organic Farmers Producers' Company Ltd. (IOFPCL), Kerala: The first producer company, IOFPCL was able to provide higher price to the organically certified spices, cocoa etc. grown by the members in the face of competition from MNCs like Cadbury's. The PC

successfully demonstrated its power by challenging the Cadbury's and the MNC was forced to increase the procurement price of cocoa from Rs.70/kg to Rs.100/kg. With organic certification and Fair Trade Certification of spices, the member of the PC could get 10-20 per cent premium at the time of procurement.

Small and Marginal Agriculture (India) Producers' Company (SAMAGRI): This is a case of a PC engaged in establishment of own market (Thottam market in Chennai) on par with any super market for fruit and vegetables and also to meet the daily needs of the member farmers. To make farming profitable and to have market access, in 2014-15, the Government set the goal of supporting the creation and/or registration of 2000 FPOs across India over the next few years. The year 2014 was labelled as the '**Year of FPO'** and support packages were developed. The qualifying criterion for an FPO to benefit from Central and State Government schemes/programmes is that it must be registered and administered by farmers focused on agricultural activities. As part of these packages, the small farmers' agribusiness consortium (SFAC) provides credit guarantees to farmers to mitigate risks and provides grants worth around $15,000. NABARD gave funding support of around 30 million dollars to 2000 FPOs and providing credit support for business operations and capacity building. The FPOs are eligible for higher subsidies. Now, GOI intends to support formation of about 10000 FPOs in five years.

Realising the importance of collective bargaining and possibility of getting profit to the member producers, the Directorate of Horticulture, Government of Karnataka formed more than 92 FPOs which would be forming their producer companies. As stated earlier, IOFPCL in Kerala and SAMAGRI and Tottam market in Chennai are indicators of success of PC. Similar successful ventures in Karnataka are not yet a reality. It is worth noting that **Raithamitra Producer Company** of Mysore made headways in linking the member producers of fruits and vegetables to market by establishing linkage with Kerala traders. Further, to help stabilise the price, during 2017, a progressive decision was taken by this PC to purchase vegetables at Rs.6/kg whenever the market price crashed below this.

Contract farming and price contract models

Contract farming has been in existence for export oriented crops like gherkins, baby corn, chillies, seed production of vegetables and flowers.

Contract price: Ooty is also called as 'carnation capital' of India and besides carnation, gerbera and liliums are also grown on a large scale due to the favourable climate. However, marketing was the main problem for these Ooty grown flowers. Price contract between the traders of Bengaluru and the flower producers of Ooty eased this problem to some extent. Further, traders of Bengaluru also facilitated the sale of Ooty grown flowers in Kolkata and Delhi.

e-marketing of flowers: International Flower Auction, Bangalore (IFAB) is a perfect case of an institution created based on the principle of PPP for online trading of flowers. The IFAB Limited is a joint venture company of public and private shareholders, established during 2002 with the objective to auction high-quality cut-flowers every day. This is the first International Flower Auction Company in Asia situated in Bengaluru. Over the last 18 years, IFAB has been bringing supply and demand together, for an optimal price and the lowest transaction costs, offer a wide range of services, and work intensively together with new and existing partners in the horticultural sector and supplies the world with fresh flowers for 365 days. "Together we are Growing strong" is the notion upon which IFAB is based. Growers come together to the same place to sell their products. At present daily average volume of flowers auctioned in IFAB has gone up from 20,000 to 2.5 lakh.

Direct linking of farmers to market: Start-ups like Ninja Cart, Apna Haat, Helpchat, Fair trade, Honey Bee solutions are slowly making their entry in to marketing of horticultural crops by establishing a direct linkage between the producers and the market. Ninjacart is India's largest fresh produce supply chain company and is offering technological solutions to the problems in the world. It connects producers of food directly with retailers, restaurants, and service providers using in-house applications that drive end to end operations. Currently, their Supply Chain is equipped to move 1400 tonnes of perishables from farms to businesses in less than 12 hours. The Ninjacart startup company tried to solve the problems of the fruit and vegetable farmers by eliminating the intermediaries by taking control of the Supply Chain by using technology and analytics. They built reliable, cost-effective, and high-speed logistics and infrastructure to solve for inefficiencies in the Supply Chain.

Value chains development in fruits

Value addition by self help groups (SHG) in underutilized fruits like Amla, Koranda, Kokum (*G. Indica*) and Uppage (*G.gummigutta*) by NGOs like BIRD-K, Tiptur (BAIF), Life trust, Sirsi was seen as a case of value addition by way of creating value chains for underutilized fruits. Further, converting aromatic mangoes (*Appemidi*) in to pickle by women SHGs to capture the niche markets is another case of value chain development for fruits. Value addition to Kokum fruit by processing it in to butter using the seed and Kokum juice/concentrate/syrup and HCA from the rind are examples of value chain development in Dakshina Kannada, Uttara Kannada and Kodagu districts.

Innovations during Covid-19 period

The Corona Covid-19 pandemic created unprecedented damage to the mankind and the economy. The supply chains were disrupted and logistics were hampered due to lockdowns and agriculture sector had to bear the brunt of this due to non-availability of labour force for agricultural operations and inadequate transport arrangements for marketing. Despite the severe setback and the subsequent post-harvest operations, many innovations unfolded during this period. The farmers found their own way by resorting to direct marketing to the residential complex dwellers and resorted to add value to the produce by drying (tomato) as well as adopting distant marketing (grapes). The FPOs rose to the occasion to extend a helping hand in marketing of the produce (Puttari Farmers' Producers' Company Ltd.).

Direct linking of farmers to market: Farmers, in association with UAS Bangalore Alumni Association, could sell about 400 tonnes of grapes in the residential complexes @ Rs.55-65/kg thereby realizing full value for their crop and also helping the consumers saving about Rs.25-35/kg. Agri War Room at UASB also facilitated sale of mangoes.

Agricultural Extension Education Centre, Bheemarayanagudi, UAS, Raichur facilitated direct linking of farmers to wholesalers. About 346 tons of fruits and vegetables worth Rs.36.77 lakh were sold. The producer's share was higher during the Covid-19 lock down period both in case of fruits (63.04 % against 57.62% before lock down) and vegetables (56.92% vis-a vis 53.68% pre-lock down period). Involvement of government agencies played an important role during the lockdown period [Reddy and Hiremath (2020)].

Value addition activities by farmers/farm groups : During Covid-19, price of tomato crashed to Rs.4-5/kg and the Kolar farmers resorted to value addition by sun drying tomato to prepare the tomato slices. The NGOs supported the SHGs by encouraging them to prepare the Sundried tomato slices using solar panels for effective conversion of solar energy.

New initiatives (Innovations) by ICAR-IIHR : The ICAR-IIHR did not lag behind in extending the facilities/technologies to manage the Covid-19 situation. When the cultivation of crops was difficult due to labour shortage, ICAR-IIHR promoted the new **seed-village concept** for seed production which ensured at least three fold increase in the returns. The Solar powered Fruit and Vegetable Vending Van of IIHR became handy in moving the produce from production point to the consumers. An interface meet on 'Role of ICAR-IIHR in boosting horticulture during and Post-Covid-19' with the media was arranged. The Institute was a co-host to CCS-NIAM, Jaipur of the month long Webinar series on supply chain arrangement for the horticultural crops. Webinars were also organized by IIHR for transfer of its technologies. Considering that the city dwellers were confining themselves to their homes due to lockdowns, the Institute prompted the idea of terrace gardening and vertical farming by arranging online training programme in association with Society for Promotion of Horticulture. The e-horticulture WhatsApp group at the Institute helped the farmers by linking the producers to the buyers.

Tomato crush – IIHR initiative: The **crushed tomato** is an intermediate product where inclusion of seed and peel adds to the consistency and colour of the product. Ready-to-use crushed tomato is rich in ascorbic acid (17.55mg/100g) and lycopene (5.65mg/100g). It is acidic and could be used as a substitute for fresh tomato for various culinary preparations. About 1000 kg of tomato can be converted in to 300 kg tomato crush. This technology is ccommercialized to AP based Sun Sip Company and licensed to 6 FPOs. Farmers are linked to these processors.

References

- Chengappa, P.G., Arun, M., Yadava, C.G. and Prasanna Kumar, H.M., 2012.IT Application in Agricultural Marketing Service Delivery — Electronic Tender System in Regulated Markets, *Agricultural Economics Research Review*, 25 (Conference Number):359-372
- GajananaT.M., Sreenivasa Murthy, D. Saxena, A.K. Sudhakar. Rao, D.V. Sudha, M. and Dakshinamoorthy, V., 2018. *Economics of post harvest loss and marketing efficiency in selected fruits and vegetables*, Technical Bulletin No. 69, ICAR-IIHR, Bengaluru
- Pavithra, S., Gracy, C.P., RakaSaxena and Ganesh Gowda Patil, 2018. Innovations in agricultural marketing: a case study of e-tendering system in Karnataka, India, Agricultural Economics Research Review, 31(1):53-64
- Reddy, Amarender, 2016. Impact of e-markets in Karnataka, India, Indian Journal of Agricultural Marketing, 30(2):31-44.
- Reddy, B.S. and Hiremath, G.M., 2020. Linking farmers to market: Marketing of perishable commodities during lock down period.

Chapter: 11

Business Planning in Horticulture, Hortipreneurship, startup and stand-up culture in Horticulture among women farmers

V.K. Jayaraghavendra Rao

Introduction

Horticulture value chains are facing growing consumer expectations for variety, food safety and security. Most horticulture supply chains operate in a push based approach rather than demand driven or pull based, which leads to a mismatch between demand expectations and supply side capabilities. In developed markets in, India, horticulture supply chains are experiencing by excess capacity, lack of differentiation and lower prices and ultimately leading to glut. Last year the 326 mt of Horticultural production for year ending 2019-20, Emerging market challenges are more related to supply shortage, lack of product variety, and safety and quality of the produce. All this leads to low income among hortipreneurs, who lack visioning and strategy for production and value addition opportunities in horticulture.

This mismatch between expectation and supply calls for restructuring of the horticulture production chain from a push based system to a combined push-pull system. A combined push-pull approach ensures that market dynamics are taken into consideration when it comes to making decisions about technology adoption and production capability. The Indian Institute of Horticultural research at Bengaluru, has a basket of 300 plus technologies for commercialising and licensing to hortipreneurs, which includes varietal, production technology, crop protection, and post-harvest technology both handling, storage and processing. Hortipreneurs in India agree that achieving the optimal push-pull requires tailored business models in Horticulture through a sound DPR(Detailed Project report) and tailormade Business plans on many technologies at different scale is developed at IIHR and Hortipreneurs, will have to take advantage of it through our BPD(Business Planning and development unit. How the hortipreneur approaches the business opportunity with vision and strategy has to scout for a genuinely differentiated business model. To facilitate right interpretation and understanding we define the critical components that constitute a business model, Entrepreneurial dynamics, psychology of an entrepreneur, his motive, the strength of his achievement motivation coupled with the right business model and technology holds the key for a profitable horticultural entrepreneurial venture. Changes in the business environment along with innovation procedures bring about new situations that need to be solved not just e*ff*ectively but with care and in an original way and finally with added value for the customer, e.g., Probiotic Juice, novel packing in horticultural produce and processed products. In spite of a record horticultural production the Hortipreneur is not able to increase his income, because only selling fresh fruits and vegetables he has to market in a buyers'

market as the production is more than the demand and supply is very huge leading to glut. So the only solution for achieving a higher income is value addition of horticulture products, and tapping the new opportunities emerging in Horticulture so that the hortipreneur is abreast with the latest Knowledge and his return on investment is ensured, enjoy through diversification and value addition and simple selling of fruits, vegetables, and flowers alone cannot increase the income of a Horticulture farmer.

Hortipreneurship is one of the key drivers for economic development. During an economic crisis, the importance of entrepreneurship development increases. Entrepreneurship has been linked to improved growth, increased wealth and quality of life. In developing countries like India, planning and implementation for development of entrepreneurial programmes are essential for raising the living standard of the vast majority of the backward regions because of their over-dependence on agriculture for employment Thus, entrepreneurship development appears to be the best substitute to find employment opportunities, income generation, poverty reduction and improvements in nutrition, health and overall food security in the national economy. And avoiding glut experienced in fresh fruits, vegetables, and flowers in the market, and value added product marketing holds the key.

Agriculture is considered as the main economic activity which adds to the overall wealth of the country. In the past, agriculture was seen as a low-tech industry dominated by numerous small family firms, which are mostly focused on doing things better rather than doing new things. However, over the last two decades, this situation has changed dramatically due to economic liberalization and a fast changing society. Agricultural companies have to adapt to the erratic demands of the market, varying consumer habits, triggered by globalisation and exposure, stringent environmental regulations, new requirements for product quality, food safety sustainability, and so on. These changes have opened up new opportunities nd challenges the way for new entrants, are innovation, and portfolio Hortipreneurship. Farmers, researchers, agricultural business and governments have recognized this and emphasized for a more competitive Hortipreneurial environment.

The Hortipreneurial skills of farmers need to be developed and addressed by all stakeholders in the agricultural socio-economic network especially ICAR IIHR has been doing this in Horticulture production, value addition, diversifying networking and strengthening the supply and value chains in Horticulture. There are various strategies available to farmers for survival and changing their economic environment which results in business growth. For example, the farm enterprise may be expanded through tourism or other forms of non-agricultural business, or by integration of the value chain by engaging in food processing, direct marketing in times of CORONA and POST CORONA , or through organic production of Horticultural products. The social and economic environment of farming should not be underestimated when studying and promoting the development of entrepreneurial skills. Entrepreneurship can only be improved when the entire agricultural socio- technical network is involved in the process,

The business management skills, availability of funds, market availability and accessibility and technology adoption are the weak links in Hortipreneurship. Therefore triggering the minds of the hortipreneurs inspite of the low success rate in successful Hortipreneuring(around 5 percent) is the key to refresh the existing hortipreneur and the emerging hortipreneur into new vistas and opportunities in the horticulture value addition sector, a low turnout is not a testimony to stop the Horticultural entrepreneurship promotion per se. the product or service may or may not be new or unique but value must be inculcated by the entrepreneur. Entrepreneurship in Horticulture can also be

defined as the formation of novel economic organization for the intention of growth under risk and uncertainty in Horticulture, employment generation, poverty reduction, improvements in nutrition, health and overall food security in the national economy especially in rural areas. In the face of growing unemployment and poverty in rural areas, there is urgency of entrepreneurship in Horticulture for more productivity and profitability

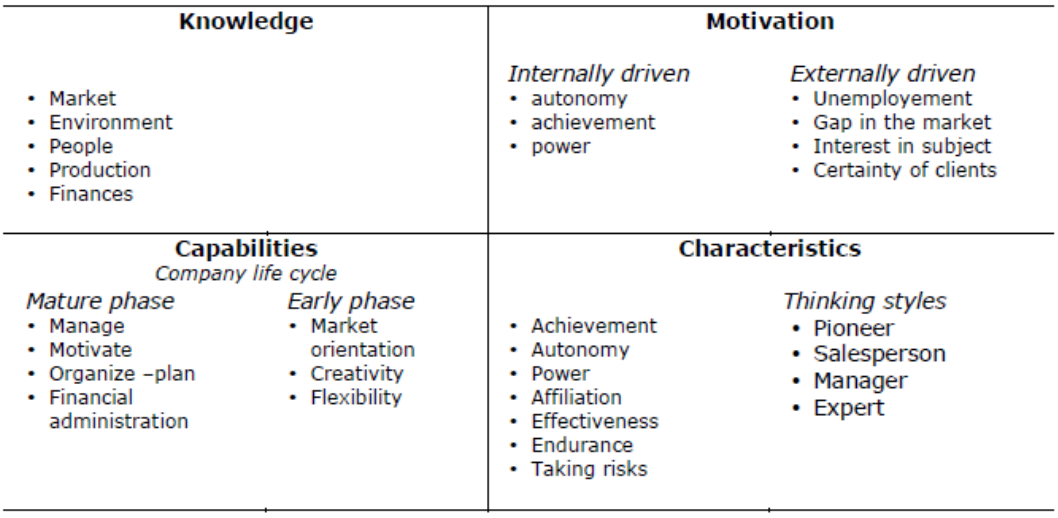
Psychology of a Hortipreneur

A hortipreneur when he starts a venture may not have the full feasibility ratios in mind about the venture, so need to upgrade from scratch, and make his decisions data driven and not emotion driven, do a thorough homework, browse various websites, discuss with experts, and practicing hortiprenuers, and then come to various business decisions of production, marketing etc. and value packing is another dimension to reduce costs without compromising on the utility of packing. The Hortipreneur should be optimistically ambitious and go slow through a pilot scale and upscaling after the required break even, and not jump into venturesome decisions. The Hortipreneur should have an experimental mindset, and base his decisions on data, and have a reasonable amount of flexibility. But most hortipreneurs or entrepreneurs are ambitious, and emotional, the research indicated, and they jump to conclusions in haste and hence suffer losses and mishaps, this needs to be rectified.

Entrepreneurial Competencies

The entrepreneurial competencies are a combination of various dimensions of a hortipreneur, like Knowledge, motivation, capabilities and his personal characteristics, the combination of all these affect the entrepreneurial outcomes. Knowledge about

Figure 3: Entrepreneurial Competences



Market, environment, people customers, production processes of competitors and finances for the technology are important besides intrinsic motivation, autonomy and achievement nd power

dimensions need to be satisfied for the hortipreneur, and a hortipreneur requires different skills at different stages of the product life cycle, like in early introduction and growth stage he requires capability to target his product, position the product through a market orientation strategy with creativity and flexibility of pricing to capture the markets to increase the market share and market growth, while t the maturity stage of the product he needs to manage his business as a cash cow and maintain his market share and growth, and his market position and not be subject to vulnerabilities of the market, for this he needs to plan, organise, and have a good financial administration and some of the characteristics he need to pick up or inculcate to be in the business include, endurance, risk taking, affiliation with success ventures, and gain control on power and autonomy of his business and not to depend on others for the success and maintenance at initial stages, his thinking style must be of pioneer, salesperson, a manger and an expert till such time the business establishes.

Business Planning

The business plan answers the key questions about the business: who, what, where, when, why, and how. For a developing business, it begins the process of making an idea materialize into reality and determining whether or not an idea should become reality. It also establishes goals and benchmarks for the business. A comprehensive business plan makes it easier for a business to receive external support, especially in terms of financing from potential investors, lenders, and grant sources. Finally, and possible most importantly, going through the process of planning is very valuable because it forces the business owners and/or managers to think through every detail of the business.

Business Plan Elements

A comprehensive business plan generally includes the following sections:

1. Description of Business
2. Marketing Plan
3. Management & Operations Plan
4. Financial Plan

1. **Description of Business**

This section provides a description of the business, including products and services offered. This section also gives a brief history of the business and background of the owners, and provides a description of why the business is being started or expansion pursued. Key components of this section along with questions covered in this section include:

Ownership/Business Structure: Who are the owners of the business? Is the business legally organized? If yes, how is it organized?

History/Background: When did you start the business? What are the highlights of the history of the business? What is the background of the owners? What sparked your interest in developing this business or launching this expansion?

Vision/Mission: What do you want this business to be in 3-5 years? What characteristics do you want it to embody? What is the purpose of the business—who we are, what we do and for who we do it? The mission statement for the business should state what the business hopes to accomplish in the bigger picture.

Goals: What are your short-term goals for the business (less than 3 years)? What are the long term goals (more than 3 years)? The goals should outline specific measurable goals for the business. They should be numbered and listed in order of importance.

Location: Where is the business located? What is a basic description of the facility and operation?

Marketing Plan

The Marketing Plan outlines the key activities of the business. Key components of this section along with questions covered in this section include:

Industry Analysis and Trends: What are the key trends that are impacting your business?

Market Background: What are the demographics for your market area? What are recent developments in your marketplace? Customer feedback or survey results (if this has been done).

Target Customers: What groups will the business be targeting with its products and services? What are key details about these groups? What are their demands and needs?

Products/Services: What are the main products or services offered by the business? What are the features of these products/services? What are the benefits of these products/services? How are new products introduced?

Key Competitors: Who are the key competitors? What products do they offer? What are their capabilities? Where are they located? What are their strengths? What are their weaknesses? What is their reputation?

Market Positioning: What is your value proposition? What is your competitive advantage? What is the goal of the business in how it wants to be regarded in the marketplace?

Pricing Strategies: What pricing strategies are used in setting prices? Who is responsible for

setting prices? What have prices been historically for similar products/services in the market? What prices are necessary to make the target market viable? What are some of initial key product prices?

- **Distribution:** Will distribution involve largely local markets or will there be significant interstate trade? How will products be distributed? Will the business use its own transportation or will it contract with 3rd party providers?
- **Sales and Promotion Strategies**: What tactics will be used to promote the business? What forms of media will be in its advertising? What type of advertising will the business use to promote its products/services?, How will the business target the most valued customer groups? How will the business measure the effectiveness of advertising and promotional efforts?
- **Marketing Goals:** What are the specific marketing goals for the business? These should outline specific measurable goals, and they should be numbered and listed in order of importance. Examples include: increase sales by $X, sell X in volume, etc.
- **Sales Forecasts:** What are the projected sales forecasts for the first 3-5 years broken down by product line or service category?

2. Management and Operations Plan

The management plan describes how the business operates with respect to employees and management structure, and the operations plan should describe the facility and equipment and operations of the business. Key components of this section along with questions covered in this section include:

Management Plan

- **Owners/Investors**: Who are the owners of the business?
- **Business Structure**: What is the legal structure of the business? When did it legally organize?
- **Organization Chart**: Section needs flow chart that shows where line of responsibility for each employee and owner.
- **Key Personnel**: What are the personnel requirements? What are the basic job profiles for each position?
- **Salaries/Benefits**: How are salaries determined? What are the expected ranges for salaries for each position? What benefits are offered to employees?

- **Staff Meeting**: How often does the business have staff meetings?
- **Training/Evaluations**: What training is offered to employees? How are employees evaluated?

1. Operations Plan

a. **Facility Description**: What is a basic description of the facility? What are key features?

b. **Equipment**: What is the necessary equipment for the business operations?

c. **Overview of Production Processes:** What are the different processes of production? What are the key elements?

d. **Regulations/Permits**: What are key regulatory requirements that must be met? What permits are necessary?

2. **Financial Plan**

The financial plan will include the current financial statements for a business that is in operation and the pro-forma or projected financial statements for a new or expanded operation. It will include the income statement or operating budget, cash flow statement which includes all inflows and outflows of cash to or

from the business, and the balance sheet which shows the current or projected net worth of the business. For a start-up business, it might also include a capitalization plan. This would list the start-up costs and a plan for how the business expects to generate the start-up capital. The financial plan should also detail how the financials of the business will be managed. Key components of this section along with questions covered in this section include:

Estimated Start-up Costs: For a start-up or expansion, what are the identified key start-up costs and what are the cost estimates for each?

Capitalization Strategy: What sources of funds will be used to capitalize the business?

Inventory Management: How will inventory be maintained? What system will be used maintain and monitor inventory? Who will be responsible for inventory management?

Accounting System: What type of accounting system will be used? How will record be maintained? Will the record be audited? Who will be responsible for maintaining the records? What reports will be generated to monitor financial performance? Will the business employ a CPA?

Insurance: What types of insurance coverage does the business carry?

Financial Projections (3-year cash flow, income statement and balance sheet)

Key Performance Measures: What performance measures or benchmarks will be monitored to evaluate the performance of the business?

THE BUSINESS PLAN

Business planning can be a highly beneficial exercise for the entrepreneur. In order to derive the desired benefits from business planning it is important to take full ownership of the process, and make it your own from beginning to end. While this does not mean that you should not seek professional advice when needed, you should be careful, not to commit the common mistake of asking others to write the plan for you or being influenced by unqualified opinions even if well intentioned.

The *Executive Summary* is a brief overview of the whole business plan. Here are some simple hints to help you build your Executive Summary:

- Description of Business: Provide some information about the product or service you wish to offer.
- The Market: What markets do you intend to target?
- Growth Potential: What is the potential for your business? (What do you hope to achieve in one to three years' time?)
- Sales & Profit Forecast: Give a summary of the sales and profit forecast figures (for the next three years).
- Financial Requirements: How much money would you require:
  - To start the business.
  - To sustain your business during the first three years.
- Utilisation of Finances: What will the loan/overdraft/investment be used for?
- Where will you source your funding from: Loan, Bank Overdraft, Personal funds ?
- Repayment of Loans: How long do you expect the loan repayment period to be?

List of Critical Issues for the Success of the Project: Present a list of the critical success factors most likely to affect your project.

- To highlight the attractions of your business—(you have to get the reader's interest).
- To show that your plan is well researched with figures to back up your forecasts.
- To demonstrate your management ability.
- To show that your product has a market.

References

https://www.kyagr.com/marketing/documents/AT_KCARD_Business_Plan_Development_Guide.pdf

https://businessfirst.com.mt/en/planning/documents/business_planning_guidelines.pdf

http://uilis.unsyiah.ac.id/oer/files/original/c07bf3e0420a6d5c391482a5a032a9e9.pdf

https://oasis.col.org/colserver/api/core/bitstreams/47549b32-45d2-4951-ac60-565b94610e5d/content

Chapter: 12

Success Stories of farm women: Experiences of North-East States

Utpal Barua[1], Mokidul Islam[1], G. A. Atheequlla[2] and B. Balakrishna[2]

[1]Krishi Vigyan Kendra Ri Bhoi, ICAR RC for NEH Region, Umiam, Meghalaya
[2]Scientists, Division of Social Sciences and Training, ICAR-IIHR, Bengaluru

ICAR-IIHR, Bengaluru in collaboration with Krishi Vigyan Kendra Ri Bhoi, ICAR RC for NEH Region, Umiam, Meghalaya and other Government agencies of North-East has spread its wings to disseminate IIHR technologies in North-East and yielded in greater profitability and supported their livelihood among farmers and farm women too. Some of the Success Stories of farm women briefing the experiences of North-East States are described in the article.

Onion Variety Arka Bheem Changing Fortune of Farm Women in Ri-Bhoi District, Meghalaya

Kong Biona Lymphuid a progressive women farmer of Kyrdem village, who prefers to explore and adopt new technologies, has been keen on cultivation of onion. During a farmers scientist interaction programme organized by KVK Ri Bhoi, she expressed her desire to cultivate onion crop. During that programme the Subject Matter Specialist Horticulture of KVK Ri Bhoi promised her for help and he started looking for a good variety of onion. Then he approached ICAR-IIHR, Bengaluru and discussed with concerned scientists about promoting onion cultivation in Ri Bhoi district. Then he has introduced onion var. Arka Bheem received from IIHR. Before taking up demonstration programme, group meeting was organized with all the 20 members of the SHG in the presence of KVK Ri Bhoi. The main aim of the meeting was to make SHG members understand about the new onion variety and its production, cultivation practices and possibility of enhancing income. It was also assured that during the whole course of crop production constant monitoring would be undertaken in the field so as to mitigate any difficulties arisen during crop production stage. As the farmers were not aware of the cultivation practices of onion, the SMS Horticulture after looking at the prevailing temperature, day length hour and rainfall pattern decided to go for nursery production in the month of November inside polyhouse. The Kyrdem village is abundant with paddy cultivation, which is harvested in the month of November. Generally farmers after paddy harvest grow winter vegetables in the paddy field as fields holds enough soil moisture, so that irrigation form outside is not required. To transplant onion seedlings raised bund of 1 m width and 30 cm height were prepared, each bund at 2 foot apart. During the first year (2017) Kong Biona raised seedling of Arka Bheem on behalf of all SHG members in her polyhouse and they collectively transplanted onion in an area of 1.0 hectare during the month of January. The package of practice provided by IIHR Bengaluru was followed thoroughly during the crop production to harvest stage.

IMPACT

The onion bulbs were ready for harvest in the month of mid April. In the first year the group members could harvest bumper yield of 375 q/hectare. The average bulb weight was 90 -100 g.

Bulbs were sorted, graded and bigger size bulbs were sold in the market at price of Rs. 30 - 35/- per Kg. This has increased their overall farm income by 15 - 20 % as compared to the previous year (Table 4). Overwhelmed by this success, the SHG members have been procuring seed of Arka Bheem every year from IIHR and are producing onion for the last five years. The group is constantly monitored by SMS Horticulture, KVK Ri Bhoi for any technological support. The success has led to the adoption of onion var. Arka Bheem by 15 SHG's of the village comprising 20 members each. Now Arka Bheem onion is being grown in 25 villages comprising 125 SHGs in the Bhoirymbong block with active support from KVK Ri Bhoi. Kong Biona has been promoting and helping other interested farmers as local resource person for onion cultivation.

S. N	**Particulars**	**IIHR variety**	**Farmers practice**
1.	Variety Name	Arka Bheem	Local variety
2.	Season	Nov - April	Oct - Feb
3.	Average price obtained per kg	Rs. 30-35/-	Rs. 20-22/-
4.	Yield obtained per hectare	375 q/ha	150 q/ha
5.	Gross cost of cultivation (Rs./ha)	1,32,200/-	1,08,600/-
6.	Gross income (Rs./ha)	7,75,500/-	2,25,000/-
7.	Net income (Rs./ha)	6,43,300/-	1,16,400/-
8.	Benefit Cost Ratio	5.86:1	2.07:1

Transplanted onion in the main field

Onion bulb harvesting

	
Farmer harvesting bulbs	**Farmers making bunch of bulbs for storage**
	
SMS Horticulture inspecting storage of Onion	**Arka Bheem onion bulbs**

Yardlong bean variety Arka Managala enabled handsome income to women farmer of Zunheboto district in Nagaland

Mrs. Edenly Chishi, Chief Technical Officer, Horticulture
Dr Rakesh Kumar Chaurasia,Principal Scientist,
KVK, Zunheboto, Nagaland

BACKGROUND OF THE FARMER

Name of the farmer: Mrs. Aholi Sumi

Village: Lumami

Block: Akuluto

District: Zunheboto

State: Nagaland

PROBLEM/NEED IDENTIFIED

Lack of high yielding and disease resistant variety of yard long bean

Technological Intervention in Brief

Farmers in this region were earlier growing their local variety named Kuithi, which was giving less yield. To address the above problem staff of KVK, Zunheboto in collaboration with ICAR-IIHR undertaken OFTs in kharif season. After successful performance of Arka Mangala variety of yard long bean two demonstrations were conducted in the farmers' field.

EFFORTS MADE BY INSTITUTE

After field visits and surveys, it was found that farmers' variety Kuithi was yielding very less. We introduced high yielding and disease resistant yard long bean variety Arka Mangala in an area of half an acre. The percentage of yield increase over farmer's variety was 61.12 %. The farmers were happy. Seeing its performance farmers in the nearby villages are cultivating Arka mangala yard long bean.

IMPACT

S.N	Particulars	IIHR variety	Farmers practice*
1.	Variety Name	Arka Mangala	Kuithi
2.	Season	Kharif	Kharif
3.	Area cultivated in acres	0.5	0.5
4.	Average price obtained per kg (in Rs.)	30	30
5.	Yield obtained per acre	3.3 tonnes	2.06 tonnes

6.	Gross cost of cultivation per acre (Rs./ac)	24,400.00	22,200.00
7.	Gross return per acre (Rs./ac)	99,000.00	60,180.00
7.	Net income per acre (Rs./ac)	74,600.00	37,980.00

FIELD PHOTOS

Vegetable Cropping System With Off Season Tomato Var. Arka Rakshak In Hilly Terrain Of Aizawl District

Dr. Santosh Kumar[1], Dr. Jotish Nongthombam[1], Dr. K. P. Chaudhary[1], Mr. Lalvensanga Pachuau[1], Atheequlla G.A[2], B Balakrishna[2]

Problem/ Need Identified:

The development in agriculture is hindered by lack of quality seeds & scientific knowledge on systematic cropping system. Further, existing high incidence of pests, diseases and weeds amplifies the constraints faced by the farmer. These constrains are drastically affecting her cropping intensity leading to low yield of crops and marginal income.

Technology Intervention in brief:

High yielding variety seed of Tomato (Variety: Arka Rakshak), a triple disease resistant variety developed by IIHR, Bangalore were demonstrated Mrs. Lalrinpuii farmers field during off season. She raised nursery in the polyhouse and then was cultivated during off season in terrace condition with 50cm x 50cm plant to plant and row to row spacing and Integrated Nutrient management with Arka vegetable special micronutrient are also implemented. The designed intervention includes timely production of healthy seedlings under polyhouse, irrigation from Jalkund (micro water harvesting structure), off season cultivation of tomato Var. Arka Rakshak, that can result in better yields for fetching higher price for the farmer. The details are as follow:

Effort Made by Institute/ KVK: Viewing all the problems and challenges faced therein, with coordinated helped from the subject experts of KVK Aizawl, a triple disease resistant of tomato Var. Arka Rakshak was introduced and also scientific interventions were made to tackle the existing scenario.

The details are as follow:

1. Off season cultivation of tomato var. Arka Rakshak with Integrated Nutrient management along with Arka Special Micronutrient are also implemented.
2. A polyhouse of 5x8m dimensions is constructed in the field with critical inputs and technical know-how from the subject experts of KVK, Aizawl which immensely helped in timely and sufficient production of healthy seedlings.
3. Nursery raising is done under protected polyhouse system with mini sprinklers. The same structure is again utilized for production of indeterminate tomato var. Arka Rakshak for additional income.
4. A jalkund (micro water harvesting structure) of 5x4x1.5 m dimensions, holding a capacity of 27,000 litres was constructed on the upper part of the field. Rain and runoff water is harvested into the jalkund during monsoon and utilized for irrigation of crops during the winter season through gravity fed micro-irrigation system (drip & sprinkler).

Off season tomato Arka Rakshak

Off season tomato

Arka Rakshak tomato under the polyhouse.

Outcome and Economics

Crop	**Before intervention (Avg. of two years)**			**After intervention (Avg. of two years)**		
	Cropping period	**Avg. Yield (Kg/acre)**	**Income (Rs.)**	**Cropping period**	**Avg. Yield (Kg/acre)**	**Income (Rs.)**
Tomato	Oct – Feb	9400	1,13,000	2nd fortnight April – 1st fortnight Aug.	14400	2,13,000
Tomato under polyhouse.	-	-	-	November to March	3.1 q/50m^2	24,500
TOTAL			**1,13,000**			**2,37,500**

Horizontal spread and Impact:

Before the intervention, generally, local leafy vegetables were cultivated during the summer season and the fields were left uncultivated during the winter season which led to a low income of the farmer. However, after the interventions were adopted, she could get an increase of 40-60% in the overall yield. There is no more shortage of quality & healthy seedlings through timely production in the polyhouse. She could also fetch higher price of the farm produce because of the off season cultivation especially tomato which was fetching almost double the price than during the normal season. Her works and efforts have been appreciated by fellow

farmers and are ready to adopt the interventions in their field. And further a total of 44 farmers learning her benefits have come forward for advisory help to KVK Aizawl, CAU (I), Mizoram regarding the details of the technology how to be properly implemented. Becoming a model for her fellow farmers, to a total of 66 farmers have replicated the technology covering a total of 5 villages which has lead to earn her a fame and popularity among the farming community. Inspired by her success and contribution to her farming community local News channel LPS and Doordarshan National, Aizawl, Mizoram interviewed her which was telecasted in the their respective channels.

Interviewed by the **local news channel (LPS)** and **Doordarshan National, Aizawl**, Mizoram for her contribution to the local farming communities.

Doordarshan National, Aizawl, Mizoram telecasted her interview on national channel.

2023 EDITION