



Agro Processing: Scope and Importance

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Abstract

In this chapter, the importance of agro-processing industry is highlighted. The agricultural production of various commodities from the leading countries of the world during the last decade is presented. The chapter includes the status of cereal industry, fruit and vegetable industry, fish industry, livestock industry, poultry industry, sugarcane industry, pulse industry, tea industry, oilseed industry, spice industry and dairy industry across the globe. The overall increase in the production of cereals, fruits, vegetables, fish, livestock, sugarcane, tea, oilseeds, pulses and spices has been observed during the last decade. The growth rate in the production is also expected to increase in number of agricultural sectors in the years to come to meet the increasing global demand. It will expand the agro-processing industry and storage facilities in particular. The untapped contribution of agro-processing industries in the economy of developing countries and employment generation is also highlighted.

Keywords

Agro-processing industries · Cereals · Fruits and vegetables · Fish · Livestock and poultry · Sugarcane · Pulses · Tea · Oilseeds · Spices · Dairy

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1.1 Introduction

The demand for agricultural commodities is mainly driven by the set of parameters, viz. income, price, preference and population. Now, the use of agricultural commodities is not limited to food only, but it has now been expanded to the non-food uses too such as fuels, feed and other industrial applications. Therefore, the expansion is expected towards the different processing units across the world in the future. Processing involves all the activities that led to the transformation of basic food material to be more usable, less prone to deterioration and easily handled so as to make it a more useful product. Processing of produce involves different unit operations to convert it into value-added form starting from harvesting to end use.

The growing urban population, working professionals and fast-pace life style has resulted time constraints for the various household that eventually is popularising numerous processed food products in different developing nations also. Therefore, the agro-processing sector is one of the most important sectors to reach new levels of growth and development. The conversion of basic food stuff to premium food quality product has not only given stability to the processed food industries but also benefited the farmers by increasing their income. However, the growth of the food processing sector depends upon the production of the agricultural produce, demand, export opportunities and policy of the government.

There are countries in which different corporations/agencies ensure procurement of wheat, paddy, pulses, fruits, etc. directly from the farmers to provide higher returns to them. Horticulture Produce Marketing and Processing Corporation (J&K, India) procures apples from local orchards for the production of apple juice concentrate without involving local dealers and suppliers, thus providing high direct return to their yield. Higher returns are also attained as apples used for concentrate production are generally not equally acceptable for direct consumption because of the quality, and therefore it fetches lower price, if sold in the market for direct consumption. Hence, producing juice concentrate adds value to the produce and yields higher returns. Similar approach is needed for the entire cultivated segment to boost up the income level of farmers.

The agriculture sector is considered as the backbone of growth and development of a country. In India, more than 60% of land is occupied by the agro sector and leads in the production of many commodities like tea, sugar, milk, fruits, vegetables, etc. Such huge production is responsible for huge investments and employment generation. However, due to insufficient processing facilities, higher losses are observed. Fruits and vegetables encounter the highest loss percentage of 5.8–18%. With the advances in science and technology, rapid strides are needed in the food processing sector to prevent such losses and convert basic crops into valuable products. This sector requires more attention not only to strengthen the concern of the food security but to promote industrialization, which can enhance rural, social and economic development.

1.2 Agro-Processing Industries

The agro industry is an enterprise that processes biomass. It is also referred to as an establishment, which diversifies the food market by processing raw materials and providing varieties of foods. Agro-processing industries are considered as the most important setup to prevent post-harvest losses of agriculture produce as well as livestock. As per the FAOSTAT database, the processing of barley for the production of beer remains on the top among processed agricultural produce with 186.5 MT in 2018, while the production of sugar remains on the second processed product with a production of 182 MT [1] (Fig. 1.1).

The food processing industries are being promoted by concerned state/department to:

- Provide hygienic, safe and quality products.
- Provide cost-effective nutritious foods to the people.
- Build a highly productive and competitive industry.
- Promote sensitization of food safety issues.
- Develop knowledge-based industry, which promotes value addition.
- Promote modernization of agriculture and bring the benefits of urbanization to the food processing sector.

The status of different agro-processing industries is described as follows:

1.3 Cereal Industry

Cereal industries have developed very fast in the world as well as in India. Consumers demand more benefits from standard foods. Therefore, cereal based products like extruded snacks, breakfast cereals, biscuits etc. are produced from basic agro products such as wheat, sorghum, oats etc. to provide not only nutritionally rich products but also healthy and palatable to match busy life style. China is the leading producer of cereals followed by the USA and India. Production of various cereals is presented in Table 1.1, and the production is expected to increase further by 1% annually for a time span of nearly 10 years. In the recent years, the supply of the cereals has exceeded the consumption, which has led to the significant buildup of stock and caused the reduction of prices in the international market as compared to the previous decade.

The maximum production of maize remains on the first place with a production of 1148.5 million tonnes, while wheat and paddy remain on the second and third places with a production of 765.8 and 755.5 million tonnes (503.9 million tonnes of milled rice equivalent), respectively [2]. The world cereal production is projected to increase to 3054 million tonnes by the year 2028 [3]. The largest growth is expected in maize production followed by wheat, rice and then coarse grains. The world average yield of the cereals is expected to increase by 1.1% annually, and mostly the

increase in the world production of cereals is mainly going to be in Asia, Latin America, Africa and Eastern Europe [3].

Rice is a staple food in most of the states of India especially southern and eastern regions. Tables 1.2 and 1.3 show the production of paddy (rice) and wheat. The global rice production is expected to reach 583 million tonnes by the year 2029 [4]. India accounts production of white and brown rice, which is more than 20% of world production and is considered as one of the largest producers. Indian paddy production reached up to 177.6 million tonnes in 2019. Rice industries are considered as the backbone of our staple food and have a significant contribution to food security. India is one of the world's best *basmati* rice producers and exported nearly 4.45 million tonnes of basmati during 2019–2020 [5]. However, the consumption pattern of rice is going to increase over the next 10 years. The utilization of rice is going to expand nearly by 1.1% annually compared to 1.4% annually in the last decade.

The global rice production is projected to grow over the next 10 years. However, the production in developed countries is going to increase marginally, whereas the growth is going to be robust in the developing nations. Asia is going to contribute to the majority of the production, and the highest growth is expected in India followed by Indonesia, China, Vietnam and Thailand. The production in China is going to see the growth at the slower pace than the previous decade due to decrease in area of plantation. The production of paddy in different countries and the world is shown in Table 1.2. The world rice trade is expected to grow by 2.3% annually, and nearly 75% of total export is traded by India, Thailand, Vietnam, Pakistan and the USA. The largest import is expected in Africa, countries where the demand is going to be higher than the production due to per capita consumption and population growth.

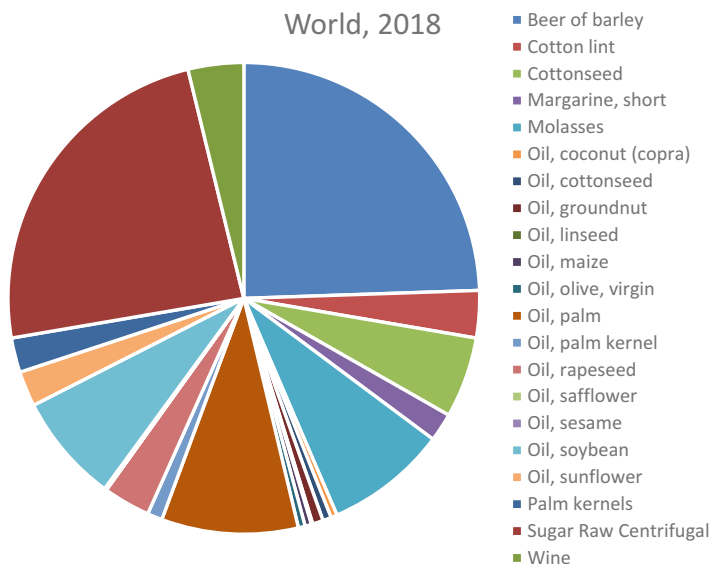


Fig. 1.1 Pattern of processed agricultural production of the world during 2018

Wheat production in India has seen a sharp increase from 6.46 million tonnes (MT) in 1950–1951 from an area of 9.75 MH to more than 93 MT during 2011–2012 from an area of about 30 million hectares (MH). After China, India is the second largest producer of wheat in the world (Table 1.3) with a share of nearly 12% in total production of the world. Global wheat production is going to increase and is expected to reach up to 839 million tonnes by 2029 [4]. The increase in production by the developed nations is projected to add by 41 million tonnes in the year 2028, whereas the production in developing countries is going to add 45 million tonnes. India is further expected to increase its production by 15.5 million tonnes in the year 2028 [3]. The consumption of wheat is also going to increase globally. China, India, Africa and the Middle East are projected to account for nearly two-thirds of the increase in consumption [3]. The production of wheat-based alcohol is also projected to grow in order to boost the production of alcohol.

The export of wheat is also expected to grow over the next 10 years. The Russian Federation is expected to remain as the leading exporter of wheat, which may account for 20% of the world wheat export by 2028 followed by EU and the USA. The import of wheat is widespread across the world, but the top five importing nations are Egypt, Indonesia, Algeria, Brazil and the Philippines [3].

1.4 Fruit and Vegetable Industry

India is the second largest producer of fruits and vegetables after China. Table 1.4 shows the production of fruits and vegetables across the globe. Fruits and vegetables are highly perishable in nature because of high moisture content (70–95%). The different processes such as pickling, dehydration, canning, bottling and other preservation techniques have been introduced to reduce the wastage of fresh fruits and vegetables and to add value. However, the processing varies in different countries depending upon the facilities and domestic patterns and policies. The USA processes around 65% of the total production, whereas the Philippines and China process around 78% and 23%, respectively. The processing in India is lesser than 3% and

Table 1.1 Production of cereals in major producing countries and the world [2]

Year	Production, million tonnes			
	China, mainland	USA	India	World
2010	496.3	401.1	267.8	2460.5
2011	519.4	385.5	287.9	2581.6
2012	539.3	356.2	293.3	2556.1
2013	552.7	434.3	294.9	2759.2
2014	557.4	442.8	296.0	2809.4
2015	618.2	431.9	284.3	2833.6
2016	614.6	503.5	297.9	2917.4
2017	614.0	440.3	310.8	2966.0
2018	608.9	439.7	321.6	2912.3
2019	612.7	421.5	324.3	2979.0

Table 1.2 Production of paddy in major producing countries and the world [2]

Year	Production, million tonnes			
	China, mainland	India	Indonesia	World
2010	195.8	144.0	59.3	694.0
2011	201.0	157.9	58.3	719.1
2012	204.2	157.8	59.7	727.7
2013	203.6	159.2	60.1	731.8
2014	206.5	157.2	59.1	730.8
2015	212.1	156.5	61.0	732.0
2016	211.1	163.7	59.4	739.5
2017	212.7	168.5	59.4	751.7
2018	212.1	174.7	59.2	762.8
2019	209.6	177.6	54.6	755.5

Table 1.3 Production of wheat in major producing countries and the world [2]

Year	Production, million tonnes				
	China, mainland	India	Russian Federation	USA	World
2010	115.2	80.8	41.5	60.1	640.8
2011	117.4	86.9	56.2	54.4	696.9
2012	121.0	94.9	37.7	61.7	673.7
2013	121.9	93.5	52.1	58.1	710.4
2014	126.2	95.9	59.7	55.1	728.8
2015	132.6	86.5	61.8	55.8	742.0
2016	133.3	92.3	73.3	62.8	748.5
2017	134.2	98.5	86.0	47.4	772.3
2018	131.4	99.9	72.1	51.3	733.4
2019	133.6	103.6	74.5	52.3	765.8

does not contribute significantly in the world trade (<1%). But, the processing is expected to grow and is projected to process 16.39 million tonnes by 2024 as compared to 8.31 million tonnes in the year 2019 [6].

The production of fruits and vegetables has been consistently increasing for the last two decades and is projected to have further growth due to the awareness towards health, nutrition, availability and functional aspects. The fruit and vegetable industry in Asia has a tremendous export potential due to a wide range of produce. The short production cycle of vegetables allows farmers to have multiple cropping and produce good volume. Asia produces nearly 74% of the world vegetable production, and China produces more than 50% of the world production of vegetables and produced 588.3 million tonnes of vegetables in the year 2019 (Table 1.4). The domestic consumption in developing countries is still low due to the purchasing capacity and eating habits. Processed vegetables including dried vegetables constitute the large share of export. However, the vegetables in frozen form is going to see the future growth tremendously.

Even fruit and vegetable processing industries in a number of countries do not receive standard quality produce due to inadequate availability of cold stores and

cold chain transport, which in turn results in low-grade processed foods. However, significant developments in technology involve efforts to reduce losses by better understanding of harvesting, handling and preservation. Packaging of fruits and vegetables has a significant role in the prevention of losses and increase of shelf life. Much of the produce is produced in rural areas, and due to inadequate facilities and lack of direct approach to the industries, producers receive much lower prices. Keeping in view, the involvement of different government corporations in post-liberalization era has helped the fruit and vegetable industry to improve upon the value chain to a certain extent.

In developing countries, the food industry has been facing problems on different fronts and need to work under the constraints of variation in the quality of raw material and varied prices, inefficient techniques for handling and storage, lack of research facilities, uncertainty in the availability of adequate quantity for processing, high cost of energy, expensive and inadequate cold chain facilities and varied processing conditions from one material to another. Research and Development in future need to focus on these issues and cost effective value-added and diversified products.

1.5 Fish Industry

Fisheries and aquaculture are one of the most important businesses in developing countries because over 500 million people depend on it. The consistent growth of production and utilization across the world can be observed from Table 1.5. The production for produce from inland water increased from 7.5 to 63.4 million tonnes in four decades, which is more than six times the initial inland production. It clearly indicates the interest of the peoples in the inland fisheries and aquaculture, while consistent growth can also be observed in marine production, but the growth rate is comparatively lower; however, it still holds the lion share in the production statistics.

Table 1.4 Production of fruits and vegetables in major producing countries and the world [2]

Year	Production, million tonnes							
	Fruits				Vegetables			
	China	India	Brazil	World	China	India	USA	World
2010	195.1	76.4	41.6	736.9	457.4	99.3	34.7	921.1
2011	204.5	76.1	44.2	761.9	475.4	105.7	34.0	954.3
2012	214.5	78.0	41.6	775.2	483.9	112.9	35.3	977.6
2013	221.5	85.3	41.0	806.4	493.4	119.6	33.6	996.5
2014	227.0	91.0	40.6	822.7	505.8	125.2	35.7	1032.6
2015	229.1	90.8	40.1	835.7	535.0	120.0	34.5	1059.1
2016	232.3	92.0	38.9	839.0	544.7	125.9	34.1	1078.9
2017	236.8	98.0	39.9	844.7	559.2	131.6	32.1	1099.5
2018	239.1	101.9	39.9	871.2	573.8	130.1	31.7	1106.1
2019	246.6	104.2	40.1	883.4	588.3	132.0	30.0	1130.2

The production of fish at the global level is projected to grow (1.1% annually) but comparatively lesser than the previous decade (2.4% annually). The top capture producers are China, Indonesia, Peru, India, the Russian Federation, the USA and Vietnam, and the major aquaculture producers are China, India and Indonesia with a total production of 47.6, 7.1 and 5.4 million tonnes, respectively, in 2018 [7].

In the world trade, the share of top five exporting nations, China, Vietnam, Norway, the European Union and the Russian Federation, is expected to grow by 46% from the current share of nearly 45%. However, the fastest growth is forecasted for Indonesia, and it is expected that it may capture the fourth position in the list of exporting nations and in the world trade by 2028 [3]. In the last four decades, the consumption pattern increased consistently in developing countries, whereas this pattern is nearly invariable in developed countries on an average basis. In the recent years, the growth of capture fisheries is not appreciable, but it is projected to increase mainly due to the higher prices and better management in some parts of the globe. The consumption of fish from aquaculture is expected to increase to 58% in the year 2028 from the current share of nearly 52% [3]. The non-food uses of the fisheries also increased in the developing countries, whereas it decreased in the developed countries. India has nearly 8118 km of marine coastline and 3827 fishing villages along with 1941 traditional fish landing centres and is considered as one of the major suppliers of fish in the world. With a total production of 12.39 million tonnes during the year 2018 makes India as the third biggest producer of the fisheries (Table 1.6). The lack of good management practices and the depletion of the stock of some fisheries are seen as the prime concern at the global level.

The trade of fish meal is also going to increase in the next decade, and Peru is going to be the major exporting nation for the fish meal followed by the European Union and Chile. Likewise, trade in fish oil may also grow. In developing nations, fish processing is mainly carried out for export purposes. The established fish processing industries have their own fishing fleets. Preliminary processing involves handling and storage under optimum conditions. Modern fish industries often have facilities for automatic filleting and freezing of fresh fish. Facilities for processing of fish are relatively small compared to production. Lack of efficient refrigerated transport and unavailability of sufficient cold stores are highly responsible for temperature abuse, which mainly contributes to losses. The efforts are needed to further increase the fish production to meet the global demand. In addition, innovations and commercialization are needed on the organized scale to isolate and fraction out the functional constituents for medicinal uses.

1.6 Livestock Industry and Poultry Industry

The livestock and poultry sectors play an important role in the livelihood of rural people and economy. India has the largest population of livestock in the world, whereas it is the fifth largest producer of broiler. China is the leading producer of eggs in the world followed by the USA and India. India produces almost 6.3 million tonnes of meat and ranks fifth in the world production. However, only 1% is

Table 1.5 Production and utilization of fisheries and aquaculture in the world [7]

Year	Production, million tonnes			Utilization, million tonnes					
	Inland waters	Marine waters	Total	Human consumption			Non-food uses		
				Developed countries	Developing countries	Total	Developed countries	Developing countries	Total
1980	7.5	64.5	72.0	26.4	25.1	51.5	11.7	8.3	20.0
1990	14.1	83.7	97.8	28.5	42.0	70.5	11.9	15.4	27.3
2000	27.3	98.7	126.0	23.8	72.8	96.6	7.7	21.5	29.2
2010	46.8	98.1	144.9	23.0	103.6	126.6	5.2	13.1	18.3
2018	63.4	115.2	178.6	23.8	132.5	156.3	5.4	16.7	22.1

converted into value-added products as per Technology Exports Development Organisations. Table 1.7 shows the production of eggs and meat, and the data indicate that the growth rate of poultry population and average production is comparatively higher as compared to livestock.

The global market for meat products is expanding, and therefore it is an opportunity for the countries to increase their share in the world market. The major increase in meat production was mainly observed in Australia, the European Union, the Russian Federation and the USA, whereas minor increase was also observed in Argentina, Mexico and India. The production of meat is expected to expand over this decade, and major growth is speculated in the developing nations, which may account for nearly 74%. The consumption of meat is also expected to increase, though the growth rate may be a little lower than the previous decade. The consumption of meat is already high in the developed countries and is expected to further increase due to purchasing power and affordability.

The lower prices of pig meat and poultry make them a favourite in developing nations, but the increase in income diversifies the range of products. However, income is not only the parameter for the product consumption, but other factors such as urbanization; environmental, cultural and health concern; and religious beliefs also affect the consumption pattern of meat and meat products. Poultry meat consumption is projected to increase irrespective of income and accounts a major share. In the world trade, Brazil and the USA are the major exporting nations and the export is further expected to increase in this decade, whereas the Asian countries are going to be the major importing nations and the share may be around 56% of the global trade.

Major problem faced by meat industries is mainly due to temperature abuse while transportation and storage. Meat industries in a number of countries have not received much attention from policy makers and scientists. Efforts are needed to further develop infrastructure for export of both fresh and processed meat and poultry. The poultry sector has been growing continuously across the world.

1.7 Sugarcane Industry

In the recent years, the demand of sugar has been slowed down due to the potential concern of health from the excessive consumption of sugars and lesser growth rate of the world population. Brazil produced about 752.9 million tonnes of sugar crops in the year 2019 and tops the world, while India ranks second with a production of 405.4 million tonnes (Table 1.8). The sugar production of the world is projected to increase over the next 10 years. The sugar consumption is going to increase over the next 10 years mainly in developing countries. The main demand is projected in Asia and Africa in the coming years. Sugar-rich processed products, mainly the confectionery and soft drinks, are expected to rise in demand in the urban markets of Asia and Africa.

The largest consumption of sugar, especially in Asia, is expected in India followed by China, Indonesia and then Pakistan, whereas the highest consumption

Table 1.6 Capture production of major producing countries and the world [7]

Year	Capture production, million tonnes					Aquaculture production, million tonnes				
	China	Indonesia	Peru	India	World	China	India	Indonesia	Vietnam	World
2010	14.81	5.39	4.30	4.69	87.12	35.51	3.79	2.30	2.68	57.74
2011	14.99	5.75	8.25	4.31	91.62	36.61	3.67	2.72	2.85	59.79
2012	15.18	5.86	4.85	4.87	88.63	38.14	4.21	3.07	3.08	63.48
2013	15.35	6.12	5.85	4.64	89.73	40.34	4.55	3.97	3.21	66.95
2014	16.12	6.46	3.57	4.98	90.38	42.30	4.89	4.25	3.34	70.51
2015	16.39	6.69	4.82	4.84	91.66	43.75	5.26	4.34	3.46	72.77
2016	15.79	6.54	3.80	5.18	89.64	45.82	5.70	4.90	3.57	76.50
2017	15.37	6.74	4.16	5.53	93.12	46.82	6.18	5.51	3.82	79.54
2018	14.65	7.22	7.17	5.32	96.43	47.56	7.07	5.43	4.13	82.10

in Africa is projected in Egypt and sub-Saharan countries. The consumption of sugar in developed countries is declining due to negative health effect such as diabetes, weight gain, heart diseases, tooth decay, etc. The countries are coming forward to impose taxes on calorific sugar products to reduce the consumption. Mexico is the first to do it. To nullify the effect of this tax, companies are replacing sugar with artificial sweeteners.

The sugarcane industry not only converts sugarcane into premium product sugar but also utilizes many of its by-products including molasses, press cake and green top. These are utilized for the preparation of pulp, paper, particle board, feed, medium, alcohols, acetic acid, sorbitol and many other valuable products. Table 1.8 shows the scenario of the sugar industry over the past two decades and establishes that the world production is almost consistently increasing. In the Russian Federation, the demand of sugar is expected to grow due to higher demand of alcoholic products.

Sugarcane industries need better infrastructure and better transportation facilities to transport sugarcane from the agriculture field to industry. A comprehensive system for the timely payment of raw material to farmers is also needed to be evolved.

1.8 Pulse Industry

India is the leading producer of pulses followed by Canada and Myanmar (Table 1.9). Canada and Myanmar and Australia do not possess adequate processing facilities of the pulses because of the consumption pattern in these countries. These countries do not have consumption of pulses to the larger extent; therefore, attempts have not been made to develop the processing facilities. India requires almost 22.0 million tonnes of pulses to meet the increasing demand. Storage of pulses is always an issue, and these are normally stored in gunny bags or in small tin containers. As per the research findings, pulses need to be stored in air-tight containers at 20–22 °C for long-time storage. Table 1.9 shows the production of pulses in India and across the globe. In the last two decades, the production of pulses increased on an average basis, though it is not the preferred crop for the farmers due to the lesser productivity and lack of assured market. India not only is the largest producer but also consumes diverse range of pulses, which are the main source of proteins in the diet especially for the vegetarian people. The lesser production of pulses as compared to the growth of population changed the ratio of demand and supply in the last two decades and resulted in higher prices and lesser per capita consumption. The improvement in the yield of the pulses and more focus to bring out value-added acceptable and economically viable products for the consumers can further increase the demand and reduce the cost.

Table 1.7 Production of eggs and meat in major producing countries and the world [8]

Year	Production, million tonnes									
	Eggs					Meat				
	China, mainland	USA	India	Indonesia	World	China, mainland	USA	Brazil	World	
2010	27.6	5.4	3.4	1.4	69.5	79.2	42.0	23.6	294.4	
2011	28.1	5.5	3.5	1.3	70.9	79.4	42.5	24.3	299.0	
2012	28.6	5.6	3.7	1.4	72.6	83.3	42.6	24.6	307.1	
2013	28.8	5.8	3.8	1.5	74.3	85.1	42.8	25.4	314.0	
2014	28.9	6.0	4.1	1.6	75.8	86.4	42.8	26.0	319.7	
2015	30.5	5.8	4.3	1.7	78.2	86.0	43.3	26.6	325.3	
2016	31.6	6.0	4.6	1.8	80.3	85.2	44.6	27.0	329.1	
2017	35.6	6.4	4.8	5.0	89.4	85.8	45.8	27.7	335.7	
2018	36.0	6.5	5.2	5.1	85.1	87.1	46.8	28.1	343.6	
2019	37.8	6.7	5.8	5.1	88.3	76.3	48.1	28.6	337.2	

Table 1.8 Production and processing of sugar crops in major producing countries and the world [1, 2]

Year	Production, million tonnes										
	Sugar crops						Processed raw sugar				
	Brazil	India	China, mainland	Thailand	World	Brazil	India	China, mainland	Thailand	World	
2010	717.5	292.3	120.1	68.8	1907.2	39.9	11.4	20.6	6.9	155.2	
2011	734.0	342.4	125.2	96.0	2069.6	37.6	12.5	26.6	9.7	169.5	
2012	721.1	361.0	134.9	98.4	2097.4	40.2	14.2	28.8	10.2	177.8	
2013	768.1	341.2	137.5	100.1	2147.7	39.5	14.5	27.7	10.0	179.0	
2014	736.1	352.1	133.6	103.7	2158.0	37.3	14.7	26.6	11.2	179.9	
2015	750.3	362.3	112.2	94.1	2117.5	35.2	11.7	30.5	11.0	173.9	
2016	768.6	348.4	111.8	94.1	2160.8	40.5	9.6	27.4	9.3	177.5	
2017	758.6	306.1	113.8	93.1	2150.4	36.7	10.2	22.2	10.7	177.9	
2018	747.1	379.9	119.4	135.1	2205.2	28.0	11.4	34.3	15.4	182.2	
2019	752.9	405.4	121.7	131.0	2228.7	—	—	—	—	—	

Table 1.9 Production of pulses [2] in major producing countries and the world

Year	Production, million tonnes			
	India	Canada	Myanmar	World
2010	17.2	5.4	5.1	72.0
2011	17.6	4.3	5.0	70.3
2012	16.8	5.3	5.3	74.7
2013	18.9	6.6	5.7	78.9
2014	20.0	6.2	6.1	78.9
2015	17.3	6.1	6.2	79.1
2016	18.1	8.3	6.5	87.8
2017	23.7	7.1	6.6	95.7
2018	25.5	6.3	6.7	92.3
2019	21.5	7.0	6.9	88.4

1.9 Tea Industry

Tea is the most popular beverage in the world after water. China is the largest producer of tea with a production of 2.8 million tonnes in the year 2019 followed by India and Kenya (Table 1.10).

According to FAO, the tea sector is going to observe the compound annual growth rate of nearly 4 to 5.5% in a time span of 2017 to 2024 [9]. The tea industry is considered to provide employment on the large scale, and therefore it is labour-intensive. Material, energy and employee are the major parameters which contribute to the cost among the inputs. To make the industry more competitive, energy and employee cost need to be reduced. The automation and modernization of the industry and application of non-conventional sources of energy can bring down the cost. The tea industry also generates indirect employment in the different sectors such as warehouses, transportation and manufacturing of aluminium foil, tin plates, cardboard paper, tea chest, fertilizers, insecticides, etc. The establishment of tea parks, proper exhibition and connectivity with the tourism industry will help this industry to grow further in rapid pace. In addition, the innovative value-added products such as proven functional tea may again catalyse the growth of tea industry.

1.10 Oilseed Industry

The oilseeds remain as the major source of fat and is one of the essential constituents in the human diet. The body requires about 44-77 g of fat per day based on the 2000 calories a day, which is provided by oilseeds and animals. Indonesia is the leading producer of oilseeds with a production of 264.1 million tonnes in the year 2019 followed by Brazil, the USA, Malaysia, China and India (Table 1.11). India ranks sixth in the world production of oilseeds. Soybean, cottonseed, groundnut, sunflower, safflower, coconut, rapeseed and mustard are the popular oilseeds. Table 1.11 shows the production of oilseed across the world with a total production

Table 1.10 Production of tea [2] in major producing countries and the world

Year	Production, million tonnes			
	China	India	Kenya	World
2010	1.5	1.0	0.4	4.6
2011	1.6	1.1	0.4	4.8
2012	1.8	1.1	0.4	5.0
2013	1.9	1.2	0.4	5.3
2014	2.1	1.2	0.4	5.5
2015	2.3	1.2	0.4	5.8
2016	2.3	1.3	0.5	5.8
2017	2.5	1.3	0.4	6.0
2018	2.6	1.3	0.5	6.3
2019	2.8	1.4	0.5	6.5

Table 1.11 Production of oilseeds in major producing countries and the world [2]

Year	Production, million tonnes						
	Indonesia	Malaysia	USA	Brazil	China, mainland	India	World
2010	165.5	83.8	104.9	76.4	66.8	59.5	833.9
2011	177.1	93.7	97.6	84.7	68.9	60.8	876.6
2012	187.2	95.7	98.8	75.6	69.6	58.3	866.5
2013	200.6	95.7	103.2	89.9	67.6	63.3	940.6
2014	199.3	96.2	121.5	96.0	67.4	58.7	965.5
2015	202.6	99.0	121.4	106.6	63.9	52.0	980.7
2016	209.0	87.0	132.7	104.9	63.6	58.7	990.4
2017	255.6	102.5	138.0	123.3	68.6	59.9	1101.8
2018	259.5	99.1	137.0	128.3	70.2	62.5	1099.2
2019	264.1	99.8	115.1	127.0	75.3	64.8	1101.3

of 1101.3 million tonnes in 2019. The increase in oilseeds is continuous in all the major oilseed-producing countries; however, Brazil observed about 66% growth and stands on the first place in the increase in production during 2010–2019 followed by Indonesia with 60% growth, whereas about 32% production growth was observed in the whole world. Indonesia and Malaysia remain as the main suppliers of palm oil in the world and dominate the vegetable oil market [2].

India is the biggest importer of edible oil in the world and is expected to maintain a high per capita consumption. Therefore, the import is expected to increase substantially along with the major growth of the domestic oilseed production.

Generally, groundnut, rapeseed, mustard, linseed, sesame and castor are grown as the main oil-bearing crops; however, other crops, viz. soybean, sunflower and coconut, also significantly contribute in oil production. Despite the significant contribution in oilseed production, there are countries which cannot fulfil the demand, and hence they import a substantial amount of oil. To meet the demand, the usage of supplementary resources for the production of oil can be an option. Supplementary sources of vegetable oil may include rice bran oil, cottonseed oil,

corn oil, etc., and these supplementary sources can be used for consumption to meet the demand.

The protein meal output is also expected to expand globally in this decade but comparatively at a lesser rate than the last decade and is projected to reach 400 Mt. by the year 2028. The protein meal is mainly dominated by the soybean, and it accounts for nearly two-thirds of the protein meal production of the world. Argentina is the largest exporter of the meal, whereas the European Union, China, the USA, Brazil, Argentina and India are going to be the lead players in the production of meal, and these countries are projected to have a share of 75% of the total world production.

1.11 Spice Industry

India is the major producer of spices and mainly produces *cardamom, pepper, ginger, turmeric, bean stew, cumin, celery, coriander, fennel, garlic, dill seed, chilli, tamarind, clove, fenugreek, ajwain* and nutmeg among several others. Spices are the essential components of diet for numerous people in the world. India is the largest producer and consumer of spices in the world. The country produces nearly 75 of the 109 varieties listed by ISO (International Organization for Standardization). In addition, it is the major exporter of spices across the globe and accounts half of the world trade. To develop this industry, functional spice parks are now established to enable processors and exporters to forge a closer and lasting relationship with spice growers. Table 1.12 shows the production of spices in major countries and the world.

In the year 2019, a total of 110 million tonnes of spices and spice products were exported to the USA, China, Hong Kong, Vietnam, Bangladesh and several other countries. India contributes around 35% ginger production, 30% pepper production and 90% turmeric production of the world.

Spices can be used in different applications such as sauces, dressings, bakery products, beverages, frozen foods and several other packaged foods and food products. Besides, spices are also used in the cosmetic industry. *Sage* and *rosemary* herbs are generally used for essential oils, which find applications in perfumes. Perfume industry incorporates spices such as cinnamon, vanilla, clove, etc. for the different fragrances. The food sector is the promising potential buyer of the spices, and the spice market is expected to grow nearly at the rate of 5% per annum till the year 2025. Seed spices are used in *Unani* and *Ayurvedic* medicines since long, but their potential effects and mechanism need to be explored and developed to cure different diseases and infections. As the demand is increasing, the production of spices and related industries is now being set up in different other countries also. The functional and medicinal uses of spices are proven based on the scientific aspects; therefore, their application can be propagated in the world over in all the culinary foods.

1.12 Dairy Industry

India is the world's largest milk producer, whereas the USA and China contribute to the milk production as the second and third largest countries across the globe. The world milk production, mainly of 81% cow's milk, 15% buffalo milk and the rest 4% percent from other milch animals such as sheep, goat, camel, etc., grew nearly by 1.6% to 880 million tonnes in 2018.

The world production of milk is expected to grow at the rate of nearly 1.7% annually. India and Pakistan are the important milk producers and are expected to contribute a major share in the world market in the coming 10 years. Currently, in India, the production is consistently increasing, but it does not have a large impact on the world trade due to the high domestic demand. Major countries, such as the European Union, New Zealand and the USA, are the major dairy product exporters, and their production increased by 0.8%, 3.2% and 1.1%, respectively, in the year 2018. In addition, Australia and Argentina are also exporting milk products internationally and expected to grow over the next 10 years.

The European Union, the second largest producer, is expected to have grown slowly as compared to the world average. This industry is well versed and has diversified its market offering products like cheese, yogurt, ghee, butter, concentrated milk, dry powders and several other processed products. Less than 30% of the milk is processed into the different commercial products. Butter and cheese have the better demand considerably. Cheese consumption especially in North America and Europe has got a major market share. WMP and SMP, which are mainly used in a number of applications such as bakery product, different liquid milks, infant formula, confectionery, etc., are largely traded and mainly used for the trades.

North Africa, the Middle East, South East Asia, developed countries and China are the major importers of dairy products. China is one of the major importers of dairy products. The developed nations import good amount of cheese and butter. The relatively higher prices of milk fat may lead to the substitution by the vegetable fat, which may bring variation in the production of milk fat and demand in the international market. Likewise, the role of plant-based dairy substitute such as soy, rice, almond-based drinks, etc. has increased in the recent years in different regions. But, there are different views regarding their wider acceptability and health aspects, which may create uncertainty on the long-term impact of these substitutes in the milk and milk product demands.

India is self-reliant in terms of the production and consumption of milk, but there are regions such as South East Asian countries, the Middle East and Africa where the demand for the milk and milk products is expected to grow faster than the production, which will lead to the increase in import of dairy products. Transport of liquid milk is expensive; therefore, the demand is expected to be meted out with the milk powders. The milk powders are largely produced across the globe due to the application in various food products.

Indian dairy industry has successfully developed a direct link between producers and ultimate users by procuring milk from the producer in rural areas and then

Table 1.12 Production of spices and condiments in major producing countries and the world [2]

Production, million tonnes											
Pepper											
Year	Ethiopia					Vanilla					World
	Ethiopia	Vietnam	Brazil	Indonesia	World	China, mainland	Indonesia	Madagascar	Mexico	World	
2010	265	105	52	84	682	1300	2600	2742	395	8257	
2011	307	112	45	87	723	799	3500	2791	362	8602	
2012	407	120	43	88	817	432	3100	2929	390	8052	
2013	289	125	42	91	720	335	2600	3021	463	7600	
2014	204	152	42	87	662	286	2000	3139	420	7081	
2015	323	177	52	82	829	566	2000	2922	482	7218	
2016	425	216	54	86	971	812	2326	2888	513	7780	
2017	347	253	79	88	983	554	2481	3191	515	7995	
2018	329	263	102	89	1039	458	2356	3169	495	7738	
2019	374	265	109	89	1103	379	2329	3217	522	7715	
Cinnamon											
Year	Cinnamon					Cloves					World
	China, mainland	Indonesia	Sri Lanka	Vietnam	World	Indonesia	Madagascar	Sri Lanka	Tanzania	World	
2010	63	88	16	21	191	98	10	4	9	128	
2011	66	90	16	24	199	72	12	4	9	103	
2012	69	90	16	27	204	100	15	4	7	131	
2013	70	92	16	29	209	110	17	4	7	143	
2014	71	91	17	30	213	122	21	6	9	166	
2015	75	92	20	33	223	140	22	6	9	184	
2016	76	92	25	35	231	140	23	8	9	190	
2017	78	92	25	37	236	113	25	7	9	164	
2018	81	90	24	39	238	131	24	6	9	180	
2019	83	90	25	41	243	135	23	4	9	182	

(continued)

Table 1.12 (continued)

Year	Nutmeg, mace and cardamoms					Anise, badian, fennel and coriander				
	Guatemala	India	Indonesia	Nepal	World	India	Iran	Mexico	Syria	World
2010	23	16	16	5	67	420	66	46	41	827
2011	26	16	20	6	75	537	62	53	48	954
2012	35	18	25	6	93	537	53	54	52	924
2013	38	17	28	7	98	546	40	65	48	908
2014	38	21	33	5	107	584	66	54	28	1004
2015	35	22	34	5	107	546	63	69	28	1082
2016	35	38	33	6	125	632	63	80	28	1166
2017	36	43	33	7	132	1529	64	133	116	2153
2018	38	43	44	7	146	1503	66	127	142	2073
2019	38	38	44	8	142	1448	68	101	83	1971

Year	Ginger					Spices nes (bay leaves, dill seed, fenugreek seed, saffron, thyme, turmeric)				
	China, mainland	India	Nepal	Nigeria	World	India	Ethiopia	Turkey	Indonesia	World
2010	365	385	211	162	1719	1.5	0.2	0.1	0.1	2.3
2011	420	702	216	460	2366	1.7	0.2	0.2	0.1	2.6
2012	460	756	255	380	2464	1.5	0.2	0.2	0.1	2.4
2013	390	683	235	497	2445	1.5	0.3	0.2	0.1	2.6
2014	470	655	276	168	2302	1.5	0.3	0.2	0.1	2.6
2015	496	760	243	413	2753	1.3	0.2	0.2	0.1	2.3
2016	550	1109	272	775	3624	1.5	0.3	0.2	0.1	2.7
2017	546	1070	280	835	3519	1.6	0.3	0.2	0.1	2.7
2018	570	1762	284	700	4081	1.4	0.3	0.2	0.2	2.6
2019	581	1788	298	691	4081	1.4	0.3	0.3	0.3	2.8

Table 1.13 Production of milk in major producing countries and the world [8]

Year	Production, million tonnes				
	China, mainland	India	Pakistan	USA	World
2010	41	122	35	88	724
2011	41	128	37	89	742
2012	42	133	38	91	759
2013	40	138	39	91	768
2014	42	147	40	93	794
2015	36	156	42	95	803
2016	35	165	43	96	814
2017	35	176	52	98	855
2018	35	188	54	99	880
2019	36	188	56	99	883

transporting it to district units and finally processing. Table 1.13 shows the production of milk. Though the production of milk is steady, still the processing of milk at the organized scale in developing countries is a challenge. In addition, the value addition is needed, and more focus on the value-added products will further expand this industry in the future.

In general, the overall increase in the production of cereals, fruits, vegetables, fish, livestock, sugarcane, tea, oilseeds, pulses and spices was observed during the last decade. The growth rate in the production is also expected through increase in the area under cultivation and productivity level [10, 11] in the years to come to meet the increasing global demand. This will expand the agro-processing sector and storage facilities in particular. The agro-processing industries also contribute in the economy, employment generation to the rural youths, as a source of foreign exchange through export, human resource development through training and creation of stable markets for raw, intermediate and finished products [12]. Bakeries, breweries, soybean processing, rice processing, wheat milling units, pulse milling, poultry processing, tea/coffee processing, sauces, pickles, traditional sweets and snacks are the major processing units. The agro-processing industry is the untapped sector in a number of developing countries and the countries which are the leading producers of the different agricultural produces.

1.13 Exercise

1. Discuss the importance of the agro-processing sector in the development of a nation with a view to mitigate the challenge of population growth.
2. What is the status of cereal production in the major producing countries in the world? Explain the various types of major cereal processing units.
3. What is the importance of pulses in agricultural production? Despite the substantial production of pulses in Canada, Myanmar and Australia, why has the processing industry not taken shape in these countries?

4. Discuss the significance of spices in agro-processing sectors. What are the production patterns of spices in the world? Discuss in brief.
5. Which are the leading producers of milk? How dairy processing units performed during the last decade? Which are the major exporting nations of milk and milk products? Why is the export share of the largest milk-producing country comparatively much lesser?
6. What is the status of the fruit and vegetable industry across the world? Why is the processing of fruits and vegetables at all needed? What are the problems faced by the fruit and vegetable industry?
7. Illustrate briefly the status of the following:
 - (a) Tea industry.
 - (b) Fish industry.
 - (c) Sugarcane industry.
 - (d) Livestock and poultry industry.
 - (e) Oilseed industry.

References

1. Crops processed—The Food and Agriculture Organization Corporate Statistical Database (FAOSTAT). (2021). Food and Agricultural Organizations of the United Nations. <http://www.fao.org/faostat/en/#data/QD>.
2. Crops—The Food and Agriculture Organization Corporate Statistical Database (FAOSTAT). (2021). Food and Agricultural Organizations of the United Nations.
3. OECD/FAO. (2019). *OECD-FAO Agricultural Outlook 2019–2028*. OECD/Food and Agriculture Organization of the United Nations. https://doi.org/10.1787/agr_outlook-2019-en
4. OECD/FAO. (2020). *OECD-FAO Agricultural Outlook 2020–2029*. FAO/OECD. <https://doi.org/10.1787/1112c23b-en>
5. Press Information Bureau. (2020). Press release of APEDA workshop on “Opportunities in Export of Organic Basmati Rice, Value Addition and Product Diversification” on 15 December 2020 at 5:39 PM, Release ID: 1680808. <https://pib.gov.in/PressReleasePage.aspx?PRID=1680808>.
6. Research and Markets. (2020). *Fruit and vegetable processing industry in India 2020*. Netscribes (India).
7. FAO. (2020). *FAO yearbook. Fishery and aquaculture statistics 2018*. FAO. <https://doi.org/10.4060/cb1213t>
8. Livestock Primary—The Food and Agriculture Organization Corporate Statistical Database (FAOSTAT). (2021). Food and Agricultural Organizations of the United Nations. <http://www.fao.org/faostat/en/#data/QL>.
9. Mordor Intelligence. (2018). *Tea market growth, trends and forecasts (2019–2024)*. <https://www.mordorintelligence.com/industry-reports/tea-market>
10. Spice Production in India. (2011). *Commodity inside yearbook. Joint endeavour of MCX and PwC* (pp. 270–276). Agriculture Commodities Databank. www.mcxindia.com. www.pwc.com/in/en.DOV:6-12-13
11. Edgerton, M. D. (2009). Increasing crop productivity to meet global needs for feed. *Food, and Fuel, Plant Physiology*, 149(3), 7–13.
12. [https://www.ascecuba.org/asce_proceedings/role-and-importance-of-the-agricultural-processing-sector-in-the-cuba-of-the-future/#:~:text=Many%20economists%20believe%20the%20agricultural,%3B%20\(2\)%20providing%20income%20and](https://www.ascecuba.org/asce_proceedings/role-and-importance-of-the-agricultural-processing-sector-in-the-cuba-of-the-future/#:~:text=Many%20economists%20believe%20the%20agricultural,%3B%20(2)%20providing%20income%20and).