

# Post Harvest Operations and Processing of Fruits, Vegetables, Spices and Plantation Crop Products

Professor H N Mishra

Department of Agriculture and Food Engineering  
Indian Institute of Technology Kharagpur

## Lecture 01 Course Introduction

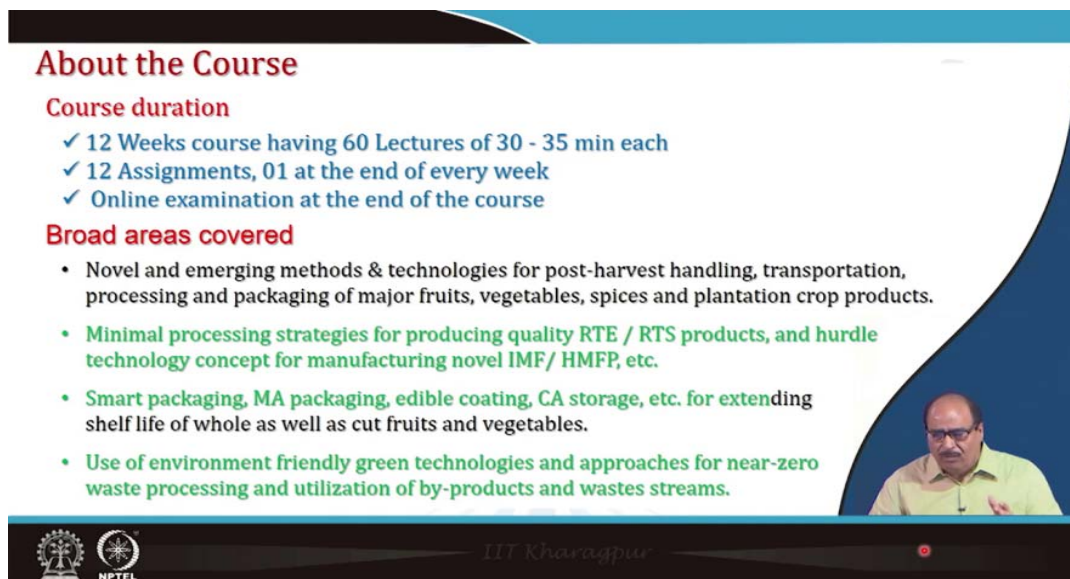
In the first lecture, a brief introduction of the course followed by a concise discussion on the current scenario particularly the production statistics, consumption pattern, and market insights along with the associated issues and challenges in the horticultural and plantation crop sector in India will be emphasized.



### Concepts Covered

- About the course
- Horticultural situation in India
  - ✓ Production statistics, consumption pattern and market insights
- Issues & challenges facing the horticulture & plantation crop sector

IIT Kharagpur



### About the Course

**Course duration**

- ✓ 12 Weeks course having 60 Lectures of 30 - 35 min each
- ✓ 12 Assignments, 01 at the end of every week
- ✓ Online examination at the end of the course

**Broad areas covered**

- Novel and emerging methods & technologies for post-harvest handling, transportation, processing and packaging of major fruits, vegetables, spices and plantation crop products.
- Minimal processing strategies for producing quality RTE / RTS products, and hurdle technology concept for manufacturing novel IMF/ HMFP, etc.
- Smart packaging, MA packaging, edible coating, CA storage, etc. for extending shelf life of whole as well as cut fruits and vegetables.
- Use of environment friendly green technologies and approaches for near-zero waste processing and utilization of by-products and wastes streams.

IIT Kharagpur

This is a 12 week course having 60 lectures of 30-35 minutes each. There will be 12 assignments, most probably one at the end of every week. There will be one online examination at the end of the course. The broad areas that will be covered in this course include novel and emerging methods and technologies for post-harvest handling transportation processing and packaging of major fruits,

vegetables, spices and plantation crop products. In addition, the course will also illustrate on the minimal processing strategies for producing high quality ready to eat, ready to serve products and hurdle technology concept for manufacturing of novel intermediate moisture foods and high moisture fruit products. Different smart packaging technologies, modified atmosphere packaging, edible coating, control atmosphere storage for extending the shelf life of whole as well as cut fruits and vegetables will be discussed. Also towards the end of the course, the application of environment friendly green technologies as well as the approaches for near zero waste processing and utilization of by-products and waste streams will be discussed.

**Course content**

Week	Topics Covered
1	Composition, Nutritional and Health Value
2	Post-Harvest Handling and Storage
3	Processing and Preservation Principles
4	Primary Process Operation (On-farm & In-plant)
5	Minimal Processing Strategies and Hurdle Technology
6	Juices and Concentrates
7	Dehydrated and Snack Food Products
8	Processing of Plantation Crop Products
9	Spices and Condiments Technology
10	Plant Based Fermented Foods and Beverages
11	Smart Packaging and Storage
12	Green Technologies, By-products & Waste Utilization



IIT Kharagpur

NPTEL

The topics that will be covered in this course include:

In the first week, various aspects related to composition, nutrition and health values of fruits, vegetables, spices, and plantation products will be discussed. In the second week, the post-harvest handling and storage aspects followed by processing and preservation principles will be covered in the third week. A brief overview on the primary process operations both on farm and in plant will be emphasized on the fourth week and the fifth week will cover the minimal processing strategies and hurdle technology. The 6<sup>th</sup> and 7<sup>th</sup> weeks will involve the development and processing of juices and concentrates and dehydrated and snack food products, respectively. The processing of plantation crop products and the science and technologies involved in spices and condiments will be discussed in the eighth and ninth weeks, respectively. The 10<sup>th</sup> week will be devoted on plant-based fermented foods and beverages. The overview on the smart packaging and storage of the fruits and vegetables, spices, plantation crop products will be taken up in the 11<sup>th</sup> week and finally the last week (12<sup>th</sup> week) will include a brief insight on the green technologies, by products and waste utilization.

A list of the suggested readings i.e. the books which might be useful for this course is given here.

- Handbook of Vegetables and Vegetable Processing by Muhammad Siddiq & Mark A. Uebersax

## Suggested Readings

- (1) Handbook of Vegetables and Vegetable Processing by Muhammad Siddiq & Mark A Uebersax
- (2) Handbook of Fruits and Fruit Processing by Nirmal K. Sinha et al.
- (3) Handbook of Post-Harvest Technology by A Chakraverty et al.
- (4) Fruit and vegetable processing: Improving quality by Wim Jongen
- (5) Post-Harvest Technologies of Fruits & Vegetables by H S Ramaswamy
- (6) Chocolate, Cocoa and Confectionary: Science & Technology by Bernard W Minifie
- (7) Handbook of Herbs and Spices by K V Peter
- (8) Food Processing Technology Principles and Practice by P J Fellows
- (9) Elements of Food Technology by N W Desrosier
- (10) Principles of Food Science Part 1: Physical Methods of Food Preservation by O R Fennema
- (11) Food Packaging Technology by Richard Coles, et al.









IIT Kharagpur

- Handbook of Fruits and Fruit Processing by Nirmal K. Sinha et al.
- Handbook of Post-Harvest Technology by A Chakraverty et al.
- Fruit and vegetable processing: Improving quality by Wim Jongen
- Post-Harvest Technologies of Fruits & Vegetables by H S Ramaswamy
- Chocolate, Cocoa and Confectionary: Science & Technology by Bernard W. Minifie
- Handbook of Herbs and Spices by K V Peter
- Food Processing Technology Principles and Practice by P. J Fellows
- Elements of Food Technology by N. W. Desrosier
- Principles of Food Science Part 1: Physical Methods of Food Preservation by Owen R Fennema
- Food Packaging Technology by Richard Coles, et al.

### **Horticultural status in India:**

India is the second largest producer of horticulture crops with 18% of area under cultivation. Horticulture contributes 33% to the gross value addition in agriculture. Horticulture production for India was of 331.05 million tons in 2021 which is the highest ever recorded.

## Horticulture Status in India

- 
 • India is the 2<sup>nd</sup> largest producer of horticulture crops.
- 
 • With 18% of area under cultivation, horticulture contributes 33% to gross value addition in agriculture.
- 
 • Horticulture production for India was of 331.05 million tonnes in 2020-21, which is highest ever recorded.
- 
 • Global horticulture export share of India is 1.7% for vegetables & 0.5% for fruits.
- 
 • India imports fruits and vegetables worth Rs. 15700 crore every year.
- 
 • Post-harvest losses of fruits & vegetables range 20-44% on account of inadequate infrastructure and value addition of produce (FAO, 2021).

Source: APEDA(2021), Statista(2019)



IIT Kharagpur

Global horticulture export share of India is about 1.7% for vegetables and 0.5% for fruits. Also, India imports fruits and vegetables worth Rs, 15,700 crores every year. Post-harvest losses of fruits and vegetables in India range to the tune of 20 to 44% on the account of inadequate infrastructure and value addition produce of the produce according to the report of FAO, 2021.

## Major fruits of india

### ❑ Fruit is the matured ovary and associated parts of a flower.

❖ India, being the largest producer of fruits, is known as fruit basket of world.

### ❑ Major fruits grown in India

 <b>Banana</b> P: 31,504	 <b>Mango</b> P: 20,444	 <b>Mandarin</b> P: 6,368	 <b>Papaya</b> P: 6,011
 <b>Guava</b> P: 4,304	 <b>Grapes</b> P: 3,125	 <b>Watermelon</b> P: 2,787	 <b>Apple</b> P: 2,735
 <b>Pomegranate</b> P: 2,315	 <b>Jackfruit</b> P: 1,835	 <b>Pineapple</b> P: 1,799	 <b>Sapota</b> P: 1,003

P: Production; '000 Tonnes ; Source: National Horticulture Board Database (2020).



IIT Kharagpur


## Major fruits of India

Fruit is the matured ovary and associated parts of a flower. India being the largest producer of fruits is known as fruit basket of the world. Major fruits grown in the India include banana, mango, mandarin, papaya, guava, grapes, watermelon, apple, pomegranate, jackfruit, pineapple, and sapota. The data for the production of these fruits given in the slide has been taken from the National Horticulture Board Database (2020).




### Major fruits of India (Contd...)

**Major production areas**



- India ranks first in production of bananas (26.08%), papayas (44.05%) and mangoes (including mangosteens and guavas) (45.89%).
- The area under cultivation of fruits stood at 6.66 million hectares.
- India is also a major exporter of fruits to the world.
- It has exported 6,09,612.91 MT of fresh fruits other than grapes and mango.
- The value of the export produces were Rs. 2,233.23 crores during the year 2020-21.

Source: APEDA(2021); Ministry of Agriculture & Farmers Welfare (2021)














NPTEL IIT Kharagpur

The major production states of fruit in India include Uttar Pradesh, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. India ranks first in the production of banana (26.08%), papaya (44.05%), and mangoes including mangosteens and guavas (45.89%). The area under cultivation of fruits is about 6.66 million hectares in the country. India is also a major exporter of fruits to the world. Recently, India has exported 609612.91 metric ton of fresh fruits other than grapes and mango. The value of the export produces were to the tune of around Rs. 2233.23 crores during the year 2021.


### Major vegetables of india

☐ Vegetables are the edible portion of a plant.

- ✓ Vegetables are usually grouped according to the portion of the plant that is eaten such as **leaves** (lettuce), **stem** (celery), **roots** (carrot), **tubers** (potato), **bulbs** (onion) and **flowers** (broccoli).
- ❖ India is the second largest producer of vegetables in the world.

 <b>Potato</b> P: 51,300	 <b>Onion</b> P: 26,738	 <b>Eggplant</b> P: 12,777	 <b>Tomato</b> P: 20,573
 <b>Cabbage</b> P: 9,207	 <b>Cauliflower</b> P: 8,840	 <b>Okra</b> P: 6,371	 <b>Peas</b> P: 5,703
 <b>Tapioca</b> P: 5,043	 <b>Chillies</b> P: 3,851	 <b>Radish</b> P: 3,107	

P: Production; '000 Tonnes; Source: National Horticulture Board Database (2020).



NPTEL IIT Kharagpur

### Major vegetables of India

Vegetables are the edible portions of a plant. Vegetables are usually grouped according to the portion of the plant that is eaten for example leaves (lettuce), stem (celery), roots (carrot), tubers (potato), bulbs (onion), and flowers (broccoli). India is the second largest producer of vegetable in the world.

The major vegetables produced include potato, cabbage, tapioca, onion, cauliflower, chili, eggplant, okra, radish, peas and tomato.

### Major vegetables of India (Contd...)

#### Major production areas

- India is the largest producer of ginger and okra amongst vegetables.
- Ranks second in production of potatoes, onions, cauliflowers, brinjal, cabbages, etc.
- The area under cultivation of vegetables is 10.35 million hectares.
- India exported vegetables worth Rs. 4,969.73 crores during 2020-21.

Source: APEDA (2021); Ministry of Agriculture & Farmers Welfare (2021)

The major production areas of vegetables in India include Uttar Pradesh, Bihar, West Bengal, Odisha, Madhya Pradesh, Maharashtra and Gujarat. India is the largest producer of ginger and okra among the vegetables. India ranks second in the production of potatoes, onions, cauliflower, brinjal, cabbages. The area under cultivation of vegetable is to the tune of around 10.35 million hectares. India exported vegetables worth Rs. 4969.73 crores during the year 2020-21.

### Major spices of india

□ A spice is a dried seed, fruit, root, bark, or vegetative substance primarily used for flavoring, coloring or preserving food.

#### Item-wise share of spices production in India 2021

Spice	Production (P)
Garlic	31,84,809 MT
Coriander	8,31,918 MT
Cardamom	33,811 MT
Chilies	20,92,153 MT
Fenugreek	2,02,631 MT
Tejpata	4,911 MT
Ginger	18,86,533 MT
Tamarind	1,58,502 MT
Turmeric	10,64,441 MT
Fennel	1,27,160 MT
Cumin	8,56,199 MT
Pepper	1,20,465 MT

Source: Malhotra et al. (2021)

### Major spices of India

Spices is a dried seed, fruit, root, bark or vegetative substance primarily used for flavoring coloring or preserving a food. In 2021, the percentage share of different spices of total production in India contributed as: garlic: 30%, chilies: 20%, seed spices: 19%, ginger: 18%, and turmeric: 10%. The

production data of the major spices like garlic, coriander, cardamom, chilies, fenugreek, tejpata, ginger, tamarind, turmeric, fennel, cumin, and pepper are given in the slide.

### Major spices of India (Contd...)

#### Production area share of spices

Spice	Share (%)
Seed spices	48%
Chilies	16%
Garlic	9%
Turmeric	6%
Pepper	6%
Ginger	4%
Mint	8%
Cardamoms	2%
Tree Spices	1%
Others	0%

- India is the world's largest producer, consumer and exporter of spices.
- It produces about 75 of the 109 varieties listed by the ISO.
- It accounts for half of the global trading in spices.
- In FY20, spices worth US\$ 3.62 billion were exported.

Source: Malhotra et al. (2021)

The percentage share of production of spices (in the area wise): about 48% i.e. half of the area under-spice cultivation contributes to the seed spices followed by 16% belonging to chilies, garlic and mint share 9 and 8%, respectively, and 6% of spice cultivation belonging to turmeric and so on. India is the world's largest producer, consumer and exporter of spice. 75 out of the 119 varieties of spices listed by ISO are produced in India, which accounts for half of the global trading in spices. In the financial year 2020, spices worth US\$ 3.62 billion were exported from India.

### Major plantation crops of India

- Plantation crops are high-value commercial crops which play a vital role in the agricultural economy and export trade of many developing and developed countries.
- The crops include **tea, coffee, cocoa, coconut, areca nut, oil palm, palmyra and cashew.**

<b>Areca nut</b> P: 1108	<b>Cocoa</b> P: 26	<b>Tea</b> P: 179
<b>Cashewnut</b> P: 703	<b>Coconut</b> P: 14195	<b>Coffee</b> P: 334

\*P- Production; '000 MT; Source: Agriculture Statistics 2020 (Ministry of Agriculture & Coffee board 2020; IBEF 2020)

## Major plantation crops of India

Plantation crops are high value commercial crops which play a vital role in the agriculture economy and export trade of many developing and developed countries. The crop which come under the



plantation crop include tea, coffee, cocoa, coconut, areca nut, oil palm, palmyra and cashew. The production data of all these plantation crop products is given in the slide.

### Major plantation crops of India (Contd...)

**Maior production areas**

State	Percentage
Kerala	27%
Karnataka	27%
Tamil Nadu	24%
Andhra Pradesh	9%
Assam	2%
Gujarat	2%
Odisha	2%
West Bengal	2%
Others	3%

- Plantation crops in India are mainly confined to the hilly areas of South India, i.e. mainly Kerala, Karnataka and Tamil Nadu.
- Assam, West Bengal, Tripura, Arunachal Pradesh, etc are tea producing states of India along with south India.

Source: ENVIS (2022)

Major production areas of plantation crops in India are mainly confined to the hilly areas of southern part of our country i.e. mainly Kerala (27%), Karnataka (27%), Tamil Nadu (24%), and Andhra Pradesh (9%). The major parts of the coconut or other plantation crop products are produced in these four major southern states. Assam, West Bengal, Tripura, Arunachala Pradesh are along with the southern states the major tea producing states in India.

### Horticulture, Spice & Plantation Crop Production Pattern

(Area: '000 Ha, Production: '000 MT, Productivity: MT/Ha)

Crop	Area			Production			Productivity		
	2004-05	2018-19	2019-20*	2004-05	2018-19	2019-20*	2004-05	2018-19	2019-20*
Fruits	5049	6597	6702	50867	97967	100448	10.07	14.85	14.99
Vegetables	6744	10073	10316	101246	183170	189464	15.01	18.18	18.37
Flowers	118	303	307	659	2910	2994	5.58	9.60	9.76
Aromatic & Medicinal crops	131	627	685	159	795	761	1.21	1.27	1.11
Plantation crops	3147	4069	4071	9835	16592	16031	3.13	4.08	3.94
Spices	3150	4067	4138	4001	9500	9754	1.27	2.37	2.36
Others	106			172	120	115			
<b>Total</b>	<b>18445</b>	<b>25737</b>	<b>26219</b>	<b>166939</b>	<b>311052</b>	<b>319567</b>	<b>9.05</b>	<b>12.09</b>	<b>12.19</b>

\*3<sup>rd</sup> Advance Estimates of Horticulture Crops 2019-20-DAC&FW

- Total horticulture production in 2019-20 is estimated to be 3.12% higher than 2018-19.
- Increase in production of fruits, vegetables, flowers and spices is seen whereas decrease in plantation crops, aromatics & medicinal plants is registered over 2018-19.
- The fruits production is estimated to be 102.03 MT compared to 97.97 MT in 2018-19.
- The production of vegetables is estimated to be 188.91 MT, against 183.17 MT in 2018-19.

Source: Ministry of agriculture & farmers welfare

### Horticulture, spice and plantation crop production pattern

The area under cultivation, production, and productivity of horticultural crops, spices and plantation crop in the year from 2004-05 to 2018-19 and 2019-20 is given in the table, which indicate that total horticulture production in the 2019-20 was estimated to be 3.12% higher than in the year 2018-19. Increase in the production of fruits, vegetables, flowers and spices are seen whereas there is a



decrease in the plantation crops, aromatics, and medicinal plants is registered over 2018-19. The fruit production is estimated to be 102.03 MT as compared to 97.97 MT in the 2018-19. The increased production of vegetables was estimated to be around 188.91 MT against 183.17 MT in the year 2018-19.

**Consumption, Export and Processing Data**

Category	Export (000 Tonnes)	Value (Rs. Crore)	Additional Info
Fruits & Vegetables	834.84	5496.38	Export of fruits
	1930.51	4617.34	Export of vegetables
	-	-	76% Consumed in fresh form; 20-30% wastage; 2% of vegetable production and 3% of fruit production are being processed.
Spices	1193.44	25642.04	Export of spices
	-	-	Export of spices contributes 41% of the total export earnings from all horticulture crops.
Plantation Crops	84.37	4018.35	India exported 84.37 '000 tonnes of cashewnuts of value Rs. 4018.35 crore in 2019-20
	254.80	5851.11	Tea: 254.80 '000 Tonnes; value – Rs. 5851.11 crores
	257.03	5236.76	Coffee: 257.03 '000 Tonnes; value – Rs. 5236.76 crores

Source : Agricultural statistics at a glance 2020, TIFAC 2020

### Consumption, export and processing data

Export of fruits is estimated to be around 835,000 tons which values at Rs. 5,496.38 crores. Similarly, export of vegetables is estimated to be around 1931 thousand tons valued at Rs. 4617.34 crores. Around 76% of the fruits and vegetables are consumed in fresh form, 20 to 30% is wasted, and 2% of the vegetable production and approximately 3% of the fruit production are being processed and converted into value-added products. For spices, the export is around 1193.44 thousand tons which is valued at Rs. 25642.04 crore. Export of spices contributes to 41% of the total export earnings from all horticultural crops. The plantation crop is exported 84.37 thousand tons of cashew nuts which is valued at Rs. 4018.35 crores in the year 2019-20. The tea production in India is around 254.80 thousand tons which is valued at Rs. 5851.11 crores and for coffee, the production is around 257.03 thousand tons that valued at Rs. 5236.76 crores.

### Market insight of fruits and vegetables

To reduce wastage as well as to add value in the fruits and vegetables processing traditional methods such as like canning, dehydration, pickling or provisional preservation and bottling are adopted. However, the percentage of processing of fruits and vegetables is currently less than 3%, which is far less for a country with the second largest production volume in the world. In the year 2019, approximately 8.31 million tons of fruits and vegetables were processed in India which is expected to reach about at 16.39 million tons by 2024 expanding at a CAGR of approximately 15% during the year 2020-2024. Indian fruits and vegetable processing industry experiences a conducive growth environment owing to the abundant supply of raw materials and the favorable government policies like Pradhan Mantri Kisan Sampada Yojana (PMKSY).

## Market Insight

### □ Fruits and vegetables

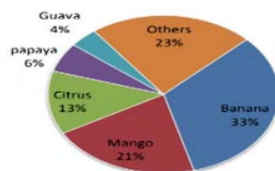
- To reduce wastage as well as to add value to them, processes like canning, dehydration, pickling, provisional preservation and bottling is done.
- However, percentage of processing of fruits and vegetables is currently less than 3%, less for a country with second largest production volume in the world.
- In 2019, ~8.31 million tons of fruits and vegetables were processed in India, which is expected to reach 16.39 million tons by 2024, expanding at a CAGR of ~14.84% during 2020-24.
- Indian fruit and vegetable processing industry experiences a conducive growth environment, owing to the abundant supply of raw materials and favorable government policies like Pradhan Mantri Kisan Sampada Yojana (PMKSY).



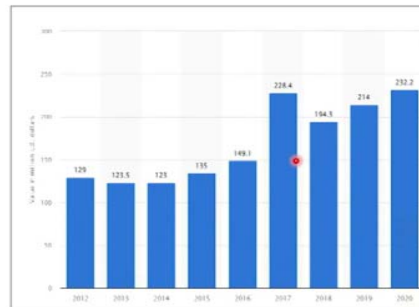
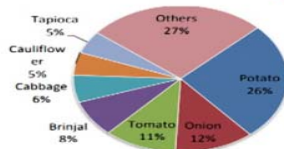
Source: Fruit and Vegetable Processing Industry in India 2020

IIT Kharagpur

### Market share of different fruits



### Market share of different vegetables



Sales value of processed fruits and vegetables in India from 2012 to 2020 (in million US\$)

Source: Director General of Foreign Trade, Technova Research & Analysis Statista (2022)



IIT Kharagpur

From the market share of different fruits, it can be clearly observed that banana contributes the highest i.e. 33% followed by mango (21%), citrus fruits (13%), papaya (6%), and guava (4%). Similarly, among vegetables potato contributes the highest percentage of market share (26%) followed by onion (12%), tomato (11%), brinjal (8%), cabbage (6%), and cauliflower along with tapioca (5%).

The graph represents the progressive increase in the sales value of processed fruits and vegetables in India from the year 2012-20. In the year 2017, the total sale value of fruits and vegetables was estimated as around 228.4 million US dollars. In 2020, amid COVID period the total sale value of fruits and vegetables was around 232.2 million US dollar.

## Key players of fresh fruits & vegetables market

S.N	Brand	Mode of presence	HQ/ Mfg	Year of Entry	Revenue (2015)	Number of Stores
1	Reliance Fresh	Indian Company – Contract Farming	Mumbai	1999	€ 760 Mn*	700+
2	Safal	Indian Company – Sourcing from Farmers	Delhi	2000	€ 80 Mn	350+
3	Nature's Basket	Indian Company – Imports and Sourcing from Farmers	Mumbai	2005	€ 27 Mn	36
4	Heritage Fresh	Indian Company – Sourcing from farmers and Contract Farming	Hyderabad	1992	€ 65 Mn	90
5	Big Bazaar	Indian Company – Sourcing from farmers	Mumbai	2001	€ 48 Mn	185



## Key players of processed fruits & vegetables market



Source: Director General of Foreign Trade, Tecnova research & analysis

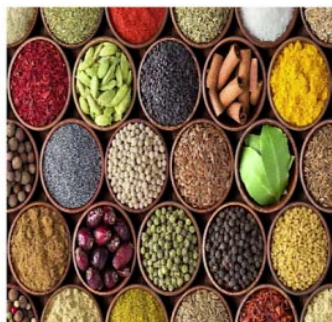
IIT Kharagpur



Key players of fresh fruit and vegetable market in India include Reliance fresh, Safal, Nature's basket, Heritage fresh and Big bazaar. They operate either through contact farming or sourcing directly from the farmers. Major key players, major players of the processed fruits and vegetables in India include Kissan, Nestle, Parle Agro, McCain, Ruchi, MTR, Heritage and LT foods Ltd.

## Market insight (contd...)

### Spices and its products



- The India spices market grew at a CAGR of 15% during 2015-2020.
- The Indian seasoning, dressings & sauces sector is led by herbs, spices & seasonings category in both value and volume terms.
- Dressings category is forecast to register fastest value growth during 2021-2026.
- Hypermarkets & supermarkets is the leading channel for distribution of seasonings, dressings & sauces products in the country.
- Tata Sons Limited, Unilever, and Nestlé are the top three companies in the Indian seasonings, dressings & sauces sector in 2020.



India Spices Market: Industry Trends, Share, Size, Growth, Opportunity and Forecast 2021-2026  
India Seasonings, Dressings and Sauces Market Size by Categories, Distribution Channel, Market Share and Forecast, 2021-2026



IIT Kharagpur

## Market insight of spices and its products

The India spice market grew at a CAGR of about 15% during years 2015-20. The Indian seasoning, dressing and sauces sector is led by herbs, spices and seasonings category in both value and volume terms. Dressing category is forecast to register fastest value growth during 2021-2026. Hypermarkets and supermarkets are the leading channels for distribution of seasonings, dressings and sauces products in the country. Tata sons limited, Unilever, and Nestle are the top three companies in the Indian seasonings, dressings, and sauces sector in the year 2020.



**Market insight (contd...)**

**Plantation crops**

❖ **Plantation crops are potential sector with lot of opportunities of employment generation, foreign exchange earnings and overall supporting livelihood sustenance of mankind at large.**

- Coconut products market size was valued at \$11.5 billion in 2018, and is estimated to reach \$31.1 billion by 2026, registering a CAGR of 13.6% from 2019 to 2026.
- In 2018, the coconut oil segment accounted for more than half of the total coconut products market share.
- **Key Market Players:** The Coconut Company (Uk) Ltd.; Marico Ltd.; Vita Coco; Sambu Group; Metshu Exports (Pvt) Ltd; Cocomate; Klassic Coconut; Cocotana Coconut Products; Universal Coco Indonesia; Thai Coconut Public Company Limited.



- The Indian cashew market is projected to register a CAGR of 4.0 % during the forecast period (2022-2027).
- India has been the top exporter in the global shelled cashew trade, accounting more than 15% of the global cashew export in the last 4 years.



India cashew market - growth, trends, covid-19 impact, and forecasts (2022 - 2027); Allied market research, 2018



IIT Kharagpur



## Market insight of plantation crops

Plantation crops are the potential sector with lot of opportunities of employment generation, foreign exchange earnings and overall supporting livelihood sustenance of mankind at large. These plantation crops are considered as cash crops in the country. Coconut products market size was valued at 11.5 billion US dollar in 2018 and is estimated to reach 31.1 billion dollar by 2026 registering a CAGR of 13.6% from 2019 to 2026. In 2018, the coconut oil segment accounted for more than half of the total coconut products markets share. The current major key market players in the coconut industry include The Coconut Company (UK), Marico Ltd., Vita Coco, Sambu Group, Metshu Exports (Pvt) Ltd, Cocomate, Klassic Coconut, Cocotana Coconut Products, Universal Coco Indonesia, Thai Coconut Public Company Limited. The Indian cashew market is projected to register a CAGR of 4% during the forecast period 2022-2027. India has been the top exporter in the global shelled cashew trade, accounting more than 15% of the global cashew export in the last 4 years.

The India chocolate market reached a value of US 1.9 billion dollar in 2020 with the country currently representing one of the world fastest growing market for chocolates. The Indian chocolate market is expected to exhibit a CAGR of 11.3% during 2021-2026. Some of the major players in India in the chocolate sector are Mondelez, Ferrero, Nestle, Mars international etc.

In India, the tea market is projected to witness a future growth of CAGR of 4.2%. In fact, Indian tea particularly Darjeeling tea is known worldwide for its flavor and aroma. In 2026, the tea industry in India is expected to attain 1.4 million tons. The ready to drink segment has the potential to witness a healthy increase. The industry will also be driven by the increasing innovation in packaging and flavors in the coming years.

Major players in the tea sector in the country include Tata consumers product limited (Tetley tea and Tata tea), Hindustan Unilever Ltd. (Lipton and Brookebond), Wagh Bakri Tea Group etc.



## Plantation crops (Market insight contd...)



- The India chocolate market reached a value of US\$ 1.9 Billion in 2020 with the country currently representing one of the world's fastest growing markets for chocolates.
- **The Indian chocolate market to exhibit a CAGR of 11.3% during 2021-2026.**
- Some of the major players in India: Mondelez India Foods Private Limited, Ferrero India Private Limited, Nestle India Limited, Mars International India Private Limited etc.



- **Tea market is projected to witness a further growth of CAGR of 4.2%.**
- In 2026, the tea industry in India is expected to attain 1.40 million tons.
- The RTD segment has the potential to witness a healthy increase.
- The industry will also be driven by the increasing innovation in packaging and flavors in the coming years.
- **Key players:** Tata Consumer Product Ltd (Tetley and Tata Tea); Hindustan Unilever Ltd. (Lipton and BrookeBond); Wagh Bakri Tea Group etc.

India Chocolate Market: Industry Trends, Share, Size, Growth, Opportunity and Forecast 2021-2026; Indian Tea Market, Expert Market Research

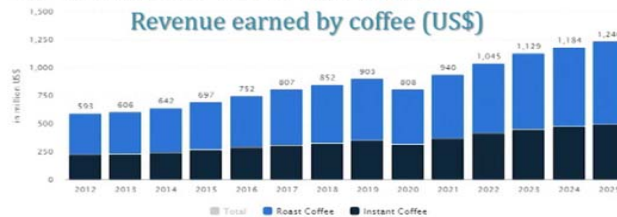


IIT Kharagpur

## Plantation crops (Market insight contd...)



- The total coffee export was US\$ 377.65 million in April 2021 to August 2021 and for August 2021 it was US\$ 76.71 million.
- In FY21, the total coffee export accounted for US\$ 719.5 million and for March 2021 it was US\$ 97.41 million.
- **The coffee segment amounts to \$ 808 million and is expected to grow annually by 8.9% CAGR in 2020-2025.**
- **HUL's Bru and Nestle's Nescafe are the key players.**



Statista, 2020. Coffee Industry in India: Growth, Challenges, and the Future

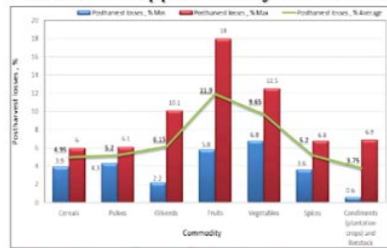
IIT Kharagpur

The total coffee export was US 377.65 million dollar in April 2021 to August 2021 and for the august 2021 it was US dollar 76.71 million. In the financial year 21, the total coffee export accounted for US dollar 719.5 million and for March 2021 it was US dollar 97.41 million. The coffee segment amounts to 808 million US dollar and is expected to grow annually by 8.9% CAGR in 2020-2025.

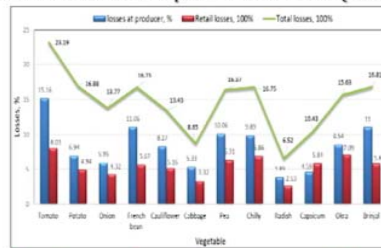
HUL's bru and Nestle's Nescafe are the key players in the coffee sector in India. In the slide, the revenue earned by coffee including roasted and instant coffee (in the US dollar) from the year 2012 to 2025 has been shown, which also represents the progressive increase in the revenue earned by coffee annually.

## Post Harvest Losses

- Post-harvest food loss is measurable qualitative and quantitative food loss along the supply chain, starting at the time of harvest till its consumption or other end uses.
- Every year about 1/3 of the food worldwide is wasted (FAO 2011).
- India loses approximately Rs 926 billions worth of food as post-harvest loss (PIB, 2016).



Post-harvest loss of different commodity



Post-harvest loss of different vegetables



IIT Kharagpur

Source : Hegazy, 2016

### Post-harvest losses

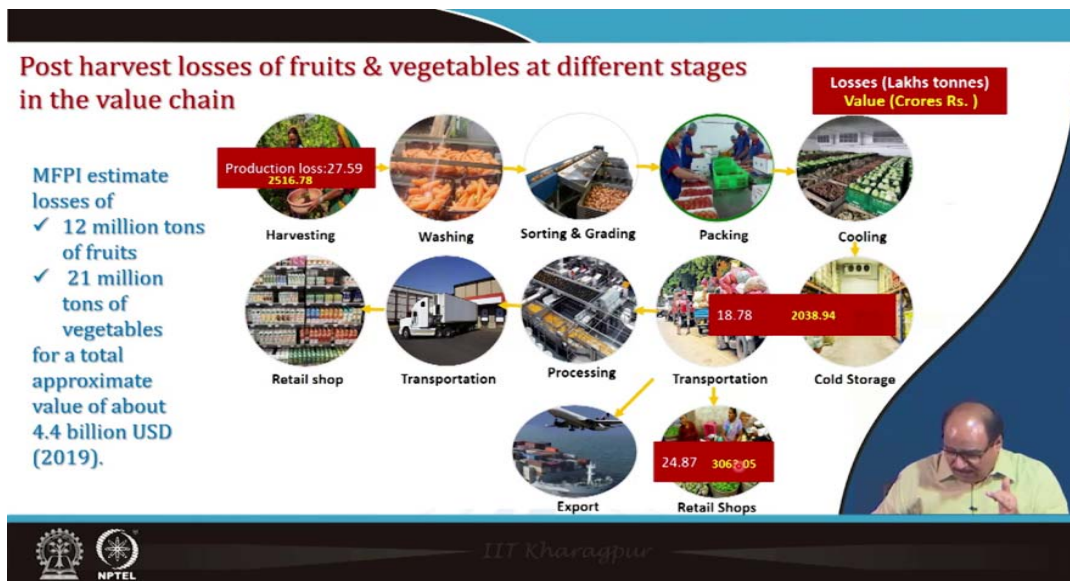
Post-harvest loss is a measurable qualitative and quantitative loss along the supply chain, starting at the time of harvest till the produce reaches to the consumer table, it has to pass through various stages and each stage in the value chain, there is a significant quantity of the product loss in India.

FAO, 2011 reported that every year about one third of the food worldwide is wasted. Fresh information bureau data in the year 2016 reported that India loses approximately Rs. 926 billion worth of food as post-harvest loss and a developing country like India cannot afford to such a huge loss or such a luxury of huge wastage of fruits, vegetables and other important produces.

The left hand side graph represent the post-harvest losses of commodities including cereals, pulses, oilseeds, fruits, vegetables, spices, and condiments with their maximum, minimum, and average values indicating in red, blue, and green color, respectively. The right hand side plot shows the post-harvest losses of vegetables at different stages (producer and retail) as well as total losses indicating in blue, red, and green color, respectively.

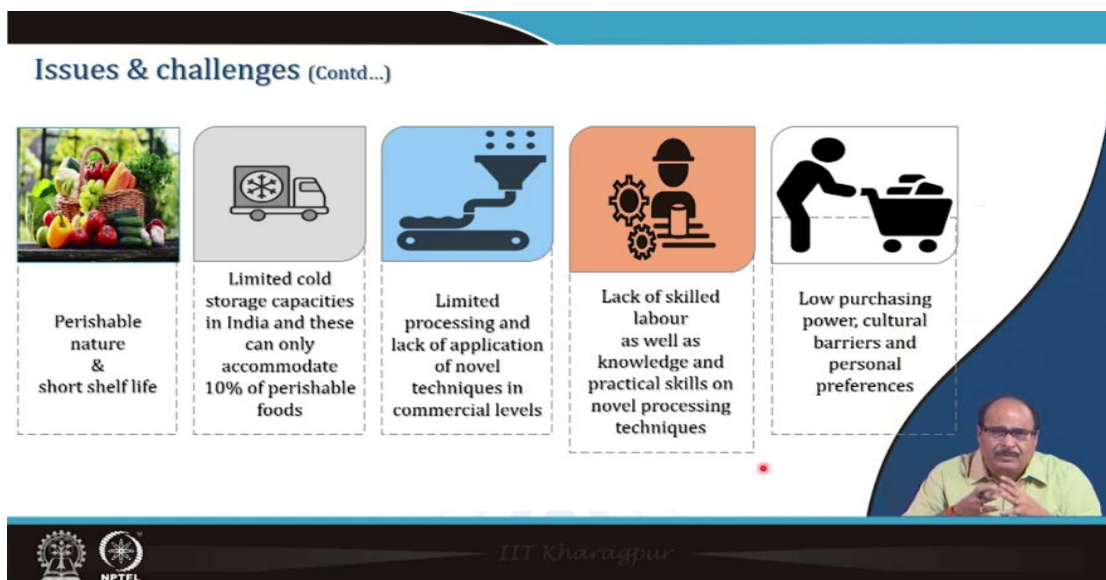
### Post-harvest losses of fruits and vegetables at different stages in the value chain

The value chain consists of different stages starting from the harvesting, washing, sorting, grading, packing, cooling, storing at cold storage, transportation to export, or directly to retail shop or processing unit followed by transporting to retail shop. In the production stage about 28 lakh ton of the produce is getting wasted at the farm level. Then in the cold storage and transportation section approximately 18.78 or approximately 19 lakh tons of the produce gets wasted. Finally the fresh produce gets wasted (around 25 lakh tons) in the retail shop. The wastage value at the farm gate is Rs. 2516.78 crores, during storage and transportation around Rs. 2039 crores and in the retail shops it is around Rs. 3063 crores. The Ministry of Food Processing reported that there was 12 million tons loss of fruits and 21 million tons loss of vegetable, which accounted around approximate value of US dollar 4.4 billion in 2019.



## Issues and challenges

Horticulture in India contributes about one third of the Indian agriculture GDP and its expenditure shares of the total Indian GDP are about 4.7%. Despite of the significant production, average fruits and vegetable consumption in India is still relatively very low and highly unequal due to underdeveloped supply chains for the distribution of fruits and vegetables. It has been reported that huge quantity of fruits and vegetables produced in India are lost in the supply chain between harvest and consumption. The major reasons are perishable nature and short shelf life of the fruits and vegetables as well as the poor storage infrastructure, poor transportation facilities and poor supply chain models.



So, the major issues which need to be resolved are the perishable nature and shelf life of fruits and vegetables, limited storage capacity in India and these can only accommodate 10% of the total perishable produced in the country. So, there is need to increase the storage capacity, cold storage

chain for the horticultural and plantation crop or perishable crop sectors. Also, there is a limited processing, lack of application of the novel technologies particularly at the commercial levels, lack of skilled labour as well as knowledge and practical skills on novel processing techniques, low purchasing power, cultural barriers and personal preferences. So, this course will provide sufficient knowledge, information and will be useful for the participant and it will help to create more entrepreneurs startups and even the existing industries.



**Summary**

- ✓ India is the second largest producer of horticulture crops in the world.
- ✓ Irrespective of highest production, only 2 - 3% of the produces are processed.
- ✓ Post harvest losses amount to 20 - 30% of the production owing to poor storage infrastructure, poor transportation and supply chain and lack of processing.
- ✓ The market insight shows a growing trend for horticulture produces and their processed products and increase in demand.
- ✓ There is a need for skill development and application of novel processing technologies to capitalize the opportunity and fulfil the demand.

*IIT Kharagpur*

NPTEL

## Summary

India is the second largest producer of horticultural crops in the world. Irrespective of the highest production, only 2-3% of the producers are processed. So there is a need for skill development and application of novel processing technologies to capitalize the opportunity and fulfill the demand. This course will be helpful to gather knowledge for improving or modernizing the storage and processing facilities in order to add value to the product so that the level of processing is increased, losses are minimized and the industry is able to give quality products which good nutritional value because fruits and vegetable are the hub of the micronutrients.



## References

- [https://apeda.gov.in/apedawebsite/SubHead\\_Products/Other\\_Fresh\\_Fruits.htm#:~:text=India%20is%20the%20largest%20producer.Papaya%2C%20Sapota%20and%20Water%20Melons](https://apeda.gov.in/apedawebsite/SubHead_Products/Other_Fresh_Fruits.htm#:~:text=India%20is%20the%20largest%20producer.Papaya%2C%20Sapota%20and%20Water%20Melons)
- [https://pib.gov.in/PressReleasePage.aspx?PRID=1703196#:~:text=Highlights%20of%202020%2D21%20\(First,%25\)%20over%202019%2D20.Font%20size%20\(14\)](https://pib.gov.in/PressReleasePage.aspx?PRID=1703196#:~:text=Highlights%20of%202020%2D21%20(First,%25)%20over%202019%2D20.Font%20size%20(14))
- <https://static.pib.gov.in/WriteReadData/specificdocs/documents/2021/mar/doc20213851.pdf>Font size (14)
- <http://nhb.gov.in/KnowledgeCenter/IFVY-Presentation-Nov.pdf>
- <https://nib.gov.in/PressReleaseFramePage.aspx?PRID=1776584#:~:text=Andhra%20Pradesh%2C%20Maharashtra%2C%20Uttar%20Pradesh,of%20production%2C%20as%20per%20the>
- <https://www.ibcf.org/exports/indian-tea-industry>
- Malhotra, Suresh & Cherian, Homay & Meena, Babulal & Kumar, Manoj & Sreeekumar, Sruthi. (2021). Spices Statistics at a Glance 2021.
- <https://www.indiacoffee.org/coffee-statistics.html>
- [http://www.kerenvis.nic.in/Database/Crops\\_1732.aspx](http://www.kerenvis.nic.in/Database/Crops_1732.aspx)
- <https://tifac.org.in/index.php/reports-publications/reports-2010-onwards/tv-2020-reports/8-publication/207-agro-food-processing-technology-vision-2020-fruits-vegetables-current-status-vision?showall=1>



IIT Kharagpur

## References

- [https://apeda.gov.in/apedawebsite/SubHead\\_Products/Other\\_Fresh\\_Fruits.htm#:~:text=India%20is%20the%20largest%20producer.Papaya%2C%20Sapota%20and%20Water%20Melons](https://apeda.gov.in/apedawebsite/SubHead_Products/Other_Fresh_Fruits.htm#:~:text=India%20is%20the%20largest%20producer.Papaya%2C%20Sapota%20and%20Water%20Melons)
- Hodges, R.J., Buzby, J.C., and Bennett, B. 2011. Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. *Journal of Agricultural Science* 149:37-45
- AO. 2011. Global food losses and food waste: extent, causes and prevention, by J. Gustavsson, C. Cederberg, U. Sonesson, R. van Otterdijk and A. Meybeck. Rome. [www.fao.org/docrep/014/mb060e/mb060e00.pdf](http://www.fao.org/docrep/014/mb060e/mb060e00.pdf)
- Steps Taken to Reduce Post Harvest Food Losses, PIB, Feb 2016
- Hegazy, Rashad. (2016). Post-harvest Situation and Losses in India. 10.6084/M9.FIGSHARE.3206851.
- [https://www.macfrut.com/public/allegatinews/1097/1097\\_food\\_sector\\_fruits\\_vegetables\\_1\\_1\\_283.pdf](https://www.macfrut.com/public/allegatinews/1097/1097_food_sector_fruits_vegetables_1_1_283.pdf)
- <https://www.alliedmarketresearch.com/coconut-products-market>
- <https://www.mordorintelligence.com/industry-reports/india-cashew-market>
- <https://www.imarcgroup.com/india-chocolate-market>
- <https://www.expertmarketresearch.com/reports/indian-tea-market>
- Negi, Saurav, and Neeraj Anand. "Issues and challenges in the supply chain of fruits & vegetables sector in India: a review". *International Journal of Managing Value and Supply Chains* 6, no. 2, pp. 47-62, 2015.
- Negi, Saurav, and Neeraj Anand. "Issues and challenges in the supply chain of fruits & vegetables sector in India: a review". *International Journal of Managing Value and Supply Chains* 6, no. 2, pp. 47-62, 2015



IIT Kharagpur

The references for this lecture are given here for further study. Thank you.