



Policy Issues in Fruits and Vegetables Post Harvest Management in India



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*ISTIP (Indian S&T and Innovation Policy):
First Study of its kind focusing on various
dimensions of innovation activity in India;
aiming at providing valuable inputs for S&T
and Innovation decision making.*

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Executive Summary

Fruits and vegetables (F&V) sector is central to various themes of Indian Economy, Agriculture, and Society etc. It is vital in relation to the nutritional component of recent food security debate. It consists of a significant part of India's export in agricultural commodities, which is around 9 percent of total food export (Jan, 2015). It provides Indian farmer with an alternative from traditional agriculture and has the potential of providing comparatively greater profit ratios. Being a labor intensive sector, it can provide employment in various sectors according to their level of skill. India has immense unrealized potential in fruits and vegetables post harvest processing sector. In spite of being the second largest producer of fruits and vegetables, India is lacking in crucial fronts like global trade share and per capita consumption of processed fruits and vegetables.

To realize the hidden potential of the sector, Government is acting through various programs, schemes, regulations and other legal initiatives. In post independence India, the first noteworthy development in the sector was experienced post green revolution which was focused mainly on staple food like wheat, rice, maize etc. but the various benefits related to technology, institutions, policies etc. were absorbed by fruits and vegetables sector too. Regarding post harvest policies, another major development which enabled this sector for trade in a transparent, competing and challenging environment was opening up of Indian economy post Liberalization Privatization Globalization (LPG) reforms of 1991. Recent phase of economic reform post global economic crisis of 2008 also gave a boost to the sector by attracting Foreign Direct Investment (FDI) in Retail, abolishing restrictive trade practices etc.

Most important among recent government initiatives for

strengthening the F&V sector is announcement of Second Phase of Green Revolution: Shift to Horticulture, which was announced in Union Budget (2014-15) speech by the Finance Minister. This will be a technology-driven phase of green revolution with emphasis on higher productivity and a protein revolution.

In addition to this encouraging picture, there are some issues inhibiting growth of India's fruits and vegetables sector. To boost the meager share in global trade which is around 1%, F&V produce need to comply with global safety and hygiene standards. The productivity per unit cropped area and level of processing is quite low when compared to global average. The state of infrastructure in the sector also leaves a lot to be desired. The amount of cold storage and cold chain is insignificant compared to the quantity of produce and additionally it is highly skewed in favor of one crop, i.e., Potato. Other important arenas with scope of improvement being promotion of indigenous technologies, price management and abolition of intermediaries, information dissipation to the grass route level, skill development by training programs and formal courses. This bulletin provides the scenarios of F&V sector and existing problems and prospects supported by fact and figures from various sources. Policy recommendations in relation to technological upgradation, skill development and incentives for Micro, Small, Medium Enterprises (MSME) business are suggested.

1. Introduction :

Post harvest management of agricultural commodities refers to wide spectrum of activities. It includes total value chain of consumables from farm to fork, including transportation, pricing, marketing, networking, research and development and most important of all, policy issues. Policy issues in post harvest management encompasses assessment of present scenario in the above areas, government initiatives such as various programs, schemes, extent of implementation, success achieved over the years and so on. Indian traditional agriculture approach and fruits and vegetables (F&V) sector in specific does not provide due emphasis to post harvest management rather the focus is on increasing the produce. Value addition of F&V produce is estimated at seven percent while processing is at meager two percent as compared to 70 to 80 percent processing in other developing countries such as Malaysia, Brazil, Thailand etc. A target specified for 2011 by expert committee of Government of India (headed by Shankerlal Guru, 2001) that value addition and processing in F&V needs to be raised to 35 and 10 percent respectively could not be achieved. Capacity utilization of fruit and vegetable processing industry was observed to be around thirty percent pre Liberalization Privatization Globalization (LPG) reform era and it could register meager 15 percent growth in following decade (1991-2001). Market links are weak and both producers and consumers are losing on the front of fair price. Government has been analyzing these issues and working on them in the past with various degree of success achieved on different fronts.

2. Government Policies and other initiatives influencing Fruits and Vegetables Sector:

During pre British era, Indian agriculture produced not only sufficient to feed the population but also surplus produce to trade. Agricultural policies got modified during British rule so as to suit their economic interest. The total food grain output during the period 1893-1947 increased at an annual rate of 0.11 per cent while that for non-food grains increased at the rate of 1.31 per cent. Non food commercial crops got precedence over food crops and production of food crops slowly got deteriorated to subsistence level. At the time of independence, though India was agriculture based economy, per capita production level was at mere subsistence. The first policy initiative since Independence was seen in the form of 'Grow More Food Campaign'. The timeline of related policy formulation and implementation since then has been mentioned below, chronologically.

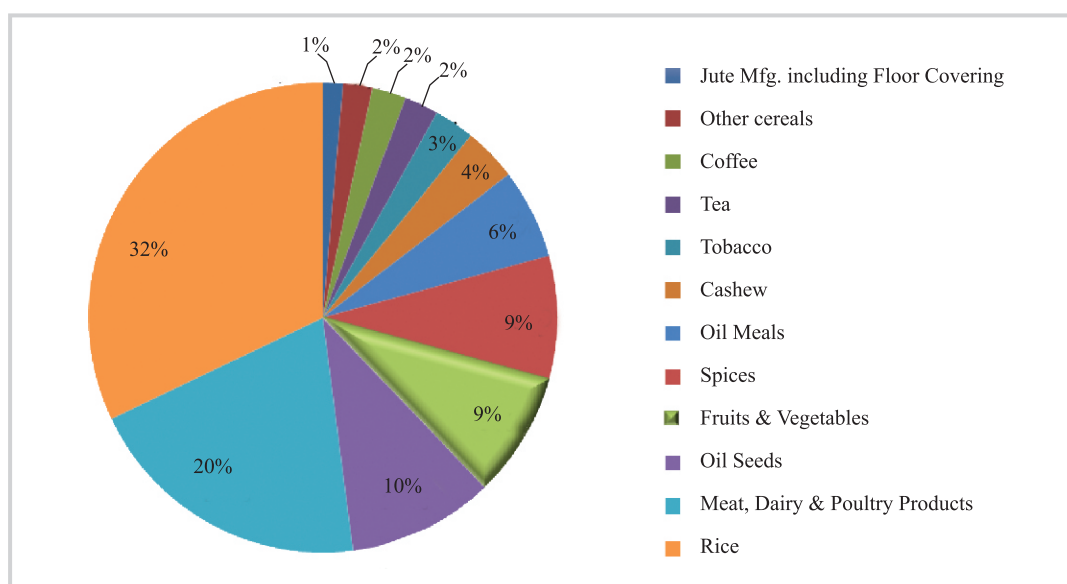
2.1. First phase of Green Revolution and its impact on Fruits and Vegetables Sector: After food crisis of 1960's, first phase of green revolution was first transition in India's agriculture policy since British impact on traditional Indian Agriculture. Although it was aimed at staple crops, introduction of facilitating public policies, efficient institutions, world class technology including high yielding variety seeds etc helped every aspect of agriculture including horticulture in India (Tripathi, 2009). Cropping pattern for decade following independence (1950-60) shows positive trend for F&V sector for percentage share of F&V in total cropped area while the total cropped area for other major agricultural commodities experienced a decline (source-Indiastat.com).

The need for a separate head for post harvest policy management was observed and in 1988, Ministry of Food Processing Industries was established which promotes policies for value addition, loss minimization, infrastructure development, technologies support, research and development and skill development.

2.2. Shift in policies post Liberalization Privatization Globalization (LPG) reforms of 1991:

Since India is second largest producer globally in fruits and vegetables and per capita consumption in the country for the same is not at par with global average, a lot of surplus is available for processing and trade. Opening up of Indian economy post 1991 LPG reforms helped in realizing the commercial potential of the sector by enabling a competitive, transparent and challenging environment in trade. India is a member of World Trade Organization (WTO) and the agreement on agriculture of WTO recognizes free and market oriented trading system in agriculture (Umali-Deininger, 2007). Our exports in fruits and vegetables have surged to significant numbers and it has a significant share in total agriculture export (figure 1), but India still constitutes meager 1% of global trade in the sector. In addition, India is at the bottom of charts in export of value added products and secondary processed food (MOFPI Report, 2011).

Figure 1: Fruits and Vegetables export share in total agricultural export in India (Jan. 2015)



Source - Indiastat.com, accessed on April 2015

a) Model Agriculture Produce Marketing Committee Act of 2003: Pre 2003 Agriculture Produce Marketing Act had a big flaw of having similar regulations for cereals as well as for perishable produce such as fruits and vegetables. The model APMC Act of 2003 aims to address special needs of F&V sector. Since agriculture is a state subject, this Act issued an advisory for the states to allow free movement of fruits and vegetables by delisting them from the purview of the

APMC Act. It established State Agricultural Produce Marketing Standards Bureau for Grading, Standardization and Quality Certification of agricultural produce. It also aims at dismantling the License system to increase competitiveness in favor of both farmer and the consumer. Additionally, farmer are not restricted to sell their produces only to APMC mandis. The merits of current Model APMC Act over the previous acts are summarized in table 1 below. According to the directives of central government, some state governments have exempted the marketing of fruits and vegetables from the purview of the APMC Act (Eco Survey, 2014-15).

Model APMC initiatives in Delhi: The National Capital Territory of Delhi has taken initiative in this direction by issuing a notification, ending the regulation of fruits and vegetables outside certain redefined market yard/sub-yard area. Similarly, the Small Farmer Agribusiness Consortium (SFAC) has taken the initiative for developing a Kisan Mandi in Delhi with a view to providing a platform to farmers for direct sale of their produce to prospective buyers reducing the unnecessary layers of intermediation in the process. They plan to scale their activities in other states based on outcome of the experience of the Delhi Kisan Mandi.

Source- Eco. Survey 2014-15

Table 1: Comparison of current Agriculture Produce Marketing Committee Act and earlier provisions

Model APMC Act 2003 recommendations	Earlier acts related to agriculture produce marketing*
Permits Private market yards, Direct Purchase Centers, farmers' market for doing trade in agriculture produce to liberate producers from the monopoly of Mandis.	Only State managed APMC Mandi can do the trade.
De-listing of perishable produce such as fruits and vegetables from the purview of model APMC Act.	Marketing of perishable and non perishable produce was governed by same provisions/Act
Public Private Partnership in the management and development of agricultural markets in the country for post-harvest handling, cold storage, pre-cooling facilities, packaging houses etc.	Completely state owned post harvest infrastructure
A separate Chapter to regulate and promote contract-farming arrangements in the country with dispute resolution mechanism.	No provision related to contract farming.
Prohibits commission agents in any transaction.	Commission agents permitted resulting in inflated prices.
*Earlier Provisions/Acts related to agriculture produce marketing- 1. Agricultural Produce (Grading and Marketing) Act-1937 2. Essential Commodities Act-1955 3. Fruit Product Order-1955	

b) Regulations related to Food Safety and Global Standards: One of major reasons of abysmal export of India in Global F&V trade is that most of our produce does not comply with safety and international standards of hygiene. Government initiatives to address this include the scheme of implementation of HACCP/ ISO 22000/ ISO 9000/ GHP/ GMP/ Quality Safety Management Systems which was introduced in draft of twelfth five year plan (MOFPI Report, 2011). One of its objectives was to prepare industry to face global competition in post WTO regime. Another important initiative is Food Safety and Standards Act (FSSA), 2006 which has been drafted to replace the archaic Act of 1954, i.e., the Food Adulteration Act. Few other Acts related to food safety rendered obsolete by FSSA (2006) are Vegetable Oil Products (Control) Order-1947, Solvent Extracted Oil, De-oiled meal and edible flour (control) order-1967, Meat Food Products Order-1973, Milk and Milk Products Order-1992. Ambit of FSSA is quite wide when compared with the former Acts because it regulates the manufacturing, storage, distribution, sale and import, ensures availability of safe and wholesome food for human consumption etc. In fruits and vegetables sector, this largely concerns with primary/secondary processed food and value added products, their production and marketing.

Seven Principles of HACCP

- Conduct a hazard analysis
- Identify critical control points
- Establish critical limits for each critical control point
- Establish critical control point monitoring requirements
- Establish corrective actions and record keeping procedures
- Establish procedures for verifying that HACCP system is working as intended

Source - DSIR reports

c) FDI in Retail and Big Multinational Food Chains-Post Global Economic Crisis of 2008: This was a period which pushed our economy to a huge fiscal deficit. To overcome this, foreign investment was encouraged in almost every sector of economy. Post this advancement, India witnessed the entry of number of small and big investors in Fruits and Vegetables sector too. Some of these business houses are promoting contract farming by dealing directly with farmer which mostly offers the small Fruits and vegetables producer a better farm gate price (Singla, 2011). The food processing sector in India has received around US\$ 6,215.46 million worth of foreign investments during the period April 2000-Janaury 2015 according to Department of Industrial Policies and Promotion (DIPP).

To facilitate investors and also to attract more FDI, an 'Investors' Portal' was launched by The Ministry of State for Agriculture & Food Processing on 15th October, 2013. The portal is intended to disseminate information on the state specific resource potential, policy support and fiscal incentives for food processing sector. The investors, both domestic and foreign, can also seek guidance on specific issues by posting their queries in the 'Investor Query' of the portal which will be promptly responded by experts, engaged by 'Invest India' exclusively for the purpose on behalf of the Ministry.

2.3. Shift to Horticulture-Second Phase of Green Revolution: After a revolutionary first phase, a second phase of green revolution is aimed with more emphasis on horticulture which was relatively ignored in the former phase. It will encompass the benefits greatly in the eastern region which is relatively under developed in agriculture. The Finance Minister during Union Budget 2014-2015 mentioned that- “we are committed to sustaining a growth of 4% in agriculture and for this we will bring technology driven second green revolution with focus on higher productivity and include protein revolution as an area of major focus”. Some of the currently operational policy initiatives related to horticulture are summarized in the table 2 below.

Table 2: Current Fruits and Vegetables related Govt. Missions/Initiatives

S. No.	F&V Related Government Schemes	Launch Year	Salient Features
1	National Horticulture Mission	2005-2006	- Holistic Development of Horticulture with ensuring backward and forward linkages - Coverage in three Union Territory, Andaman and Nicobar, Lakshadweep, Pondicherry and all states except eight north eastern states, J&K, Himachal and Uttarakhand
2	Horticulture Mission for North East and Himalayan States	2001-2002 (Earlier Technology Mission for North East for integrated Development of Horticulture)	- Coverage in states not covered by NHM - Aims to harness the potential of region by increasing production and productivity with help of technological development
3	Mission for Integrated Development of Horticulture	2014-2015	- Aims to achieve a growth rate of 7.2 % in horticulture sector during twelfth plan - Strategizes on production of quality seeds and planting material, creation of infrastructure to reduce post harvest losses, improved marketing
4	Vegetable Initiatives for Urban Clusters	2012-2013	- A component of Rashtriya Krishi Vikas Yojana - Promotion of group farming - Protected cultivation of high value vegetable crop like capsicum, broccoli, bhutjolokia etc.

3. Infrastructure related to Fruits and Vegetables: Infrastructure is the backbone of forward and backward linkages in any sector, which is why most of the schemes mentioned in previous section include provision about infrastructure development. The focus is on issues related to three fields-cold storage, mobile cold chains, linkage based on road and ports, new marketing initiatives like Mega Food Park, Retail chain etc. The details regarding current scenario in these three fields are given in the next section.

3.1. Cold Storage: As of March 2014, India has approximately 6,891 cold storage facilities, with a capacity of 31.82 million metric tons. About 60 per cent of cold storages are concentrated in just four states: Uttar Pradesh, Gujarat, West Bengal and Punjab (Table 3). Figure 2 categorizes states into three regions based on availability of cold storage in thousand metric tons. Uttar Pradesh has the highest capacity of 13.633 million metric tons. The remaining states and the bulk of the country remain inadequately resourced (National Centre for Cold Chain Development).

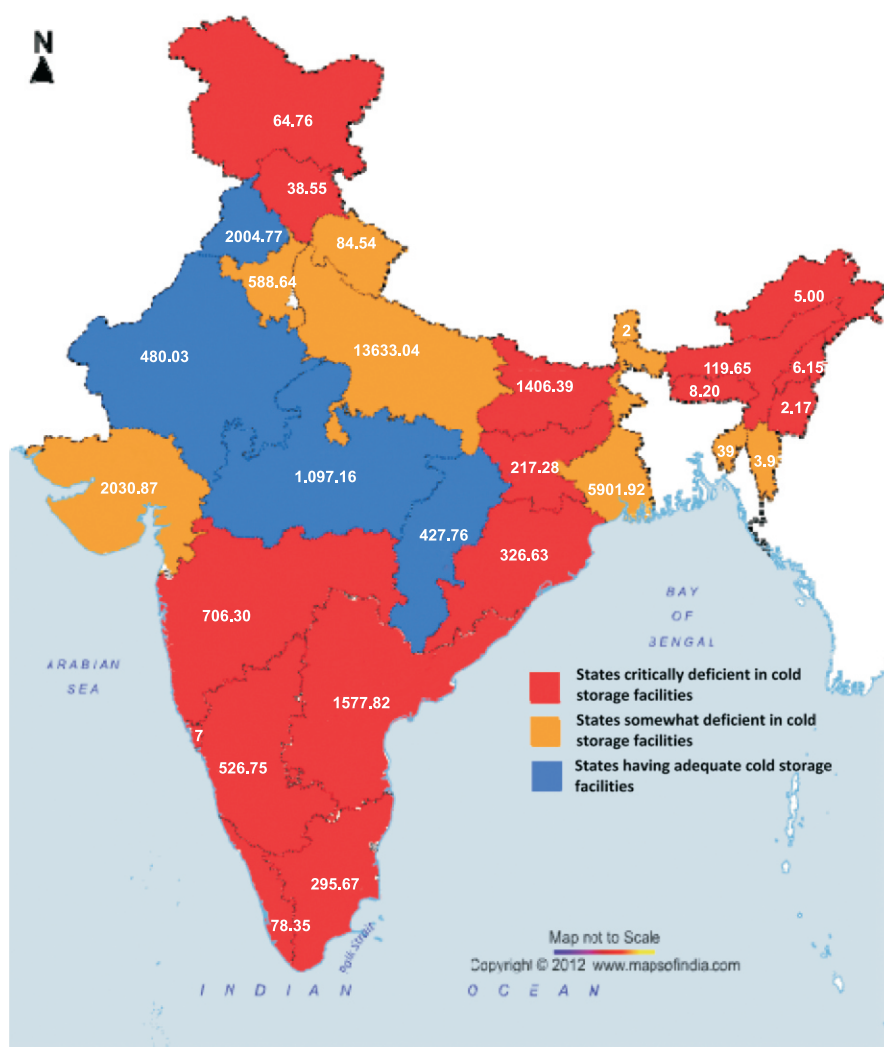
Table 3: State-wise Capacity of Cold Storages in India (As on 31.03.2014)

S. No.	State/UTs	Number of Cold Stores	Capacity in MT
1	Andaman & Nicobar	2	210
2	Andhra Pradesh	404	1577828
3	Arunachal Pradesh	2	5000
4	Assam	34	119652
5	Bihar	303	1406395
6	Chandigarh (UT)	6	12216
7	Chattisgarh	89	427766
8	Delhi	97	129857
9	Goa	29	7705
10	Gujarat	560	2030873
11	Haryana	295	588649
12	Himachal Pradesh	32	38557
13	Jammu & Kashmir	28	64769
14	Jharkhand	55	217280
15	Karnataka	189	526752
16	Kerala	197	78355
17	Lakshadweep (UT)	1	15
18	Madhya Pradesh	260	1097168
19	Maharashtra	540	706302.6
20	Manipur	1	2175
21	Meghalaya	4	8200
22	Mizoram	3	3931
23	Nagaland	2	6150
24	Odisha	111	326639
25	Puducherry (UT)	3	85
26	Punjab	606	2004778
27	Rajasthan	154	480032

S. No.	State/UTs	Number of Cold Stores	Capacity in MT
28	Sikkim	2	2000
29	Tamil Nadu	163	295671
30	Tripura	13	39181
31	Uttar Pradesh	2176	13633039
32	Uttarakhand	28	84545
33	West Bengal	502	5901925
	Total	6891	31823700.6

Source-National Centre for Cold Chain Development (NCCD), 2014 Report

**Figure 2: State wise capacity of cold storage in thousand metric tons
(as on 31.03.2014)**



Source-National Centre for Cold chain Development (NCCD), 2014 Report

On an average, a farmer needs to carry his horticulture produce as far as 10 to 125 km for renting a cold storage facility according to a study done as a part of socio economic research by Planning Commission in Bihar and UP. Small scale cold storage facilities need to be developed at distances which are convenient and economically feasible to travel for the farmer (GoI, Planning Commission Report, 2003).

Additionally, since different type of F&V produce need different type of parameters for storage (say, temperature and humidity conditions); there should be different chambers available for such commodities in cold storage houses. Presently, majority of cold storage in country is dedicated to potato crop. Multi-purpose cold store capacity created by India so far stagnates at 7.63 per cent against 92.82% for potato and 1.07% for fruits and vegetables which hardly suffice for 10% of our F&V produce (Planning Commission, 2012; PHDCCI Report, 2014). Infrastructure needs to be increased to double and an investment of INR 550.74 billion in new cold storage capacity by 2015–16 is required to keep up with the fruit and vegetable production increase (Emerson Climate Technologies, 2013).

Majority of Indian farmers with low disposable income depend on daily sales and an immediate low price seems more favorable to them than an uncertain higher price after keeping the produce in cold storage for a specific period of time. This combined with lack of access to big markets and price discovery networks make farmers reluctant for investing in rental to the cold storage.

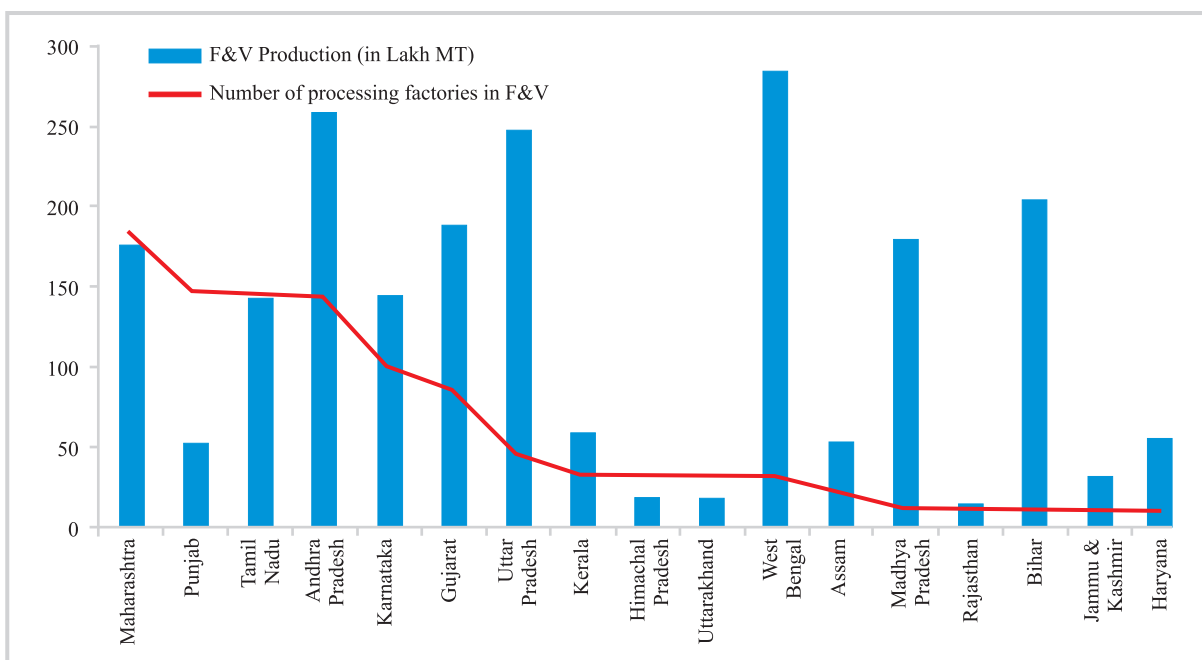
Moreover, power shortage and frequent load shedding makes our cold storage less efficient and adds up to the loss.

3.2. *Mobile Cold Chains:* About 105 million MT of perishable produce is transported annually in India. To minimize loss of produce during transportation, a strong network of mobile cold chains with efficient technology is required. In India, cold chain sector is fragmented. Around 85 percent of transportation is covered by cold chain service providers, and rest 15 percent is refrigerated trucks, reefers etc. Like permanent cold storage is skewed towards potato, here also 80 percent of vehicles are absorbed in dairy industry and 20 percent caters to the need of rest of agriculture produce.

Additionally, cold chain sector is also a capital intensive sector, which makes its spread across the nation difficult. The permits for vehicles are also one time, granted for short period of eight years for interstate movement, after which they need to be renewed. Other problems faced by mobile cold chains are octroi, poor roads, traffic congestion, lack of cost effective indigenous technology.

3.3. *Connectivity for backward forward linkages:* Analyzing the relation between production and commercial processing capacity in different states of India, fig. 3 gives an impression that some states such as Maharashtra, Punjab, Tamil Nadu, Karnataka etc. have better statistics for processing capacity in spite of having not so massive production as in states like West Bengal, UP, Bihar etc. This can be attributed to a number of factors such as high power supply, per capita disposable income, law and order, linkage through road and ports etc.

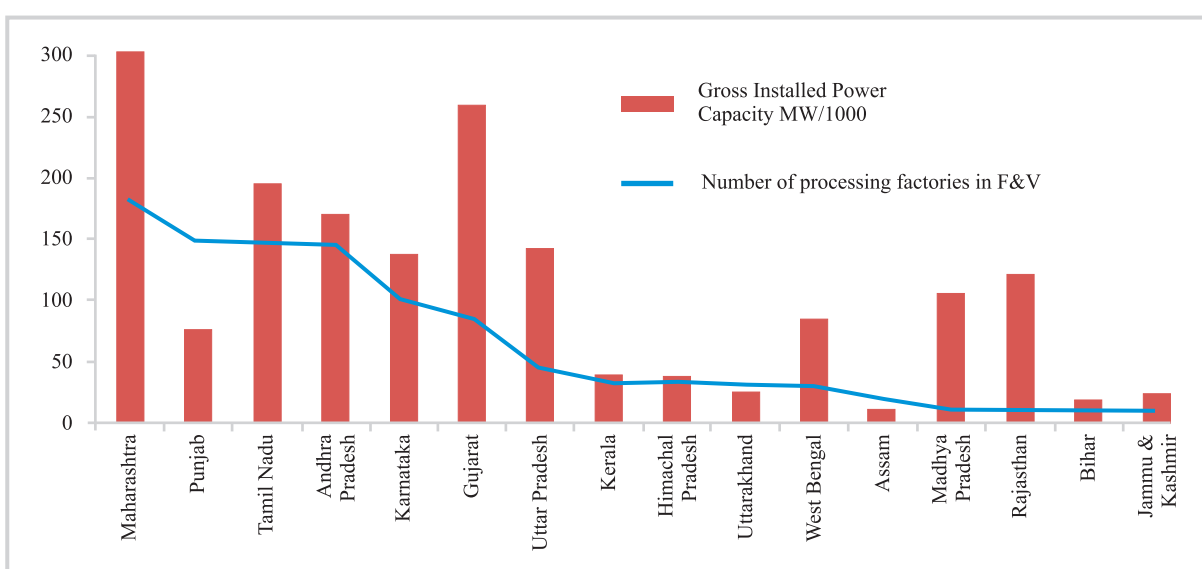
Figure 3: Fruits and Vegetables production vs. number of Fruits and Vegetables processing factories (2012-13)



Source- NHB 2015 report, CMIE (2015)

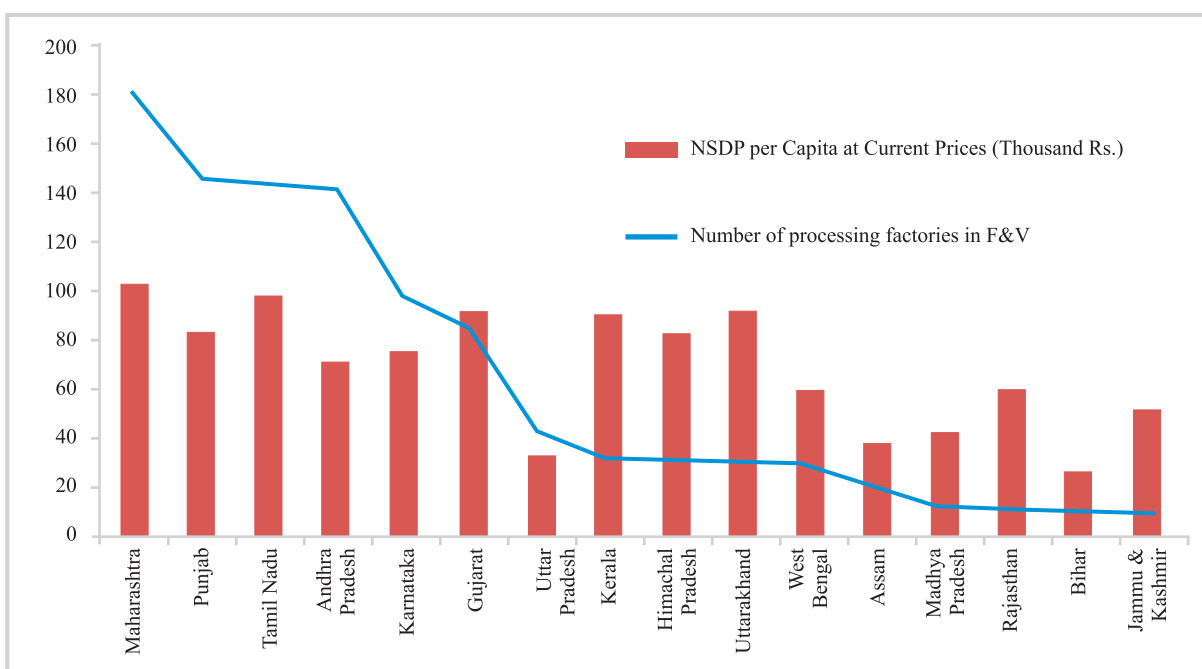
Upcoming figures 4 and 5 describe the relation of number of F&V processing units with installed power capacity and net State Domestic Product (SDP) per capita respectively for different states.

Figure 4: Gross Installed Power Capacity MW/1000 vs. number of Fruits & Vegetables processing factories (2012-13)



Source- CMIE (2015)

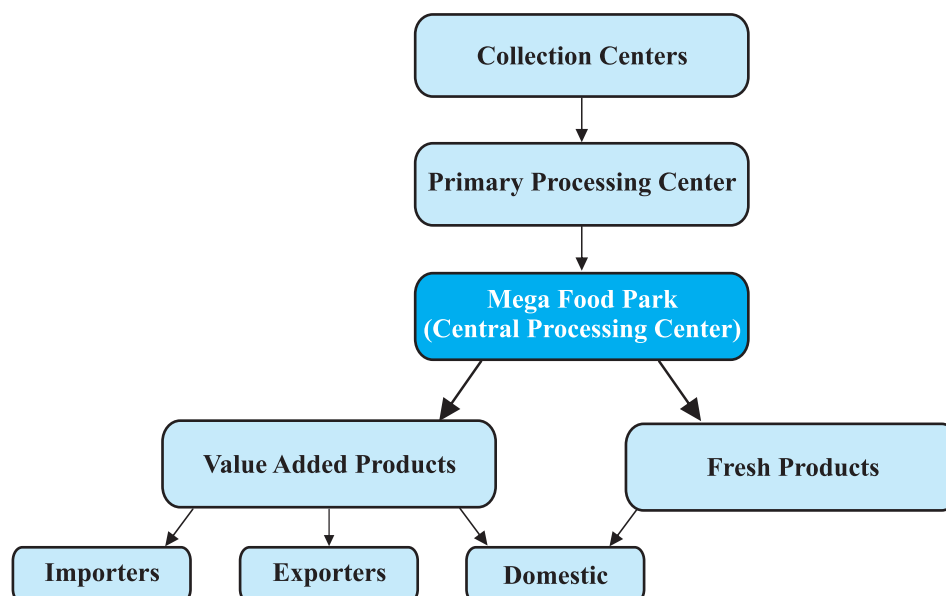
Figure 5: Net State Domestic Product per Capita vs. number of Fruits & Vegetables processing factories (2012-13)



Source- MOSPI website, accessed on 30th September, 2015 and CMIE (2015)

3.4. Innovation in food retail-Mega Food Parks: The Mega Food Park is an inclusive concept which is aimed at establishing direct linkages from the farm to processing and on to the consumer markets, through a network of collection centers and Primary Processing Centers (Figure 6).

Figure 6: Flow of produce from farm gates through Mega Food Parks



Source- eBook, MOFPI 2014

Mega food park initiative was launched during eleventh five year plan as a replacement of Central Sector Food Park Scheme of Eighth Five Year Plan (1992-97). There has been admirable achievement in rate of infrastructure built up in this field recently. Three mega food parks have been made operational in past one year in comparison to two mega food parks built up in last six years (as on May 2015, website of MOFPI). Countrywide statistics of Govt. assisted Mega Food Park projects have been summarized in table 4.

Table 4: List of Project assisted under Mega Food Park Scheme

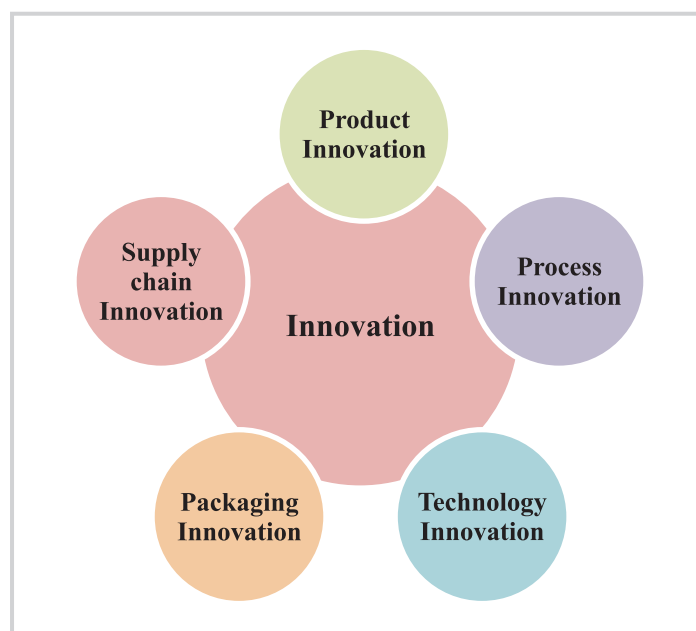
S. No.	Party	Project Location	District	State	Project Cost	Approval Date
1	Srini Food Park Pvt. Ltd.	Mogili Village, Bangarupalem	Chittoor	Andhra Pradesh	1,169,400,000	27.03.2009
2	M/s Godavari Mega Aqua Food Park Pvt. Ltd.	Tundurru Village, Bhimavaram Mandal	West Godavari	Andhra Pradesh	1,226,000,000	16.12.2013
3	North East Mega Food Park Ltd.	Nathkuchi Village, Tihu	Nalbari	Assam	759,800,000	27.03.2009
4	Pristine Logistics & Infraprojects Pvt. Ltd.	Mansi	Khagaria	Bihar	1,276,000,000	06.08.2014
5	JVL Mega food Park Pvt. Ltd.	Village Jorabarpur	Rohtas	Bihar	1,142,200,000	-
6	Indus Best Mega Food Park Pvt. Ltd.	Village Sarora and Bemta, Tehsil Tilda	Raipur	Chhattisgarh	1,245,000,000	04.06.2014
7	Raipur Mega Food Park Ltd.	Village Neonara, Tehsil Berla	Bemetara	Chhattisgarh	1,261,200,000	04.06.2014
8	Gujarat Agro Infrastructure Mega Food Park	Villages Jhahkharda, Shah and Vasravi in ITDP notified area in Mangrol Taluka	Surat	Gujarat	1,178,700,000	22.05.2014
9	Fanidhar Mega Food Park Ltd.	Village Munderda, near Mehsana	Mehsana	Gujarat	1,178,000,000	-
10	Poliyan Mega Food Park Pvt. Ltd.	Village Singha, Tehsil Haroli	Una	Himachal Pradesh	997,000,000	06.08.2014
11	RFK Greens Food Park Pvt. Ltd.	Lassipora Village	Pulwama	Jammu and Kashmir	794,300,000	19.02.2014
12	Jharkhand Mega Food Park Pvt. Ltd.	Village Getalsud	Ranchi	Jharkhand	1,139,500,000	27.03.2009
13	Integrated Food Park Pvt. Ltd.	Vasanta Narasapura Ind. Area	Tumkur	Karnataka	1,443,300,000	27.03.2011
14	Indus Mega Food Park Pvt. Ltd.	Panwa Village, Kasrawad Tehsil	Khargaoan	Madhya Pradesh	1,277,000,000	27.08.2012
15	Paithan Mega Food Park Ltd.	Village Wahegaon and Dhangaon, Taluka: Paithan	Aurangabad	Maharashtra	1,245,600,000	08.03.2013
16	Satara Mega Food Park Pvt. Ltd.	Degaon Village	Satara	Maharashtra	1,393,300,000	06.08.2014
17	Mizoram Mega Food Park	Khamrang	Aizawl	Mizoram	719,100,000	-
18	MITS Mega Food Park Ltd.	Bhujbul and Sindhubadi Mouza	Rayagada	Odisha	801,700,000	16.04.2012
19	International Mega Food Park Ltd.	Village Dhabwala Kala, Malout-Fazilka Road, Dana Mandi Rd, Arniwala Shakh Subhan	Fazilka	Punjab	1,303,800,000	25.05.2011

S. No.	Party	Project Location	District	State	Project Cost	Approval Date
20	Greentech Mega Food Park Pvt. Ltd.	Village Rupangarh	Ajmer	Rajasthan	1,135,600,000	19.02.2014
21	Smart Agro Industries Corporation Pvt. Ltd.	Village Lakkampally, Nandipet Mandal	Nizamabad	Telangana	1,164,400,000	-
22	Sikaria Mega Food Park Pvt. Ltd.	Champamura & Tulakona Mouza Agartala	West Tripura	Tripura	874,500,000	30.11.2011
23	Patanjali Food & Herbal Park Pvt. Ltd.	Village Padartha	Haridwar	Uttarakhand	950,800,000	27.03.2009
24	Himalayan Food Park Pvt. Ltd.	Mauha Kheraganj Village, Kashipur	Udam Singh Nagar	Uttarakhand	999,600,000	23.01.2014
25	Jangipur Bengal Mega Food Park Ltd.	Mouza: Katnai & Kulori, Raghunathganj I Block, Subdivision Jangipur	Murshidabad	West Bengal	1,327,000,000	16.03.2010

Source- MOFPI website, accessed on 30th September, 2015

4. Promoting Innovation in Fruit & Vegetable Post Harvest Management- To address issues such as low productivity, low shelf life, to comply with global standards of safety and hygiene and to explore new possibilities in field of food processing and preservation, innovation in F&V sector needs to be promoted. Innovation in this sector includes a lot of aspects; innovation in product, packaging, supply chain etc. (Figure 7). With the industry growing at around 13% per annum, there are several new players in food processing retail experimenting with innovation in all these aspects for discovering the hidden potential the sector holds.

Figure 7: Innovation in food processing Industries

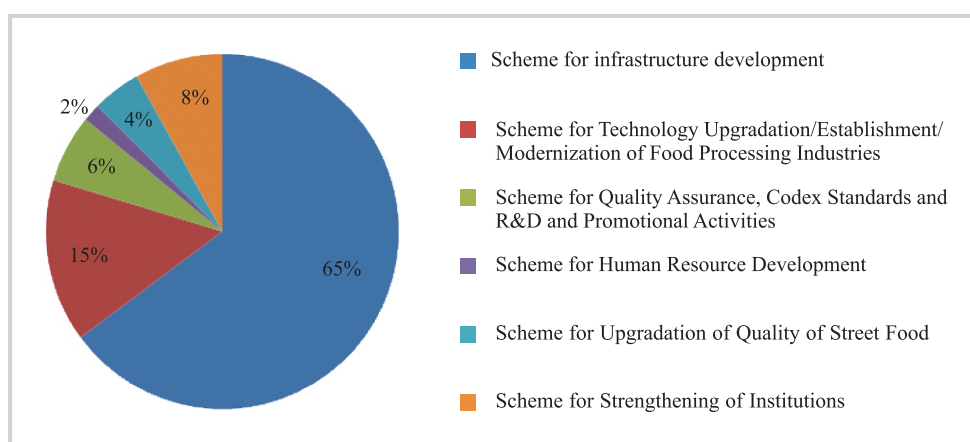


The latest innovation in this area is e-commerce in F&V sector, providing facility of booking through SMS, call, internet and delivery of fresh fruits and vegetables at doorstep of

customer. Most of these initiatives are set up by individual entrepreneurs in National Capital Region. Examples worth mentioning are babumoshay.com, a venture started by Rotary club of Delhi NCR; which promises to create 150,000 jobs all over India. Another such venture is Apna Haat Retail Pvt Ltd. working through tie up with major established corporate giants such as Aditya Birla group (More), Reliance (Reliance Fresh) etc.

4.1. Funding for Fruit & Vegetable Post Harvest Management: Less than 5% of funding for horticultural research and extension (R&E) has been allocated to post harvest issues over the past 20 years as the historical focus has been on increasing production (Kitinoja, 2011). In the 1990s the focus moved to marketing and more recently to value chain development. While thousands of development projects have been launched in developing countries between 1990 and the present time by dozens of donor agencies, few have focused on agriculture, very few have focused upon horticulture (approximately 1% of the agricultural projects), and only 1/3 of these very few horticultural projects included a post harvest component. In the changing scenario though, policy makers have realized that growth of food processing sector would be key to growth of agriculture in the country. The development activities received a boost with approximately 40-fold increase in budget from the 7th and 8th Plan. One tenth of the total budget of Indian Council for Agricultural Research (ICAR) and 18 per cent of the total budget of Department of Agriculture Co-operation was earmarked for the horticulture sector in the 9th Plan. Total plan outlay of MOFPI rose from Rs. 650 Crore during the 10th Plan to Rs. 4,031 Crore during the 11th Plan (Annual report MOFPI, 2014). The maximum increase in the fund has been under infrastructure building which shows the current emphasis of policy formulation as shown in scheme wise break up in figure 8.

Figure 8: Total 11th Plan Outlay (2007-2012) Share of Schemes in Value Terms (Rs. Crore)

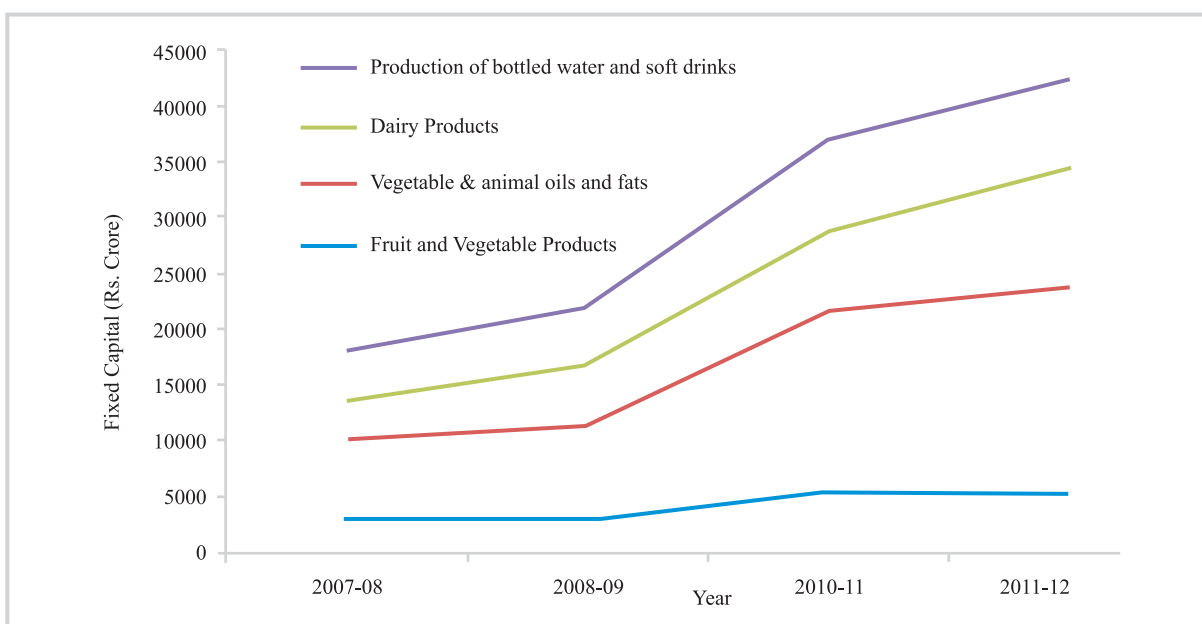


Source - MOFPI, 2011

According to Annual Survey of Industries report (2012-13) estimated fixed capital invested in F&V sector over past five years (i.e. during 11th FY Plan) has been both meager and stagnant when compared to other sectors in food processing such as dairy products, beverages, vegetable

oil etc. This implies that investment in F&V sector has failed to keep pace with growth in economy since beginning of 11th five year plan and this sector holds a huge potential for growth if funding/investment is judiciously managed. As per the trend suggested by figure 9, fixed capital investment in F&V processing unit ranks at the bottom with negligible growth.

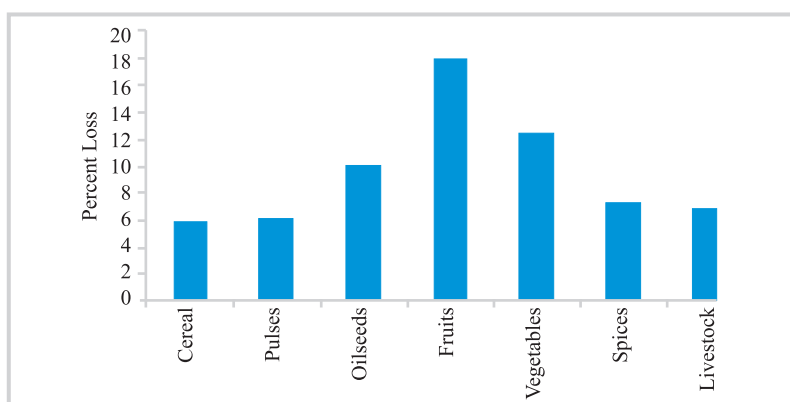
Figure 9: Estimated Fixed Capital in Registered Food Processing units from (2007-08 to 2011-12) (Rs. Crore)



Source- Annual Survey of Industries, 2012-13

4.2. Technology advancement in F&V Post Harvest Processing in Recent Years: The need for innovation in technology can be stressed by the fact that due to the short shelf life of these crops, as much as 30-35% of fruits and vegetables perish during harvest, storage, grading, transport, packaging and distribution. Post harvest loss of fruits and vegetables in contrast with that of different agricultural commodities are shown in figure 10.

Figure 10: Percent post harvest losses in different agricultural commodities



Source- ICAR, 2010 Study

Major methods to increase shelf life of fruit and vegetable harvest are to delay the ripening of food, storing the harvest in appropriate environment, using protective surface coating etc. Details of R&D projects supported by MOFPI during 2013-14 are given in annexure 1. Some of the new innovations in this field are -

- a) Indian Institute of Natural Resins and Gums (IINRG) in Namkum (Jharkhand) has developed a specialized fruit coating formulation that increases shelf life by two weeks, preserves moisture and protects fruits from germs.
- b) GoI is considering using nuclear irradiation technology developed by Bhabha Atomic Research Centre (BARC) for increasing the shelf life of fruits and vegetables, especially that of onions and potatoes.
- c) The CSIR-Institute of Himalayan Bio-resource Technology (CSIR-IHBT), Palampur has signed a memorandum of understanding with its industry partner Phyto Biotech, Kolkata, to formalize technology transfer for production of unique enzyme which may be used in extending shelf life of fruits and vegetables.

Other than the technology mentioned above, some promising research is going on in germplasm identification, micro propagation, green house technology, photometry, acoustic response, short wave radiation, machine vision and laser technology.

4.3. Information Dissipation to Channels Targeting Grass root Farm workers: The NSSO 70th round survey indicates that about 59 per cent of farmers do not get much technical assistance and know-how from government-funded farm research institutes or extension services. To solve this, government has been trying to connect with even the most remote villages, occasionally with the help of private players. Keeping in mind the popularity of television in rural India, recently a channel 'Kisan' has been launched with Doordarshan which will broadcast programs with an aim of connecting the farmers with new technology advancement, research and development, global standard, price discovery etc. Additionally, since India has a good rural tele-density of near 50% (CCI report, 2015), a Kisan call centre with a toll free number has been started which will provide expert advice to farmers in regional languages related to all aspects of farming.

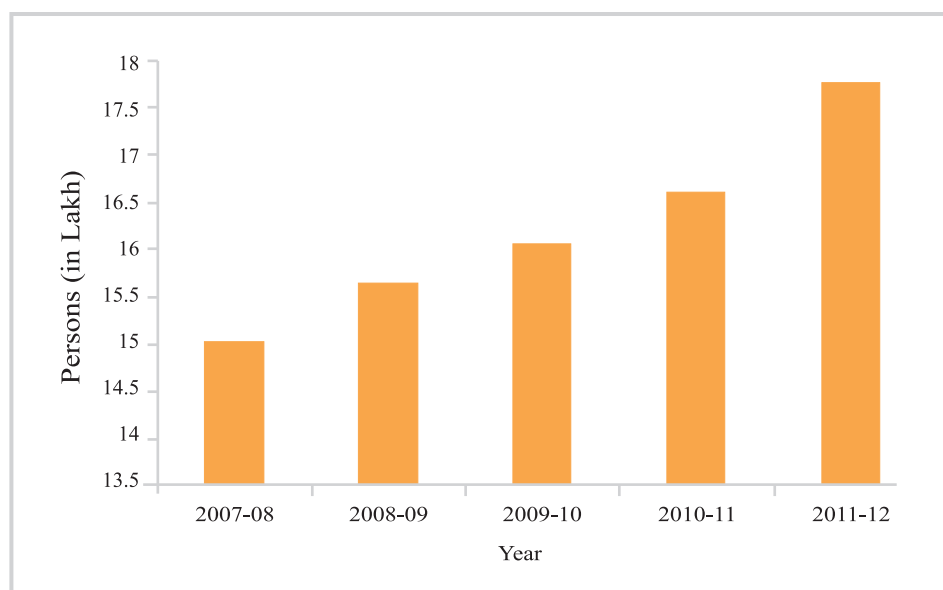
4.4. Center of Research in Fruit & Vegetable Sector: Research in fruit and vegetable is being promoted by both government and private players and the institutes are spread all across the country. Some of the research is done by centre specifically dedicated to F&V while number of other organizations are also contributing significantly to this area. Table 5 below includes centre of research related to fruit and vegetable sector located in India.

**Table 5: Centre for food processing research in India
(Including fruits and vegetables processing)**

Institute/University	Location
Indian Institute of Natural Resins and Gums	Ranchi, Jharkhand
CSIR-Institute of Himalayan Bio-resource Technology	Palampur, Himachal Pradesh
National Centre for Agricultural Economics and Policy Research	Delhi
National Institute of Food Technology Entrepreneurship and Management	Sonipat, Haryana
International Crops Research Institute for the Semi-Arid Tropics	Hyderabad, Telangana
Central Food Technological Research Institute	Mysore, Karnataka
Amity International Centre for Post Harvest Technology & Cold Chain Management	Noida, Uttar Pradesh
Indian Grape Processing Board	Pune, Maharashtra
Indian Institute of Horticultural Research	Bengaluru, Karnataka
Indian Institute of Vegetable Research	Varanasi, Uttar Pradesh
National Research Centre for Banana	Tiruchirapalli , Tamilnadu
National Research Centre for Citrus	Nagpur, Maharashtra
National Research Centre for Grapes	Pune, Maharashtra
Central Potato Research Institute	Meerut, Uttar Pradesh
Central Institute of Temperate Horticulture	Srinagar, Jammu & Kashmir

5. Human Resource in Fruit and Vegetable Post Harvest Management in India: It is broadly accepted that food processing sector is among the most appropriate sectors for creating jobs for rural poor because of their familiarity with agriculture sector. The multiplier effect of investment in food processing industry on employment generation is also believed to be higher than any other sector. These are the reasons why twelfth five year plan mentioned special emphasis on mapping the skill gaps and identifying priority areas for human resource development in food processing sector. Figure 11 below depicts the rising number of persons employed by food processing sector. Additionally, according to Annual Survey of Industries Report 2012-13, food products related industries provide employment to maximum number of people, i.e., 11.94% followed by textile-10.87%, and basic metals-7.85%. However by the same survey, the order is reversed in wages to workers parameter, and food products industry is at the third place.

Figure 11: Persons employed in registered food processing units



Source- MOFPI, 2011

5.1. Labor Requirement in Fruit and Vegetable Sector as compared to Food Grain Production: This sector is far ahead of traditional agriculture in the avenue of employment generation. The average labor requirement for fruit production is 860 man days per hectare per annum as against 143 man days for cereal crops. Crops like grape, banana and pineapple generate much larger employment roughly from 1000-2500 man days per hectare per annum (GoI, Planning Commission Report, 2003).

5.2. Training, Skill Development and Professional Courses: To absorb the research and innovations in the field and for enabling the youth for employment, there are several training programs and long term courses. Various research labs and government institutes as well as private institutions are involved in this area.

- a) Short term training:** Institutes committed to research and development studies in the sector organize training programs specific to various aspects, ranging from few days to weeks. For instance-One day training by MOFPI, India on topics such as dehydration of fruits and vegetables, functional bakery product, sugar confectionary etc.
- b) Formal Courses:** Information related to major courses related to post harvest and/or F&V sector is summarized below in table 6.

Table 6: Professional Courses in Post Harvest Management

Institute	Name of Course	Duration
Amity International Centre for Post Harvest Technology & Cold Chain Management	M.Sc. - Post Harvest Technology	Two Year
	PG Diploma in Cold Chain Management	One Year
Central Institute of Post-Harvest Engineering and Technology (CIPHET)	B. Tech. in Agricultural Engineering	Four Year
	B. Tech. in Food Technology	Four Year
	M.Tech. in Food Engineering	Two Year
	M.Tech. in Farm Power and Machinery Engineering	Two Year
Horticultural College and Research Institute, Coimbatore	B. Tech. in Horticulture	Four Year
	B. Sc. in Horticulture	Three Year
KRC College of Horticulture Arabhavi (Belgaum), University of Horticultural Sciences	M. Sc. in Horticulture	Two Year
	PhD in Horticulture	Four Year
Mahatama Jyoti Rao Phoolle University, College of Agriculture & Research	Diploma program (Horticulture Nursery Management)	Nine Month
	Certificate Course (Horticulture Business Management)	Three Year

5.3. Promoting Entrepreneurship and MSMEs in F&V Sector: Given that Indian agriculture is characterized with small land holdings and lack of capital investment, this sector is highly unorganized and with limited geographical spread. Nearly 70 percent F&V processing units are in the cottage and household sector while around 17 percent are in the small scale sector. For maintaining quality of the produce and promoting entrepreneurship, entrepreneurship development program and scheme for creating Primary Processing Centers/Collection Centers in Rural areas was announced in eleventh and twelfth five year plan respectively (Rais, 2013).

6. Price Management at both Farm gate and Consumer Level: As mentioned earlier, the desired link between production, marketing and demand in horticulture produce is missing. The McKinsey analysis on intermediary economics (Fruits and Vegetables) shows that farm gate prices available to the farmers is only 25% of the retail price in India, whereas the same is as high as 70% in case of Dutch and US farmers, where more efficient system is in place. Some of the Government initiatives are listed further.

- To mitigate price volatility in agricultural produce, 2014-15 Union budget includes a provision of a sum of Rs 500 Crore for establishing a Price Stabilization Fund.
- Advisory for the states to allow free movement of fruits and vegetables by delisting them from the preview of the APMC act. A number of state governments have acted on

the same.

- c) Bringing onions and potatoes under the preview of the Essential Commodity Act 1955, thereby allowing state governments to impose stock limits to deal with cartelization and hoarding, and making violation of stock limits a non-bailable offence;
- d) Imposing a minimum export price (MEP) of US\$ 450 per MT for potatoes with effect from 26 June 2014 and US\$ 300 per MT for onions with effect from 21 August 2014.
- e) Another initiative for rapid dissemination of F&V market related information with the help of technology is AGMARKNET - NICNET based Agricultural Marketing Information System Network. It was included as a Mission Mode Project under National e-Governance Action Plan. Earlier, e-Chaupal by private player ITC was based on the same vision.

7. *Recommendations for Policy Issues:*

- a) There is need for simplification of policies and issues and multiplicity of institutions and overlap of functions needs to be done away with. There should be clear assignment of role and responsibility among all government bodies related to fruit and vegetable sector, such as ministries, research labs, educational institutes.
- b) Agriculture being a state subject renders it important that a holistic view should be analyzed while forming policies. Additionally, every state has unique potential and weakness, requiring a state specific policy approach.
- c) To get the maximum out of opening economy, increase in FDI flowing in, ventures like Make in India-food processing; role of government should shift from controlling to enabling gradually. Linkage with corporate sector and regulated form of practices like contract farming should be encouraged.
- d) Food safety and hygiene standards need to be standardized and strongly complied with. To be at par with global standards in this sector, we should internalize practices such as HACCP. Also, domestic market has to be strengthened in order to increase exports. Without organized domestic market base, we cannot promote exports. Models like HOPCOM (Horticulture Producers' Co-operative Marketing and Processing Society) need to be created in all the metropolitan cities in the country.
- e) In view of low productivity and poor quality, there is urgent need for effective transfer of technology within the country to increase production, productivity and to improve quality. Certification of testing labs should receive high priority.
- f) In infrastructure reforms, building some F&V dedicated cold storage should be given priority. Mobile cold chain sector needs to be formalized. Easy credit should be provided to aspiring entrepreneurs. Skill development to bridge human resource gap is required.
- g) For better price management, farmers need to be educated about price discovery,

contracts, marketing and other related technical support. Black marketing and hoarding needs to be strictly penalized.

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Annexure 1: Details of R&D projects supported by MOFPI during 2013-14

S. No.	Topic of Research	Institution/University	Approved Grant in aid (Rs. in Crores)
1	Development of enzyme based extraction process for improving quality and recovery of starch from different varieties of Colocasia Esculenta (Arbi) of Assam for food use.	Tezpur University, Assam	27.26
2	Processing of apple for value added product development	IHBT, Palampur	107.44
3	Processing and packaging of tender coconut water for rural market.	IIP, Mumbai	46.66
4	Studies on preservation of vegetable juices and non acidic fruit juices by microwave heating and development of prototype model of continuous microwave pasteurization/sterilization system	CFTRI, Hyderabad	38.82
5	Development of value added products from minor fruits of Assam.	Agriculture University, Assam	65.93
6	Pilot scale process technology for "Bhim Kol" (Musa Balbisiana) slice, grits and powder using hybrid drying methods.	Dept. of Food Engineering and Technology, Tezpur University, Assam	35.32
7	Package of technologies for on-farm processing, value addition and safe storage of onion.	Indian Institute of Crop. Processing Technology, Tamilnadu	49.97
8	Studies on post harvest application of 1-MCP on shelf life of and quality of mango and tomato fruits	Dept. of Chemical Technology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad	36.94
9	Scale up of chitosan based coating formulation for preservation of selected fruits.	Central Food Technology Research Institute, Mysore	21.89
10	Developing post harvest mechanization package for banana central core.	Central Institute of Agriculture Engineering, Coimbatore	37.96
11	Functionalized polymers for processing of soymilk and apple juice.	Indian Institute of Chemical Technology, Hyderabad	33.34

Source- MOFPI, Annual Report, 2013-14

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