Agriculture Department

Government of the Punjab

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ADU

AGRICULTURE DELIVERY UNIT

Advise for Excellence

FEASIBILITY STUDY

FROZEN CONCENTRATED

Kinnow Juice

Acronyms

Acronym	Description
AED	Arab Emirates Dirham
CFU	Colony Forming Unit (Bacteriology)
CIP	Cleaning in Place
CPEC	China Pakistan Economic Corridor
FAO	Food and Agriculture Organization
FCKJ	Frozen Concentrated Kinnow Juice
FCOJ	Frozen Concentrated Orange Juice
GST	General Sales Tax
IMF	International Monetary Fund
IRR	Internal Rate of Return
ITC	International Trade Center
JNSD	Juice, Nectars and Still Drinks
NFC	Not from Concentrate
NPV	Net Present Value
PKR	Pakistan Rupee
RO	Reverse Osmosis
RTD	Ready-to-Drink
SMEDA	Small and Medium Enterprise Development Authority
TDAP	Trade Development Authority of Pakistan
UAE	United Arab Emirates
UCM	Unit Contribution Margin
UK	United Kingdom
UN	United Nations
USA	United States of America
USD	United States Dollar
USDA	United States Department of Agriculture

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Disclaimer

Government of Punjab is determined to adopt an integrated and enterprising approach to bring about paradigm shift in agricultural development in the province with a focus to increase the profitability of the farmers. The major focus of agriculture development has most often been a staple crops like wheat, rice and other major crops such as cotton, etc. Agriculture offers a high potential in other non-traditional sectors as well; such as horticulture, oilseeds, floriculture, etc. Lack of timely and accurate information, for farmers and investors alike, can prove to be costly and economically unproductive. The effort requires strengthening internal capacity and engaging new partners into an integrated and reined system independent of unnecessary, irrational interruptions.

For this purpose, the Agriculture Delivery Unit (ADU) undertook a series of feasibility studies for knowledge enhancement of predetermined areas of agriculture, keeping in view medium- and long-term goals of the sector. The aim of conducting research for and compiling these feasibility studies was to identify gaps as well as areas of potential development and enhancement particularly for fruits, vegetables and oilseed sector. The variety of reports respectively, suggest means of adding value to these non-traditional sectors through extraction, pulping, dehydration, canning, packaging and so on. These business plans - determined with the help of firsthand primary and secondary research - provide an outline of the current status of selected areas in Pakistan's agriculture sector; identify potential areas of investment while also highlighting the risks involved; and determine approaches towards more sustained growth keeping the role of technology in and prioritizing future research and development efforts as cross-cutting themes.

This document has been prepared in continuation of these paper series with the objective to provide basic information about the subject business proposition. The content of the document has been derived from data and information collected from various reliable secondary and primary sources and is based on certain assumptions. While reasonable due diligence has been carried out during information collection and working out the presented calculations, the reader is strongly encouraged to carry out any further scrutiny and diligence to collect any other information that may be deemed necessary to take an informed decision. Professional advice from qualified technical expert/consultant should preferably be sought before taking any decision to act upon the information presented in the document. The Department of Agriculture, Government of Punjab does not assume any liability for any financial or other loss in consequence of undertaking any activity on the basis of the information provided in the document.

VISION

TRANSFORM PUNJAB'S AGRICULTURE INTO A MARKET-DRIVEN, DIVERSIFIED AND SUSTAINABLE SECTOR THROUGH INTEGRATED TECHNOLOGIES TRANSPARENCY AND VALUE-FOR-MONEY

1.0 EXECUTIVE SUMMARY

Agriculture sector is the mainstay of Pakistan's economy. The sector offers host of attractive opportunities for private sector investment. Horticulture is an important subsector producing large volumes of variety of fruits, vegetables and condiments. Major share of national horticultural production is contributed by the province of Punjab. Lack of proper harvest and post-harvest practices is a major issue that leads to wasting significant share of production. Fruits and vegetable processing offers a practical route to reduce these losses by converting the surplus produce into value added products like pulps, purees, concentrates, fruit juices/drinks, dehydrated fruits and vegetables, squashes, canned products, frozen fruits and vegetables, jam, jellies, syrups, etc.

Citrus is the largest produced fruit of Pakistan with its major production hubs concentrated in Punjab. In 2016, the province produced 2.34 million tons of citrus fruit; accounting for 97% of the national production. Sargodha is the largest citrus producing district that accounted for 53.1% of the provincial production in 2016. Kinnow is the major citrus variety grown in the country; accounting for around 85% of the province's total citrus production. Kinnow can be processed to produce 'Frozen Concentrated Kinnow Juice' (FCKJ) which is the raw material to produce ready-to-drink juices and drinks. FCKJ manufacturing is an attractive investment opportunity that derives its rationale from abundant availability of raw material, uniqueness of the local Kinnow fruit, high value addition potential, large export and local markets and presence of an existing industrial cluster. Along with

the main product FCKJ, Kinnow peel oil, Kinnow pulp and waste peel are the byproducts of the manufacturing process.

The global citrus scene is dominated by Brazil, the largest producer of oranges in the world. In 2016, Brazil produced 17.2 million tons of citrus fruit accounting for 24% of global production; followed by China, India, USA and Mexico. In tangerines, mandarins, etc. (fruits resembling Kinnow), China is the largest producer that held 52% share of global production in 2016. By virtue of large availability of raw material, Brazil is also the largest producer of frozen concentrated orange juice (FCOJ). Global orange juice market operates as an oligopoly. Total global FCOJ production in 2016 was 1.94 million tons of which 64.8% share was contributed by Brazil. USA and Mexico respectively held 16.1% and 8.8% shares of the global FCOJ production. North American and Western European markets are the largest consumers of orange juice. USA and Canada together account for around 40% and Europe 35% of the total global consumption. In 2016, orange juice consumption in USA was 2.8 billion liters and that in Europe was around 2.5 billion liters. The two markets experienced a rapid growth in 1980s and 90s, peaking in the year 2000 and following an oscillating trend after that. The consumption has been on an increase in other major markets like Eastern Europe, South America, Japan and South Korea.

Fruit and vegetable juice products represent an important category of international trade. In 2016, total global trade of fruits and vegetable juice was 13.8 million tons; worth USD 14.6 billion. During the past three years, the export market grew in quantity terms and declined in value terms. In 2016, 36% of the total global trade was constituted by orange juice products; 32.5% of which was that of frozen concentrated orange juice (including all citrus varieties). Total global trade of FCOJ in 2016 was 1.04 million tons against a total value of USD 1.74 billion. The trade trends have been oscillating during the past ten years; with the year 2016 appearing to be the start of the next rising trend. Brazil was the largest exporter of FCOJ accounting for 50% of the total global trade in 2016. Mexico and USA respectively were the second and third largest exporters. Trade trends indicate that over the past decade, Brazil and USA have been decreasing their exports and the resulting gap is being filled by smaller suppliers like Mexico, Netherlands and Belize. The phenomenon marks an opportunity for players like Pakistan to increase their presence in international market.

Major importers of FCOJ are mostly the developed countries where the people have the necessary purchasing power to buy orange juice. USA, Germany, Japan and China are the large importers of FCOJ. USA alone accounted for 46% of the total import quantities of FCOJ. Global average export price of FCOJ in 2016 was USD 1639 per ton. Overall, the average export price has increased over the past ten years.

Major share of FCKJ produced by Pakistan is exported. However, there is also a large local demand as well by the local fruit juice processing sector. Citrus-based juices and drinks represent an important product category in the local market. The local 'Juice, Nectars and Still Drinks' (JNSD) market has grown at a high rate of around 16% during the past decade. The size of the local beverage market in 2017 was estimated to be 44 billion liters. JNSD market is around 4% of this market which in 2018 was estimated to be 2.0 billion liters. Juice and nectars market is around 10% of the total JNSD market which means that the estimated size of local juice and nectars market of Pakistan in 2018 is around 200 million liters.

FCKJ manufacturing in Pakistan started in late 1980s and since then, the industry has grown to establish a visible presence in local and international markets. In 2016, orange juice products accounted for 84% of the total value of Pakistan's fruits and vegetables juice exports. In 2016, Pakistan exported 6,743 tons of FCKJ worth USD 11.4 million. This translated into 0.67% of the total value and 0.65% of the total quantity of world exports. During the period from 2003 to 2016, Pakistan's FCKJ exports grew by 629% in quantity and 1228% in value terms. This performance is an indicator of the potential of Pakistani FCKJ to further penetrate into the international markets. Pakistan's average export price in 2016 was USD 1,694; higher than the world average price. The price trend has been fluctuating during the past decade; being on a decline during the past five years. However, the future projections indicate a rising export price trend. Netherlands was the largest buyer of Pakistani FCKJ accounting for 56.5% share of the total export value; followed by India, Thailand and UAE.

The province of Punjab has an abundant availability of Kinnow, the raw material for producing FCKJ. Punjab's total citrus production in 2016 was 2.34 million tons which was 97% of the total national production. Around 90% of the total citrus production is that of Kinnow. Citrus production is concentrated in the belt extending from central Punjab into Southern Punjab. Sargodha Division is the largest in terms of citrus production; accounting for around 55% of total provincial production. Faisalabad and Multan are respectively the second and third largest citrus producing Divisions.

Estimates indicate that there is reasonably good availability of raw material for a new FCKJ manufacturing facility in district Sargodha. Though Kinnow market for processing factories has become more competitive over the past years, there remains enough room for new investment. A significant share of the total Kinnow production is of

smaller size which does not have value as a table fruit and is thus only suitable to be used as raw material for processing into value added products.

Kinnow juice manufacturing sector of Pakistan is not very big and currently comprises of five manufacturing units; all of which are located in Punjab. The current installed capacity of FCKJ manufacturing is around 1,900 tons of Kinnow processing per day. CitroPak is the largest manufacturer with two processing facilities; each of 600 tons Kinnow per day.

The price of Kinnow procured by the processing factories depends upon the crop performance during each season. During the year 2016-17, the average price of Kinnow supplied to the juice factories was around PKR 130 per maund or PKR 3,750 per ton. Kinnow procurement by the processing factories is started when the fruit achieves a Brix-Acid ratio of at least 11; higher ratios being more desirable.

The proposed business is of FCKJ manufacturing using locally grown Kinnow as the raw material. The final product FCKJ will be sold in export and local markets. Byproducts from the process will be Kinnow peel oil, Kinnow pulp and waste peel. The proposed location for the project is district Sargodha. Keeping in view the locations of the existing units in the area, Tehsil Sillanwali appears to be a suitable location for establishing a new facility. The processing capacity of the unit has been proposed to be 30 tons Kinnow per hour. Using an average of 20 hours operations per day, total processing capacity of 600 tons Kinnow per day has been used for calculations.

Total cost of the project has been estimated to be PKR 992.37 million. Capital cost constitutes 74% of the total project cost and the working capital the balance 26%. Total land requirement for the project has been worked out to be 8 acres. Total covered area of the buildings is estimated to be 40,900 sq. ft. that entails a civil construction cost of PKR 82.85 million. The project has been based on Chinese processing machinery. Total machinery cost has been estimated to be PKR 540.36 million; of which PKR 417.22 million is the cost of the processing machinery and the balance of utility/allied machinery and freezing store. The project requires pre-operating expenses of PKR 44.98 million and a working capital of PKR 259.07 million. The project is assumed to be financed with 100% equity.

The project will be operational for 110 days. Incorporating lower capacity utilization during the season start and end days, the effective number of operational days have been calculated to be 93.3; during which the plant will process 56,000 tons during the whole season. Effective capacity utilization for the first year of operations has been assumed to be 70% which will progressively increase to 95% in four years. Production yield of FCKJ has been assumed to be 8.5% of the weight of Kinnow. Peel oil yield has been assumed to be 0.03% of Kinnow weight. Revenues have been calculated at the first year sale price of USD 1,700 (PKR 188,700) per ton which will grow at an average rate of 5% per year. Sale price of peel oil has been considered as USD 5,100 (PKR 566,100 per ton). Using these bases, the project's first year's revenues have been calculated to be PKR 648.42 million.

Kinnow is the biggest direct cost which has been calculated at the rate of PKR 150 per maund (PKR 3,750 per ton); growing at a rate of 10% per annum. Kinnow cost for the first year of operations is PKR 147 million. Other direct costs include the costs of chemicals, furnace oil, electricity, packaging and direct labor. Indirect costs include depreciation/amortization, marketing, administration, insurance, fixed electricity and indirect labor. Manpower requirement of the project is 280; that entails a cost PKR 60.86 million during the first year of operations.

The project is found to be financially viable with a positive NPV of PKR 376.8 million and an IRR of 29.6%. Payback period of the project is found to be 3.59 years. Gross profit and net profit margins for the first year of operations have been calculated to be 56.8% and 25.5% respectively. Breakeven capacity of the project is found to be 21.7%; which is equivalent to processing 130 tons of Kinnow per day during the entire season of 93.3 days to produce 1,035 tons of FCKJ.

Project's sensitivity to different business parameters was evaluated. The business proposition remains viable up to an FCKJ sale price drop of 18% which is equivalent to USD 1,400 per ton. Project's viability decreases with increasing Kinnow price and remains in the viable range up to an increase of 57% which is equivalent to PKR 236 per maund or PKR 5,900 per ton. Project's sensitivity with respect to FCKJ yield was evaluated and it remains in the viable range up to a yield of 6.9%. Project's viability is found to be not very sensitive to land price and remains feasible even if land is acquired at a cost of 2.5 times more than the assumed rate. The project is found to have sufficient capacity to absorb debt cost. Financial feasibility exists up to 63% share of debt assumed at a rate of 15% p.a. for ten years. Net profit margin falls by 1.5% for every 10% increase of debt in the capital structure. The impact of using expensive machinery of European origin was also observed and the project is found to be in the viable range even by using a machinery of double the cost of Chinese machinery.

1.1 Project Summary Sheet

Project's Concept	
Objective	Manufacturing of Frozen Concentrated Kinnow Juice (FCKJ) from locally available Kinnows
Product Line	Main product - FCKJ Byproducts - Peel Oil, Kinnow Pulp, Waste Peel
Operative Capacity	600 Tons Kinnow per day
Location	Sargodha, Punjab
Target Market	Export and local
Technology Employed	Squeezer type extraction

Project Cost (PKR Million)	
Total Project Cost	992.3
Capital Cost	733.2
Working Capital	259.1

Financing Plan (PKR Million)		% Share
Equity	992.3	100%

First Year's Summary Income Statement (PKR Million)		% of Revenues
Revenues	648.4	100.0%
Cost of Sales	279.9	43.2%
Gross Profit	368.6	56.8%
Operating Costs	114.6	17.7%
Earnings Before Interest and Tax	253.9	39.2%
Tax	88.9	13.7%
Net Income	165.1	25.5%

Financial Feasibility	
Internal Rate of Return (IRR)	29.60%
Net Present Value (NPV) @ 18%	376,806,417
Payback Period (years)	3.59

Conclusion
The project is financially viable keeping in view all the bases and assumptions used for marketing, technical and financial assessments /calculations.

2.0 INTRODUCTION

2.1 Economic Context

With a population of over 19 million people, Pakistan is the sixth most populous country and the 43rd largest economy in the world. In the current global economic scene, Pakistan is being viewed as the top emerging market economy in South Asia and being classified as one of the Next Eleven (N-11) countries that have the potential to become one of the world's large economies in the 21st century. Economic growth of the country has been on a rise during recent years; being 4.51% in 2016 and 5.28% in 2017; the highest growth realized during the past ten years. The economy has successfully maintained its growth momentum above 4.0% for four years in a row.

The IMF projects that the growth trend will be maintained at around 5.2% till the year 2020. The World Bank projects that by 2018, Pakistan's economic growth will increase to 5.4% due to greater inflow of foreign investment from China-Pakistan Economic Corridor (CPEC). The present government is fully committed to capitalize on this emerging growth trend and is making tireless efforts to implement all the necessary steps in

the right direction to facilitate consistent flow of private sector investment. Strengthened macroeconomic outlook, improved law and order situation and facilitative government policies are acting as the key drivers to improve investment climate for foreign and local investors. Increased private sector investment is expected to expedite economic activity, generate new employment opportunities, strengthen associated sectors and contribute towards the overarching goal of reducing poverty and improving the economic wellbeing of the common man of Pakistan.

For private sector investment to flow, identifying and providing information about the feasible business opportunities is an important initial step. Investment promotion materials introduce the investors to potential business opportunities and provide basic information about the projects' capital and operational costs and technical and financial feasibility of the presented propositions. Agriculture, being the mainstay of Pakistan's economy, offers host of attractive opportunities which possess a high potential of being converted into profitable businesses. The current document discusses the feasibility of one such business proposition.

2.2 Agriculture Sector Overview

Pakistan is an agriculture-based economy. Agriculture is the lifeline of Pakistan's economy accounting for 19.5% of the GDP, 42.3% of labor force and supplying raw material to several value added sectors. Agriculture GDP is derived from four major subsectors. Livestock is the biggest contributor to GDP that accounted for 58.3% of the total value (2016-17). Crops represented the second largest subsector accounting for 37.2%. It was followed by two smaller subsectors, Fishing and Forestry, respectively accounting for 2.1% and 2.3% of the total agriculture value added in 2016-17. The subsector distribution of agriculture GDP is shown in Figure 1.

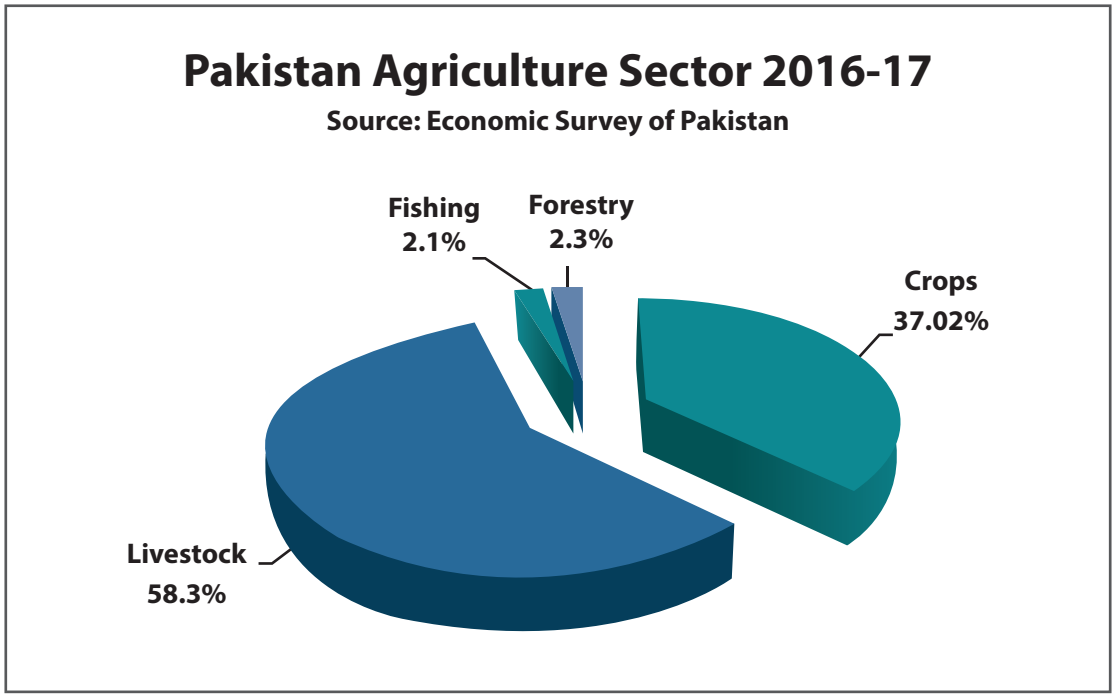

Figure 1 - Pakistan Agriculture Subsectors Distribution

The crops subsector is further divided into three categories. In 2016-17, 'Important Crops' category accounted for 64.1%, 'Other crops' category 29.6% and 'Cotton Ginning' 6.3% of the total value of crops. Horticultural crops, including fruits, vegetables and condiments are covered under the 'Other crops' category.

Punjab is the most populated province and the largest agriculture producer in the country. Figures provide a snapshot of Punjab's contribution in the productions of different agriculture commodity groups during the year 2014-15.

[1]Economic Survey of Pakistan 2016-17
[2]Ibid

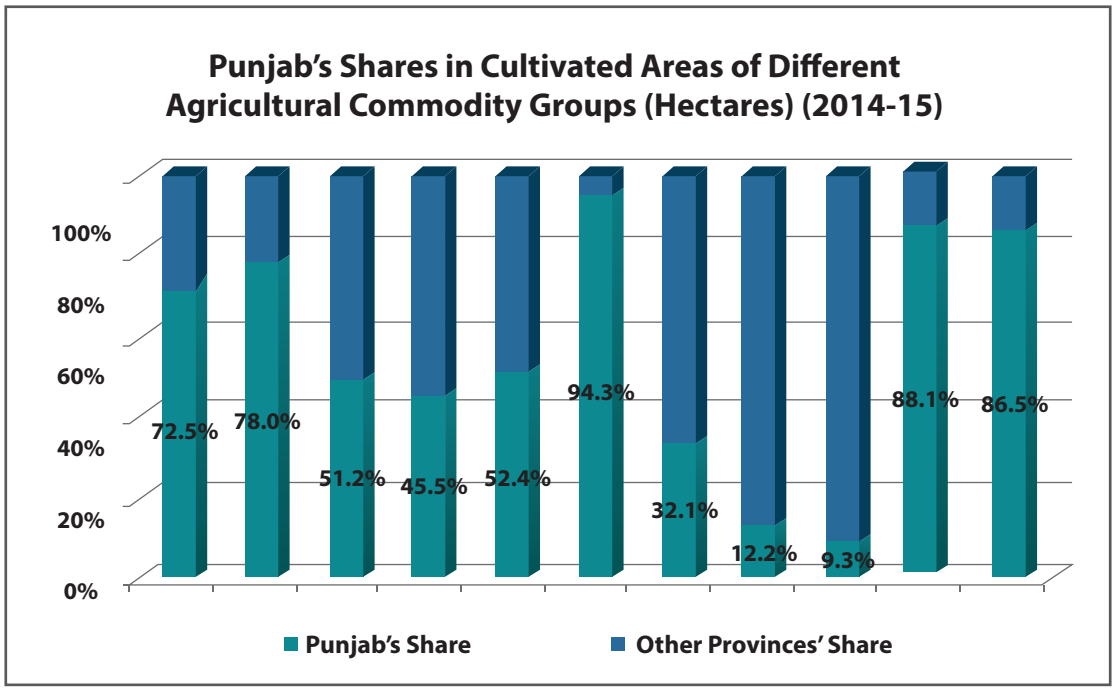

Figure 2 - Punjab's Share in Cultivated Areas of Different Commodity Groups

Punjab holds the largest shares in cultivated areas and productions of majority of the agricultural commodities. Cereal crops were cultivated on an area of 10.13 million hectares to produce 27.32 million tons. That translated into 72.5% share in cultivated area and 72.9% share in the overall national production of cereal crops. Similarly, the province held a leading position in cash crops as well where it produced 51.5 million tons; accounting for 66.8% of the national production. During the same year, Pakistan's total production of edible oilseeds was 581 thousand tons of which 51% was contributed by Punjab.

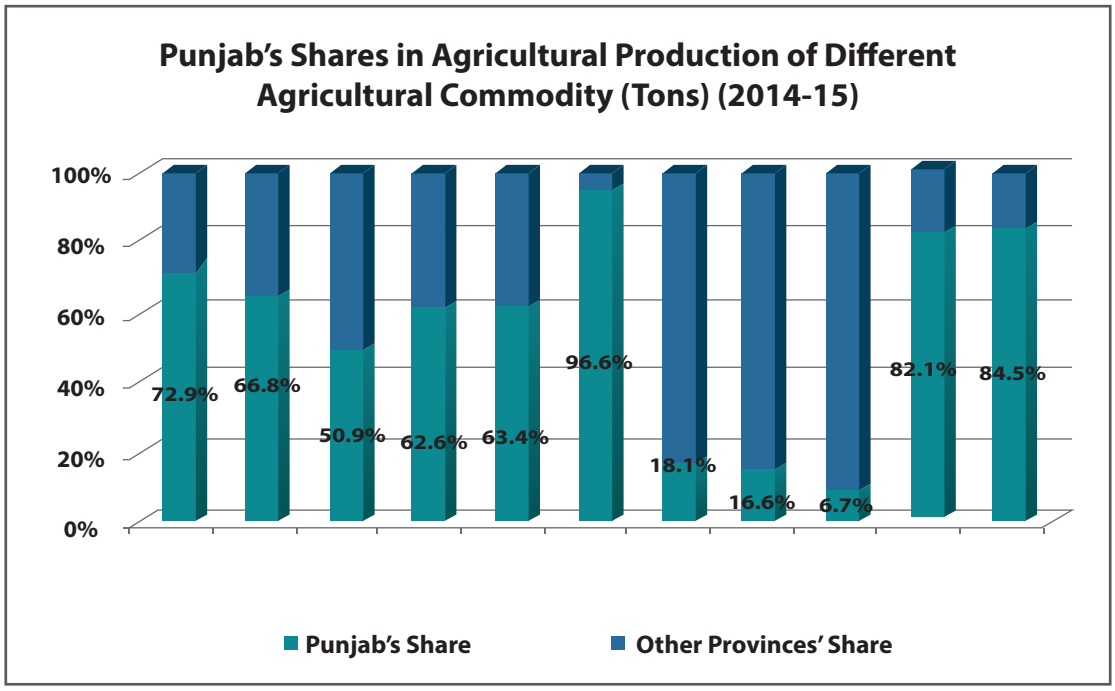

Figure 3 - Punjab's Share in Production of Different Commodity Groups

In horticultural production as well, Punjab maintains a leading position. Total fruit cultivation in Pakistan was carried out on an area of 775 thousand acres to produce 6.79 million tons of fruit. Punjab held a share of 45.5% in total cultivated area and 62.6% in total national fruit production. During the same year, the vegetable production in Punjab was 1.96 million tons that accounted for 63.4% share of the total national production. In potato, Punjab held 93.4% and 96.6% shares respectively in potato's total national cultivated area and production. A similar situation also existed in pulses and fodder crops where Punjab's shares in total national production respectively were 82% and 84.5%.

In some horticultural commodities, Punjab is a smaller producer; such as onion, tomato and chillies; where in 2014-15, the province held 18.1%, 16.6% and 6.7% shares in the total national productions of these commodities respectively.

2.3 Horticulture Sector of Punjab

Pakistan's horticulture basket is diverse containing large variety of fruits, vegetables and condiments. Pakistan's total horticultural production in 2015-16 was 15.87 million tons from the total cultivated area of 1.47 million hectares. Fruits accounted for 41.4% and vegetables 45.9% of the total national horticultural production. The vegetables included potato as the largest product that claimed 55% of the total vegetables production. Condiments accounted for 12.8% of the total national horticultural production. Figure 4 shows the split between three main horticulture product categories.

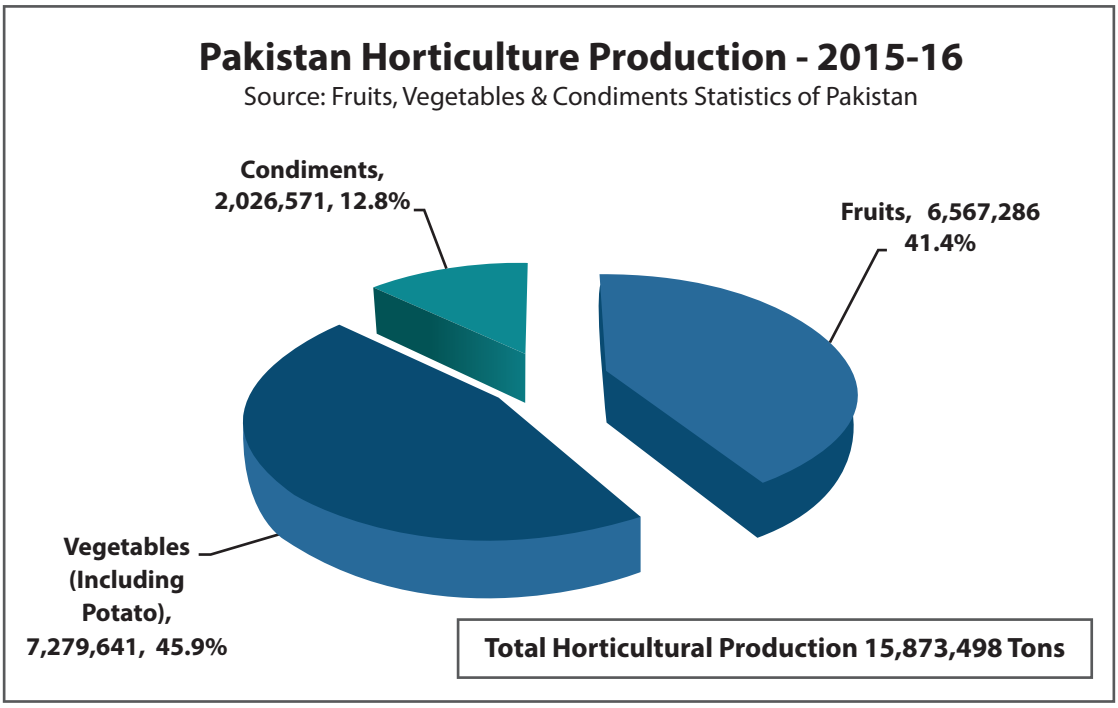

Figure 4 - Pakistan Horticultural Production Distribution

Punjab is the major contributor in most of the horticulture product categories. In 2015-16, Punjab's total horticultural production was 10.71 million tons which accounted for 67.5% of the total national production. 66.5% of the national fruit production was contributed by Punjab. Citrus and mango are the two main fruits of Punjab. The province's share in national vegetable production (excluding potatoes) was 66.5%.

[3]Wheat, Rice, Maize, Jowar, Bajra and Barley
[4]Cotton, Sugarcane, Tobacco, Jute, Sugar beet, Guar and Sunhemp
[5]Rapeseed, Mustard, Canola, Sesame, Groundnut, Soybean, Sunflower and Safflower
[6]Onion, garlic, coriander, chillies and turmeric

Punjab enjoyed a monopolistic position in potato production by producing 3.81 million tons and claiming 95.9% share in the total national production in 2015-16. Condiments represent the only horticultural product category where Punjab is not the largest producer. In 2015-16, the province produced 0.43 million tons of condiments to contribute 21.3% to the national condiments basket.

Figures 5 to 8 show the share of Punjab in total national production of different horticultural products.

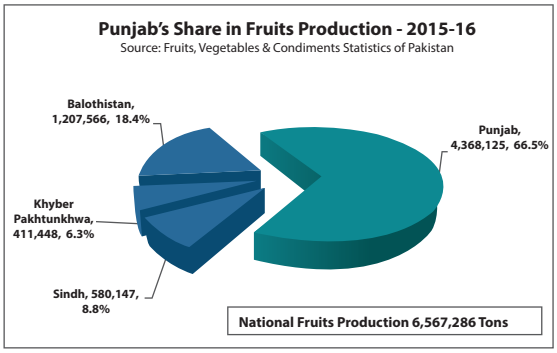

Figure 5 - Punjab's Share in Fruit Production

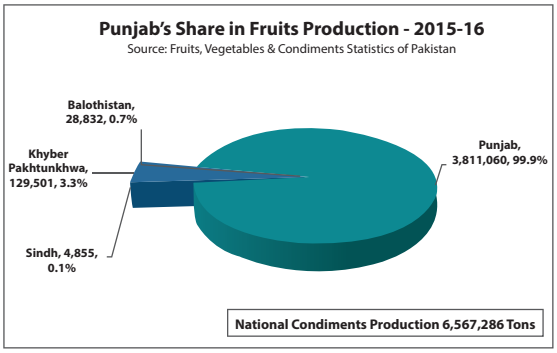

Figure 7 - Punjab's Share in Potato Production

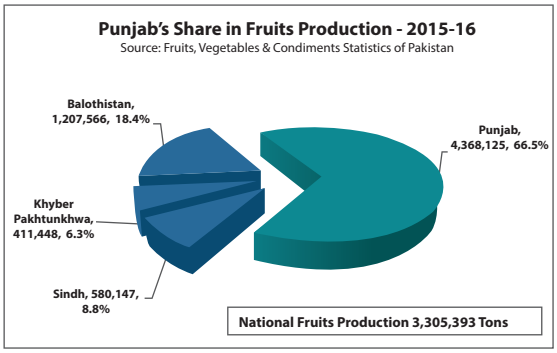

Figure 6 - Punjab's Share in Vegetable Production

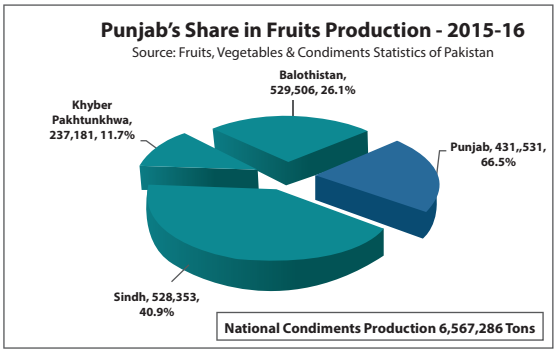

Figure 8-Punjab's Share in Condiments Production

During the six year period from 2011 to 2016, the horticultural production of Punjab has been almost stable. There was no increase in fruit production; whereas potato production increased by 14%. There was an increase of 5% in vegetables production and decrease of 4.5% in condiments production during the six year period.

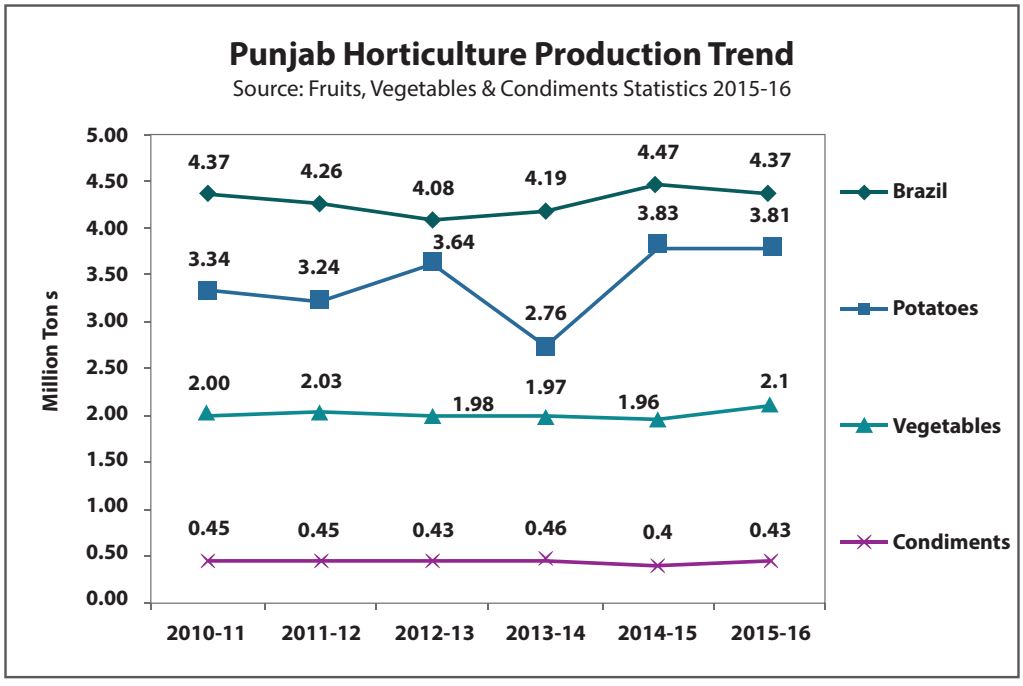

Figure 9 - Punjab's Horticultural Production Trend 2011-15

2.4 Horticulture Value Added products

Fruits, the marvelous gift of nature, besides having delicious taste and being source of readily available energy, are natural sources of vital nutrients like organic acids, minerals, vitamins and enzymes. These nutritional components are essential for proper functioning of the human body. Fruits are harvested in their respective production seasons and because of their perishable nature have to be consumed or processed within that limited time. To extend the shelf life, a very small percentage is stored for a limited period by the application of microorganism growth inhibiting chemicals and by controlling storage conditions including temperature, pressure, humidity and composition of surrounding gases. Fruits are preferred to be consumed fresh, however, the entire production cannot be consumed directly as such. The surplus produce is processed into value added products including dried fruit, fruit juices and drinks, squashes, canned fruit, frozen fruit, jam, jellies, murabbas etc. The predominant part of the value added products comprises of fruit juices and drinks.

Fruit juices derive their importance from their relishing taste and the associated health benefits. Fruit juices have a high concentration of vitamins and minerals. Orange juice holds a special importance in this regard by being a major source of vitamin C. One cup serving of raw, fresh orange juice, amounting to 248 grams contains 124 mg of vitamin C. Orange juice also supplies potassium, thiamine and folate and is a good source of antioxidants.

During recent past, fruit juice has become very popular and an essential part of everyday diet of medium to high income families. Hundreds of thousands of tons of fresh fruits are processed all over the world to meet the growing demand of fruit juices; made from variety of fruits. Some juices, however, remain more popular than the others. The most popular product in this regard, with the globally highest demand, is the orange juice.

In Pakistan, only a small share of the surplus fruit production is preserved and converted into value added products. A significant share of horticulture production cannot be processed and thus gets wasted. Attracting more investment in horticulture value added sector can help reduce this economic loss. It will lead to improving the overall value of horticulture crops for the farmers, traders and consumers, generating new employment opportunities and increasing exports; thereby contributing towards the overall economic development of the country.

2.4.1 Frozen Concentrated Citrus Juice

Pure citrus juice is prepared from fresh oranges and other varieties of citrus fruits. At the time of processing, the natural single strength juices (unaltered, non-concentrated, natural) are in such huge volumes that their packaging, storage and transportation are hardly practicable. To overcome this difficulty and economize packaging, storage and transportation, volumes of juices are reduced by concentration process in which the major part of the naturally present water content is physically removed. The single strength juices are mostly boiled under vacuum conditions to evaporate a defined portion of the water content of fruit juices by using special equipment. Reduction of the water content reduces weight and volume of the product, i.e. 100 kg single strength (natural juice) can be reduced to 15-20 kg concentrate by evaporating its water content. This results in cutting transportation and storage costs, and improving the storage stability of the product.

The product prepared by concentrating the single strength juice is usually stored in frozen condition to maintain the originality of the product. The final product prepared in this manner is known as Frozen Concentrated Orange Juice (FCOJ). In Pakistan, major share of citrus fruit is that of Kinnow which is a high yield mandarin hybrid (loose skin orange) cultivated extensively in the wider Punjab region of Pakistan, predominantly in Sargodha division. Kinnow is a hybrid of two citrus cultivars 'King' Citrus Nobilis and 'Willow Leaf' Citrus Deliciosa; first developed at the University of California Citrus Experiment Station. 'Kinnow' was released as a new citrus hybrid for commercial cultivation in 1935. Since in Pakistan, Kinnow is the main raw material available for processing, the concentrate product produced from Kinnow is known as 'Frozen Concentrated Kinnow Juice (FCKJ).

The frozen citrus concentrate is not a consumer product. It is used as a raw material to prepare ready-to-drink (RTD) juices. The concentrated juice or juice concentrate is brought into natural form by diluting with the same amount of water removed at the time of concentration process. The fruit juice so produced is called juice reconstituted from concentrate. Kinnow juice concentrate is used for the production of 100% pure Kinnow mandarin reconstituted juice and drinks, squashes, jams, etc. It is also used to enrich natural color and taste of the pure orange juice. 10% Kinnow juice can be blended with orange juice to improve the organoleptic characteristics of the final product.

Another category of orange juice sold in the market is known as 'Not-from-Concentrate' (NFC) juice which is not produced by reconstituting concentrate. The production process of NFC juice involves squeezing out the single strength juice from citrus fruit, pasteurizing it and either filling it directly into consumer packs or storing it for a

period of time under chilled aseptic or frozen conditions. NFC juice is also a popular product mainly due to the consumer's perception of its taste and quality being closer to those of 'fresh' juices. Comparing on single strength basis, the production volumes of NFC juice are five to six times higher than those of the citrus juice concentrate. Consequently the storage and shipping costs of NFC juice are also higher in the same proportion.

The document discusses the business feasibility of manufacturing Frozen Concentrated Kinnow Juice using the locally available Kinnow fruit.

2.5 Opportunity Rationale

Establishing an FCKJ manufacturing unit is a good investment opportunity from multiple perspectives. Key factors are discussed below:

2.5.1 Abundant Availability of Raw Material

Kinnow is the major raw material for manufacturing FCKJ which is abundantly grown in the province of Punjab. Production cluster exists in a concentrated format; with more than half of the total production coming from just one district. District Sargodha is the center of Kinnow production in the province. Area under Kinnow cultivation and the fruit production have been increasing over the years. New orchards are being cultivated every year that ensures a consistent supply of the fruit for consumption as fresh fruit and as raw material for manufacturing value added products.

2.5.2 Uniqueness of Kinnow Fruit

Kinnow has a unique taste, color and aroma which have earned it a distinct status among other citrus fruits. FCKJ is usually not used alone to prepare ready-to-drink juices. Instead, it is commonly used as an important ingredient of the overall juice recipe to improve the color, taste and aroma of the final orange juice product. Since it is a natural product, the final juice product can still be rated as a 'pure' juice with no artificial additives. FCKJ offers a great potential for exports due to this unique comparative advantage.

2.5.3 Value Addition Potential

Major share of fruit production is consumed in fresh form. However, there is always a significant share of the total production which does not have a value as table fruit; mainly due to its smaller size. This fruit serves as the raw material to be processed into value added products. In the absence of a processing sector, this grade of fruit would be wasted. Thus value addition of horticulture products directly contributes towards reducing the post-harvest losses to create added value for the farmers, traders, processors, consumers and the economy as a whole.

2.5.4 Large Export Market

Citrus juice is the most popular juice in the world for which citrus juice concentrate is the basic raw material. There is a high global consumption of orange juice that has led to creating a large export market of frozen citrus juice concentrate. Pakistan is a large citrus producer is the world with high potential to get a respectable share of this market. Country's increasing exports of FCKJ over the past years indicate towards this potential and provide a base to further increase this market penetration by realizing new investments in the sector.

2.5.5 Large Local Market

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2.5.5 Large Local Market

By being a populous country with sizeable middle-to-upper income class, Pakistan is a large market for fruit juices and drinks. The market has been growing at high rate during the past few years. This is evident by a continuously increasing sale of fruit juices/drinks and growing product diversity in terms of flavors and packaging. Average fruit juice consumption has increased over the years. The last decade has seen a mushroom growth of fruit juice/drinks companies to meet the growing demand of the local market. Citrus fruit based juice/drink products is a popular product which provides a strong rationale to invest in FCKJ manufacturing business.

2.5.6 Existing Market Presence

Pakistan already has an established presence in frozen citrus concentrate manufacturing. There are number of existing processing units producing FCKJ. As a result, the country already has a presence in the international markets as a known reliable supplier of frozen concentrated citrus juice. This presence can be capitalized upon to further develop the industry to achieve its fullest potential in the years to come.

2.5.7 Punjab Horticulture Sector Development

Kinnow is a product of the province of Punjab. Value addition projects like FCKJ manufacturing are based on the raw material grown in Punjab. Investment in such projects provides a boost to the local horticulture sector by reducing the post-harvest losses and generating enhanced economic benefits for the sector stakeholders.

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3.0 FROZEN CONCENTRATED KINNOW JUICE PRODUCTION

3.1 Main Processes

The production process of Frozen Concentrated Kinnow Juice (FCKJ) is carried out in four major process stages; shown in Table 1.

No.	Process Stage	Operations
1.	Pre extraction treatment of the received fruit	Sorting, size grading, washing
2.	Extraction of juice from Kinnow and pre-concentration treatments	Refining, pasteurization, pulp adjustment i.e., removal of extra/undesired pulp, de-acidification, de-bittering
3.	Juice concentration	Evaporation, batching
4.	Packaging	Preservation, packing, storage

Table 1 – FCKJ Manufacturing Operations

Definitions of the key technical terms used in KCKJ manufacturing are provided in Annex I.

3.2 Plant Utilities

The main production processes require the support of different types of utilities. These include:

No.	Utility	Source
1.	Electricity	WAPDA; with backup generator
2.	Process water	Tube well
3.	Steam	Boiler, with water softening facility; furnace oil fired
4.	Chilled water	Chiller
5.	Instrument air	Air compressor

Table 1 – FCKJ Manufacturing Operations

3.3 Process Flow Description

3.3.1 Kinnow Selection

On arrival at the processing plant, fruit is checked by the quality assurance department and sound, healthy and mature fruit is accepted. Brix is the index of the fruit maturity, as soluble solids (brix) of orange/Kinnow juice increases with increase in maturity of the fruit. Original brix of the juice extracted from the fruit has a direct impact on the yield of the concentrate produced i.e., low brix juice results in poor yield percentage of the concentrate. During the Kinnow processing season, brix of the juice starts from 10 and goes up to14.5 degree by the season end. The fruit not meeting the required quality standards is rejected.

3.3.2 Kinnow Sorting and Grading

The Kinnow received at processing plant is fed to the receiving conveyer which delivers it to the fruit washer for initial washing to remove the surface dust/dirt. After the first washing, the fruit is manually sorted to discard the unwanted ruptured or blemished fruits.

Figure 10 – Kinnow Sorting on Roller Sorting Machine

The fruit is then conveyed to the second washing in a two-stage brush washing machine followed by final inspection. The sorted lower quality fruit is separated and flows through a separate line into a rejection hopper. The rejected fruit is returned to the supplier by loading it into the same vehicle which brought the fruit. This fruit is included as part of the tare weight of the vehicle. The Kinnow rejected by the processing plants has no buyer and it is usually dumped on the roadsides to be consumed by the animals.

Figure 11 – Brush Washer

The selected fruit is size graded by the mechanical grader and conveyed to the extraction section which is equipped with extractors of various sizes. When Kinnows of different sizes, graded by the grading machine, reach the juice extractor of matching size, optimum juice yield is achieved.

Figure 12 – Kinnow Size Grading Machine

3.3.3 Juice Extraction

Juice extraction is the most critical operation in a citrus concentrate manufacturing facility; since it determines the yield and quality of the juice. It is therefore very important that extraction machinery is selected with all the required due diligence. There are two main citrus juice extraction systems having their own merits and demerits:

i) Rotary Press Extractor

With this type of extractors, the fruit is cut in two halves which pass between rotating cylinders to press out the juice. The peel oil is extracted in a separate step before extracting the juice where major part of the peel oil is removed from the peel of the fruit. The whole fruit is passed through a machine where major part of the peel oil is removed from the fruit and recovered. The equipment possesses a high capacity per unit, is cheaper, easily maintainable and uses a simple extraction process. However, yield and quality of the extracted juice is less optimal as compared to the juice extracted with squeezer type extractors. Hard extraction of the fruit halves leads to better yield of juice but results in mixing of fruit peel extract in the juice. Soft extraction results in poor juice yield.

ii) Squeezer Type Extractor

Squeezer type citrus juice extractor sucks the juice from inside of the whole fruit though a tube and separates the fruit into four parts; pulpy juice, peel oil emulsion, peel and core (rag, seeds and pulp). The head of an extractor is composed of upper and lower cups. After receiving fruit in the lower cup, the cups having metal figures mesh together as the upper cup lowers onto the lower cup. A cutter comes up from the center of the lower cup and cuts a hole through skin of the fruit allowing the inner parts of fruit to flow out. The cutter is part of the perforated strainer tube. Once the cutter of strainer tube has made cut into the fruit, the upper cup lowers down and squeezes the citrus fruit. The pressure forces the juice to burst out of the juice vesicles to pass out through the strainer tube. The upper cup continues squeezing down on the lower cup to squeeze as much as possible. In this extraction system, contact is avoided between peel and juice, and juice and oil. Most commonly used extractor of this type has five cups, each cup extracting 100 oranges/Kinnows per minute. Different sizes of cups handle fruits of corresponding sizes. The previous operation of the automated size grading machine separates different sizes of the fruit and feeds them to the relevant extractor according to size of their cups.

Figure 13 – Orange Juice Extractor (Squeezer Type) and Feeding Machine

Figure 14 – Extractor Cups and Kinnow Feeding into Extraction

Squeezer type extractors are preferred over rotary type extractors because of the superior quality and better juice yield. This type of extraction technique avoids contact of the juice with oil and with the peel that results in extraction of high quality juice without contamination of the juice with oil or extract of the peel. Microbiological quality of the juice extracted by this type of extractor is much better than the juice extracted with a Rotary Press extractor.

Criterion	Rotary Press Extractor	Squeezer type Extractor
Capital Cost	Lower	Higher
Operation	Simple	Highly technical
Extraction Method	Two halves of the Kinnow fruit, along with peel, pass through rotary press. The extracted juice may contain peel extract or peel oil.	A tube of small diameter penetrates into the fruit and sucks juice from inside of the fruit. The juice extracted is free of peel extract or peel oil. extracted is free of peel extract or
Overall Juice Quality	Hard extraction of the fruit results in poor quality juice containing peel extract. The skin of Kinnow is too soft and hard extraction helps ooze out the peel extract which mixes with juice. Soft extraction gives good quality juice but yield of juice is poor.	High quality juice and better juice yield is achieved.
Microbiological Quality	Juice of lower microbiological quality	Juice of higher microbiological quality

Table 3 – Juice Extraction Technologies Comparison

A processing plant of 30 ton per hour capacity is usually equipped with 60 extractors of various sizes, which squeezes out juice from the Kinnows of the corresponding sizes.

3.3.4 Refining

The extracted Kinnow juice, along with natural pulp, also contains membrane material and coarse particles. This undesired material is removed to make the juice more smooth and palatable. The extracted pulpy juice is refined by finisher or refiner, a cylindrical sieving machine which separates the coarse pulp particles leaving the refined edible pulp in the juice. This pulp is natural part of the orange/Kinnow juice contributing towards natural texture; viscosity and mouth feel of the product.

Figure 15 - Juice Refiner (Finisher)

3.3.5 *Pulp Washing*

Soluble solids of the pulp can be recovered by washing the pulp and using the 'pulp wash' after its concentration. Pulp washing is carried out to extract juice soluble solids of the pulp coming from juice finishers and from the centrifuges which can increase the yield of soluble solids by 6-7%.

Figure 16 – Pulp Wash System

3.3.6 *Pasteurization*

The refined juice before centrifugation is heated up at 95C (15-20 sec) and cooled at 70-75 C before it enters the centrifuge machine. This thermal treatment (pasteurization) inactivates the Pectin Methyl Esterase (PME) Enzyme and the spoiling microorganisms. The elevated temperature of the juice helps separate the pulp effectively by the centrifuge machine. Heat treatment or pasteurization is done by using a plate heat exchanger/pasteurizer. The pasteurized juice is stored in buffer tanks for uninterrupted supply to the concentrator/ evaporator.

Figure 17 – Plate Heat Pasteurizer

3.3.7 Centrifugation

The pulp percentage in the extracted/refined juice fluctuates during the fruit production season, and may be as high as 15-16%. The pulp percentage in the juice gradually decreases with the increase in maturity of the fruit. 8-10% pulp is considered optimum for good mouth feel and palatability of the juice. It is therefore adjusted as per the customer demand or keeping in view the intended use of the Kinnow Juice concentrate. The extra/unwanted pulp from the extracted/refined Kinnow juice is separated by the centrifuge machine before the concentration step. The separated pulp is one of the byproducts of the industry and can be used as cattle feed or as fuel for brick kilns.

Figure 18 – Centrifuge Machine

3.3.8 De-bittering and De-acidification

i) De-bittering

Kinnow/orange juice should have no noticeable traces of bitterness, as even very small amount of bitter compound is detectable and disliked by most of the consumers. Kinnow fruit naturally contains a precursor (a chemical substance that gives rise to another more important substance) of a very bitter compound called Limonin. The precursor itself is not bitter, which explains why fresh fruit and freshly extracted Kinnow juice does not taste bitter. During processing, when the juice is heated, the juice sacs rupture and Limonin-precursor enters the juice where it is rapidly converted into bitter Limonin. Limonin at the early stage of Kinnow production season is as high as 15 ppm, whereas the acceptable threshold of bitter taste resulting from Limonin in Kinnow juice is 2-3 ppm.

To make the juice more palatable, the bitterness can be controlled by reducing the Limonin content. This process, termed as de-bittering, involves adsorption of Limonin onto special resin by using ion exchange equipment and technique. After extraction and refining, prior to treating with resin, the juice is centrifuged to adjust it at less than 1% pulp content to prevent clogging the de-bittering resin bed. When the pulp-free juice to be de-bittered, is passed though the resin bed, the bitter substance Limonin is adsorbed by the resin; making the juice free of the bitterness. The pulp removed before starting the de-bittering process is added back to the de-bittered juice before it goes to the evaporator for concentration.

ii) De-acidification

Kinnow juice at the start of the season is too sour to drink. Acidity or sourness of the juice decreases with the increase in the degree of ripeness of the fruit. To adjust the juice acidity, batches of the juice with higher acidity produced at the early stage of the season can be blended with the juice produced from fruit harvested at advanced maturity stage. Acidity of the juice can also be reduced by passing it through de-acidifying resin bed;

just like reducing bitterness by passing the juice through de-bittering resin. De-acidification is optional, and is needed only for the limited quantity of the FCKJ produced during initial weeks of the season when acidity of the fruit is high. Because of product loss due to de-acidification and de-bittering, 7.5-8.0% yield is achievable. However, with pulp wash step in place, 8-8.5% product yield can be achieved.

3.3.9 Evaporation

The process of evaporation is widely used to concentrate liquid foods. Evaporation technology is a process of separating water content of the food by supplying heat to produce the desired concentrated liquid that can be handled by transferring pumps. Heat transfer, vapor-liquid separation and vapor condensation are the three basic elements of this process. In the evaporator, the juice is boiled under vacuum to evaporate the water. Vacuum conditions of the concentrator/evaporator facilitate boiling and evaporation of the juice at much lower temperature as compared to the boiling/evaporation at normal atmospheric conditions. This is important since boiling at higher temperatures can cause deteriorative changes in the product.

Depending on the need, evaporation is conducted in batch or continues mode. In the food industry, the most adopted mode is continuous evaporation. There are several types of evaporators but multistage evaporators are most commonly used. The heating medium for each stage is steam, water vapor from the previous stage, or both. When water vapor from the previous stage (boiling juice) is used as heating medium to evaporate water from juice at a lower temperature, the process is known as an 'effect.'

Figure 19 - Triple Effect Falling Film Evaporator

Oil phase (essence oil) and water phase (essence aroma) are separated at the time of juice evaporation. During evaporation, the vapors from early product stages of the evaporator contain most of the volatiles stripped from the juice. These volatile compounds (Oil phase and water phase), in the form of vapors, are recovered in an essence recovery system connected to the evaporator. The recovered essence is separated into oil phase and water phase either by decantation or centrifugation.

Essence oil contains over 90% D-Limonine which carries flavoring substances including esters, aldehyde, and ethyl alcohol. The most important compound is ethyl butyrate. In fact, the price of the essence oil is set by its ethyl butyrate content. High value components of the oil phase can be recovered by using advanced technology and sophisticated equipment.

3.3.10 Preservation of Juice Concentrate

The Kinnow juice concentrate produced during Kinnow production season may have to be preserved for about one year i.e. till the next season. Life of the juice concentrate can be extended for more than two years. The most common modes of preservation are freezing and aseptic processing/packaging. Both the preservation techniques have their own merits and demerits. Comparison of the two types of packaging is shown in Table 4.

Criterion	Freezing	Aseptic Packaging
Capital Cost	Higher	Lower
Storage Cost	Higher, due to higher energy consumption	Lower, due to lower energy consumption
Handling and Transportation	Higher handling and transportation cost	Easier handing and lower transportation cost
Overall Product Quality	Highest quality	Relatively lower quality
Product Life	Longer keeping quality product; can be stored for 3-4 years without any deteriorative changes during storage	Shorter/limited keeping quality; longer storage leads to deteriorative changes in the product.

Table 4 – Concentrate Preservation Methods Comparison

Freezing is one of the many preservation methods. When some food item is kept at extremely low temperature (freezing), the microorganisms cannot act to spoil it. Similarly, freezing significantly ceases those chemical and biochemical reactions which can spoil the food if kept at ordinary conditions. In freezing method of preservation, the product keeps its own individual form, texture, taste and nutritional value better than any other way of preservation. Freezing can be successfully employed for long-term preservation of many foods. The process involves lowering the product temperature generally to -18C or below.

During freezing storage of 65 degree Brix Kinnow concentrate, microbiological growth is very slow due to high sugar content causing high osmatic pressure. The concentrate stored at below 0C is principally stable against microbiological growth. To minimize changes in quality during long storage, juice concentrate is kept at freezing temperature (below -18C). The 65 degree brix juice concentrate from evaporator/concentrator is collected in a jacketed stainless steel tank where it is chilled at 4-5C. The chilled product is filled in poly lined metal drums, and initially, the sealed drums are placed in blast freezer and then shifted to freezing room maintained at -18C. The storage condition can extend the product life for more than two years. A temperature of -8C is considered safe enough during transportation. This feasibility study document has been developed considering preservation by freezing.

Orange juice concentrate produced at 65-66 degree brix is mostly stored in frozen form. However, it can also be *Processed/Packed* aseptically and stored below 8C. In this mode of preservation/packaging, fruit pulps/juice concentrates are thermally processed at high temperature, cooled, and filled in a pre-sterilized bag by using sterile filling equipment. Before thermal treatment (sterilization), air entrapped in the pulp during different processing steps is expelled by de-aeration operation. There are three key ingredients for good aseptic packaging:

a. Sterile product (pulp or juice/concentrate) is processed at an ultra-high temperature (105-107 C). The product is heated and aseptically cooled before filling.
b. Sterilized bag: The bags are gamma-irradiated with 3.5 m RAD for low acid foods and 1.5 m RAD for high acid foods. The hermetic spout, devoid of any leaks, applied after filling does not allow microorganisms to enter the bag.
c. Aseptic filler: The purpose and function of the filler is to fill the aseptic product in a pre-sterilized bag. Filling is carried out in aseptic (sterile) zone of the machine.

The aseptic bags provide protection against contamination to the aseptically processed and packed product. The extent of oxygen penetration (resulting in color and flavor deterioration) varies with the materials used for bag manufacturing. Aluminum foil Bag (Alu Foil or Foil Bag) possesses high barrier properties against penetration of oxygen through their pores. Aseptic packaging has not been included as part of this feasibility study.

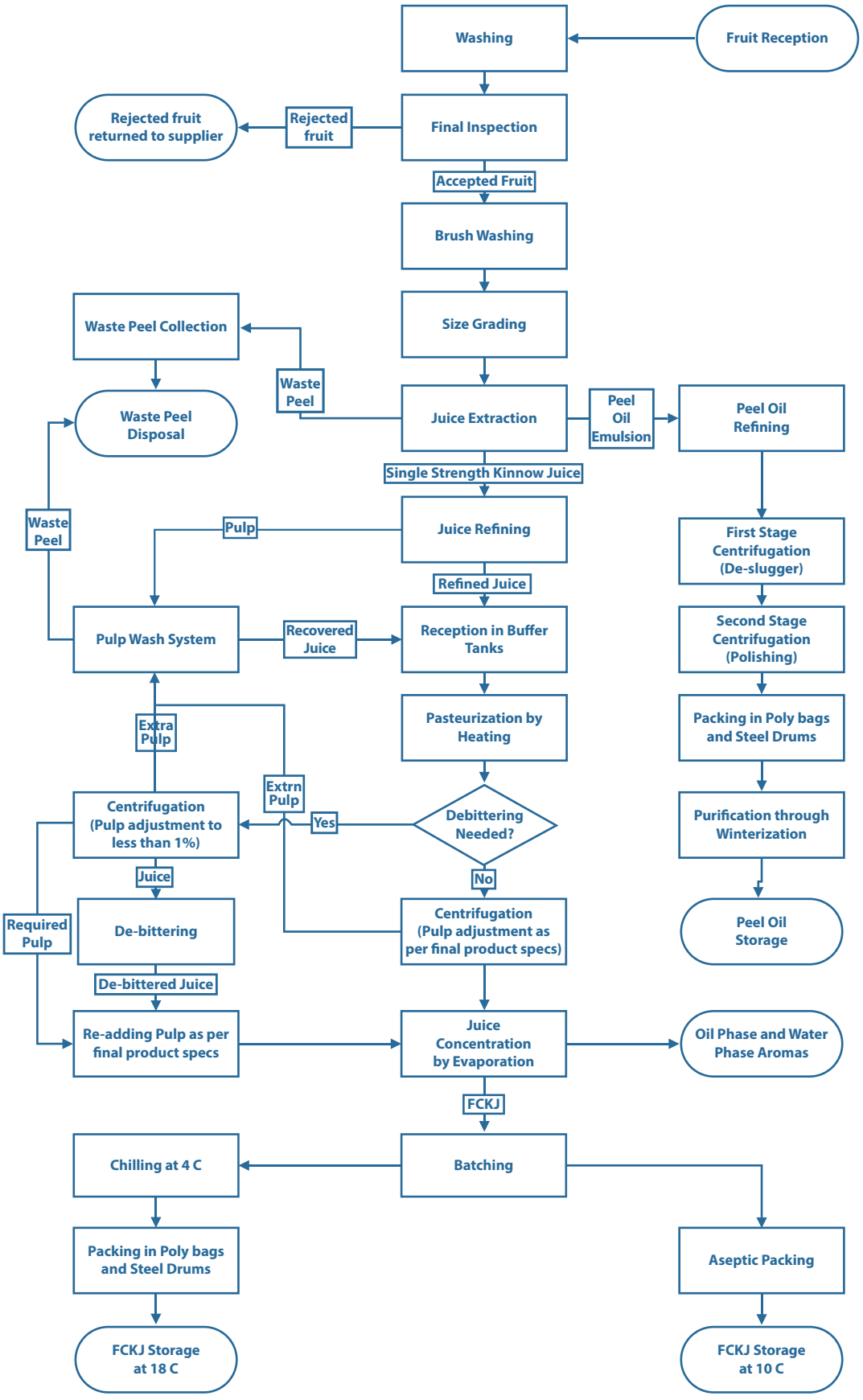


Figure 20 – Process Flow Chart for FCKJ Manufacturing

3.4 Byproducts

Three byproducts are obtained from FCKJ manufacturing process, peel oil, Kinnow pulp and Kinnow waste peel and fiber.

3.4.1 Cold Press Peel Oil

Peel oil is the most precious byproduct of the citrus juice concentrate industry. Kinnow fruit contains 0.02% to 0.04 % peel oil; the percentage increases with the increase in maturity of the fruit. The oil-water emulsion produced during juice extraction operation is centrifuged to separate oil from water. Before centrifugation, it is passed through a strainer or refiner to remove large bits of peel and parts of fruit. After straining/refining, the oil emulsion, containing 0.5-2% oil, enters the first stage centrifuge called de-slugger which purifies the oil up to 70-90%. The concentrated oil stream then passes to the second stage centrifugation process called (polishing) which further concentrates it to more than 99% purity.

Peel oil consists of over 90% D-Limonine; a water-soluble hydrocarbon which does not contributes much to the flavor but acts as a carrier of the real aromatic compounds like aldehyde. Peel oil can be folded (concentrated) by separating the hydrocarbon content (D-Limonine) to increase the proportion of desired flavoring substances such as aldehyde and esters. This value addition is suitable at higher capacity fruit processing facilities.

In the juice extracted from fruit, the main source of D-Limonine is peel oil which mixes with juice at the time of extraction. Extent of peel oil mixing with citrus juice depends on the type of extractor or extraction technique adopted. Squeezer type extractors proposed in this feasibility report give best results regarding contamination of juice with peel oil. Removing traces of D-Limonine before juice feeding to de-bittering resin bed will involve pre-evaporation by an additional evaporator which will significantly raise the capital and operating costs.

3.4.1.1 Winterization of Peel Oil

The naturally present wax in cold pressed peel oil can be separated by placing the oil container at 1C or lower temperature. This process of wax separation, called Winterization, is very slow and separation may take couple of months.

3.4.2 Kinnow Pulp

The juice contains as high as 15-16% natural pulp which decreases with the passage of time during the season. During the Kinnow processing season, on an average, the separated pulp is 4-5% of the single strength juice and 2% of the weight of the fruit. The extracted refined juice before concentration has to be standardized as per the required pulp percentage. The undesired extra pulp is removed by centrifugation to make the juice more palatable with smooth texture. The optimal level of the pulp in the juice concentrate is considered to be 8-10%. The separated pulp can be used to recover soluble solids to enhance FCKJ yield. It can also be used as raw material for making different ready-to-drink juices; the market however for this product is not large.

3.4.3 Waste Peel & Fiber

Waste peel, seeds and rag is also another byproduct from FCKJ manufacturing; generated in large quantities. The yield of waste peel as a percent of the processed fruit is around 40-45%. This waste peel has to be disposed of the factory premises on daily basis. It can be used as cattle feed or as fuel for brick kilns. One possible use of this waste peel is using it as a fuel in the boiler to meet the steam requirements for FCKJ manufacturing process. This will reduce the product's operating cost by eliminating the requirement of furnace oil or other fuels which entail a higher cost. However, in order to do this, the waste pulp has to be dried first to make it usable as a boiler fuel; which also entails an additional cost. A cost and benefit analysis should be carried out before this option may be executed.

3.5 Quality Assurance Standards

3.5.1 Fruit Quality Standards

With oranges grown to be eaten fresh, a certain percentage of the fruit is rejected because of the less optimal appearance/cosmetic value. Such fruit can be used for juice production. However, the fruit used for juice production must be appropriately mature, undamaged, and free from blemishes, bruises and diseases. The fruit must be fresh or maintained in sound condition by suitable means.

3.5.2 FCKJ Quality Standards

Kinnow/orange juice concentrate standardized at 65-66 degree brix is the globally traded standard product. It is produced by concentrating (5-6 times) the single strength juice. The product having Brix value Should not be less than 62.5 degrees and should have a Brix to acid ratio of minimum 14 and maximum 19. On single strength

basis (11-12 Brix), the juice is generally standardized at 10-12 % pulp. However, the pulp content is adjusted as per the customer demand. Microbiological Standards

- Total plate count must be less than 1000 CFU.
- Yeast and mold must be less than 300 CFU.
- Coli forms should be Nil.

FCKJ is a bulk product, shipped at -6C to -10C, and stored at less than -18C.

3.5.3 Quality Issues in FCKJ during Storage

3.5.3.1 Color changes in FCKJ

Storage at low temperature helps retard Maillard reaction (non-enzymatic browning) caused by reaction between sugars and amino acids which is temperature driven reaction and not related with oxygen. Long term storage at higher temperature, at the end phase of Maillard reaction, results in browning of juices.

Aerobic/oxidative degradation of vitamin C also helps develop browning of juice. In case of aseptic packaging, quality of packaging material used for juice plays a role in color deterioration of orange juice; poor oxygen barrier of the packaging allows penetration of oxygen. Higher temperature facilitates oxygen penetration into the packaging.

3.5.3.2 Flavor Changes in FCKJ

Orange juice possesses very delicate flavor which is a mixture of several volatile components of different chemicals. During storage, changes in these flavor fractions lead to loss of freshness and original taste. Gradual development of unpleasant odors deteriorates the original taste of the product. High acidity and storage temperature promote such changes; without any impact of packaging material type. Vitamin C degradation is one of the causes of the flavor changes associated with the availability of oxygen. Oxygen-barrier property of the packaging determines the extent of oxygen penetration. Besides the oxygen-barrier nature of the packaging, higher storage temperature promotes the oxygen permeability of the packaging material.

3.5.3.3 Selection of Raw Material

Quality of raw Kinnow is the most important factor in determining the quality of the final frozen concentrate product. It is influenced by varietal characteristics, climate of the growing area, irrigation, cultural practices and ripeness level at harvesting time.

3.5.3.4 Storage of Frozen Product

The frozen product is packed in plastic bags/pots/containers. For long term storage, the frozen product after packaging is stored at -18C. This temperature halts the growth of microorganisms and spoilage caused by them. Similarly, changes caused by chemical and biochemical reactions in the product during storage are significantly reduced.

[9]Research indicates that the heating value of citrus peel is 7,470 +/-212 BTU per pound. The volumes of peel generated during the process may be sufficient to meet the energy needs to produce process steam. However, for burning this peel, it has to be first dried for which energy will be required; solar drying may be one possible option in that regard. It is important that a thorough cost and benefit analysis is undertaken before opting to use peel as boiler fuel. Modifications will also be required in boiler fuel intake design to use this solid fuel instead of the standard furnace oil.

4.0 FCKJ PRODUCTION & CONSUMPTION

4.1 Global Scene of Citrus Concentrate Production

Citrus concentrate is prepared by processing citrus fruit to extract its juice and evaporating a major part of the naturally present water content. Orange is the most commonly used citrus fruit in this regard and the major share of citrus concentrate in the world is made from oranges. The prepared product is preserved and stored in frozen state and is known as Frozen Concentrated Orange Juice (FCOJ). Other types of citrus fruits which are used for making concentrate include tangerines, mandarins, clementines and satsumas. Although, FAO data does not mention Kinnow as a separate variety, it is a variety similar to all the mentioned varieties and is also included under this category.

Figure 21 –Citrus Fruit Varieties

Since citrus fruit is the key raw material for making citrus concentrate, the manufacturing of the product is carried out only in countries/regions where citrus fruit is grown in large quantities. It is therefore important to look at global citrus fruit production trends and the major producers.

In 2016, the global production of oranges and tangerines was 105.9 million tons. During the 15 year period from 2002 to 2016, the world production grew from 83.4 million tons to 105.9 million tons which represents an overall increase of 27% and a compounded annual growth rate of 1.6%. Increasing global production of citrus fruit indicates towards the growing demand of the fruit; both for consumption as fresh fruit and as raw material for making value added products like citrus concentrate. Global citrus fruit (oranges and tangerines) production trend is shown in Figure 22.

The production trend shows an overall increase in the long term; however, between any two adjacent years, the production figures may increase or decrease. This is a natural phenomenon since the production of agriculture commodities depends on multiple factors which depend on nature and may be favorable in one year and not favorable in some other year.

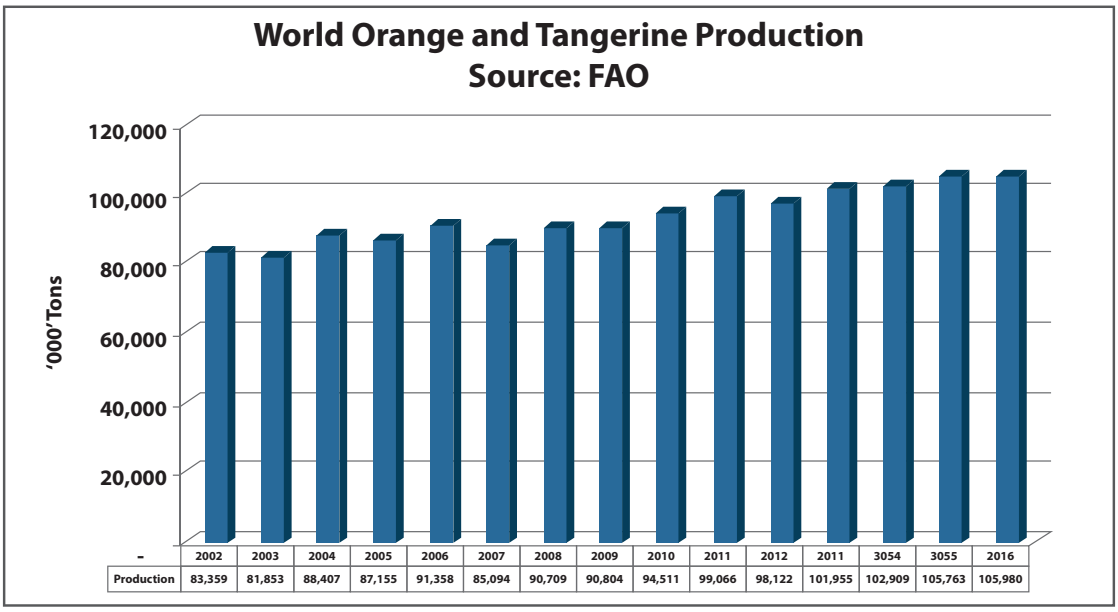
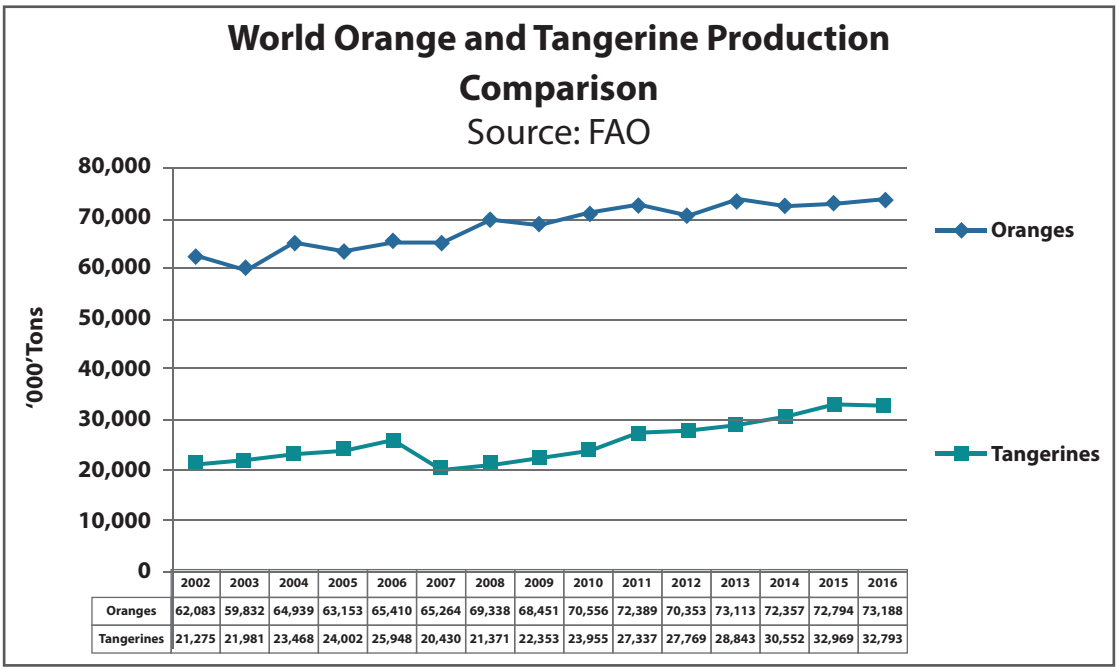


Figure 22 – Global Citrus Fruit Production Trend

Orange is the largest citrus fruit cultivated in the world. The trend shows that the share of oranges in the global citrus production has been declining over the years. In 2002, the share of oranges in the total production was 74% which dropped to 69% in 2016. This indicates that the global orange production has grown at lower rate compared to that of the tangerines during the past fifteen years. During this period, the global orange production increased from 62 million tons in 2002 to 73.1 million ton s in 2016 which represents an overall increase of 18%. In comparison, the tangerines production increased from 21.2 million tons in 2002 to 32.8 million tons in 2016 which is an increase of 54%. The growth in tangerines production was three times of that the growth in orange production during this period. In terms of yearly growth rate, the compounded annual growth of oranges was 1.1% and that of tangerines was 2.9%. Production trends of the two types of citrus fruits are shown in Figure 23.

[10]For the purpose of this document, the term tangerine will represent all the similar categories of citrus fruit (tangerine, mandarin, clementine, satsuma, kinnow)



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Oranges	62,083	59,832	64,939	63,153	65,410	65,264	69,338	68,451	70,556	72,389	70,353	73,113	72,357	72,794	73,188
Tangerines	21,275	21,981	23,468	24,002	25,948	20,430	21,371	22,353	23,955	27,337	27,769	28,843	30,552	32,969	32,793

Figure 23 – Global Orange and Tangerines Production Trends

4.1.1 Major Citrus Producing Countries

4.1.1.1 Major Orange Producing Countries

Orange production is concentrated in South American continent. Brazil is the largest producer of oranges in the world. In 2016, it produced 17.2 million tons of oranges contributing 24% of the global production. China and India respectively are the second and third largest orange producers. During the same year, they produced 8.4 and 7.5 million tons oranges respectively; accounting for 11% and 10% shares of the world production. USA is another important player in global citrus market. It is the fourth largest producer of oranges with production of 5.1 million tons; accounting for 7% of the global production in 2016. Production shares of the ten largest orange producers are shown in Figure 24.

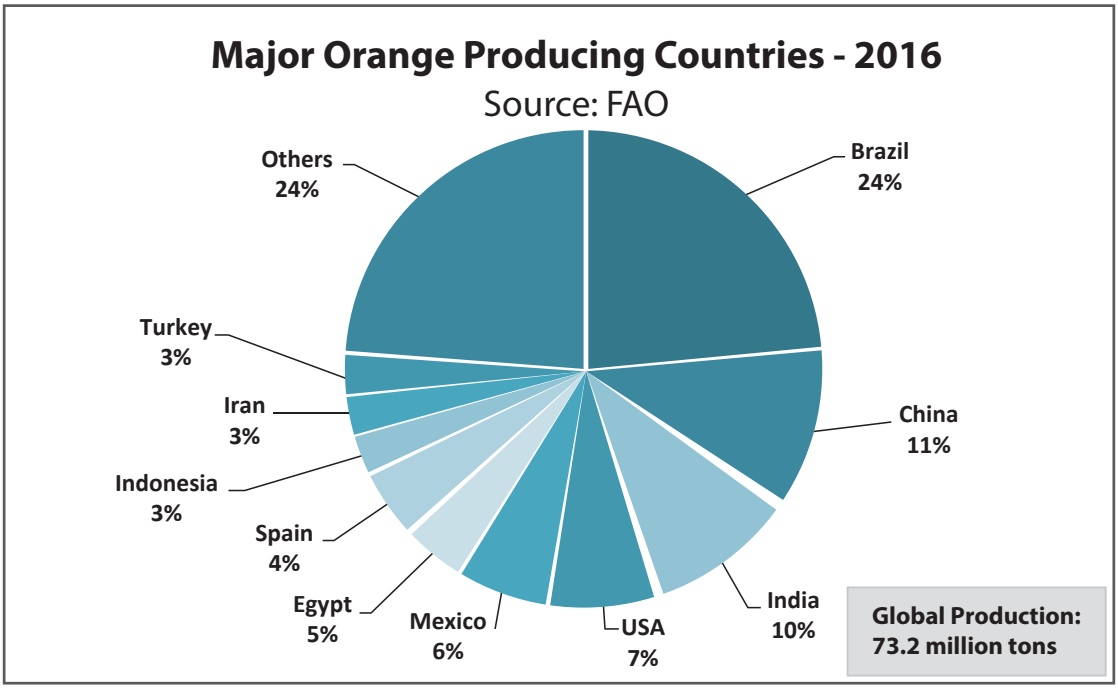


Figure 24 – Major Orange Producing Countries

Total Global Exports:

As per the FAO data, Pakistan is the 11th largest orange producer in the world with production of 1.59 million tons in 2016. However, it is important to consider the fact that major share of citrus production in Pakistan is not that of oranges. Instead it is that of Kinnow which is considered a fruit resembling tangerines and mandarins and is not classified under oranges. As per the sector representatives, around 80-90% of Pakistan's citrus production is contributed by Kinnow. Therefore, it can be inferred that the FAO data showing 1.59 million tons of orange production is not reported correctly. It is actually the Kinnow production that has been reported as that of orange.

4.1.1.2 Major Tangerine Producing Countries

Global production of Tangerines is dominated by China which claims around half of the total production. In 2016, China produced 17.1 million tons of these citrus fruits; contributing 52% share of the total global production of 32.8 million tons. Spain is the second largest producer claiming 9% global share with production of 2.94 million tons. The third and fourth largest producers of tangerines respectively are Turkey and Morocco with 1.3 and 1.0 million tons. Production shares of the top ten tangerine producers in 2016 are shown in Figure 25.

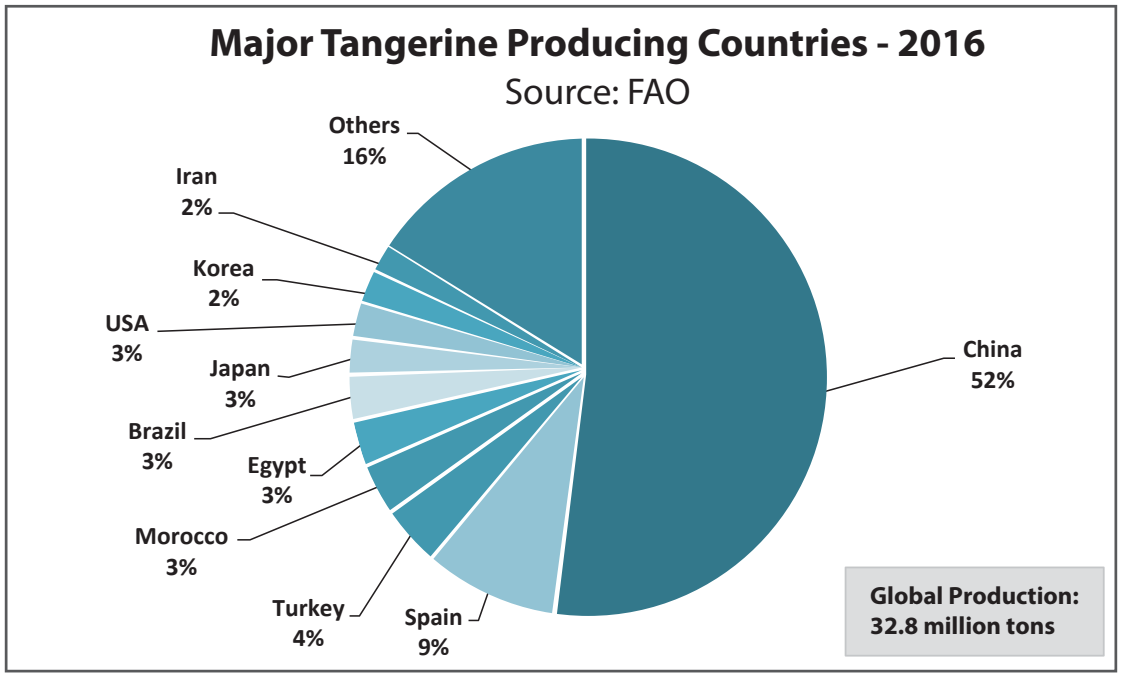


Figure 25 – Major Tangerines Producing Countries

4.2 Global Citrus Concentrate Production

Citrus fruit grown all over the world is consumed as fresh fruit as well as processed to produce citrus juice concentrate. The production of citrus concentrate is driven by the market demand as well as by the supply of fruit available for processing. In 2016-17, the total global production of citrus concentrate (65 degree brix) was 1.938 million tons. The ten-year production trend has been downward; decreasing from 2.486 million tons in 2007-08 to 1.938 million tons in 2016-17; representing an overall decrease of 22%. The production data available includes citrus concentrate produced from oranges, tangerines and other similar varieties. Data, segregated on the basis of concentrate made from orange or from other citrus varieties, is not available. Ten-year global production trend of citrus juice concentrate is shown in Figure 26.

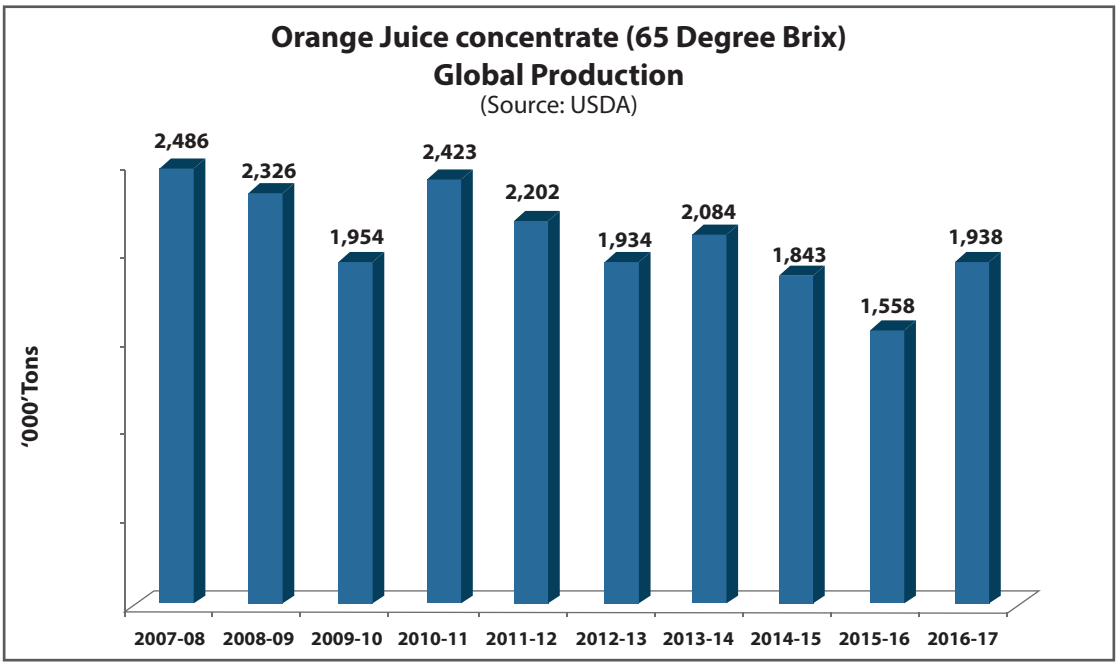


Figure 26 – Global Citrus Concentrate Production Trend

Production of citrus concentrate also depends upon the available stocks of the product which in turn are dependent upon its consumption during any particular year. The production and consumption trends usually go hand in hand but sometime may be opposite based on the future market projections and the availability and price of the citrus fruit. Figure 27 shows the comparison of global production and consumption of citrus concentrate.

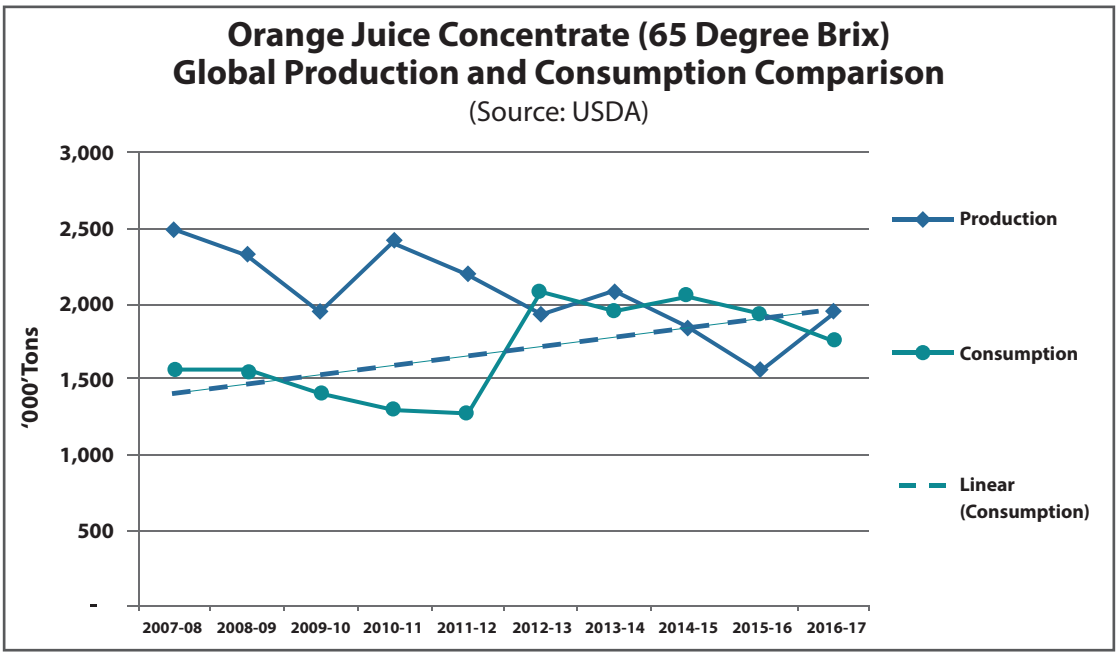


Figure 27 – Global Citrus Production and Consumption Trends

During the ten year period, the production remained higher than the domestic consumption during most of the years. There were only three years when the domestic consumption became higher and surplus stocks had to be used to meet the demand for citrus concentrate during those years. The graph also shows that although the product's consumption has been decreasing during the two most recent years, the overall consumption trend during the past ten-year period has been upward.

4.2.1 Major Citrus Juice Concentrate Producing Countries

Major Orange juice producing countries are the same which are the major citrus growing countries since having local supply of raw materials is a prerequisite in this regard. It is not practical and not feasible to make value added products by importing fruits. Major Orange juice concentrate producing countries are shown in Figure 28.

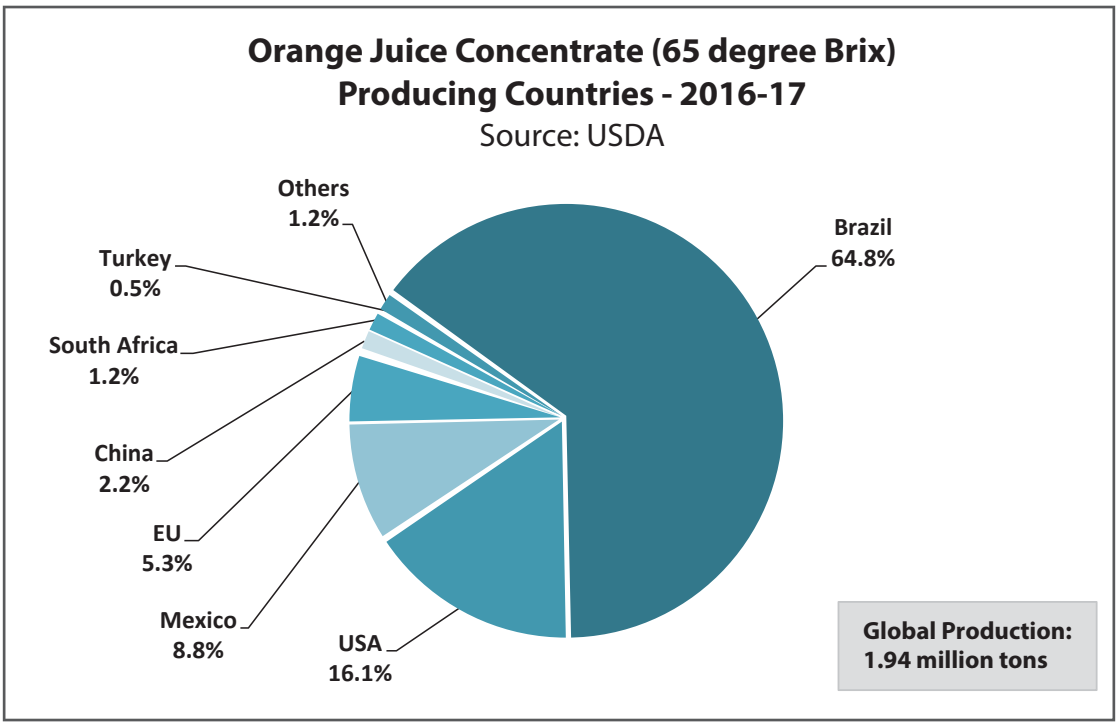


Figure 28 – Major Orange Juice Concentrate Producing Countries

Global FCKJ market is an oligopoly; with around two third of the total production supplied only by Brazil. In 2016-17, Brazil produced 1.257 million tons of citrus concentrate accounting for 64.8% share of the total global production. Brazil is also the largest citrus fruit producer with 24% share of the global production which ensures the required supply of raw material for this value addition. USA is the second largest producer of citrus concentrate with production of 0.312 million tons in 2016-17; accounting for 16% share of the global production. Together, the top two producers account for 81% of the total global supplies of citrus juice concentrate. Combining the production of Mexico to these, the three largest producers account for over 90% of the total global production. Thus, the dynamics of the international market of FCOJ is dictated by these two to three major players. Supplies from other smaller producers like China, South Africa, Turkey and Pakistan have little impact on the market dynamics. The large players are the price-makers while the other smaller players are the price-takers.

In the above perspective, it is important to remember that international market price of orange juice concentrate cannot be called as strictly market driven since it is operating as an oligopoly. In such a situation, the smaller players are quite vulnerable to price fluctuations by having no control on that. The larger players have the capacity to 'kill' the smaller players by maneuvering the market dynamics. Moreover, the market is also vulnerable to the fluctuations in fruit production due to natural factors like climate conditions, disease attacks, etc. Any drop in fruit production can lead to increase in price and any bumper crop in Brazil and USA can drop the price of orange juice concentrate. Thus the smaller producers like Pakistan need to have reasonable cushions in these feasibility calculations to absorb such potential price shocks.

However, Pakistani producers can use one differentiating factor and may convert it into a unique selling point in the international markets. Kinnow is a fruit that is grown in the largest quantity in Pakistan having its unique taste, color and aroma. Locally, it is the main fruit used for making citrus juice concentrate. The distinct properties of Kinnow fruit are reflected in the Frozen Kinnow Juice Concentrate (FCKJ) produced from it. These unique product characteristics may be used by Pakistani exporters to create a niche market for citrus concentrate produced by Pakistan.

4.3 Global Orange Juice Consumption Trends

North American and European markets are the largest consumers of orange juice. USA and Canada alone account for around 40% of total global consumption of packaged orange juice. Europe accounts for about 35% of the total global consumption. Historically, the world orange juice consumption grew consistently during the last century, particularly during the 1980s and 1990s. This high growth was supported by increased global production capacity and affordable prices.

4.3.1 USA Market

The overall global consumption of orange juice has declined since peaking in about 2000. Decline in US market was the major factor behind this decline since it is the largest orange juice market. This decrease has not been compensated by growth in emerging markets, such as China. In 2016, the orange juice consumption is USA was about 2.8 billion liters, far below the 5 billion liters drunk in 2001. The decline reflects changes in eating habits (trend of skipping breakfast), dietary concerns and higher retail prices due to citrus disease in Florida, which decreased juice production. US consumers consume orange juice in three forms; frozen concentrate for home dilution, ready-to-drink (RTD) juice made from concentrate, and Not-from-Concentrate (NFC) juice. During previous decades, use of frozen concentrate (home dilution) has steadily decreased from a dominant position to less than 5% of total orange juice retail sales. NFC, which was introduced in USA orange juice market in the 80s, has steadily gained a market share that now exceeds 60%. RTD juice made from frozen citrus juice concentrate accounts for about 35% of the total market.

4.3.2 European Market

In Europe, home dilution of concentrate to make orange juice is not a popular practice. Therefore retail selling of frozen citrus concentrate is very low. Almost all the retail orange juice falls in RTD category; prepared from frozen citrus juice concentrate. Total orange juice consumption in Europe in 2016 was about 2.5 billion liters. Just like USA market, the European market also experienced a rapid growth of orange juice consumption in the 1980s and 90s. The consumption almost doubled from 1983 to 1993. However, since the start of the new millennium, there has been a gradual decline in orange juice consumption. Currently, the share of Western Europe predominates, but Eastern Europe's share of total juice consumption is increasing.

Most orange juice in Europe is made from frozen juice concentrate. But consumption of NFC has been increasing over the last decade and now accounts for about 25% of total orange juice market. NFC is priced higher than RTD and retails up to double the price of orange juice made from concentrate, In spite of this, the NFC market share has been increasing. The key reason is the increased per capita incomes and the customer perception that NFC is closer to fresh fruit juice.

In other markets around the globe, South America (especially Brazil) is experiencing rapid growth in the consumption of packaged orange juice. Some Far East markets such as Japan and South Korea have also shown high growth rates. However, even with this overall rising trend, the juice consumption may still fluctuate from year to year due to economic factors. In China, the consumers generally prefer beverages with low juice content. However, demand for orange juice is growing in large cities in the fast-growing coastal regions. Orange Juice consumption in the top 10 European markets is shown in Figure 29.

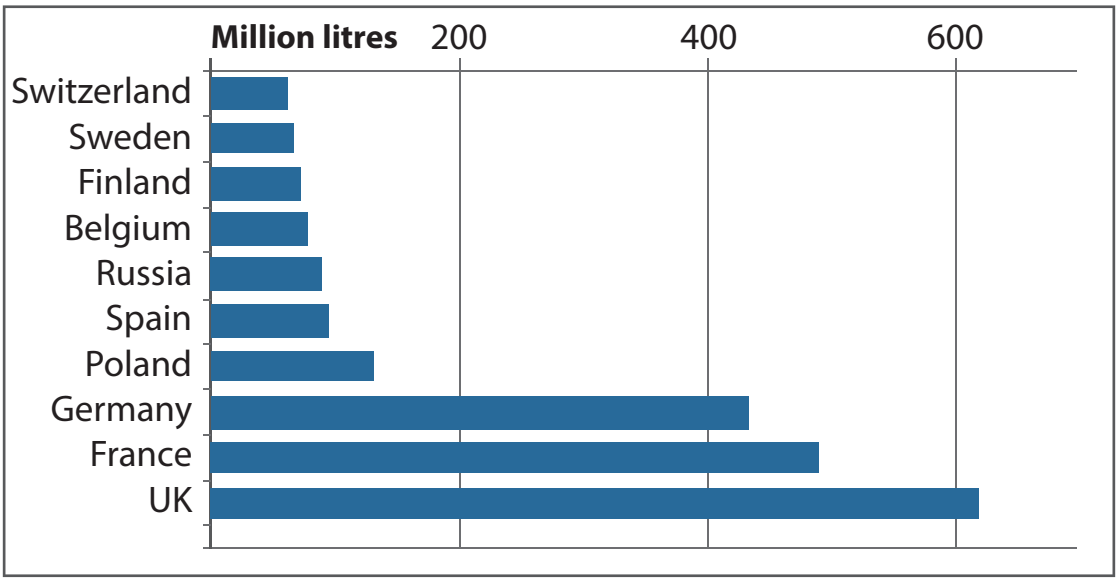


Figure 29 – Orange Juice Consumption in Top 10 European Markets (Orange Book)

In spite of decreasing consumption over the past decades, USA remains the largest total consumer of orange juice in the world. However, in terms of per capita consumption, estimated at almost 9 liters per year, it is no longer the highest. Maximum orange juice is consumed by the people of UK where the per capita consumption is around 12 liters per year. In the UK, orange juice holds the highest share of all fruit juices at more than 70%. Germany has the highest total fruit juice consumption in Europe. But because apple and blends are most the popular products, per capita orange juice consumption is much lower than that in the UK. The per capita estimates shown in Figure 30 are based on a range of market data and refer to 100% orange juice.

The Florida Department of Citrus (FDOC) also estimates the overall orange juice consumption based on both bulk orange concentrate and NFC. It includes orange concentrate used to produce nectars and fruit drinks as orange juice consumption. The FDOC's figures are therefore higher than the actual consumption of 100% juice only. These figures provide a valuable understanding of the total usage of processed orange juice in different markets.

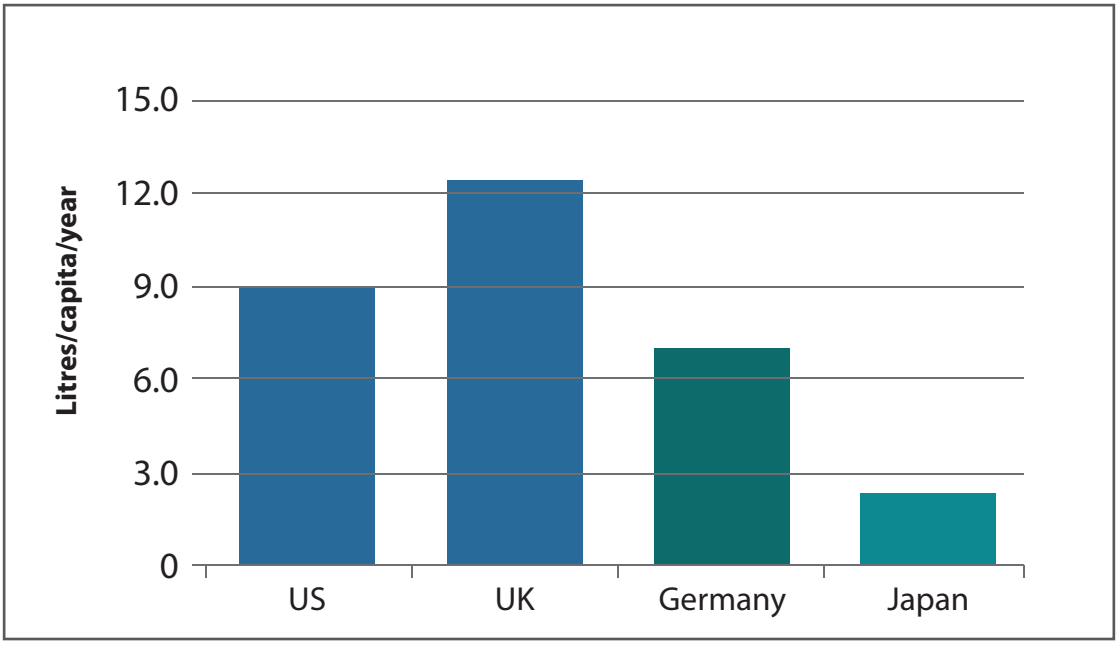


Figure 30 – Per Capita Orange Juice Consumption in Different Markets (Tetrapak)

The FDOC estimates that the presumed consumption of orange juice in the US dropped from 20 liters per capita in 2000 to 10 liters in 2015 (singe strength equivalents). Overall decline in consumption from 2006 to 2016 is shown in Figure 31.

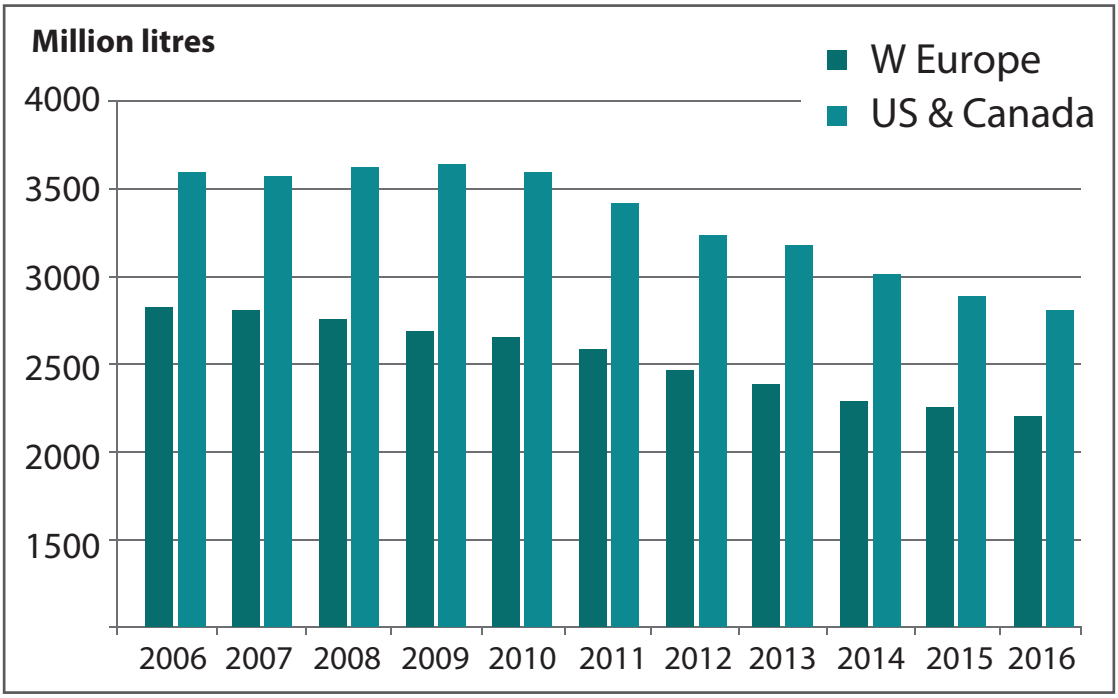


Figure 31 – Orange Juice Consumption Trends in North America and Western Europe (Tetrapak)

5.0 FCOJ EXPORT MARKET ANALYSIS

The planet earth has different climatic and agro-ecological zones suitable for growing different types of fruits and vegetables in different parts of the world. All types of fruits and vegetables are not grown in all parts of the world. Demand for fruits and vegetables and their processed products in different parts of the world is thus met through trade between different countries/regions of the world. Consequently, the fruits, vegetables and their products constitute a large share of the total international trade.

5.1 Citrus Concentrate International Trade

Fruits and vegetables juices represent a major category in international trade. The trade is classified under the main HS code of 20.09. There are eight sub categories of this main code for different fruits and vegetables; shown in Table 5.

HS Code	Description
20.09	Fruit juices (including grape must) and vegetable juices, unfermented and not containing added spirit, whether or not containing added sugar or other sweetening matter
Orange juice	
2009.1100	Frozen
2009.1200	Not frozen, of a Brix value not exceeding 20
2009.1900	Other
Grapefruit (including pomelo) juice	
2009.2100	Of a Brix value not exceeding 20
2009.2900	Other
Juice of any other single citrus fruit	
2009.3100	Of a Brix value not exceeding 20
2009.3900	Other
Pineapple juice	
2009.4100	Of a Brix value not exceeding 20
2009.4900	Other
Tomato Juice	
2009.5000	Tomato juice
Grape juice (including grape must)	
2009.6100	Of a Brix value not exceeding 30
2009.6900	Other
Apple juice	
2009.7100	Of a Brix value not exceeding 20
2009.7900	Other
Juice of any other single fruit or vegetable	
2009.8100	Cranberry juice
2009.8900	Other
2009.9000	Mixtures of juices

Table 5 – HS Codes of Fruits and Vegetables Juices

5.1.1 Fruit Juice International Trade

In 2016, the total international trade of all types of fruit and vegetables juices, categorized under HS 2009, was USD 14.6 billion against a total quantity trade of 13.8 million tons. Ten-year trends of export value and quantity are shown in Figures 32 and 33.

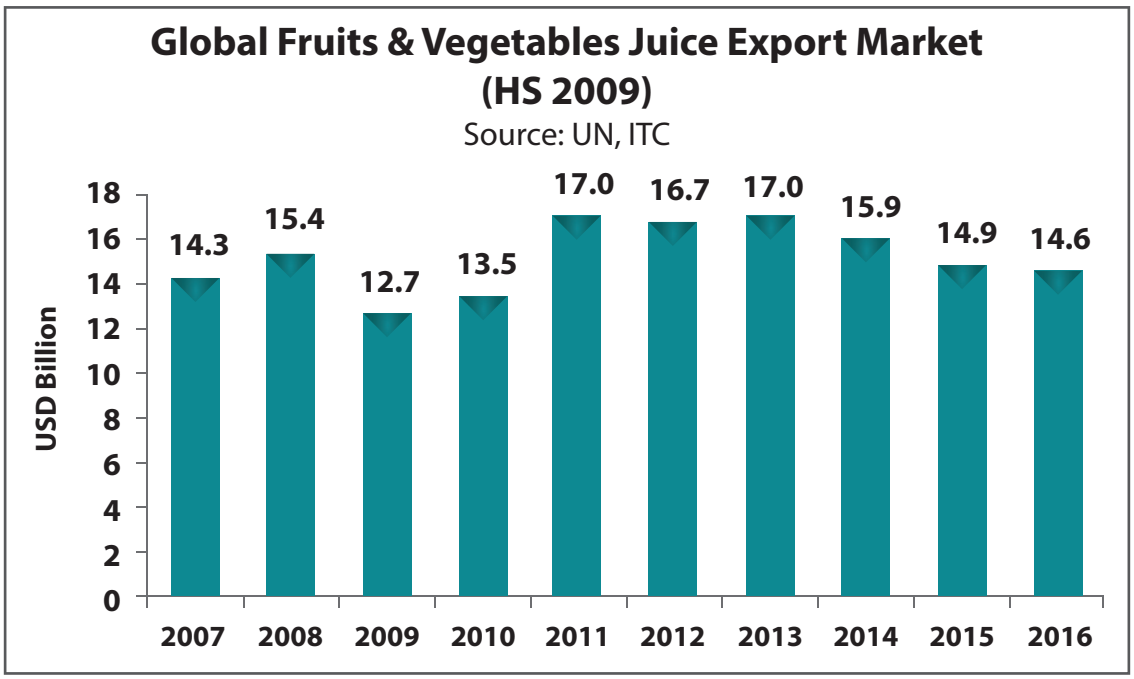


Figure 32 – Global Fruit Juice Export Value Trend

The global market of fruits and vegetables juices has been stable over the past ten year period. The market saw many ups and downs during this period and touched its highest in the year 2011 when the global exports reached 16.4 million tons for a total value of USD 17 billion. Since that year, overall export trend has been in a downward direction in terms of value. However, in terms of the traded quantity, the market has risen from 11.9 million tons in 2014 to 13.8 million tons in 2016; which represents an increase of 16%. During the ten year period from 2007 to 2016, the exports increased by 9.5% in quantity terms and 2.1% in value terms. In terms of compounded annual rate, the market grew at 1% in quantity terms and 0.23% in value terms over this period.

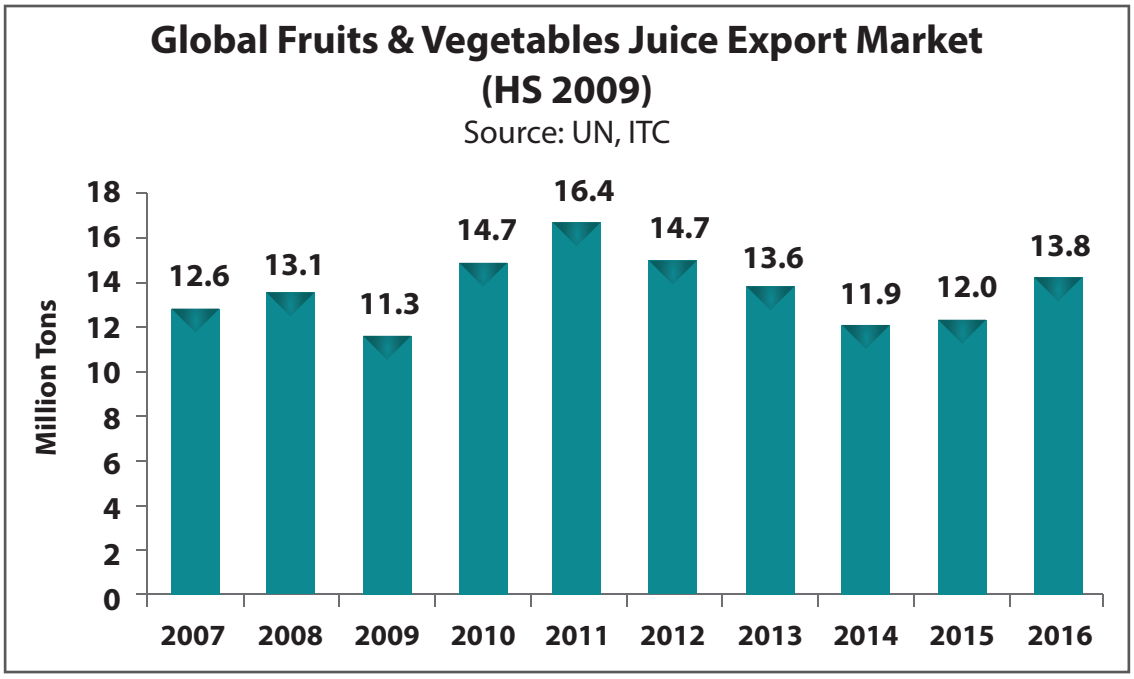


Figure 33 – Global Fruit Juice Export Quantity Trend

Positive growth in the world export market is an indicator of the rising demand of fruits and vegetables juices. Increase in population and increasing per capita consumption of juices are the main drivers of this growth in demand.

Looking at the market distribution with respect to different fruits, it is seen that orange juice products represent the biggest category. In 2016, 36% of the total export value of fruits and vegetables juices was accounted for by orange juice. During that year, USD 5.26 billion worth of orange juice products were traded around the world. Distribution of global juice trade value with respect to different fruits is shown in Figure 34.

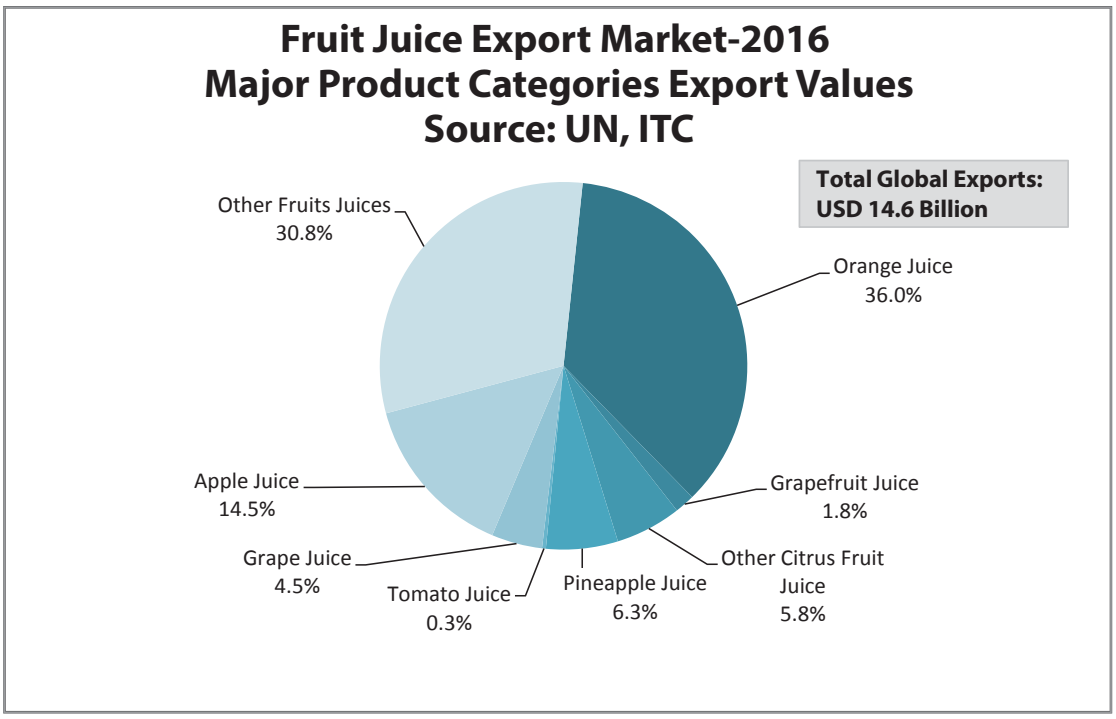


Figure 34 – Fruit Juice Exports 2016– Major Product Categories Distribution

Apple juice was the second largest product category accounting for 14.5% of the total global export value. It was followed by Pineapple juice and juices of citrus fruits other than orange. 'Other fruits juices' was also an important category accounting for about one third of the total global trade of fruits and vegetables juices. It is seen that major share of products under HS 2009 is contributed by fruits and not by vegetables. Tomato is the only notable vegetable which is processed into juice. In 2015, tomato juice accounted for 0.3% of the total global trade of fruits and vegetable juices.

5.1.1.1 Orange Juice Export Product Categories

The total USD 5.26 billion market of orange juice is divided into three categories; frozen, not frozen (brix value less than 20 degree) and the 'other' types of orange juices. Total trade of frozen orange juice concentrate of 65 degree brix in 2016 was 1.04 million tons; worth USD 1.71 billion. It accounted for 20.4% share of the total orange juice trade in terms of quantity and 32.5% share in terms of value of the total exports. The splits of total trade of orange juice between the three product categories, in terms of the traded quantity and value, are shown in Figure 35 and Figure 36.

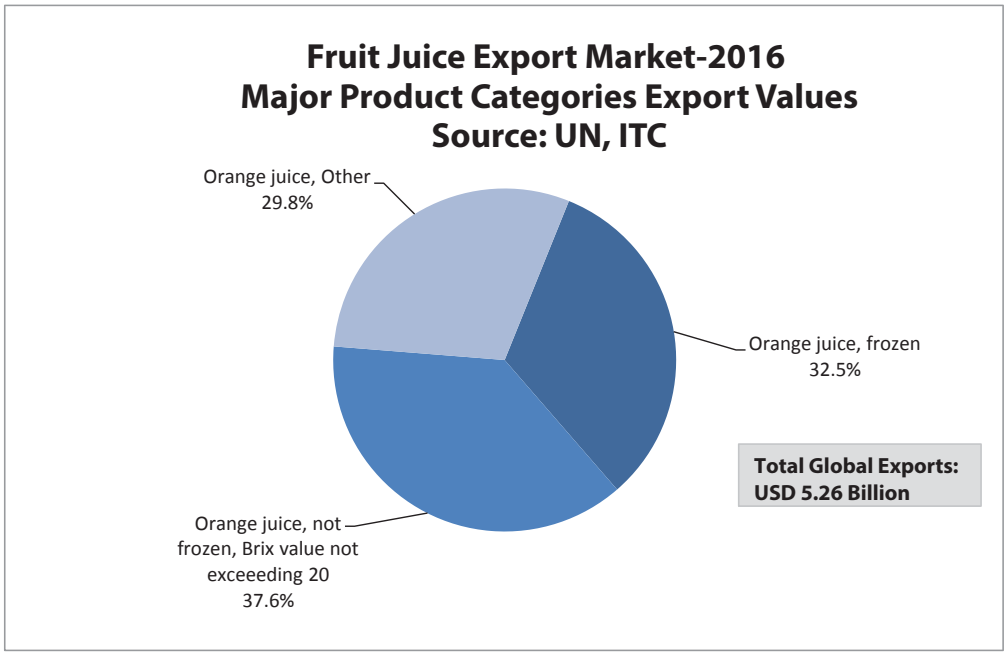


Figure 35 – Orange Juice Trade 2016 – Major Product Categories (Value)

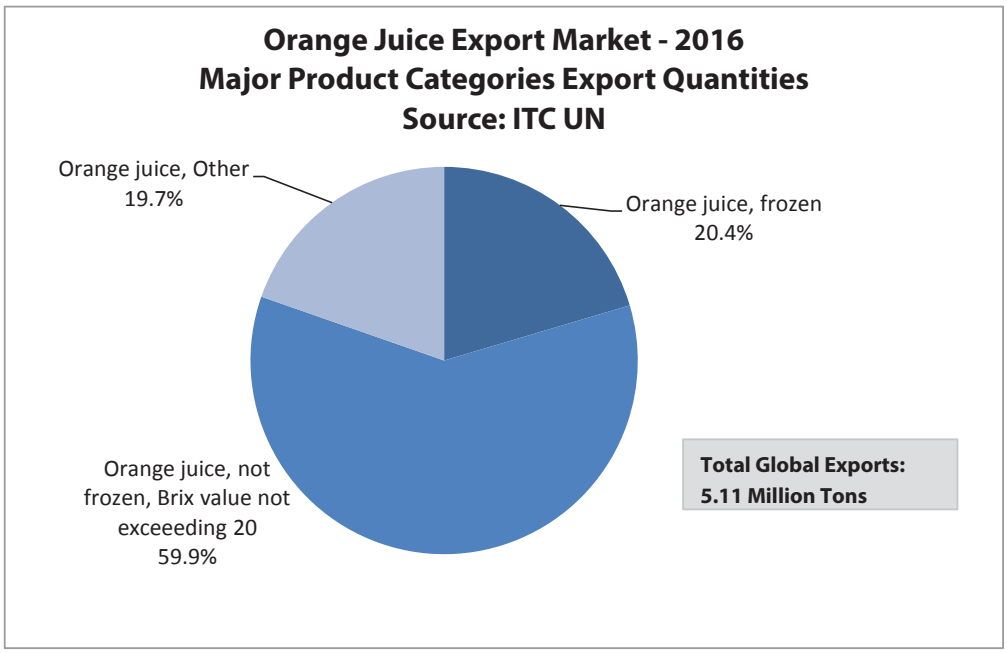


Figure 36 – Orange Juice Trade 2016 – Major Product Categories (Quantity)

Technically, tomato is classified as a fruit; however, it is included in vegetables since it is usually sold on vegetable shops and is an important ingredient in most of cooking recipes.

5.2 Global Trade of Frozen Concentrated Orange Juice

The global trade of frozen concentrated orange juice followed an oscillating trend during the past ten year period. Overall, the trend remained in downward direction and exports dropped from USD 2.29 billion in 2007 to USD 1.71 billion in 2016. This represented a decrease of around 25%. The drop in export quantity terms was even more pronounced; dropping from 1.55 million tons in 2007 to 1.04 million tons in 2016; a decrease of around 33%. However, during the last two years, the trend appears to be reversing since the exports in 2016 were around 2% higher than those in 2015. Looking at the previous trend, it can be seen that the trend reverses after every three to four years. Ten year trends of global exports of frozen orange juice concentrate are presented in Figure 37 and Figures 37 & 38.

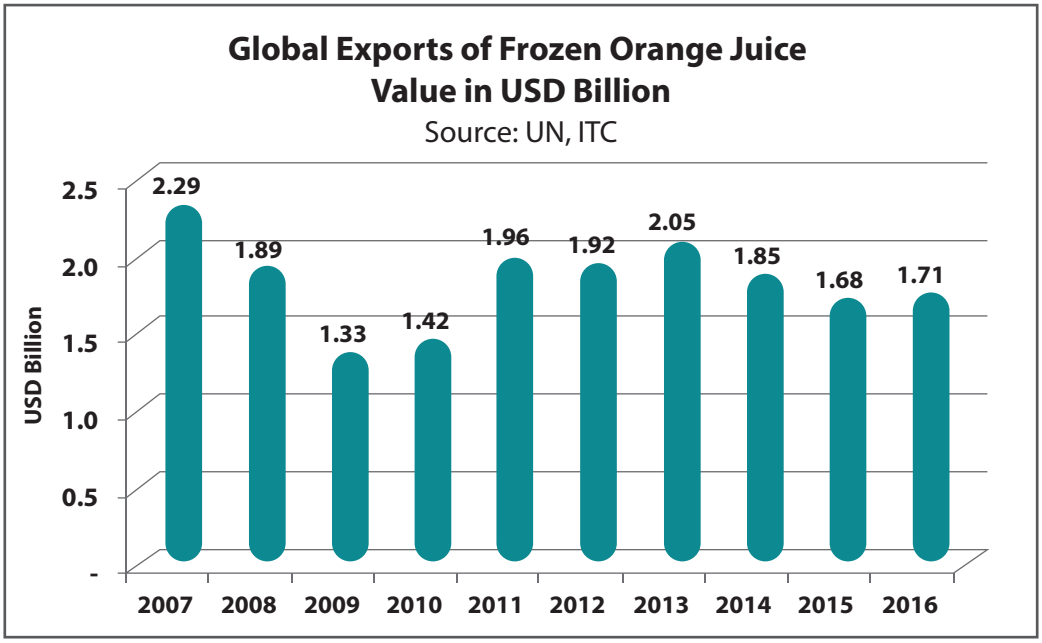


Figure 37 – Global Exports of Frozen Orange Juice (Value)

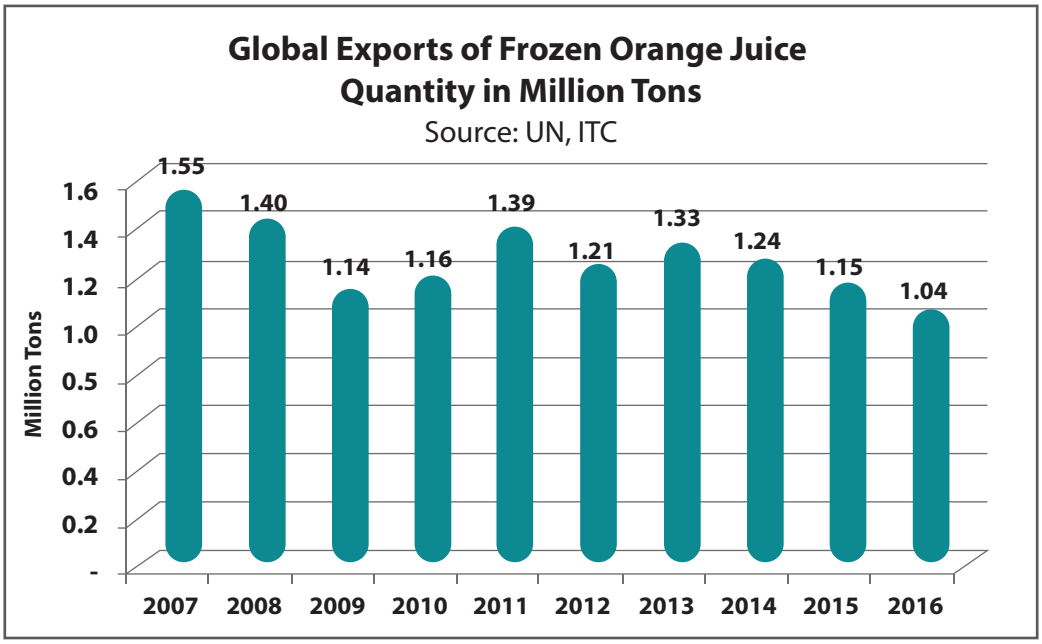


Figure 38 – Global Exports of Frozen Orange Juice (Quantity)

5.2.1 Major Exporters of Frozen Concentrated Orange Juice

The international export market of frozen concentrated orange juice operates as an oligopoly with more than three fourth of the total exports claimed only by three countries; located in two American continents. The American continents thus exercise a control on the market of frozen orange juice concentrate. The market shares of the major exporters are shown in Figures 39 & 40.

Brazil is the largest exporter of frozen orange juice concentrate with 50.4% share of the total global trade of this product in 2016. This is in line with the fact that Brazil is also the largest producer of orange juice concentrate holding 65% share of the global production. This position is derived from the comparative advantage that Brazil is the largest producer of oranges in the world accounting for one fourth of the total global production. The country has successfully converted its comparative advantage into its competitive advantage to develop a control on the global market of orange juice. The market dynamics are driven by Brazilian performance.

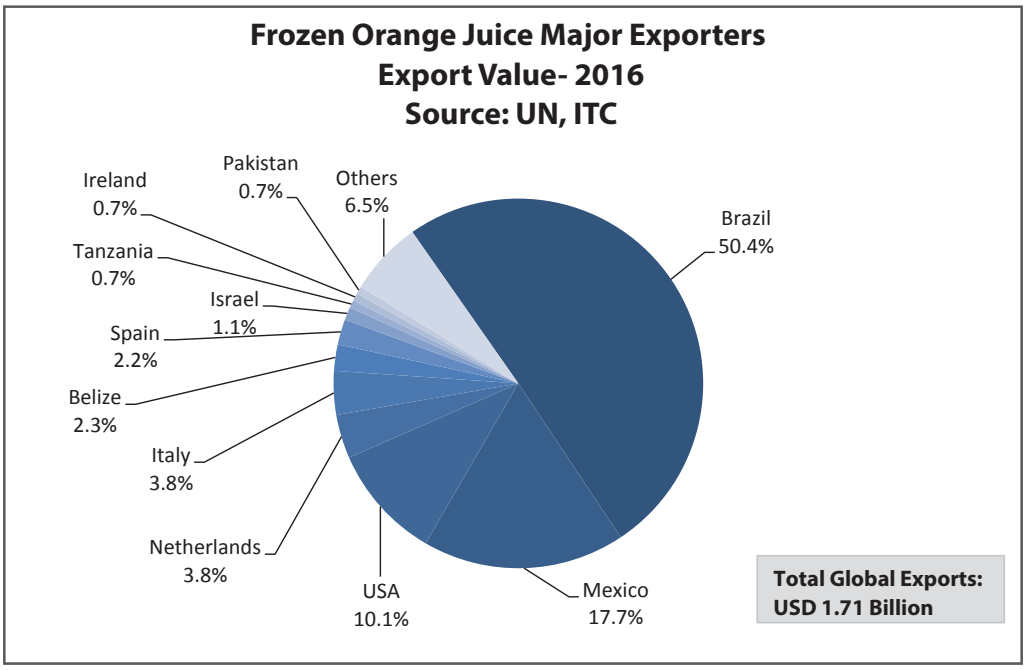


Figure 39 – Frozen Orange Juice Major Exporters - 2016 (Value)

Mexico is the second largest producer of frozen orange juice concentrate. In 2016, the country held 17.7% share of the total value of global trade. Country's rank with respect to quantity of exports was third. Mexico managed to export 127,177 tons of orange juice for USD 303 million to capture 12.2% share of total exported quantity. The third largest producer of frozen orange juice is from the North American continent. In 2016, USA was the third largest producer in terms of export value and second largest in terms of export quantity. USA exported 135,167 tons of juice for USD 172 million to capture 10.1% share of export value and 13% share of export quantity. Comparing the export figures of the two countries, it can be inferred that the orange juice exported by Mexico has a higher price compared to the one exported by USA.

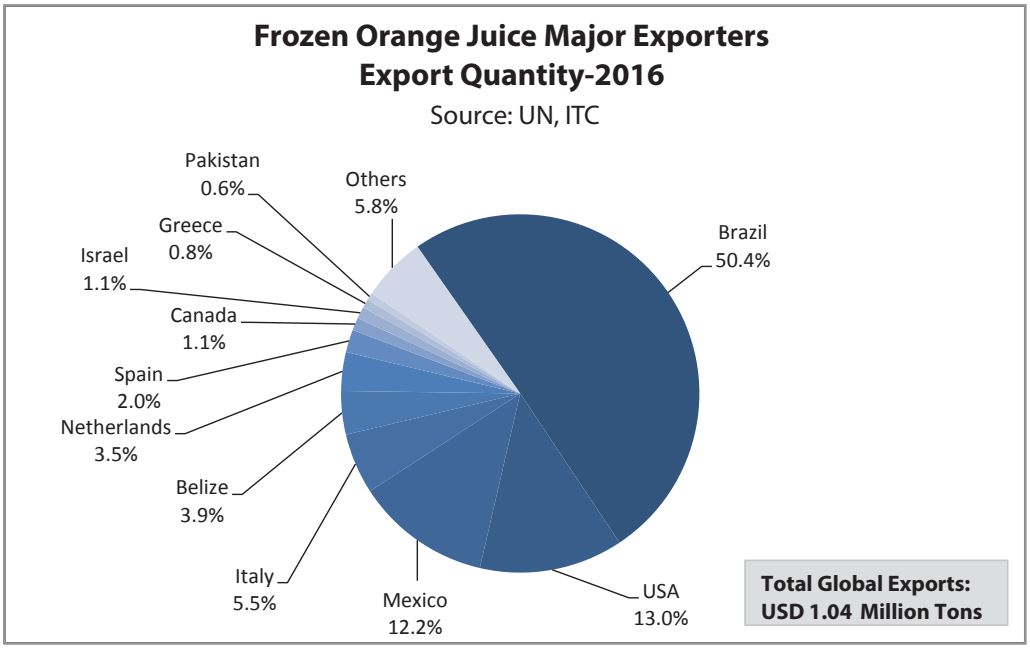


Figure 40 – Frozen Orange Juice Major Exporters - 2016 (Quantity)

Other major orange juice exporting countries are from Europe; including Italy, Netherlands and Spain. In 2016, Italy exported 57,090 tons of juice for USD 65 million to capture 5.5% share of total export quantity and 3.8% of total export value. Netherlands and Spain respectively held 3.5% and 2% shares of the total international trade of frozen orange juice. Other notable exporters are from the American continent. Belize is a smaller country of Central America, bordering with Mexico. In 2016, Belize was the fifth largest exporter with 3.9% share of the world market. Canada is the other country from North America which was the eighth largest exporter. Israel was the only country from Asia which was included in the list of top ten exporters of frozen orange juice concentrate.

In 2016, Pakistan was ranked as the eleventh largest exporter of frozen concentrated citrus juice. The country exported 6,743 tons of orange juice for USD 11.4 million. This translated into 0.6% share of global export quantity and 0.7% share of global export value. Keeping in view the fact that Pakistan is a large citrus producer, the country appears to possess even higher potential to further penetrate into this market. Expanding local production base and increasing marketing efforts can increase the country's exports to have a higher share of the international market of frozen concentrated citrus juice.

5.2.1.1 Major Exporters Trends

Since Brazil has 50% share of the global export market, the ten-year export trend of Brazil is very similar to that of the trend of the entire global exports. Though Brazil still holds the lion's share in global exports, its share has declined over the years. In 2007, Brazil held 67% share of the world trade of frozen orange juice that decreased to 50% in ten years. It even touched the lowest of 45% when its exports declined from USD 1.54 billion in 2007 to USD 685 million in 2009. This erosion of market share can be seen in Figure 41 and Figure 42 as sharp drop in Brazilian exports from 2007 to 2010. Following that, there was a recovery and the exports touched the USD 1.0 billion mark once again in 2013. Since then however, during the past four year period from 2013 to 2016, the Brazilian exports have once again been on a decline. Overall, the Brazilian exports decreased by 44% from 2007 to 2016 in value terms and 46% in quantity terms.

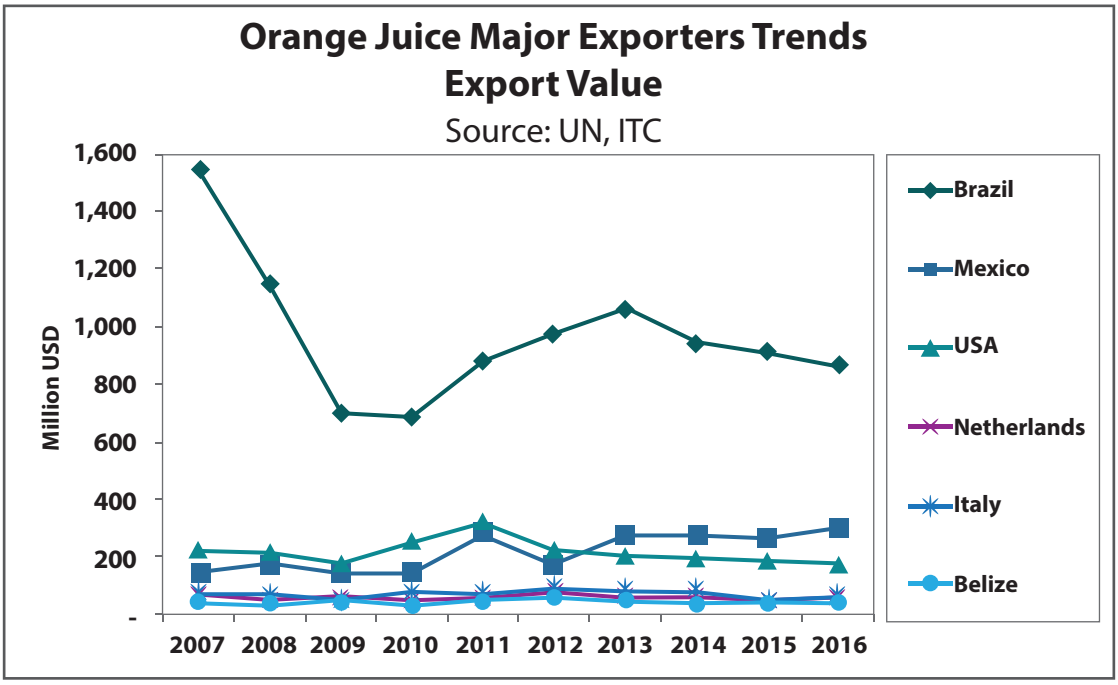


Figure 41 – Orange Juice Major Exporters Trends (Value)

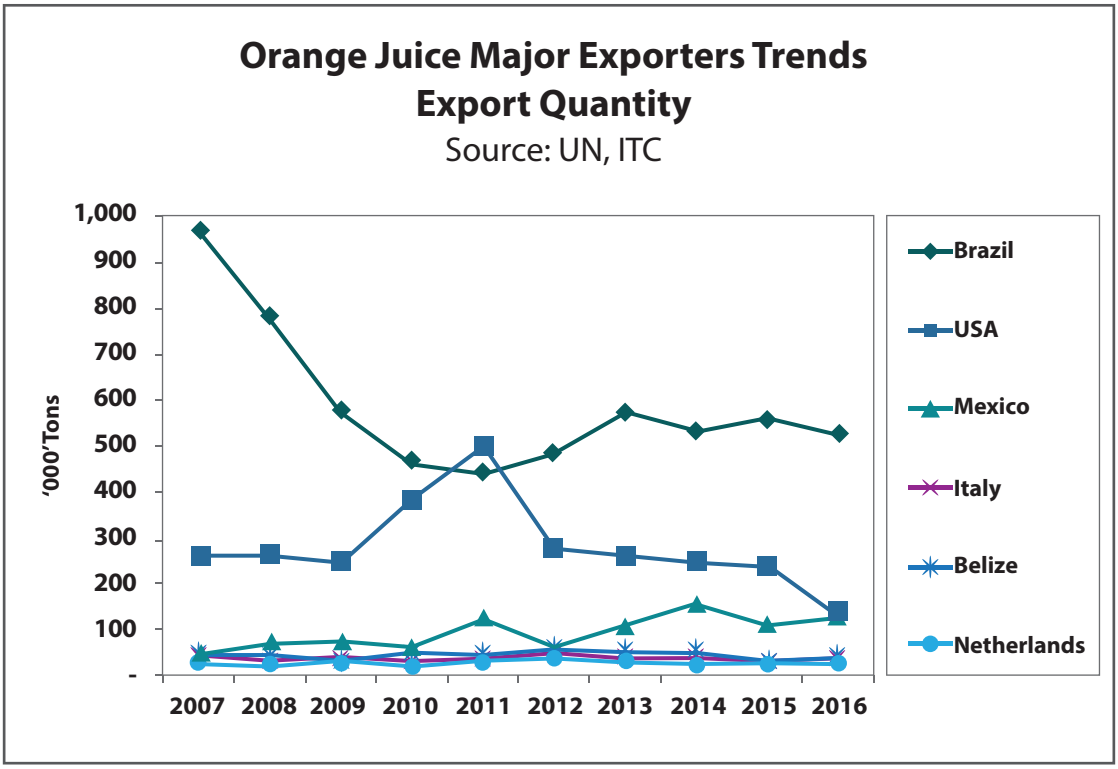


Figure 42 – Orange Juice Major Exporters Trends (Quantity)

Similarly, the exports of the second largest exporter USA have also been on a continuous decline since the year 2011. During the last five year period, USA's exports dropped from USD 373 million in 2011 to USD 172 million in 2016; which represents a drop of 46%. In terms of quantity, the decline was even sharper. The quantity of frozen orange juice exported by USA dropped from 495,053 tons in 2011 to 135,167 tons in 2016. This translates into a decrease of 72%. However, in spite of this drop, USA has maintained its relative market share at around 10% of the global export value during the last ten year period.

The export trends show that the two largest suppliers of frozen concentrated orange juice are decreasing their supplies in the international market. The vacuum being created by the phenomenon is being filled by smaller suppliers. In 2007, Brazil and USA together exported 1.23 million tons whereas the rest of the world exported 0.315 million tons. In 2016, the exports of Brazil and USA decreased by 46% and those by the rest of the world increased by 21%. Smaller players had only 20% share of the international market in 2007 which increased to 36.7% in 2016. The situation is highlighted in Figure 43. The phenomenon marks an opportunity for players like Pakistan to increase their presence in international market of frozen concentrated citrus juice by capturing a respectable share from the vacuum being created by the displacement of larger players.

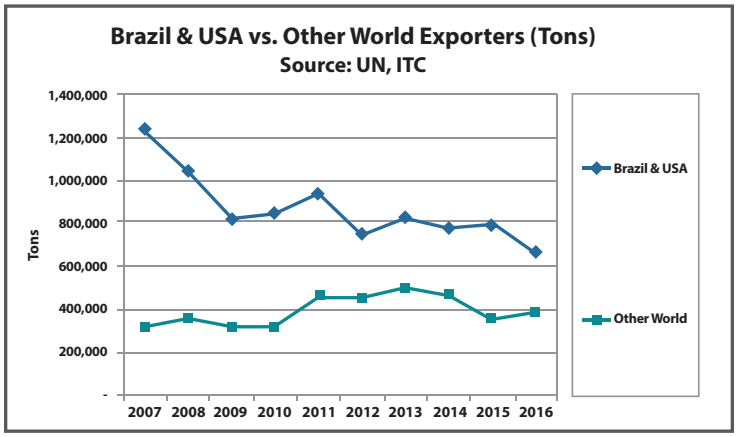


Figure 43(A) – Orange Juice Exports Brazil & USA vs. Rest of the World

Figure 43(B) – Orange Juice Exports Brazil & USA vs. Rest of the World

Mexico is an important example of the countries which have successfully capitalized on this emerging opportunity and has successfully achieved an increase in exports of frozen orange juice. Looking at the last ten year period, the country increased its exports by 167% from 47,539 tons in 2007 to 127,177 tons in 2016. The export value increased from USD 147 million to USD 302 million; representing an increase of 104%. Similarly, other smaller players like Italy, Netherlands Belize and Israel exhibited a positive export growth rate and increased their presence in this oligopolistic market. Overall increase in export quantities by Italy, Netherlands, Belize and Israel respectively were 3%, 130%, 53% and 48%.

Pakistan is also included among those countries that showed an increase in exports of frozen orange juice concentrate during the last ten year period. The exports increased from 4,389 tons in 2007 to 6,743 tons in 2016 which represents an increase of 54%. During this period, the export value increased from USD 5.8 million to USD 11.4 million. Table 6 identifies the growing and diminishing markets by showing the change in exports from 2007 to 2016 and growth rates for the top twenty exporters of frozen orange juice.

Rank	Exporter	Exports (Tons)		Growth
		2007	2016	
1	Brazil	976,364	524,920	-46.2%
2	USA	257,859	135,167	-47.6%
3	Mexico	47,539	127,177	167.5%
4	Italy	55,460	57,090	2.9%
5	Belize	26,598	40,837	53.5%
6	Netherlands	15,564	36,408	133.9%
7	Spain	47,050	21,329	-54.7%
8	Canada	16,788	11,980	-28.6%
9	Israel	7,476	11,080	48.2%
10	Greece	2,321	8,481	265.4%
11	**Pakistan**	**4,389**	**6,743**	53.6%
12	Costa Rica	4,169	5,596	34.2%
13	South Africa	4,563	3,764	-17.5%
14	Argentina	6,915	3,327	-51.9%
15	Thailand	276	3,255	1079.3%
16	Belgium	24,374	2,903	-88.1%
17	China	2,142	2,772	29.4%
18	Jordan	1,144	2,515	119.8%
19	Ghana	-	2,494	NA
20	Cyprus	2,892	2,470	-14.6%

Table 6 – Top Twenty Exporters Ten-Year Growth Rates

5.2.2 Major Importers of Frozen Concentrated Orange Juice

Orange juice is a product mainly consumed by higher income groups of the population. Naturally, the major importers of frozen orange juice concentrate are mostly the developed countries where the people have the required purchasing power to include orange juice as part of their nutritional needs. The market shares of the top ten importers in terms of export value and export quantity are respectively shown in Figure 44 and Figure 45.

USA is the largest importer of frozen orange juice. In 2016, USA imported 550,510 tons of frozen orange juice concentrate for USD 309 million. The country held a 22% share of total value and 46% of the total quantity of exports. USA market exhibited shrinkage during the last ten year period. The import value dropped by 41% from USD 2.35 billion to USD 1.4 billion while imported quantity dropped by 56% from 1.239 million tons to 0.55 million tons from 2007 to 2016.

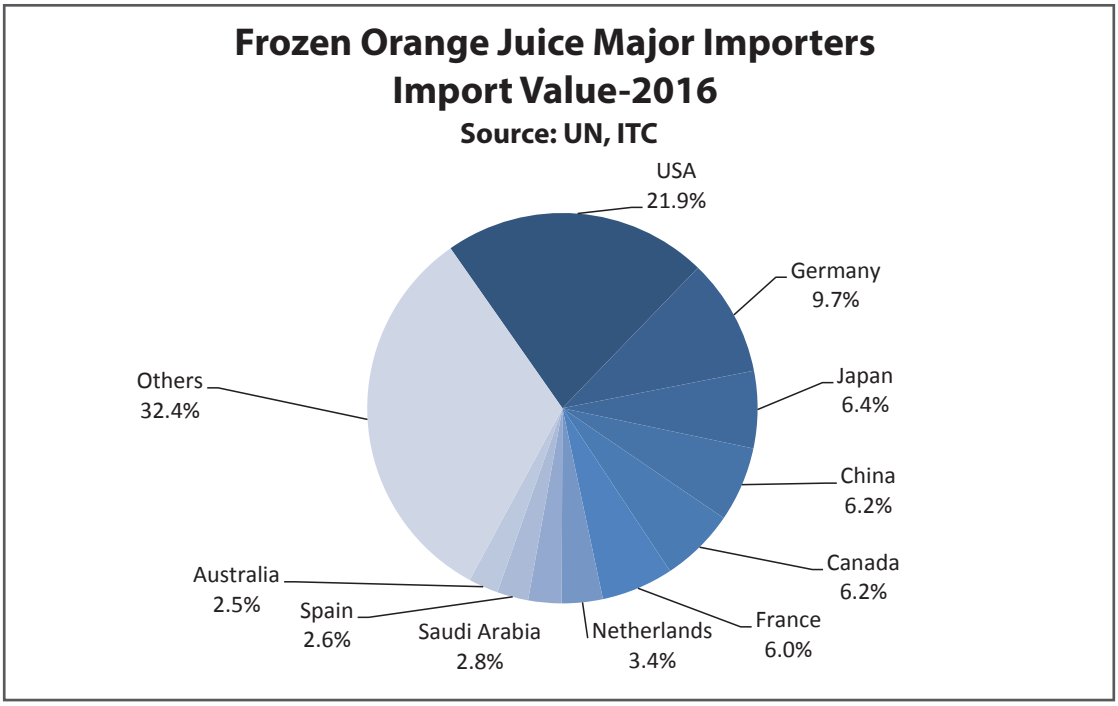


Figure 44 – Major Importers of Frozen Orange Juice (Value)

USA has a unique position in international trade of orange juice since it is included in both the major exporters and major importers of orange juice. Comparison of import and export figures of USA along with its unit price is shown in Table 7. It is seen that USA is a net importer of orange juice. There is a huge difference in price of the product imported and exported by USA. The country imports a cheaper product at a unit price of USD 561 per ton and exports a high priced product at USD 1,273 per ton.

USA Trade -2016	Imports	Exports	Net Imports
Quantity (tons)	550,510	135,167	415,343
Value (000 USD)	308,858	172,030	136,828
Unit Price	561	1,273	

Table 7 – USA Trade of Orange Juice

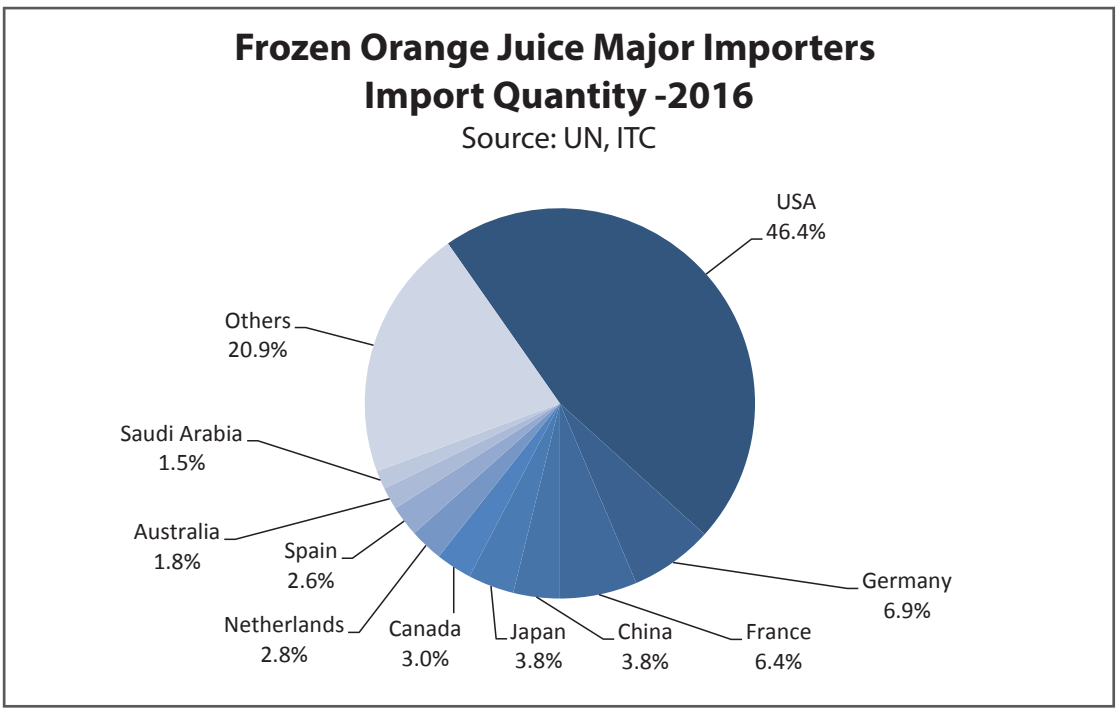


Figure 45 – Major Importers of Frozen Orange Juice (Quantity)

Germany, Japan and China respectively are the second, third and fourth largest importers of orange juice; with market shares of 9.7%, 6.4% and 6.2% respectively of the total global export value in 2016. China was the fourth largest buyer of orange juice with imports of 45,618 tons for a total value of USD 87.4 million. Other major importers included France, Netherlands, Saudi Arabia and Spain. It can be seen that all the major importing countries are strong economies where a sizeable share of population has the purchasing power to buy orange juice.

5.2.2.1 Major Importers Trends

Overall trend of the major importers of orange juice has been downward. All the top six markets shown in Figure 46 and Figure 47 dropped in both value and quantity terms during the ten year period from 2007 to 2016.

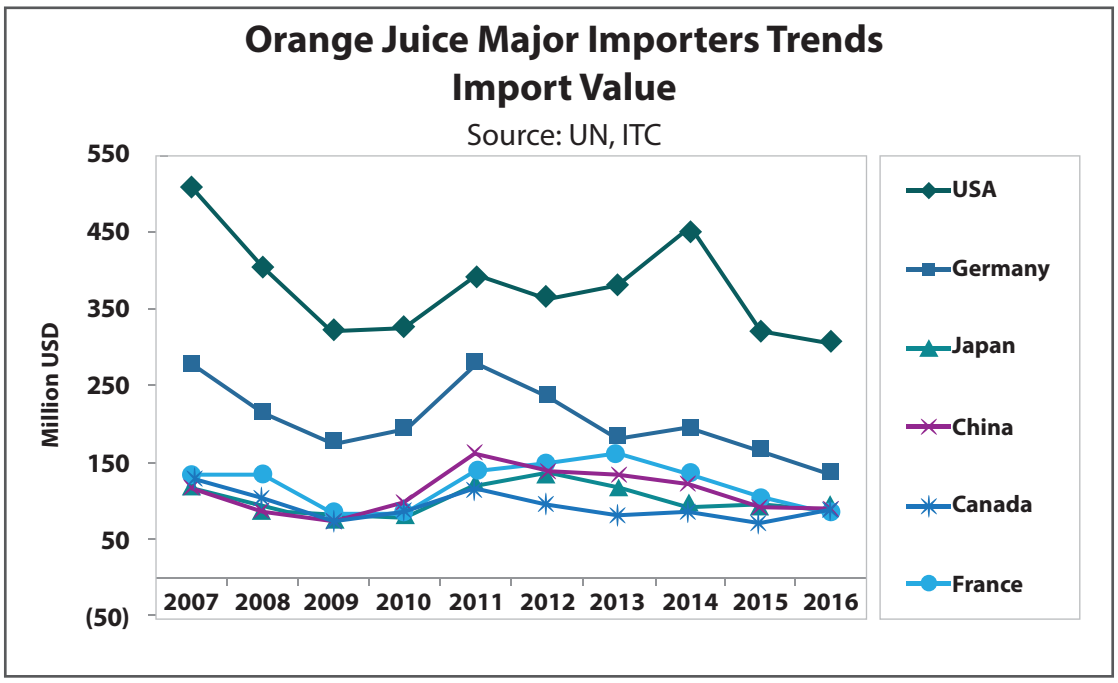


Figure 46 – Orange Juice Major Importers Trends (Value)

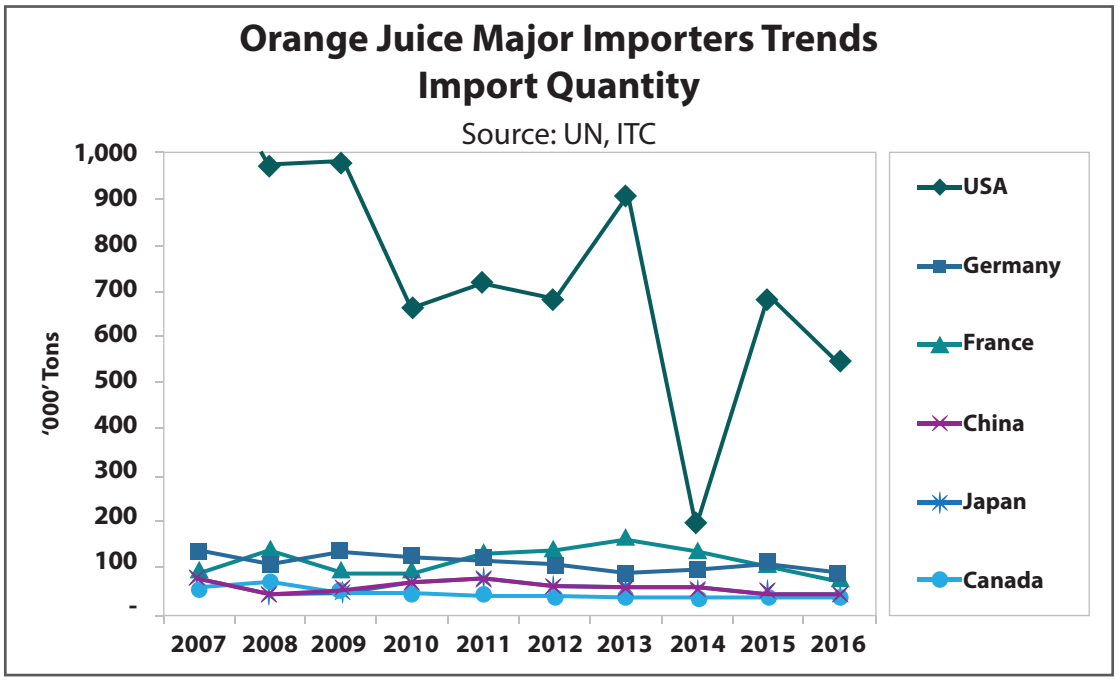


Figure 47 – Orange Juice Major Importers Trends (Quantity)

There are however some smaller markets which have shown positive growth rates during the past ten years. A comparison of the top twenty import markets of frozen concentrated orange juice is shown in Figure 48.

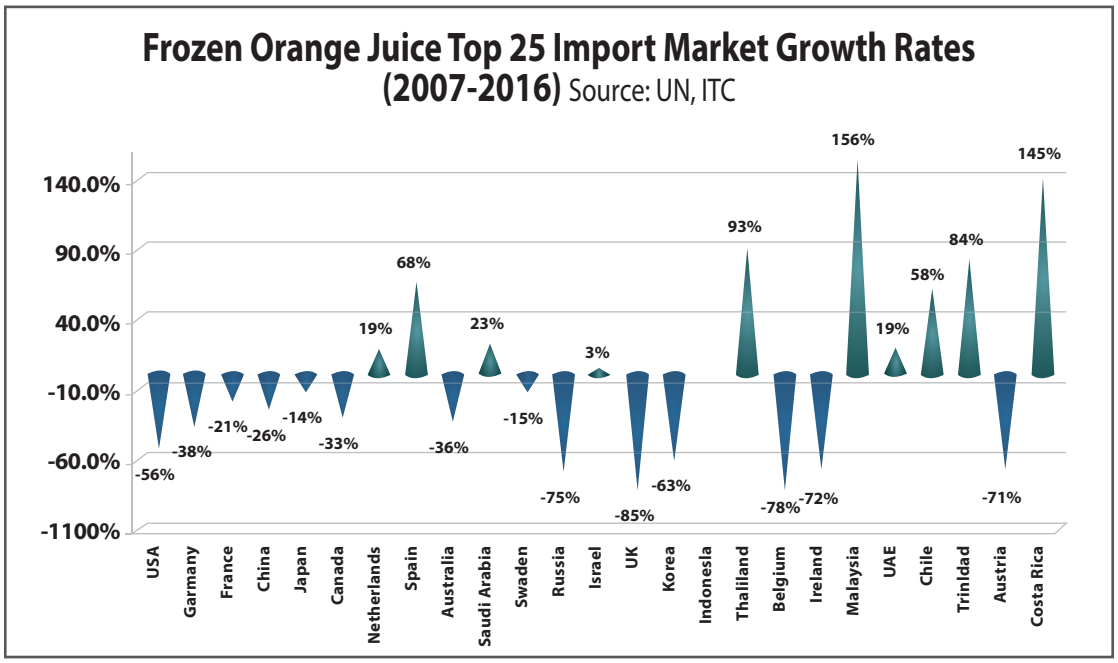


Figure 48 – Frozen Orange Juice Import Market Growth Rates Comparison

It can be seen that the six largest markets have declined in size during the last decade. However, there are other markets which though currently are smaller but they have grown at positive rates. It appears that a phenomenon of market shift is in process where the growing economies from European and Asian continents are increasing their consumption of orange juice as part of their nutritional needs.

[15]Indonesian market has also grown positively at high rate of 1241% during the past decade. Its bar was not included in the graph since the high figure distorted the whole graph.

5.2.3 Major Import Markets Analysis

5.2.3.1 United States of America

USA is the largest import market of frozen citrus concentrate. In 2016, the country imported 550,510 tons of juice concentrate worth USD 308.8 million. In value terms, USA imported 21.9% of the total global frozen orange juice world trade. The market however has been on a decline during the past decade. USA's imports in the year 2007 were USD 508 million in value terms and 1.24 million tons. During the ten year period, the imports dropped by 39% in value terms and 55% in quantity terms. However, in spite of this drop, the country still maintains its rank as the biggest importer of FCOJ.

USA market of frozen citrus concentrate is dominated by the exporting countries from the two American continents. Brazil is the biggest supplier of FCOJ to USA meeting 69% of the country's import needs and accounting for 61% of USA's import spending on this product. The second largest supplier to USA is Mexico which is its first-door neighbor. In 2016, it exported 378,113 tons of FCOJ worth USD 188 million; accounting for 31% import value and 21.7% import quantity. Mexico's imports to USA have also followed a declining trend over the ten year period; dropping by 53% in quantity terms and 22% in value terms. Average unit price of the products being imported from two countries is different. In 2016, Brazil exported FCOJ into USA at an average unit price of 498 per ton whereas the average unit price of the product exported by Mexico was USD 779 per ton.

Together, Brazil and Mexico held 90% share of the total FCOJ market of USA in 2016. Costa Rica, Canada and Belize respectively were the third, fourth and fifth largest suppliers; accounting for 2.7%, 2.7% and 1.6% of the total value of FCOJ imported into USA. Apart from these countries, there are some other countries which have increased their presence in USA market during the last few years. Two important examples in this regard are Spain and Turkey with export values of USD 0.44 million and USD 0.40 million respectively in 2016.

In spite of the fact that USA is the largest import market, Pakistan has never exported any quantity of frozen citrus juice to this market. The key reason in this regard is the large distance of USA market from Pakistan which makes it uncompetitive compared to the exporters like Brazil and Mexico which are located closer to USA. Moreover, the average unit price of Pakistani product in export market is higher than USA's average import price of FCOJ.

5.2.3.2 Germany

Germany is the second largest import market of frozen citrus concentrate. In 2016, Germany imported 81,727 tons of juice concentrate worth USD 136 million. In value terms, it imported 9.7% of the total global frozen orange juice world trade. Just like USA market, the German market has also been on a decline during the past decade. Germany's imports in the year 2007 were 132,539 tons bought for USD 278 million. During the ten year period, the imports dropped by 51% in value terms and 38% in quantity terms. However, in spite of this drop, the country managed to maintain its rank as the second largest importer of FCOJ in the world.

German market of frozen citrus concentrate is dominated by Brazil which in 2016, met 85% of the total imports needs of the country by supplying 69,144 tons worth USD 116 million. The second largest supplier to Germany in terms of export value was Mexico claiming 3.4% share of the total market. However, in terms of quantity, the second largest supplier was Spain which exported 3,196 tons to get 3.9% share of the total quantity of FCOJ exported into Germany. Compared to this, Mexico's share was 2% in quantity terms. In spite of the overall declining imports, Mexico's exports to Germany have followed a rising trend over the ten year period; increasing by 358% in quantity terms and 520% in value terms during the period from 2007 to 2016. Average unit price of the products being imported from three countries was different. In 2016, the average unit prices of FCOJ imported from Brazil, Mexico and Spain were USD 1,684, 2,812 and 867 per ton respectively.

Together, Brazil, Mexico and Spain held 90% share of the total German FCOJ market. Netherlands was the third largest importer to Germany in value terms; exporting 2,314 tons worth USD 4.3 million. Other notable countries exporting FCOJ to Germany include South Africa, Italy, Belize, Egypt and Austria. In spite of the fact that Germany is the second largest import market, Pakistan has never exported any quantity of frozen concentrated citrus juice to this market.

5.2.3.3 Japan

In 2016, Japan was the third largest import market of FCOJ with 6.4% share of global market. The country imported 45,247 tons of FCOJ worth USD 90 million. Brazil was the largest supplier in the Japanese market that exported 23,319 tons of orange juice for USD 44 million. 49% of the total import demand was met by Brazilian exports. Mexico was the second largest supplier that claimed 18% of the total imports value by exporting USD 19 million worth of orange juice for 8,351 tons. In quantity terms, Mexico was the third largest supplier of FCOJ

to Japan with 8,351 tons of exports. Brazilian exports to Japanese market declined by 49% during the period from 2007 to 2017. However, the Mexican exports to this market increased by 155% in value terms and by 187% in quantity terms during the same period. It can be seen that the Japanese market is following a trend of shifting its supplier base from Brazil to Mexico and other countries to meet its needs of frozen concentrated citrus juice.

Israel was the third largest supplier of orange juice concentrate supplying USD 13.3 million worth of this product in 2016 against a quantity of 6,869 tons. Israel was able to capture 14.9% share of value and 15.2% share of quantity of the orange juice concentrate imported into Japanese market. Israel's export growth during the decade from 2007 to 2016 was 4.4% in value terms and 15.2% in quantity terms. Other important suppliers in Japanese market were Spain, Italy and USA with market shares of 6.7%, 5.3% and 1.0% respectively. Compared to USA and Germany markets, Japanese market has lesser dependence on Brazil and Mexico since exports of these two countries only meet around 70% of the total imports of FCOJ into Japan.

Average unit price of frozen citrus concentrate imported by Japan was USD 1988 per ton in 2016. Brazil exported at less than average price of USD 1886 whereas the average price of the product exported by Mexico was USD 2303. Increasing share of more expensive Mexican product indicates that Japanese market is making a shift towards higher quality product. Unit prices of FCOJ exported by Israel, Spain and Italy were USD 1947, 1733 and 2221 per ton respectively. Highest unit price of USD 2466 was fetched by the product exported by USA. China was also a small exporter in Japanese market; exporting 72 tons of juice for USD 74,000 and fetching a unit price of USD 1028 per ton.

Pakistan was also an important supplier of frozen citrus concentrate to Japan in 2016; exporting 131 tons for USD 241,000. This translates into a higher average price of USD 1840 per ton. Looking at the historic trends, it is seen that Pakistan used to be a regular exporter to Japanese market till the year 2005; after which there were no exports for many years. Exports revived in 2016 when Pakistan once again managed to supply this product to the more quality conscious market of Japan.

5.2.3.4 China

China is the fourth largest global importer of frozen citrus juice concentrate. In 2016, it imported 45,618 tons of FCOJ for USD 87 million; accounting for 6.2% of the total value and 3.8% of total quantity of imports. Chinese import market dropped by 26% during the decade from 2007 to 2016. Brazil was the largest supplier to China that met 77% of the country's needs by exporting 35,312 tons worth USD 687 million. Israel was the second largest exporter that sold 9,067 tons of orange juice to China to claim 20% market share. The value of FCOJ exported by Israel to China was USD 16.5 million. The third largest supplier was Netherlands that exported 683 tons to get 1.5% market share.

Other suppliers of FCOJ to China were Hong Kong, Spain and Mexico that respectively claimed 0.5%, 0.3% and 0.1% shares of the import market in 2016. It appears that China is reducing its reliance on traditional suppliers of FCOJ and moving towards newer suppliers. Hong Kong, Spain and Taipei Chinese are notable in this regard which have exhibited positive growth rates in this market. The exports of Hong Kong to China increased from USD 0.042 million to USD 0.48 million in ten year period. Similarly, two other new players are Pakistan and Turkey which started exporting to China from the year 2015. In 2016, Turkey exported 24 tons of orange juice for USD 43,000 and Pakistan exported 25 tons of juice for USD 37,000.

Average unit price of FCOJ exported into Chinese market was USD 1916 per ton. The price was different for the different exporters. Netherlands was able to fetch the highest price of USD 2609 per ton; followed by USD 2118 by Mexico. The largest supplier Brazil sold the product at an average price of USD 1929 per ton and Israel at USD 1825. Pakistan operated in the lower price range and was able to get USD 1480 per ton of FCOJ sold. However, it was not the lowest price since Taipei Chinese sold its product at a very low of USD 864.

5.2.3.5 Indonesia

Indonesia is relatively a newer importer in the FCOJ market. The country is included among those few which have increased their imports of orange juice over the past decade. The Indonesian import market increased from 781 tons in 2007 to 10,473 tons in 2016 which is an increase of 1241%. In value terms, the imports increased from USD 1.6 million to USD 16.5 million during the same period. In fact, Indonesia is the only market that has grown consistently every year during the last decade. Indonesia's share of total import market increased from 0.07% in 2007 to 1.2% in 2016. In this regard, it was deemed important to have a look at the dynamics of this growing market.

Brazil was the largest supplier of FCOJ to Indonesia meeting 70% of the country's needs. Brazilian exports increased from 372 tons in 2007 to 7,292 tons in 2016; an increase of around twenty times. Surprisingly, the second largest exporter to Indonesia was Switzerland which is not seen as a notable supplier of frozen citrus juice. Other important exporters into Indonesian market are USA, China, Spain and Netherlands with respective market shares of 7.3%, 3.3%, 2.1% and 1.0%. Pakistan does not have any presence in Indonesian import market of FCOJ.

5.2.3.6 Saudi Arabia

Saudi Arabia is another growing market of frozen concentrated citrus juice; accounting for a share of 2.8% of the global value of exports. Overall growth in Saudi Arabian imports from 2007 to 2016 was 23% in quantity terms and 3% in value terms. In 2016, the country imported 18,197 tons of FCOJ for USD 39 million. Brazil, Netherlands and USA respectively were the first, second and third largest exporters of FCOJ to Saudi Arabia; catering to 60%, 19% and 13% import needs of the country. Over the ten year period from 2007 to 2016, the exports of Brazil and Netherlands grew by 41% and 40% respectively. However, the exports of USA to this market decreased by 27% during the same period. Other important exporters to Saudi Arabian market included Greece, Spain, Italy and Thailand. Pakistan has not been a regular exporter to Saudi Arabia. It was only in 2010 that Pakistan exported 82 tons of FCOJ to this market for USD 95,000.

5.2.3.7 Netherlands

Netherlands is the seventh largest import market of FCOJ. In 2016, the country imported 32,754 tons of juice worth USD 48 million. During the last decade, the market grew by 19% in quantity terms whereas in terms of value, there was no change during this period. Netherlands is a unique market since it is an important import as well as export destination for FCOJ. A significant share of the FCOJ imported by Netherlands is re-exported. That is the reason that the country is the sixth largest exporter with exports of 36,408 tons of FCOJ sold for USD 65 million. That shows that Netherlands is a net exporter of frozen concentrated citrus juice.

Unlike other major importers, Brazil is not the largest supplier of FCOJ in Netherlands market. Italy takes the lead in this regard and was the largest exporter to Netherlands with exports of 11,323 tons worth USD 9.8 million. Mexico was the largest supplier in value terms with exports of USD 20 million against a quantity of 10,000 tons. Belgium, Brazil and Turkey were the other important importers of FCOJ in Netherlands market.

Netherlands is the biggest destination of frozen citrus juice concentrate exported by Pakistan. In 2016, Pakistan exported 4,003 tons of this product for USD 6.45 million; at a unit price of USD 1613 per ton.

Average Unit Price Analysis

Average unit price of frozen orange juice has been oscillating during the past decade; however the overall trend has been in upward direction. Average unit export price per ton was USD 1478 in 2007 that suffered continuous decline for two years to reach USD 1163 in 2009. This phase was followed by a continuous rise in price during the next three years to reach USD 1591. This was followed by another period of price fall which continued for the next three years and the average price became USD 1463. In 2016, the next rising trend started and the price reached USD 1639. Looking at the previous trends, it can be expected that this phase of price increase will continue for the next three to four years.

The ten-year trend shows that every peak in the graph has been higher than the previous peak. Thus it can be expected that the overall trend in three to four year scenario will be positive. Average unit price trend is shown in Figure 49.

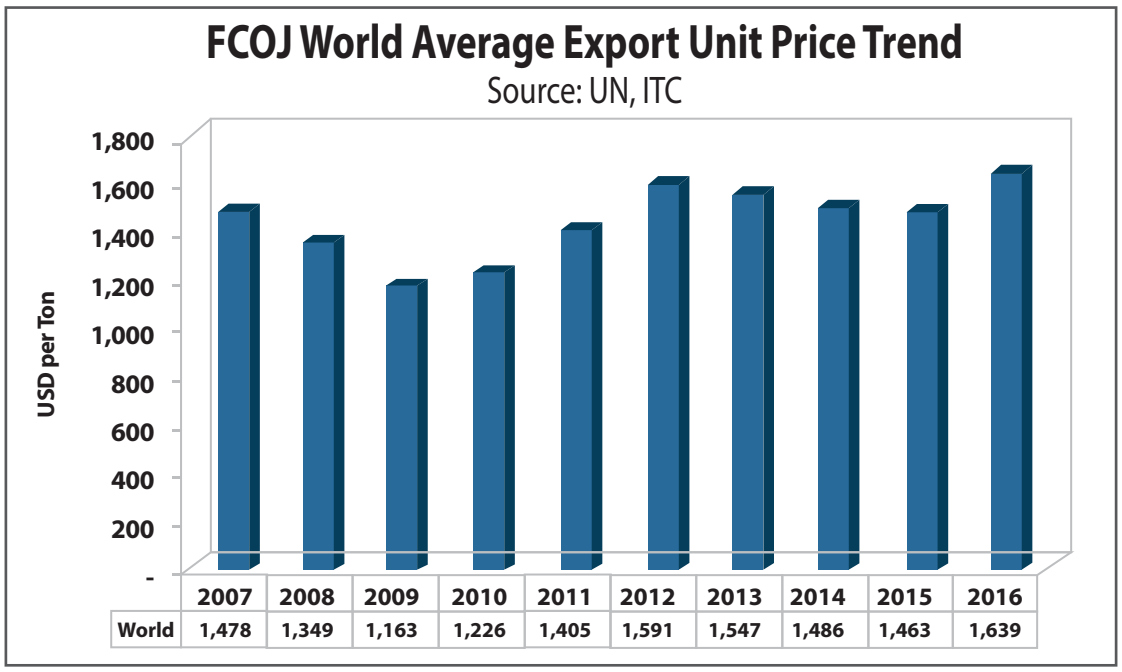


Figure 49 – FCOJ Global Average Export Price Trend

5.2.4.1 Average Unit Prices of Major Exporters

Comparing the average unit price of leading exporters of FCOJ in 2016, it is seen that Mexico was able to fetch the highest average unit price in the international market. Mexico's unit price was USD 2380 per ton that was 45% higher than the world average price of USD 1639. Netherlands was also among the countries that claimed a higher price for their exports. Most of the juice supplied by Netherlands is through re-exports since the country is not a major producer of orange juice concentrate. The average unit price of Brazilian exports closely matched with that of the world's average since Brazil accounted for about half of the total global exports. The unit prices of FCOJ exported by USA, Belize and Italy fell in the lower range of less than USD 1300 per ton. Comparison of average unit prices is shown in Figure 50.

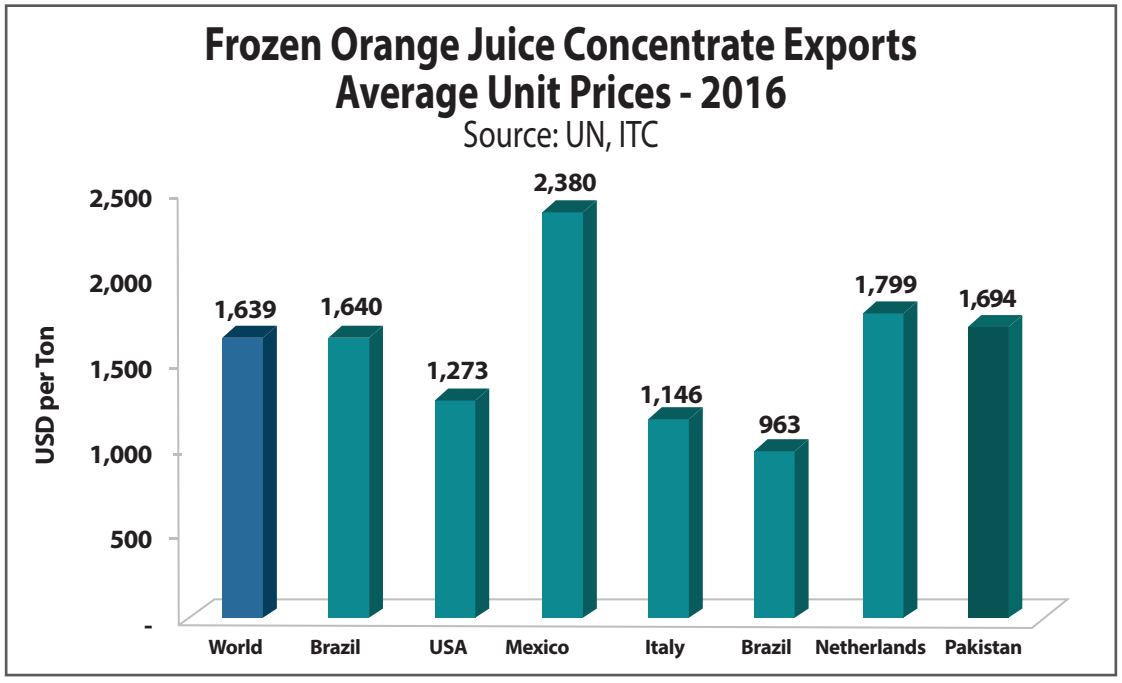
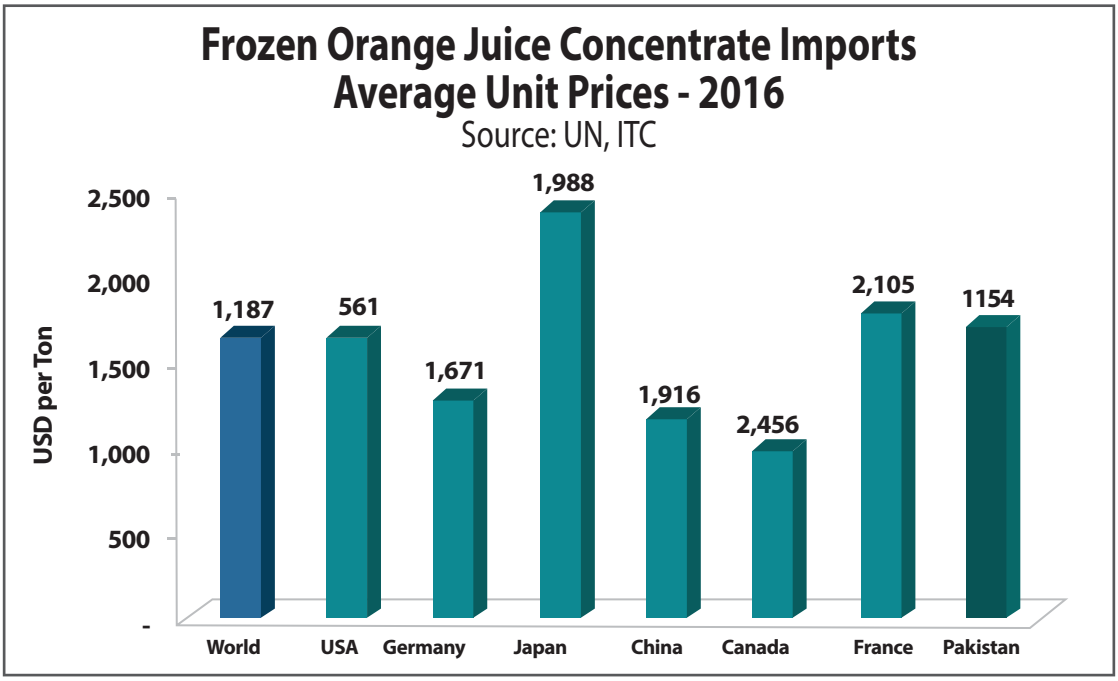


Figure 50 – FCOJ Average Unit Price Comparison of Leading Exporters

Pakistan was able to fetch a unit price higher than the world average. In 2016, the country managed to sell its frozen citrus juice concentrate (produced from Kinnow) at a unit price of USD 1694 per ton that was 3% higher than the world average price. Higher price realization is an indicator of the quality strength of the Pakistani product in the international markets. There is potential for Pakistan to further build upon this strength and increase its presence in the international FCOJ/FCKJ market.

5.2.4.2 Average Unit Prices of Major Importers

Average unit price of FCOJ traded across the world also varies with the import markets. Figure 51 shows that comparison of unit prices realized in leading global import markets of FCOJ. Average global import price was reported as USD 1187 per ton. Canada was identified as the most expensive market where the product was sold for USD 2456, a price that was 107% higher than the global average. Japan and China were the two other larger markets that imported FOCJ in a higher price range. USA was the largest importer of frozen orange juice that imported about half of the total quantity traded around the world. However, the unit price of the product bought by USA was only USD 561 per ton; the lowest in the world. Pakistan imported small quantity of FCOJ in 2016 at a price of USD 1154, close to that of the world average price.



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6.0 LOCAL MARKET ANALYSIS

Pakistan has a large fruit juice processing sector to cater to the needs of the large population of 210 million people. Fruit processing and juice manufacturing industry of Pakistan has a long history. With the passage of time, the industry has exhibited an exponential growth and has managed to develop a diverse product portfolio of the ready-to-drink fruit juices and drinks; in line with the growing market demand. The growth has been fuelled by the rising health consciousness among the urban population. There has been a shift in demand away from carbonated cola drinks and increased customer focus on fruit based beverages. Increased quality awareness among consumers has also been a factor making the companies move towards better product development in diverse flavors. Other factors have been the population growth, increased disposable incomes of middle to high income families and increased penetration in newer smaller markets in peri-urban and rural areas.

The fruit processing sector is the supplier of pulps, purees and concentrates for the local juice manufacturing sector. Frozen concentrated citrus juice thus also has a local market. The demand of FCKJ by the local industry is derived from the consumption of fruit juices and drinks by the local population. It is therefore important to evaluate the growth of this sector to understand the market demand for pulps, purees and concentrates.

The market for fruit juices is a part of the cold beverage market which includes different product categories and sub-categories. Major product classification is shown in Figure 52.

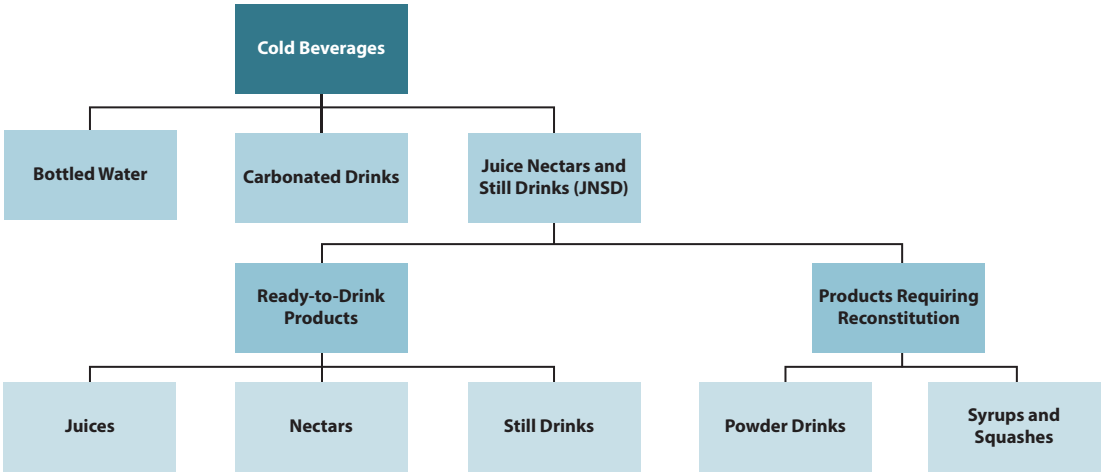


Figure 52 – Cold Beverage Market Product Classification

Pulps, purees and concentrates are the basic raw materials to manufacture ready-to-drink juices, nectars and still drinks (JNSD). The three types of products differ with respect to the percentage of fruit pulp. Pure juice is the 100% juice with nothing added or removed. These may be straight juice or obtained after reconstituting concentrates, pulps, purees with water and other ingredients. Nectars are the processed juice products having 20-50% fruit content with added water, sugar and other ingredients. Still drinks are the processed juice drinks with 8-10% fruit juice pulp, added water, sugar and other ingredients so that they closely mimic fruit juice.

6.1.1 Major Brands in Local Juice Market

There are a large number of players in the local market manufacturing different JNSD products. However, the larger players, selling popular brands, are not many. These popular brands are large established companies selling their products mostly in larger urban markets. Along with these, there are a large number of smaller players which sell their products in the markets of smaller cities and towns. The brand names of such juice products are usually not well known and their products are characterized by lower quality and lower price. The consumers in smaller markets have lower awareness and concern about hygiene and quality and they are not brand conscious. Introduction to the four major fruit juice/nectars/drinks manufacturers and their brands sold in the local market is provided below:

6.1.1.1 Nestle Pakistan

Nestle Pakistan is the largest manufacturer of fruit-based beverage products in the local market with around 50% market share. The company has products in all the three categories of fruit juices, nectars and still drinks. The pure juices and nectars are marketed under the brand name of 'Fruita Vital' and the fruit drinks are marketed under the brand name of 'Nesfruita'. Product lines under the two categories are shown in Figure 53 and Figure 54.

Figure 53 - Nestlé's Juice and Nectar Products

Figure 54 - Nestlé's Still Drink Products

6.1.1.2 Shezan International

Shezan International is the other large player in fruit-based beverages in the local market.

Just like Nestle, Shezan has a strong presence in all the three product categories of juices, nectars and still drinks. Pure juices and nectars are marketed under the brand name of 'All Pure' and still drinks under the brand names of 'Twist'. Some drinks are also marketed with the name of fruits; such as mango drink, apple drink, etc. Products under the juice & nectars and still drink categories are shown in Figure 55 and Figure 56.

Figure 55 - Shezan Pure Juice and Nectar Products

Figure 56 - Shezan Still Drinks Products

6.1.1.3 CitroPak

CitroPak is a major fruit processor with a presence in consumer fruit juice products with the name 'Fruitien'. . Fruitien is a new brand that was launched only a few years ago and within small time, it has been able to gain respectable share of the local juice and nectars market. CitroPak has presence only in high value added product categories of pure juices and nectars. Product line of 'Fruitien' is shown in Figure 57.

Figure 57 - CitroPak (Fruitien) Juice and Nectar Products

6.1.1.4 Shakarganj Foods

Shakarganj Foods is also in the business of fruit processing and has a product line of consumer fruit-based beverages also. The company markets its pure juices and nectars under the brand name 'Anytime' and the still drinks under the brand name 'Refresh' There is a separate product line with the name 'Mango Tango' under which mango drinks made from different varieties of mango have been launched. Product Lines of Shakarganj Foods are shown in Figure 58 and Figure 59.

Figure 58 – Shakarganj Foods (Anytime) Juice and Nectar Products

Figure 59 – Shakarganj Foods Still Drinks Products

6.1.1.5 Fruit Drinks Manufacturers

In addition to these large players, there are numerous smaller companies which only operate in the lower market tier of fruit drinks. Some important brands in this category selling in Punjab markets are 'Country' and 'Maza'. In the southern market of Karachi, Frooto and Polly are two known brands of fruit drinks. Slice is a fruit drink launched in the local market by PepsiCo. Recently, a large group has launched a new fruit drink brand with the name 'Must' in the local market. In addition to these known names, there are many small brands selling locally in smaller markets throughout the country. Figure 60 shows some popular brands of fruit drinks.

Figure 60 – Popular Fruit Drinks Brands

6.1.1.6 Imported Juices

Major share of the local fruit juice market is captured by the locally manufactured brands. However, there is a presence of imported products as well. International brands like Malee, Rani, Tropicana, Minute Maid and many others are available in the local market. These brands are generally sold at higher prices than the local brands. The availability of imported brands is usually limited to larger stores. The share of imported juices in the local market is less than 10%.

6.1.2 Citrus Fruit Juice

Fruit juices are made from different fruits in large variety of flavors. Globally, orange juice is the most popular fruit juice in the world accounting for around one third of the total fruit juice market; followed by apple, mixed fruit and grape. The situation however is different in the local market. Mango juice remains as the most popular fruit juice in the local market. Around 50% share of the local JNSD market is claimed by mango-based products. This dominance of mango flavor holds in both nectar and drinks categories. It is followed by apple and grapes nectars. Other juice flavors including guava, peach, pineapple, pomegranates and mixed fruits have smaller shares compared to these three leading flavors.

Citrus fruit juices represent an important category in the local JNSD market; ranking as the fourth largest flavor in terms of the total volumes of pure juices and nectars sold in the local market. Estimated share of citrus fruit juice of the total juice and nectars is around 10%. The Pakistani market is different from other markets since it offers two types of flavors in citrus-based juices; Orange and Kinnow. Orange juice is produced in smaller volumes and the recipe uses imported orange juice concentrate; along with the local Kinnow juice concentrate. The orange juice produced locally by the largest player Nestle is not sold on general retail outlets. Its sales are limited to hotels and major store chains. Kinnow is the main citrus-based juice that is sold in larger quantities in the local market. The recipe of Kinnow juice contains the locally produced FCKJ as its main ingredient. Other major players in the country producing pure orange juice include Fruitien, Shezan International and Shakarganj Foods.

The four major Orange/Kinnow juice producers are the major consumers of FCKJ in the local market. Of these, 'Fruitien' brand juice is produced by CitroPak which itself is the largest producer of FCKJ in the country. Therefore, it meets its requirements from its own manufacturing facility. Similarly, Shakarganj Foods has its own FCKJ manufacturing facility and it sources the required supplies from there. Nestle and Shezan, the two largest players in the local fruit juice market, do not have their own FCKJ manufacturing facilities and thus they have to buy the required citrus juice concentrate from the local FCKJ manufacturers. Along with these pure Orange/Kinnow juices, FCKJ is also an important ingredient in citrus-based fruit drinks. However, the consumption of citrus juice concentrate for fruit drink is not high because it contains sugar as its major ingredient. Moreover, orange drink is a very popular product and is thus not produced by all the manufacturers.

6.1.3 Local JNSD Market Size

Local JNSD market has grown at a high rate during the past decade. Increasing disposable incomes of middle to high income families have driven the market growth. Increasing heath consciousness and aggressive marketing by the juice companies have also played a key role in developing this market. As per a previous report by Tetrapak, in 2009, the total JNSD market in Pakistan was 461 million liters (Tetrapak juices). The share of bottled juice in the total juice market was around 13%. This made the total market size as around 527 million liters. Market growth in 2009 was estimated to be 16% per annum. Using this growth rate, Pakistan's JNSD market in 2018 can be estimated at around 2 billion liters.

Using another source, a similar result is obtained. As per a newspaper article of September 2017, the total size of Pakistani beverage market was 44 billion liters. JNSD was quoted to hold 4% share of this market which makes the total market size as 1.76 billion liters. Using a growth rate of 16%, JNSD the market size in 2018 would be 2.0 billion liters.Juice and nectars market is around 10% of the total JNSD market. This means that around 0.2 billion or 200 million liters of juice and nectars would be sold in Pakistan in 2018.

[17]www.businesswire.com

[18]Potential for Processing Afghanistan Pomegranates – A Study of Pakistani Market for Pomegranates, International Finance Corporation, Tanveer-ul-Islam & Sohail Moghal, 2009

[19]https://aurora.dawn.com/news/1142372

7.0 PAKISTAN FCKJ SCENE

Pakistan is a large producer of diverse variety of fruits and vegetables. Large horticultural production, growing at high rates, provides a strong raw material base for the processing sector. Pakistan's fruits and vegetables processing sector dates back to past three decades. During this period, the sector has not only been successful in meeting the local needs for processed foods but has also established a visible presence in the international markets by exporting variety of value added products to different parts of the world. FCKJ manufacturing was started in Pakistan in late 1980s and since then, the industry has been performing successfully to meet the growing demand of the product in local and international markets.

7.1 Pakistan's FCKJ International Trade

In 2016, Pakistan's total exports of fruits and vegetable juice products were 15,374 tons that earned USD 21.8 million of foreign exchange for the country. The export product line included variety of products derived from different fruits and vegetables. Figure 61 and Figure 62 respectively show the split of Pakistan's total export value and quantity of fruits and vegetables juices.

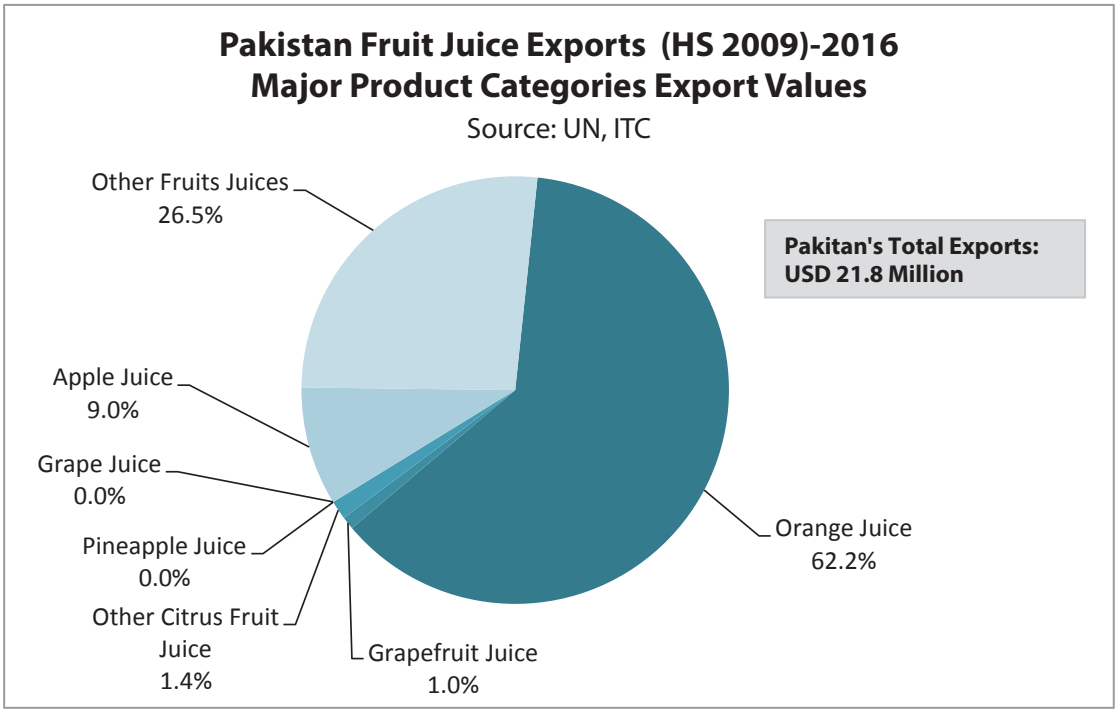


Figure 61 - Pakistan's Fruit Juice Export Categories (Value)

Orange juice was the largest export product that accounted for 62% of the total value and 57% of the total quantity of exports under this category. Apple was the second largest export item with 9.0% share in total export value and 9.7% in total export quantity. 30% share of exports was provided by juices of other fruits (fruit with smaller production that are not included in the main fruit categories). Orange and apple constitute the major share of Pakistan's exports of fruits and vegetables since the country is a major producer of these two fruits and surplus supplies of fruits are available that are used by the processing sector to produce these value added products.

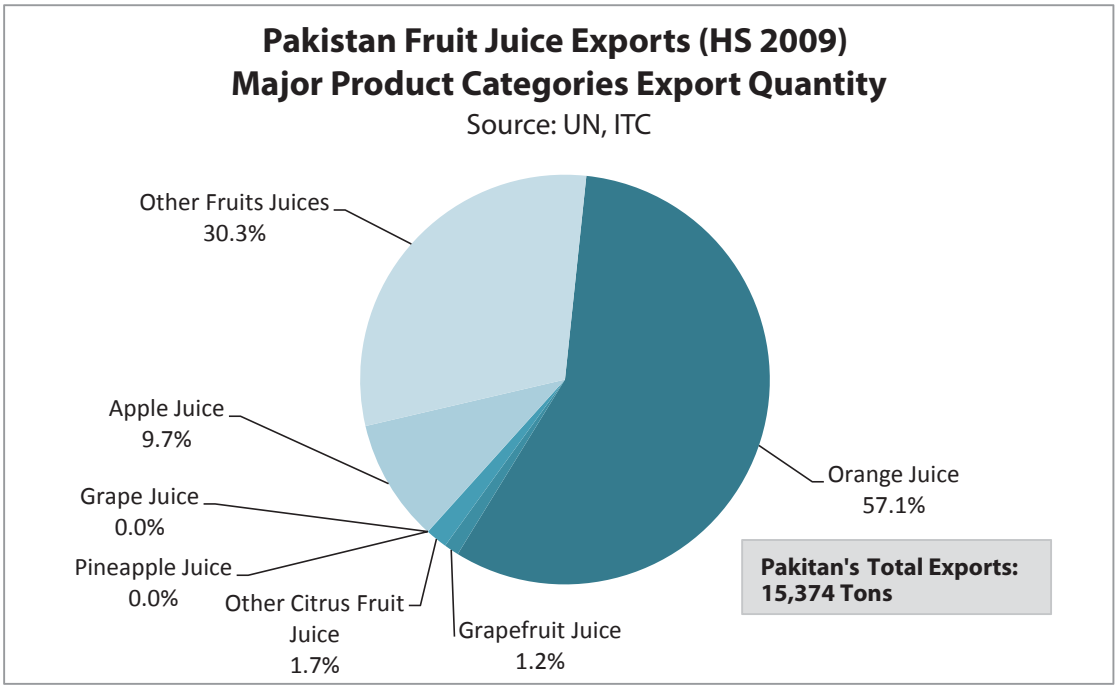


Figure 62 - Pakistan's Fruit Juice Export Categories (Quantity)

Pakistan's exports of juices of the fruits like grapefruit, pineapple and grapes are smaller since there is not enough production of these fruits in the country. Globally, pineapple juice accounted for 6.3% of the total export market, but in Pakistan's export profile it was less than 0.1%. Similarly, grape juice was 4.5% of the global market, but in case of Pakistan, it was negligible. Tomato juice was also part of the global export profile, but Pakistan did not have any exports of tomato juice.

Looking further into the orange juice category, it is seen that the major share in its exports is contributed by frozen concentrated orange juice. In quantity terms, frozen citrus concentrate (HS 200911) accounted for 84% and in quantity terms, it accounted for 77% of the total exports in this category. Figure 63 shows the shares. The balance exports were done under the 'Other' orange juice category (HS 200919). Pakistan did not have any exports under the third category of orange juice represented by HS 200912 (orange juice not frozen, of a brix value not exceeding 20); though globally, this was the biggest export category, accounting for 60% share of export quantity and 37% share of export value.

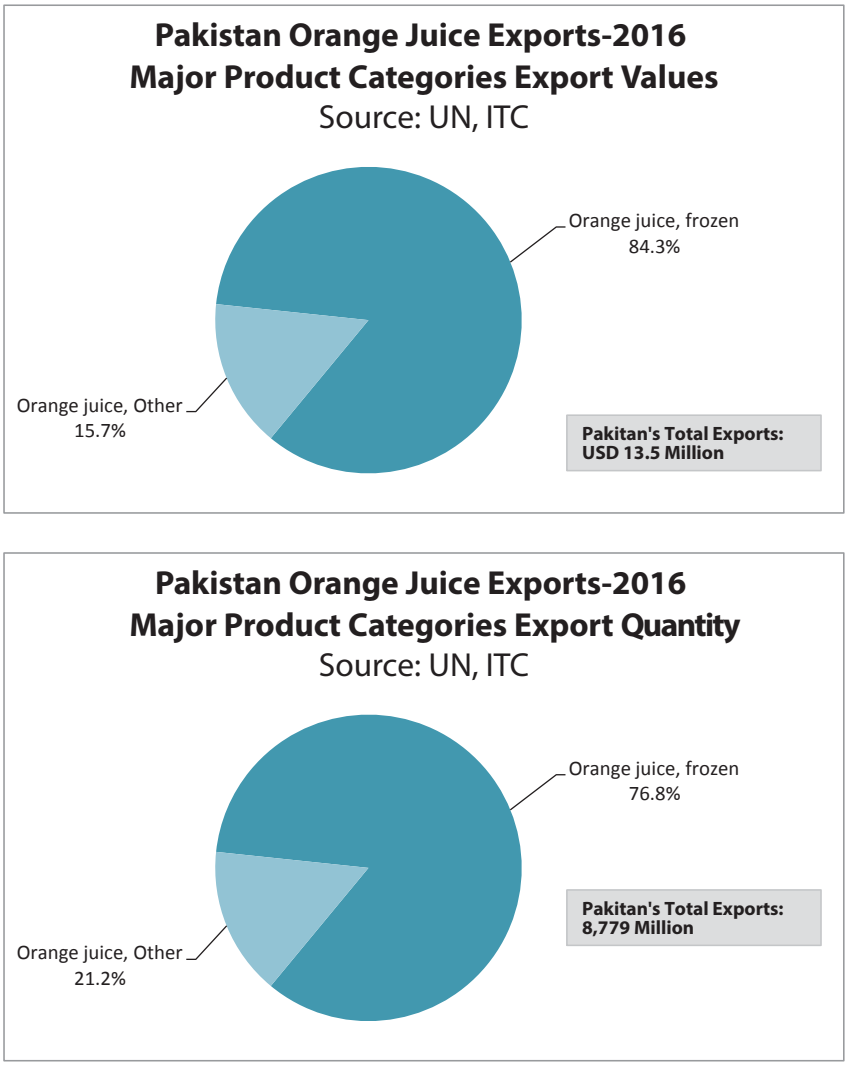


Figure 63 - Pakistan's Orange Juice Export Categories

7.1.1 Pakistan's Trade of Frozen Citrus Juice Concentrate

Pakistan has been active in international market of frozen concentrated citrus juice since early nineties when the first processing facility was established in the citrus growing hub in Sargodha. The country established its recognition as an important exporter of Frozen Concentrated Kinnow Juice (FCKJ). However, the momentum gained initially was disrupted due to management crises in the processing companies and the exports of FCKJ by Pakistan were discontinued by the end of 1990s. It was in 2003 when Pakistan reentered the international market and FCKJ exports were revived. Since 2003, Pakistani exports of frozen citrus juice concentrate have been on a rise during the past fourteen years. Export trends in terms of value and quantity are shown in Figure 64 and Figure 65.

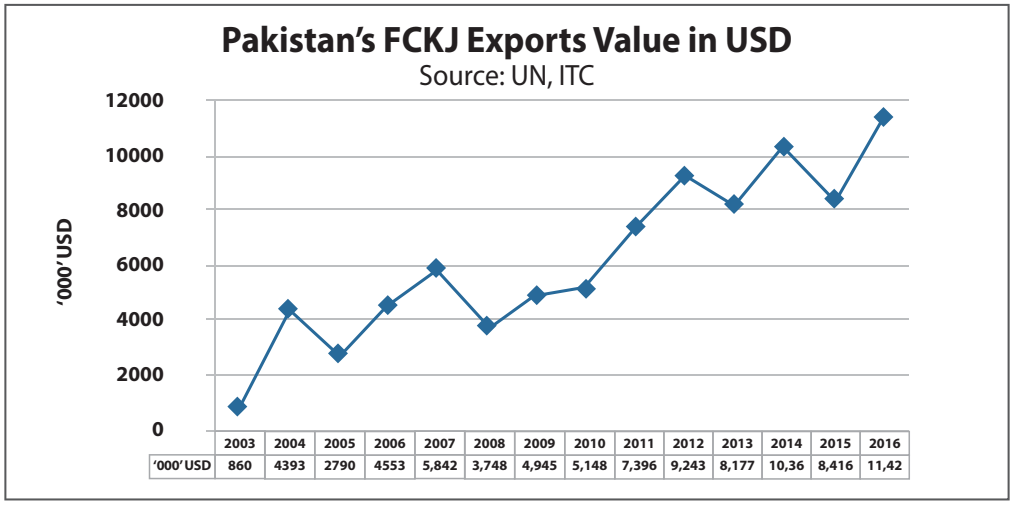


Figure 64 – Pakistan's FCKJ Exports Trend (Value)

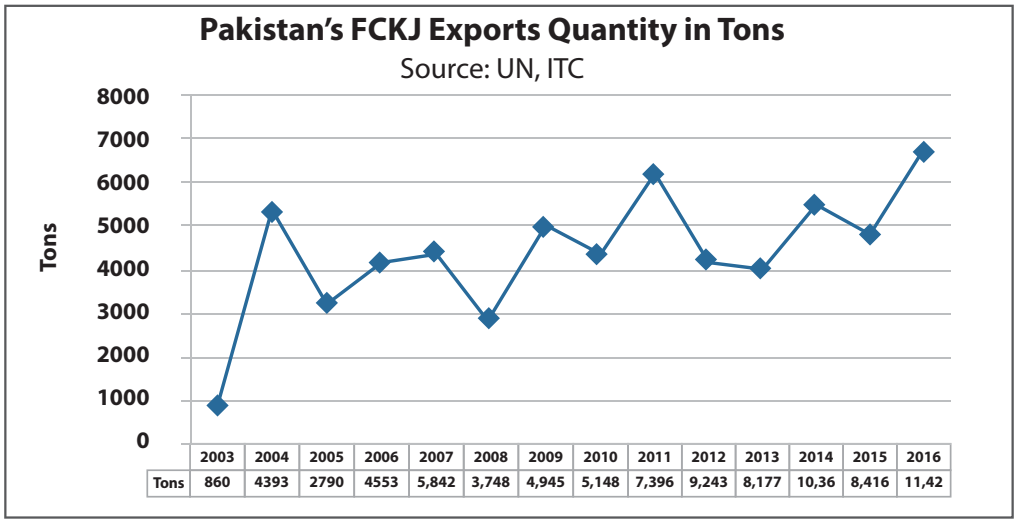


Figure 65 – Pakistan's FCKJ Exports Trend (Quantity)

During the period from 2003 to 2016, Pakistani exports grew by 629% in terms of quantity and 1228% in terms of value. The trend is a clear indicator of the potential of Pakistani FCKJ to penetrate into the world market. Although, the world export market has been on a decline, Pakistan has still been able to increase its exports in that market. Not only the exports volumes have increased but there has been a continuous increase in the average unit price of the Pakistani FCKJ over the years. A higher percentage increase in export value compared to that in export quantity is an indicator of this trend.

7.1.2 Pakistan's Average Export Unit Price of FCKJ

It is seen that there was a continuous increase in unit price from 2004 to 2007. During these four years, the price increased by 61%. Following this, there was a two year period in which per ton price dropped to USD 998 but again increased to USD 1192 in the next two years. The year 2012 saw a major jump in average price of FCKJ exports from Pakistan when it touched the peak of USD 2185. Along with the increase in global price of the product, the other factor for this change was a change in export market mix. In 2011, Pakistan was selling its 37% juice to India which is a low-priced market and offered an average price of only USD 1098 per ton. In 2012, there was a shift in market mix and Pakistani exports to India decreased from 2501 tons to 732 tons; a huge drop of 43%. This was however compensated well by increased exports to higher priced markets from Europe and Asia. Share of Pakistani exports to Netherlands increased from 17% to 20%, that to UAE increased from 4.9% to 8% and that to Thailand increased from 6.5% to 8.0%. Average unit prices in these three markets in 2012 respectively were USD 1352, 1475 and 1122. This shift in market led to a huge increase in average unit price from the year 2011 to 2012. Figure 66 shows the fourteen year trend of average unit price of Pakistan's FCKJ exports.

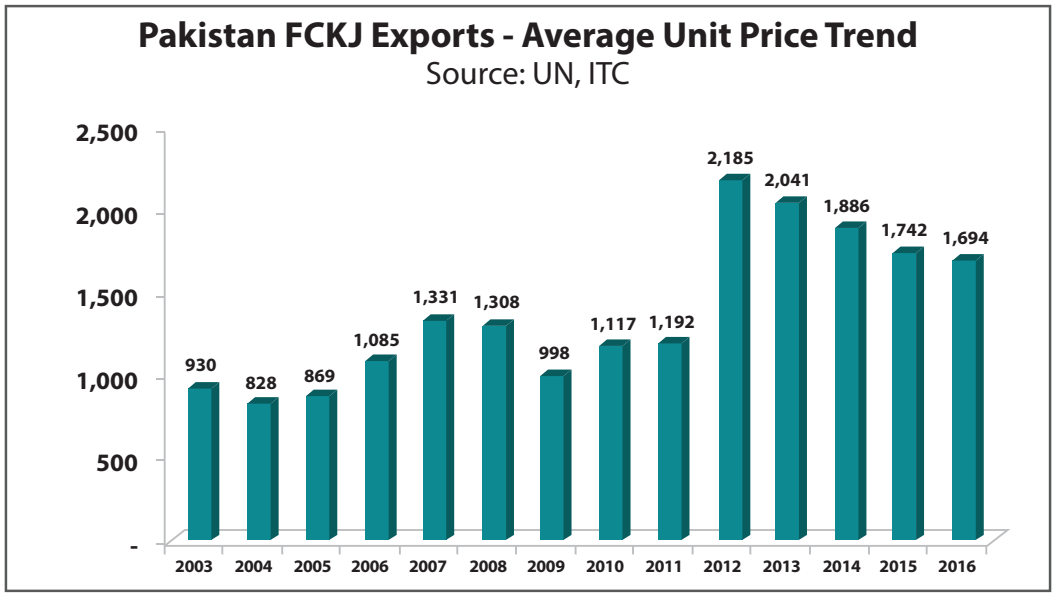
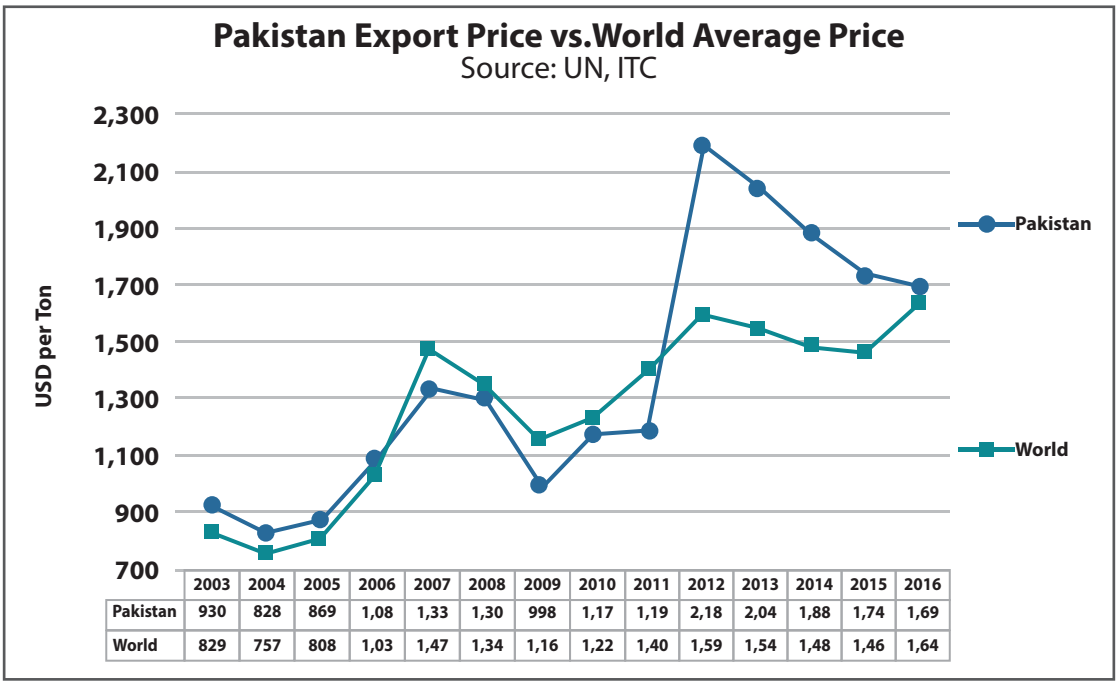


Figure 66 – Pakistan FCKJ Exports – Average Unit Price Trend

Since the year 2012, the average unit price of Pakistani FCKJ has been on a decline. The key reason for this was the overall fall of prices in the global FCOJ market. It is important to remember that Pakistan is a small player in the international markets. Therefore, it cannot assume the role of a price-maker. It is bound to remain in the position of a price-taker. However, the good point is that even in this declining period, the average unit price realized by Pakistani exporters has been higher than the world average price. This shows the strength of the Pakistani product in the international markets. The uniqueness of the juice being prepared from Kinnow instead of orange creates that competitive advantage for the Pakistani exporters.

Figure 67 shows a comparison of average unit price of Pakistan's FCKJ exports with that of the global average. It can be seen that that the average unit price of Pakistani exports of FCKJ have been higher than the world average during most of the years. There were only the years from 2007 to 2001 when the Pakistani unit price was lower than the world average price. These were the same years when India was a major destination of Pakistani FCKJ and the lower unit price realization in Indian market was the main reason for reducing the overall average price of Pakistani exports.

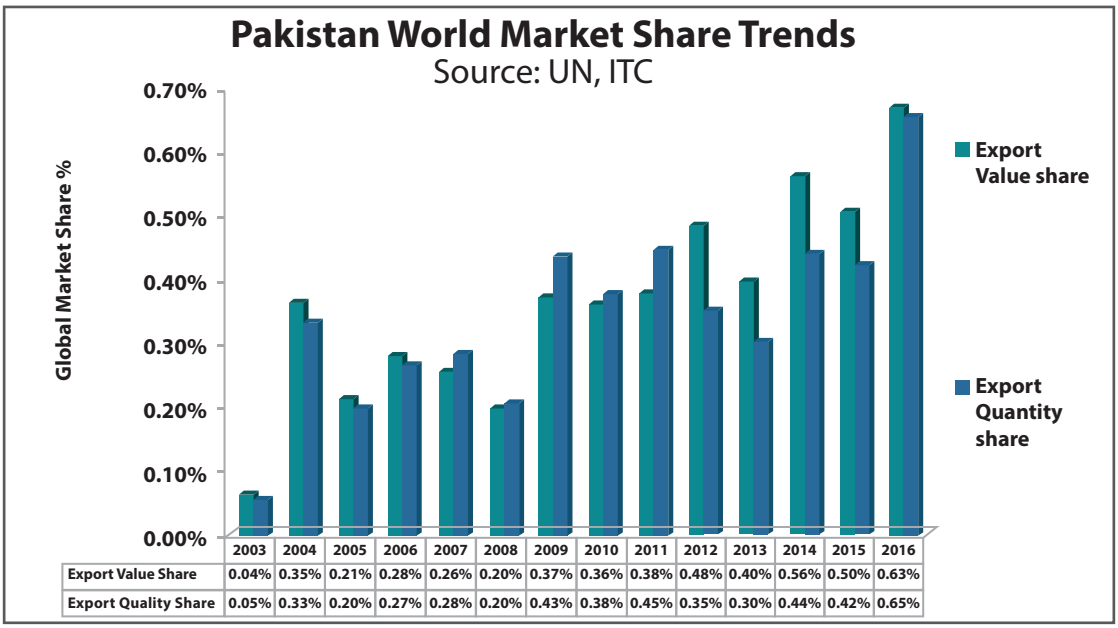


	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Pakistan	930	828	869	1,08	1,33	1,30	998	1,17	1,19	2,18	2,04	1,88	1,74	1,69
World	829	757	808	1,03	1,47	1,34	1,16	1,22	1,40	1,59	1,54	1,48	1,46	1,64

Figure 67 – Pakistan Export Price vs. World Average Price

7.1.3 Pakistan's Global Market Share

Pakistan's exports of frozen concentrated citrus juice have been on a continuous rise during the past fourteen years. Pakistan restarted its exports in 2003 and managed to get 0.06% share of the world market during that year. Since then, the market share has been increasing and in 2016, Pakistan had 0.67% share of the value and 0.65% share of the quantity of global exports of frozen citrus juice concentrate. Higher share in value terms indicates that Pakistani product has been able to fetch a price higher than the world average. Value share was lower than that of quantity share in 2009 and 2011. These were the same years when major share of Pakistani exports were going to lower priced Indian market. Market shares trends are shown in Figure 68.



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Export Value Share	0.04%	0.35%	0.21%	0.28%	0.26%	0.20%	0.37%	0.36%	0.38%	0.48%	0.40%	0.56%	0.50%	0.63%
Export Quality Share	0.05%	0.33%	0.20%	0.27%	0.28%	0.20%	0.43%	0.38%	0.45%	0.35%	0.30%	0.44%	0.42%	0.65%

Figure 68 – Pakistan's Market Share of Global Exports of FCOJ

Increasing market share shows the acceptability of Pakistani product in the international markets. It also shows that the country has not touched its fullest potential in this regard. With concerted marketing efforts, the country can further increase its presence in export market of frozen citrus concentrated juice.

7.2 Major Importers of Pakistani Orange Juice

Major share of Pakistani frozen citrus juice concentrate is sold in Europe. In 2016, Netherlands was the largest buyer claiming 56.5% share of value and 59.4% share of quantity of FCKJ exported by Pakistan. Pakistan exported 4003 tons of orange juice to Netherlands in 2016 for USD 6.45 million. Netherlands is the trading hub of orange juice in Europe. Major portion of these imports is re-exported to other countries. Other important buyers from Europe included Italy and Spain which respectively were the seventh and tenth largest buyers accounting for 2.1% and 1.0% share of the total value of Pakistani exports. Shares of different buying countries in value and quantity of Pakistani exports are shown in Figures.

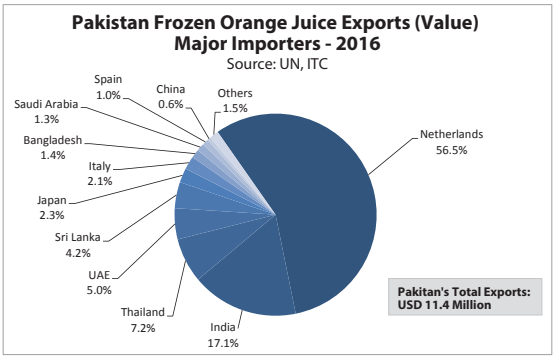


Figure 69 – Major Importers of Pakistani Orange Juice (Value)

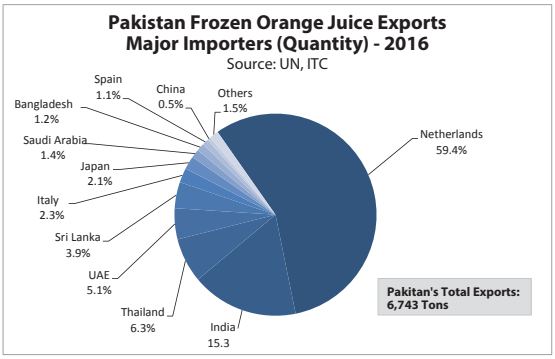


Figure 70 – Major Importers of Pakistani Orange Juice (Quantity)

India is the second largest buyer of FCKJ from Pakistan. In 2016, it claimed 15.3% share of the total export volumes and 17.1% share of the total value by importing 1034 tons for USD 1.95 million. Thailand, Sri Lanka and UAE were the other important importers. Japan is another important buyer of Pakistani orange juice that accounted for 2.1% of the Pakistan's total export volumes. Japan is an important market since it is the third largest importer of frozen orange juice with 6.4% share of the global market. Japanese market also derives its importance from that fact that it is a higher priced market. In 2016, the average price of orange juice imports into Japanese market was USD 1988 per ton which was 67% higher than the global average price of USD 1187.

Another important importer of Pakistani FCKJ was China which in 2016 imported 37 tons of the product for USD 65,000. China is the fourth largest importer in the world accounting for 6.2% share of the global value of imports. It is also a higher priced market with a global average unit import price of USD 1916 in 2016.

The market profile of Pakistani exports of FCKJ does not include the top three orange juice buyers, USA, Germany and France. Together, these three countries accounted for 60% of the total global imports, but they have not been a focus of Pakistani exporters. During the last fourteen years, no exports have ever been done to USA and France. However, there have been four years in which some small volumes of orange juice have been exported by Pakistan into German market. 2013 was the last year in which Germany bought small quantity of 19 tons FCKJ from Pakistan for USD 42,000. This presents an opportunity for the Pakistani exporters to focus their attention on these three biggest markets to help Pakistan get its due share therein. Along with the current market shares, it is also important to look at the export trends in different import markets. Figures 71 and 72 shows the ten-year trends of Pakistani exports in top six import markets of the country.

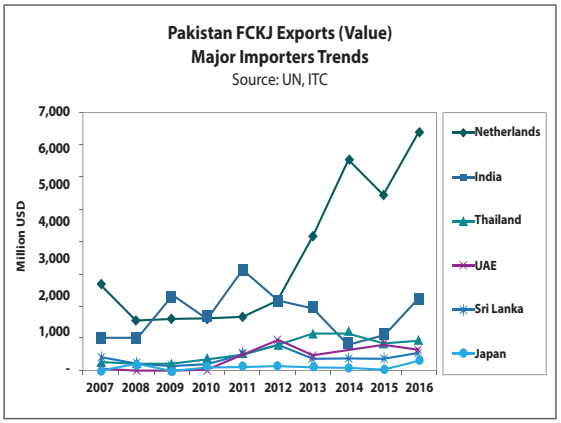


Figure 71 – Pakistan FCKJ Export Trends in Different Markets (Value)

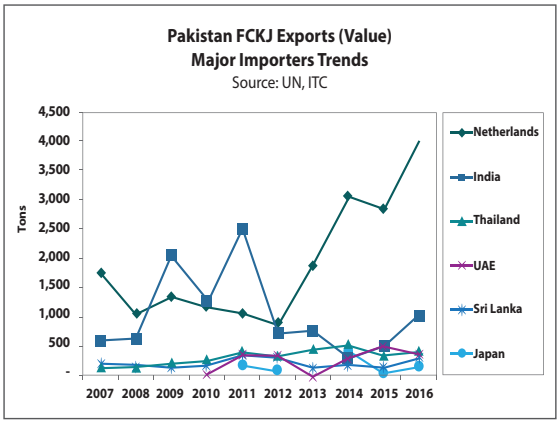


Figure 72 – Pakistan FCKJ Export Trends in Different Markets (Quantity)

It is seen that during the last ten years, Pakistani FCKJ exports to Netherlands market have increased. This rise has been very sharp during the last five years when the exports increased from 862 tons in 2012 to 2,003 tons in 2016. This represented an increase of 4.64 times. In terms of export value, the increase was 3.42 times. The other prominent trend was seen in case of Indian imports which decreased during this period. Pakistan's exports of orange juice to India decreased sharply from 2,746 tons in 2011 to only 743 tons in 2014; which was a decrease of 73%. In value terms, the decrease was 87%. However, following this, the last two years have seen a recovery and Pakistani exports to India increased by 2.6 times to reach 1,954 tons in 2016. This trend is healthy for Pakistan in terms of export volumes; but not in terms of per ton price which decreased from USD 2245 in 2014 to USD 1890 in 2016. Trends in other markets have been oscillating during the past decade.

7.2.1 Pakistan's Unit Price in Different Markets

In 2016, the average export price of Pakistani frozen citrus concentrate was USD 1694 per ton. The price varied in different markets with the biggest market Netherlands buying Pakistani juice at an average price of USD 1613. The highest price of USD 2013 was realized in Bangladesh market. Figure 73 shows the export price comparison for the top markets of Pakistani orange juice.

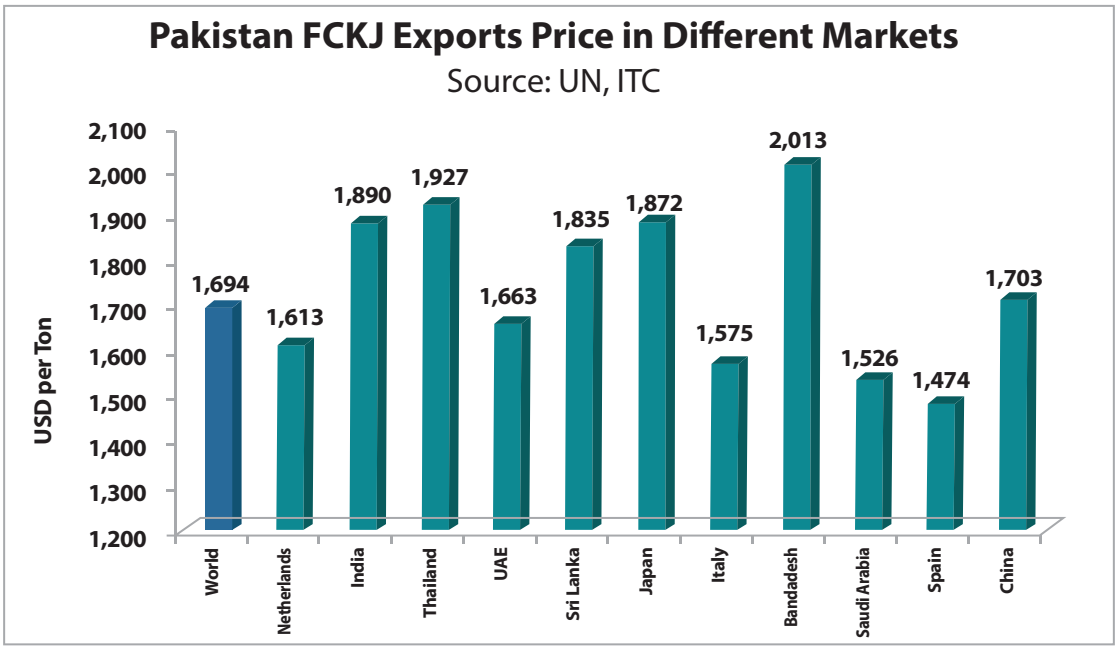
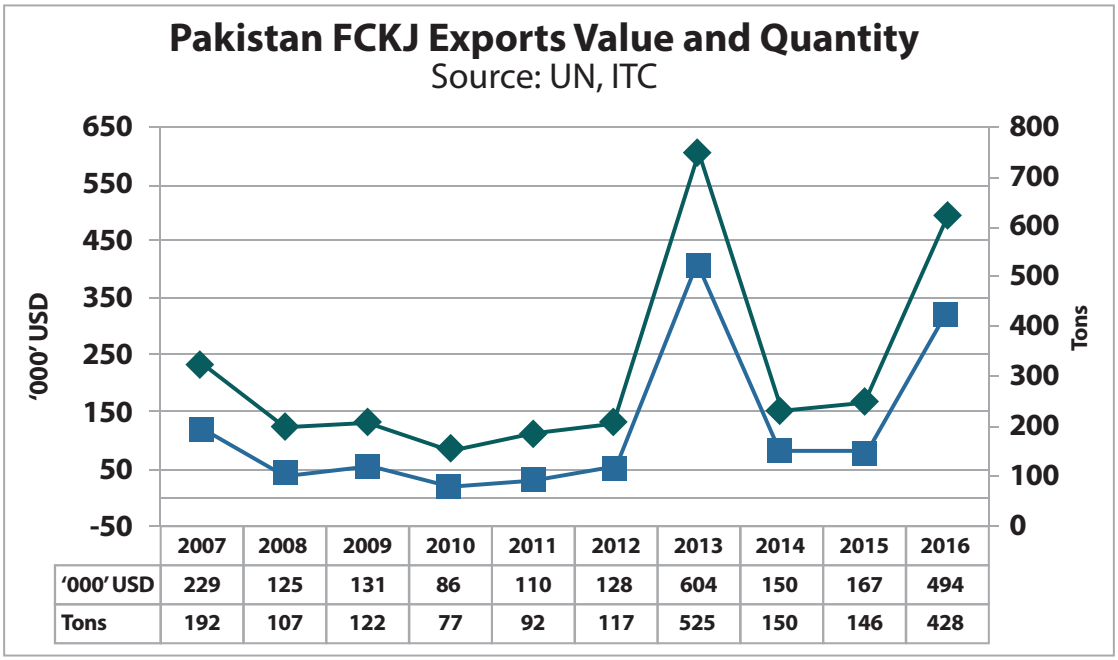


Figure 73 – Pakistan FCKJ Export Prices in Different Markets

Unlike the years from 2007 to 2011, the unit price fetched in Indian market has improved and Pakistani exporters managed to sell their product at an average price of USD 1,890; higher than the average price. Thailand, Japan and Sri Lanka were the other markets where better than the average prices were realized.

7.2.2 Pakistan's Imports of Frozen Citrus Concentrate

Pakistan is also a large consumer market where the fruit juice market has grown sharply over the last two decades. The growing demand has led to developing a large juice processing sector in the country. Ready-to-drink orange juice is produced from frozen juice concentrates of different citrus fruits. Since Kinnow is the major citrus fruit grown in Pakistan, FCKJ is the main ingredient of the orange juice sold in the local market. However, for developing the required taste, Kinnow juice concentrate alone is not sufficient and the recipe has other ingredients also; including orange juice concentrate as well. Since the local orange production is small, there is not enough availability of orange for processing into FCOJ. Therefore the local orange juice producers have to import orange juice concentrate. Figure 74 shows Pakistan's ten-year import trend.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
'000' USD	229	125	131	86	110	128	604	150	167	494
Tons	192	107	122	77	92	117	525	150	146	428

Figure 74 – Pakistan Imports of Frozen Citrus Concentrate

The imports decreased from the year 2007 to 2010; following which there was a steady upward trend; with an unusual hike in 2013 and fall in line with the previous trend in 2014. Another sharp increase was seen in 2016 when the imports of frozen citrus concentrate increased from 146 to 428 tons; an increase of about three times. It can be expected that Pakistani imports will continue to rise in the coming years to meet the growing demand of pure fruits juices in the local market.

7.2.3 Pakistan's Major Suppliers of Orange Juice

Pakistan meets most of its import requirements of frozen orange juice from Netherlands which is the major trading hub in Europe. In 2016, Pakistan imported 137 tons of juice from Netherlands that accounted for 35.5% of the total export volumes and 38% of the total import value. Figure 75 shows the shares of different suppliers of orange juice to Pakistan.

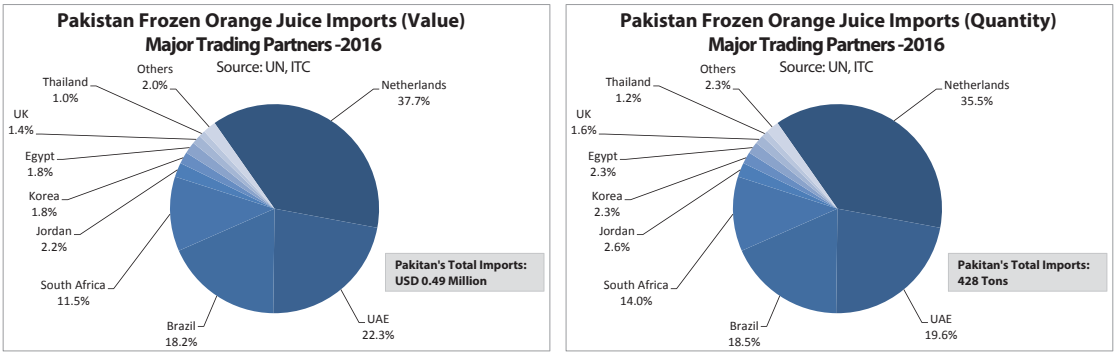


Figure 75 – Major Suppliers of Orange Juice to Pakistan

Imported quantities and values of the top exporters of orange juice to Pakistan and the average unit prices are shown in Table 8.

Exporting Country	Value (000 USD)	Quantity (Tons)	Unit Price (USD/Ton)
Netherlands	186	152	1,22 4
UAE	110	84	1,310
Brazil	90	79	1,139
South Africa	57	60	950
Jordan	11	11	1,000
Korea	9	10	900
Egypt	9	10	900
UK	7	7	1,000
Thailand	5	5	1,000
Others	10	10	1,000
Total	**494**	**428**	**1,154**

Table 8 – Pakistan's Imports of Orange Juice – Major Importers

After Netherlands, UAE and Brazil are the second and third largest suppliers of orange juice to Pakistan. Highest price of USD 1310 per ton was paid for the product being imported from UAE.

8.0 CURRENT INDUSTRY STRUCTURE

8.1 Historical Perspective

Kinnow juice manufacturing sector of Pakistan is not very big and currently comprises of five manufacturing units. All of these units are located in Punjab since the province is the main producer of Kinnow in the country. The history of Kinnow juice manufacturing sector in Pakistan is not very long. The first processing facility was established in late eighties by an American company. The processing facility was established in 1988 in district Sargodha on Sargodha-Lahore road. This was followed by the establishment of another facility with the name of Sunflo Cit-Russ Ltd. This unit was also established in district Sargodha on Sargodha-Bhalwal road. During the same period in 1989, another juice processing unit with the name of Fresh Juices Ltd. was established near Lahore in Bhai Pheru district Kasur.

The unit had a smaller capacity and was established outside the Kinnow growing area of Sargodha. During the last two decades, two more Kinnow juice manufacturing units were established. One of those was Shakarganj foods established in district Chiniot and the other was Oriental Foods Ltd. The latter unit was established in district Sargodha at Shahpur but was recently shifted to Kot Momin closer to Kinnow growing area to have easier access to raw material. These units are smaller compared to the two initially established units.

Kinnow juice manufacturing has been a profitable business in Pakistan. Availability of raw material and large demand of citrus juice concentrate in international market were the key triggers of investments in late eighties. The two units established initially were profitable ventures. The manufactured FCKJ was sold in local and export markets. Sunflo Cit-Russ Ltd. also successfully launched the first locally manufactured ready-to-drink pure orange juice (SunRipe) in Pakistani market. However, both Cargill and Sunflo Cit-Russ faced management issues which became so severe that the two companies had to stop their operations by the end of nineties. In case of Cargill, it was a strategic decision by the international parent company of local subsidiary (Cargill Pakistan) whereby it decided to divest from Pakistan. The company sold all its local operations including citrus juice and seed businesses. The company was purchased by a local investor who renamed it as CitroPak and revived the juice manufacturing operations during next few years. The other large unit, Sunflo Cit-Russ, was closed in 1998 due to serious management issues. The plant remained closed for about a decade after which it was also purchased by the same investor who bought Cargill Pakistan. Sunflo's plant was also renamed as CitroPak. The third company, 'Fresh Juices', operating in district Kasur managed to continue its operations; though inconsistently. Ever since its establishment, the issue of being located away from Kinnow growing area has created issues for the company in getting access to raw material; directly affecting the competitiveness of the business. Shakarganj Foods and Oriental Foods have been performing reasonably well over the past years.

8.2 Current FCKJ Manufacturing Capacity

The currently installed manufacturing capacity of FCKJ in Pakistan is around 1,900 tons of Kinnow per day. Breakup of the capacity between the five processing facilities is listed in Table 9.

Sr. No.	Name	Location	Capacity	
			Kinnow per Day (Ton)	FCKJ per Year (Ton)
1.	CitroPak (Unit 1)	District Sargodha	600	4,800
2.	CitroPak (Unit 2)	District Sargodha	600	4,800
3.	Fresh Juices	District Kasur	200	1,6 00
4.	Shakarganj Foods	District Chiniot	150	1,200
5.	Oriental Foods	District Sargodha	350	2,800
Total			**1,900**	**15,200**

Table 9 – FCKJ Manufacturing Units in Pakistan

All the FCKJ manufacturing units are operational and process Kinnow to produce FCKJ throughout the season. Assuming a season of 100 days and an average yield of 8%, the local industry has the capacity to manufacture 15,200 tons of FCKJ during one Kinnow growing season.

The local manufacturing scene is dominated by CitroPak which holds 63% share of the total processing capacity. Oriental Foods is the second largest player with 18% share; followed by Fresh Juices and Shakarganj Foods. Distribution of the national FCKJ manufacturing capacity between different processing facilities is shown in Figure 76.

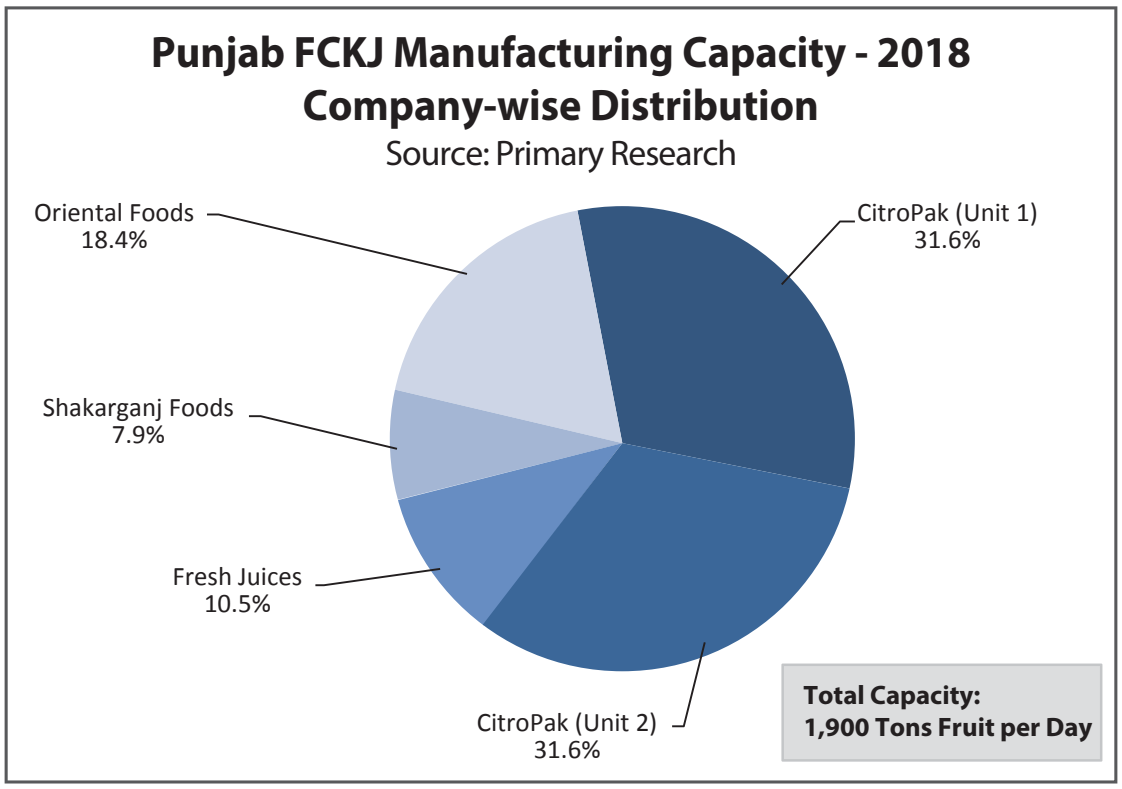


Figure 76 – Pakistan FCKJ Manufacturing Capacity – Major Players

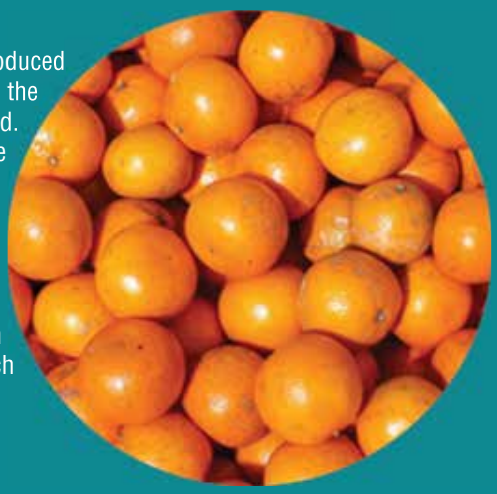
It is important to note that all the FCKJ manufacturing players also process other fruits like mango, peach, guava, etc. to manufacture the respective pulps and purees; the raw material for making ready-to-drink juices of different flavors. These products are sold to different juice manufacturing companies in the local market. Nestle and Shezan are the two large players in this market. Thus the profitability of these units is not solely dependent upon Kinnow juice concentrate. In addition to selling these industrial products, the largest manufacturer CitroPak has also as established presence in local consumer juice market. Few years back, the company launched ready-to-drink juices of different fruits under the brand name 'Fruitien'. Within few years, the brand has successfully captured a sizeable share of the local juice market and is offering strong competition to the market leader Nestle.

8.3 Future Ventures

Operations of the existing FCKJ manufacturing units at full capacity and increasing demand of the product in local and export markets indicate that the sector possesses potential for more investment. Pakistan's FCKJ exports have been continuously increasing over the past years which show an increasing demand for frozen citrus juice concentrate from Pakistan. Looking at the growing export trends and the demonstrated profitability of this business, it is expected that new investments will flow into the sector in the coming times. As per the industry sources, a major fruit processor of the country is expected to invest in FCKJ manufacturing in the coming years. The investor is already a big player in fruit processing and plans to diversify its product portfolio by investing in citrus juice manufacturing sector. Interest and confidence of successful businessmen in FCKJ manufacturing business is also an important indicator of the high potential of this business.

9.0 RAW MATERIAL ANALYSIS

Citrus is the largest grown fruit in Pakistan. The country produced 2.344 million tons of citrus fruit in 2016; making Pakistan the tenth biggest producer of oranges and tangerines in the world. National Citrus production has grown at a high rate during the past six decades. Figure 77 shows the citrus production trend of Pakistan for the past fifty five years. During this period, the national citrus production grew from 88,000 tons in 1958 to 2,344,086 tons in 2016. This represents an overall increase of 26.6 times and translates into a compounded annual growth rate of 6.1%. Increase in cultivated area during the same period was 13.4 times which equates to a compounded annual growth rate of 4.8%.



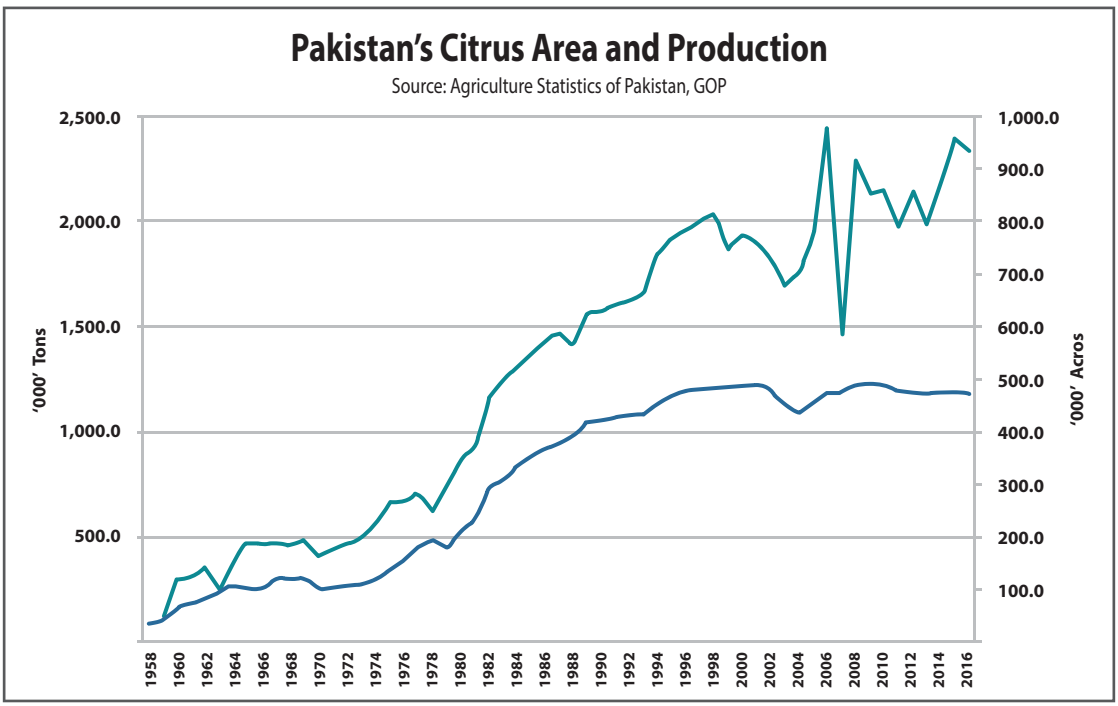


Figure 77 – Pakistan Citrus Production Historic Trend

A higher percent increase in production compared to that in cultivated area indicates that citrus yield has increased significantly over the years. Average per acre citrus production yield almost doubled from 2.5 tons in 1958 to 4.9 in 2015. The comparison is shown in Figure 78.

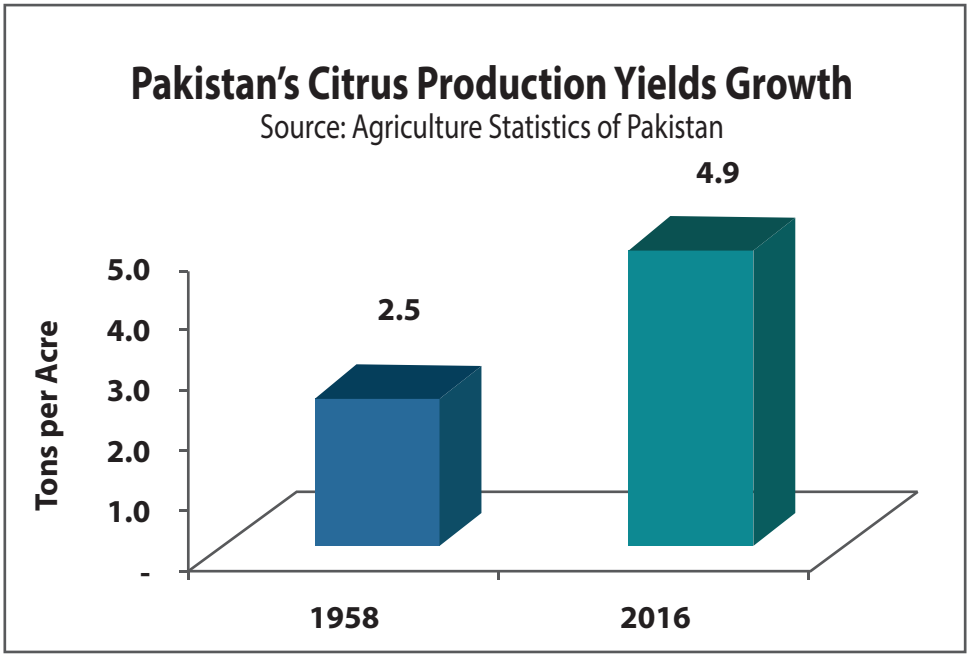


Figure 78 – Pakistan Citrus Production Yields

Talking to the citrus sector stakeholders it was found that the officially documented yield of 4.9 tons of citrus fruit per acre is under-reported by large difference. As per the citrus farmers and traders, the production yield of citrus from a medium grade orchard is around 10 tons per acre. This value is even higher for better maintained citrus orchards. One of the possible reasons for the difference between the government's data and the data collected from field is that the government's estimates may also include the area under citrus orchards which are new and not productive at the time of crop estimation. Inclusion of non-productive cultivated area may have led to reporting a lower per acre yield.

9.1 Citrus Harvesting Season

The overall harvesting season of citrus fruits in Punjab extends over six months; starting in November and going up to April. Different varieties mature in different months. Harvesting seasons of different varieties of citrus fruit in Punjab are shown below:

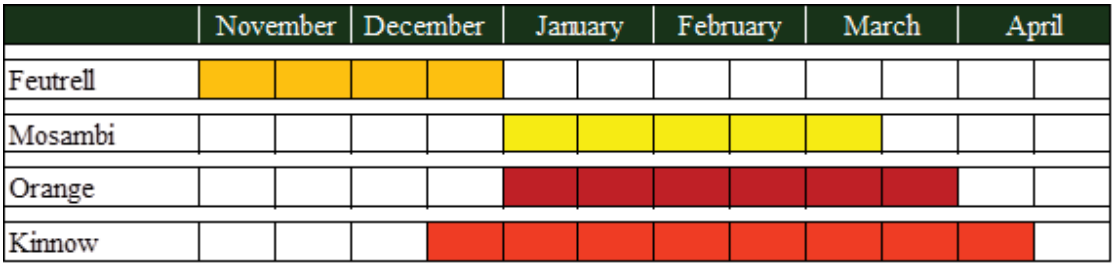


Figure 79 – Harvesting Calendar of Citrus Fruits in Punjab

Feutrell is first variety to get mature and harvested. Early harvesting of Feutrell starts in the first week of November and continues by the end of December. Musumbi is an early fruit in Sindh where the harvesting starts in the beginning of November and continues by the end December. In Punjab, its harvesting is late and gets started in January and continues for three months going till the end of March. The harvesting season of orange in Punjab lasts for three months, January to March. The other important orange producer is the province of Khyber Pakhtunkhwa (KP). Harvesting of orange in KP starts early in mid-November and goes till the mid-March. Kinnow is grown only in Punjab and its harvesting usually starts by the middle of December and continues by the middle of April. It has the longest harvesting season of all the citrus fruits.

Figure 80 – A Kinnow Tree Ready for Harvesting

9.2 Punjab Citrus Production

Citrus production is concentrated in the province of Punjab. In 2016, the province produced 2,276,077 tons of citrus fruit from a total cultivated area of 449,200 acres. This translates into 97.1% of the total production and 94.7% of the total cultivated area of citrus in the country. Figure 81 and Figure 82 show the shares of the four provinces in the national citrus production in 2016. Khyber Pakhtunkhwa and Sindh respectively were the second and third biggest citrus producers respectively accounting for 1.4% and 1.3% of the total national production in 2016.

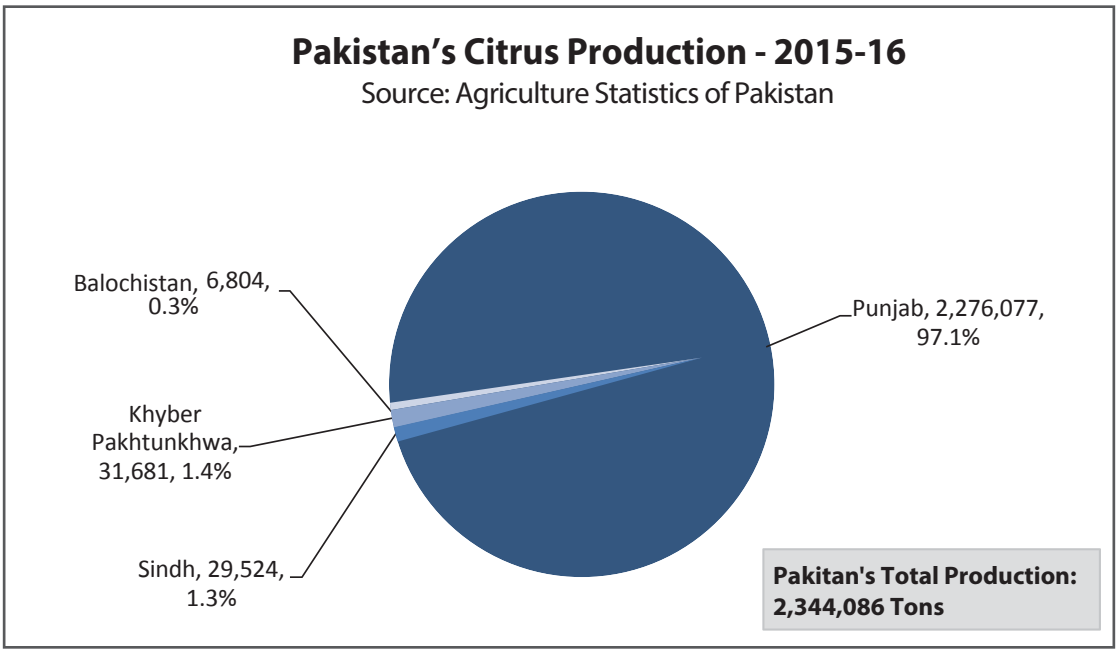


Figure 81 – Pakistan Citrus Production 2015 – Provincial Distribution

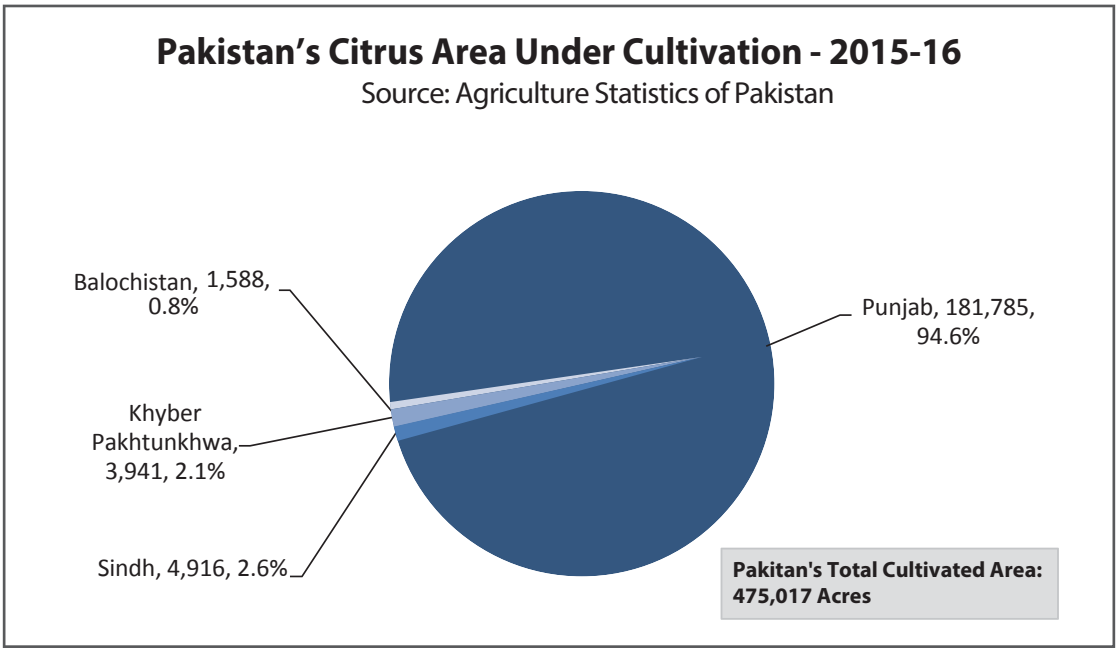


Figure 82 – Pakistan Citrus Cultivated Area 2015 – Provincial Distribution

9.2.1 Punjab Citrus Production Clusters

Citrus production is concentrated in the belt extending from central Punjab into the Southern Punjab. Sargodha Division is the largest in terms of cultivated area and production of citrus in Punjab. In 2016-17, the division accounted for 54.8% share of production and 52% share of the total area under citrus cultivation. Faisalabad and Multan Divisions are respectively the second and third largest in citrus production. Together, the top three divisions account for around 80% of the provincial citrus production. Division-wise distribution is shown in Figure 83.

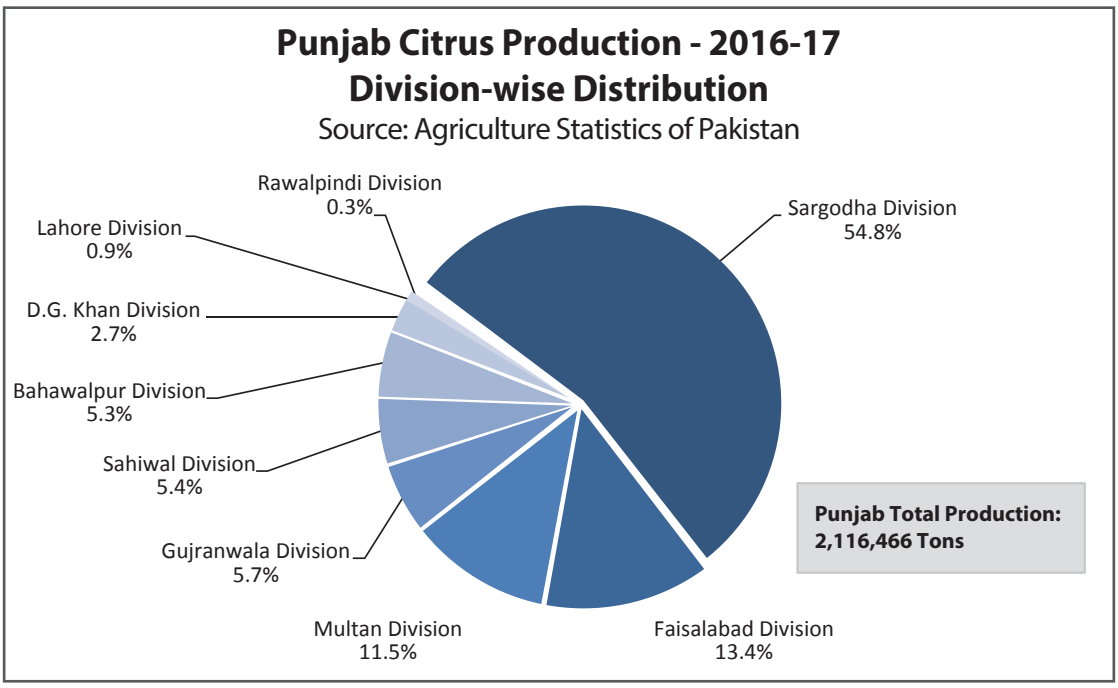


Figure 83 – Punjab Citrus Production – Division-wise Distribution

Looking into the district-wise distribution, Sargodha is the largest citrus producing district of Pakistan. In 2016-17, District Sargodha produced 1.16 million tons of fruit that accounted for 52.7% share of the provincial production. This production was obtained from a cultivated area of 218,440 acres that was 49.9% of the total cultivated area under citrus orchards in Punjab. Within Sargodha district, Tehsil Bhalwal is the largest in producing citrus fruit in the province.

Figure 84 – A Kinnow Orchard in Sargodha

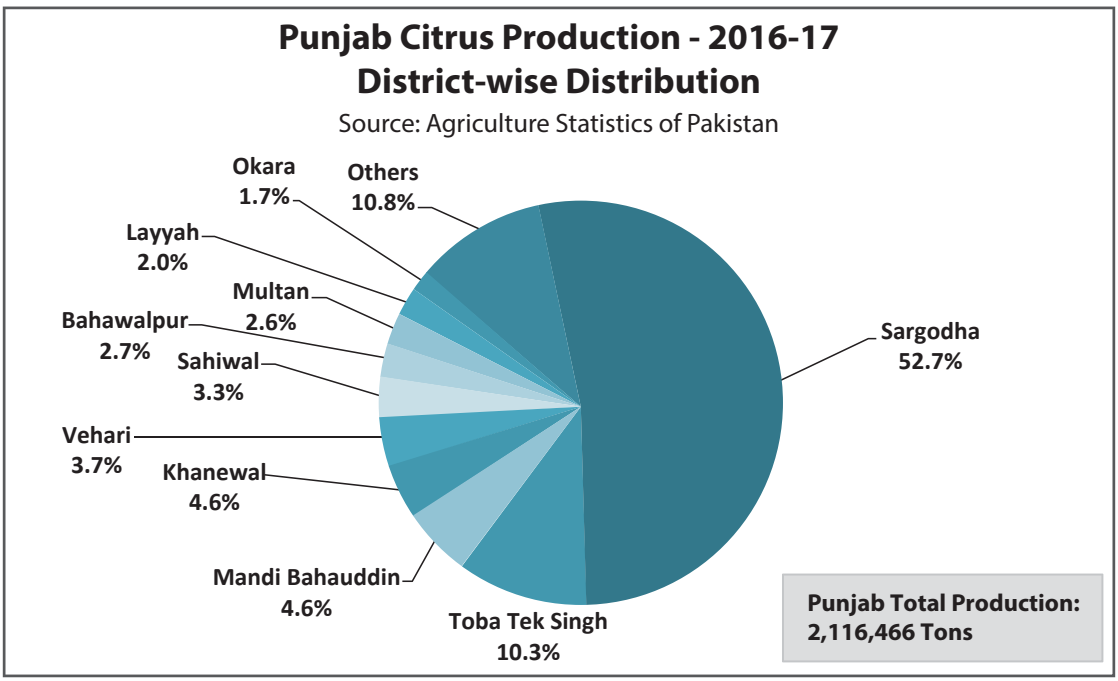


Figure 85 – Punjab Citrus Production – District-wise Distribution

Toba Tek Singh and Mandi Bahauddin respectively are the second and third biggest citrus producing districts; that held 10.3% and 5.6% shares of the total provincial production in 2016-17. Other important citrus producing districts include Khanewal, Sahiwal, Vehari, Bahawalpur, Multan, Okara and Layyah. Most of these districts are located in Southern Punjab. Shares of different districts in citrus production and the cultivated areas of Punjab are shown in Figures. The top ten citrus producing districts are highlighted in the map of Punjab shown in Figure 87.

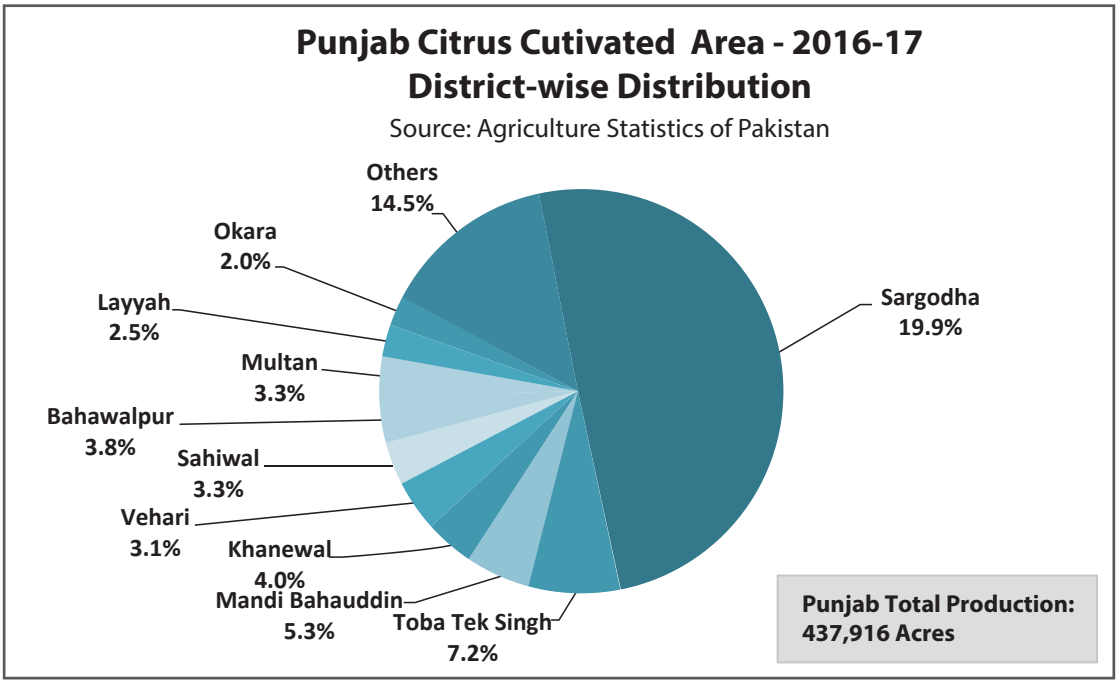


Figure 86 – Punjab Citrus Cultivated Area – District-wise Distribution

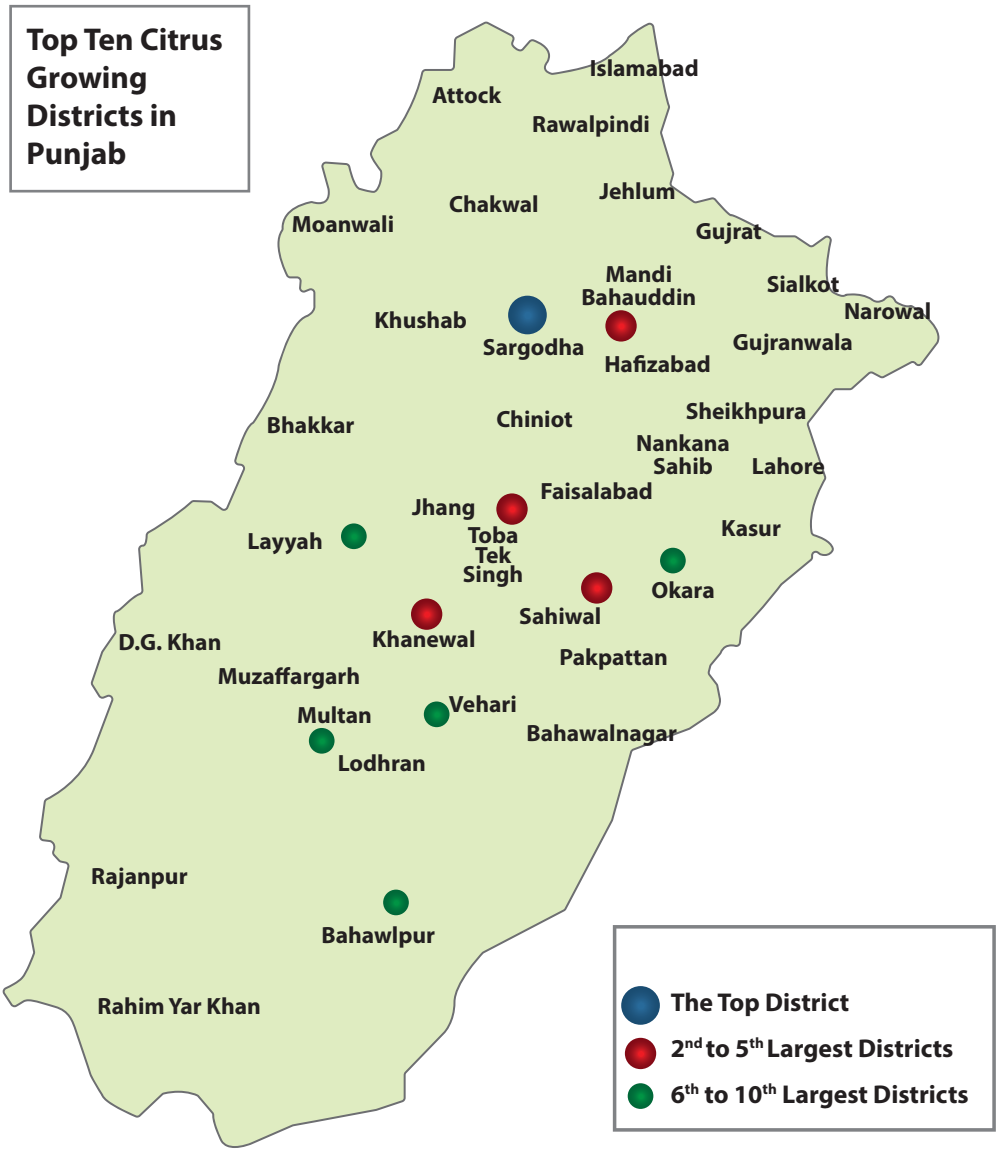


Figure 87 – Major Citrus Producing Districts on the Map of Punjab

9.2.2 Kinnow Production in Punjab

Of the different citrus fruits grown in Punjab, Kinnow is the most commonly growth fruit and the key raw material of the processing factories. Kinnow is a cross between 'King' and 'Willow leaf' species which was developed at Citrus Research Center, University of California, USA in 1951. The specific variety grown in Punjab has the botanical name 'Citrus Reticula'. This unique variety is indigenous to this part of the world. The specific soil and climatic conditions of Punjab province have developed a unique flavor in Kinnow which has earned it a distinct position among other comparable cultivars grown in other parts of the world. As per the estimates, around 95% of the global Kinnow production is contributed by Pakistan.

Fruit variety-wise split of Punjab's total citrus cultivated area and production in 2016-17 is shown in Figure 88 and Figure 89. Kinnow dominated the citrus scene of Punjab with 84.8% share in total citrus cultivated area and 90.6% of the total citrus production of Punjab. Orange was the second largest citrus fruit that accounted for 4.7% of the area and 3.4% of the total citrus production. All other citrus varieties accounted for around 5% of total production and area.

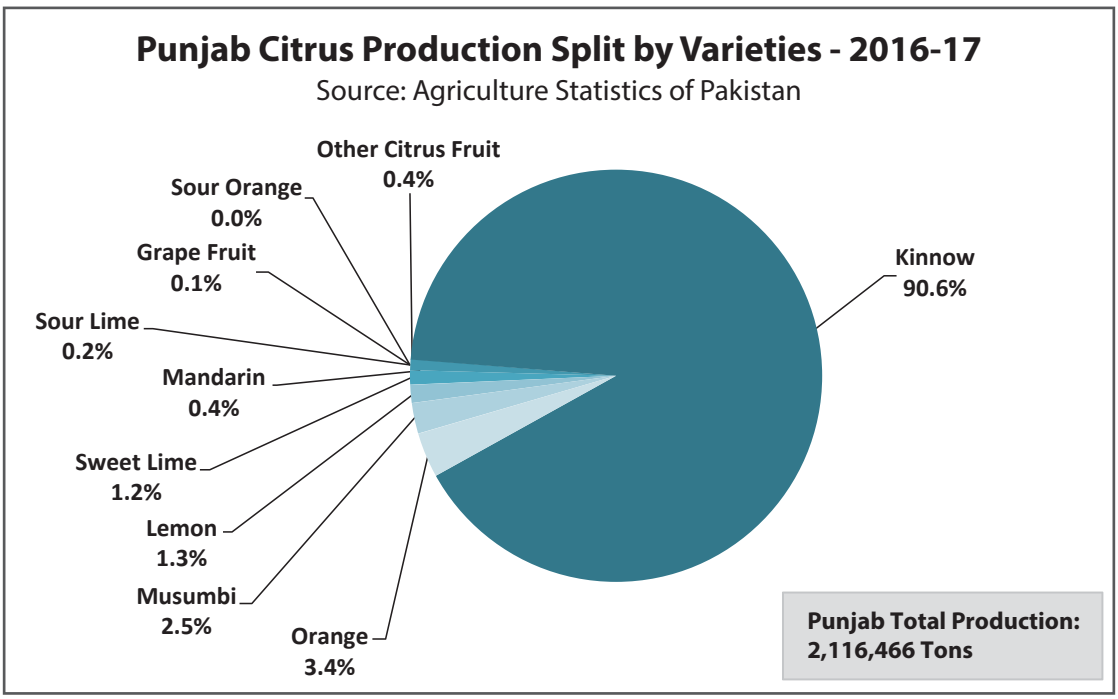


Figure 88 – Punjab Citrus Production Split by Varieties – 2016-17

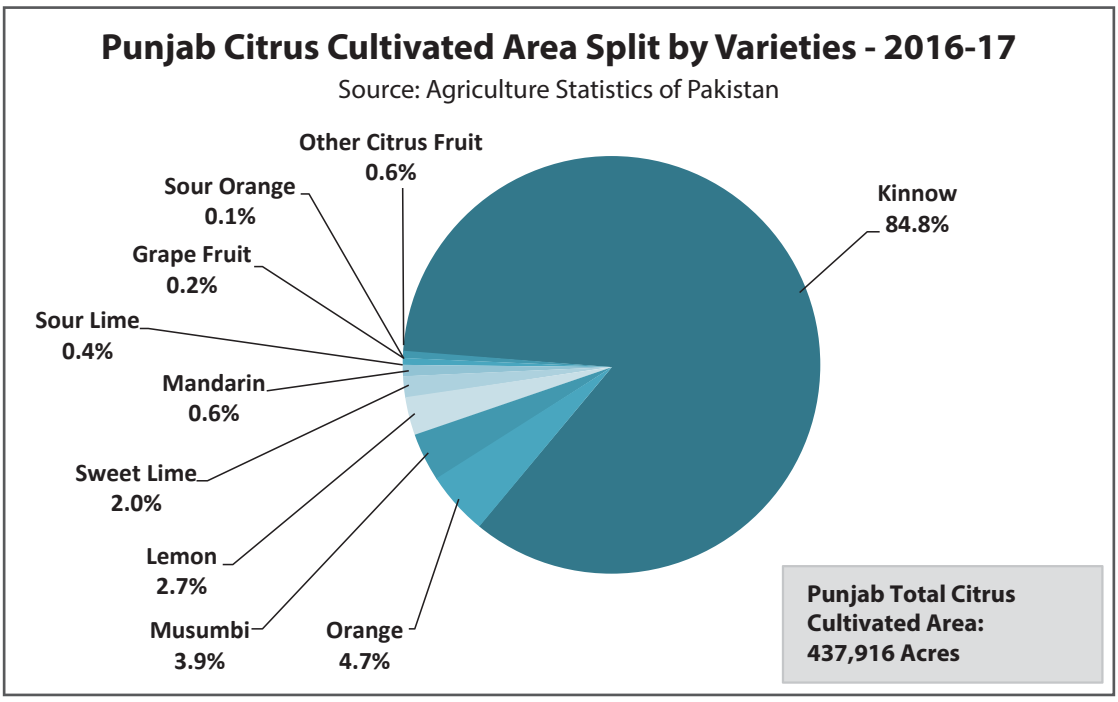


Figure 89 – Punjab Citrus Cultivated Area Split by Varieties – 2016-17

Kinnow is not only the largest in terms of production but also generates the highest production yield compared to all other citrus varieties. In 2016-17, as per the government's official data, the average yield of Kinnow production in Punjab was 5.16 tons per acre; which was 48% higher than the next highest yield of 3.49 tons per acre; by orange. This is one of the key reasons that the farmers prefer to grow Kinnow instead of other citrus varieties. Majority of the new orchards being established in district Sargodha are based on Kinnow trees. Mandarin, Grapefruit and Musumbi were the next in line in terms of per acre production yield. Yields comparison is shown in Figure 90.

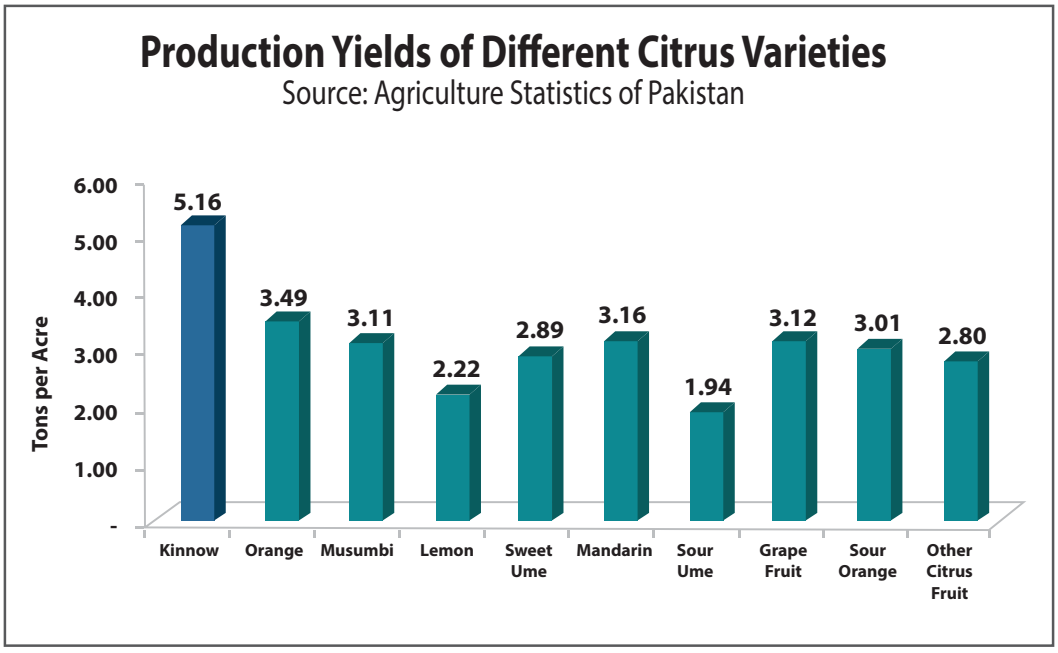


Figure 90 – Production Yields of Different Citrus Varieties

9.3 Kinnow Market Analysis

9.3.1 Kinnow Orchards Management Practices

Kinnow is grown on large areas in Sargodha and other districts of Punjab. The size of Kinnow orchards ranges from a few acres to few hundreds of acres. Majority of the orchards are of smaller size which keeps reducing further due to division of the land as inheritance to the members of the next generations. Corporate farming is practically non-existent. There is low level of awareness about modern agricultural practices. Support from the government is not sufficient. All such factors lead to lower farm productivity, lower fruit quality and inefficient utilization of resources. Larger orchards are so large in size that the owners find it practically impossible to manage the operations by themselves and not pushed to use their farm resources in an optimal manner. The smaller farmers are constrained by resources and knowhow to maximize their profits from their orchards by managing those by themselves.

Figure 91 – A Kinnow Orchard along Kot Momin-Sargodha Road

All such factors lead to a situation where the farm owners have little interest to manage their orchards by themselves. As a result, a wide majority of the Kinnow orchards (and other fruits orchards as well) are contracted out to third parties. The farm owners choose the easy-money option due to their lack of interest and capacity. These contracts are made between the orchard owners and professional farm contractors before the start of harvesting season. The orchard owner gets his confirmed payment and the entire risk is assumed by the contractor. The management of the farm is also undertaken by the contractor. However, he is only interested in the short term management to maximize his profits in that particular contract. He has little interest in the long term well-being and improvement of the orchard. Thus, there is generally no longer term investment made by the contractor in the orchards to increase production yields or the fruit quality.

9.3.2 Kinnow Market Segments

Just like all other fruits and vegetables, the Kinnow price in Punjab is also determined by the market forces of demand and supply. There is no intervention of the government in determining the price of the fruit. The Kinnow fruit may be consumed in fresh form as table fruit or it may be processed in factories to manufacture variety of value added products. Broadly, the market can be divided into three main segments and the fruit sold in these markets is rated as A, B or C grades.

1. Export Market: The best grade Kinnow is large in size, has proper orange color and is free from any rots or blemishes. This is rated as 'A' grade and is usually destined for export markets. A smaller share of this grade of fruit is also sold in high-priced premium markets in larger cities of Pakistan. This Kinnow fetches the highest price in the market. It is procured by the Kinnow grading and packing factories; mostly located in district Sargodha. There are around 300 Kinnow grading factories which process fresh Kinnow to sell that in export markets. The fruit is graded, waxed and packed in boxes and exported to different countries around the world. The Kinnow intended for exports is very high priced and thus cannot be used for processing into juice.
2. Local Markets: The second market segment is that of the 'B' grade fruit which is intended for the local markets to be consumed by the local population. This segment represents the biggest market since Pakistan is a populous country of 210 million people; the number increasing at around 1% per annum over the past decades. Kinnow is auctioned in the wholesale markets by the farmers or the orchard contractors (who buy the orchards' production before the harvesting season). The sales volumes in different wholesale markets of the country is determined by the demand of each area; driven by the population and the average per capita consumption. The larger cities like Karachi, Lahore, Faisalabad, Multan, Peshawar, Hyderabad and Quetta have higher purchasing power and thus higher per capita consumption. The average grade of fruit sold in local markets is lower than the one sold in export markets. However, the quality is still high and this grade of fruit is not affordable for the processing factories.
3. Processing Factories: The local markets have a certain capacity and any volumes of Kinnow over and above that capacity become the raw material for the processing factories. The fruit grade procured by the processing sector is the lowest grade in terms of the fruit size and is classified as 'C' grade. This fruit is smaller in size than the one sold as table fruit. This grade of fruit is sorted in Kinnow orchards. The smaller size fruit rejected by the export factories is also considered 'C' grade fruit. Sometimes, when the supply is short, even 'C' grade fruit becomes acceptable as table fruit in smaller markets. The fruit is this grade is further sorted and an even lower category is created. This category is usually known as 'Cargill' to signify that this fruit is only suitable for juice factories.

Figure 92 – Kinnow Sale in Bhalwal Market, District Sargodha

Kinnow prices in the three market segments are closely linked to each other. Market supply and demand forces affect the prices of all the three segments. The average price of the Kinnow used by processing sector is around five to six times lower than that of the fruit sold to the export factories and two to three times lower than that of the fruit sold in the local markets. A higher demand in export market also leads to increasing the price of Kinnow for the processing sector.

9.3.3 Kinnow Market Channels

9.3.3.1 Major Kinnow Markets

There are different wholesale Kinnow markets in district Sargodha. Major trading of Kinnow is carried out in the markets of Bhalwal and Sargodha cities. Kot Momin is another important citrus fruit market in the district.

9.3.3.2 Kinnow Procurement Channels

The procurement channel of Kinnow for the processing factories involves three to four different stages. Key steps are:

- Kinnow is picked in the orchards by the labor engaged by the contractor. An initial sorting of the fruit is carried out in the orchard to remove unacceptable fruit. Fruit is divided into different categories on the basis of its size.
- The Kinnow picked from the orchard may go to fruit markets or to the export factories. The export factory owner is a powerful player in the chain. Usually, he is also a contractor having control of multiple orchards to ensure supply of fruit for his export operations.
- The stream of fruit going into the export factory is sorted and the 'A' grade fruit is retained by the factory. 'B' and 'C' grade fruit is separated and is transported to fruit markets where it is sold in open auction.

Figure 93 – Kinnow Loading on Trucks in Citrus Market Bhalwal, District Sargodha

- The procurement departments of juice factories have arrangements with traders in wholesale markets who supply Kinnow to them. Normally, smaller factories have around 30 to 40 traders working with them. Whereas the larger factories may have up to 70-80 different traders acting as their suppliers.
- An important link in Kinnow procurement chain is the smaller middleman (known as 'Phariya' in the local language). He buys fruit from export factories as well as from smaller orchards and sells that in wholesale markets. He also buys 'C' grade fruit from the export factories and sells that to juice factories.

9.3.4 Kinnow Price

During the year 2017-18, the average price of the Kinnow sold to the juice factories was around PKR 130 per maund (PKR 3,250 per ton).

9.3.4.1 Factors Affecting Kinnow Price

The price of Kinnow depends on the crop performance. A good crop leads to increasing the fruit supply which decreases the market price. Just like any other agricultural product, the production and supply of Kinnow is also dependent on multiple natural factors. Unfavorable climate and disease attacks can affect the crop and the supplies of fruit in the market. Along with these factors, mismanagement on the part of farmers and lack of proper infrastructure also act as important factors that determine the supply of fruit in the market. Delay in harvesting, absence of proper link roads, lack of cold storage facilities lead to increasing post-harvest losses and may decrease the supply of fruit. Such a situation increases the fruit price, not only for the local consumer of fresh fruit, but also for the fruit processing factories. The profitability of fruit processing sector in any particular year thus remains dependent on the crop performance during that year.

A major issue of Pakistan's horticulture sector is the weak and inefficient harvest and post-harvest practices. Kinnow is no exception in this regard and a significant share of the produce is lost due to this mismanagement. As per the sector sources, such losses may be as high as 25%. This limitation also acts as an important factor that determines the final market price of Kinnow. Creating awareness in the regard and implementing measures to improve harvest and post-harvest practices can help increase the supply of raw material for the value added fruit processing sector.

Another important factor in Kinnow crop performance each year is the virus attack which decreases the overall production as well as the affects the fruit quality. While this reduces the profitability of the farmer, contractors and trader, a viral attack may become beneficial for the juice factories. The low quality fruit loses its value as table fruit and thus a large share of the total production becomes available for the juice processing factories. Increased supply leads to reduction in the raw material price.

Another factor affecting the Kinnow price for juice factories is the decreasing affordability of the lower income segments of the local population to consume high quality fruits. The people in this income segment naturally become more interested in lower quality fruit. An increased demand for lower quality fruit to be consumed as table fruit increases its price for the juice factories. Lower quality fruit is not only consumed by the lower income segments of the local population but also gets exported to low-priced markets like Afghanistan.

Kinnow price for the juice factories also varies with the distance of the processing factory from the Kinnow orchards. The factories which are located close to the major Kinnow growing areas enjoy the benefit of easier access as well as lower fruit price. The factories located at relatively larger distances from the Kinnow areas have to offer higher prices as an added incentive to make the grower/trader bring Kinnow to their factories. This price is around 15-20% higher than the normal market price. This premium comes around to PKR 20-30 per maund during the year 2017-18. For the purpose of this feasibility study, an average price of Kinnow has been assumed to be PKR 150 per maund (PKR 3,750 per ton). Kinnow price during the year 2016-17 was around PKR 120 per maund, lower than this year. However, the prices in 2012-13 and 2013-14 respectively were Rs 170 and Rs 200 per maund; around 30-50% higher than the current price. Thus the key factor affecting the raw material price is the situation of Kinnow crop during each season. With all the natural factors being constant, the annual price growth swings in the range of 5-10%.

9.4 Kinnow Procurement by Processors

Kinnow is the key raw material for manufacturing FCKJ; constituting a significant portion of the total product cost. Efficient and effective procurement thus is the key to maximizing profits for the FCKJ manufacturing business. The Kinnow procurement for processing into juice depends upon multiple factors and executing right decisions at the right times is important to ensure the profitability of the processing facility.

The decision by the processing factories to start operations depends on the crop maturity situation. The procurement teams visit the orchards to assess the maturity of the fruit crop. The physical condition of the fruit is assessed; especially its color. Only that fruit is considered ripe and ready to be harvested which is not green and has turned orange. Another physical factor is the size of the fruit. The fruit coming to processing facilities is usually of smaller size which does not have value as a table fruit. However, it is not recommended to buy a fruit with extremely small size since the juice recovery from such a fruit is very low which makes it commercially unviable to process.

The key factor driving the procurement decision is the brix of the fruit. Brix is not seen in isolation but usually in the form of a ratio known as Brix-Acid ratio. In the unripe fruit, the Brix-Acid ratio is low since the concentration of acid (mainly citric acid) is high due to which the fruit is sour in taste. As the fruit gets ripe, the acid keeps getting converted into sugar and the sweetness of the fruit increases. Thus the ripe Kinnow has a higher Brix-Acid ratio. Generally the procurement of Kinnow is considered viable when the fruit achieves a Brix-Acid ratio of at least 11. A higher ratio of up to 13 or 14 is considered more desirable. In addition to the season, the Brix-Acid ratio is also affected by the climatic conditions. In case the temperature drops earlier than expected, the brix value and the brix-acid ratio increases earlier than expected. Therefore, the decision to procure Kinnow fruit may have to be taken earlier than the original plan. Another important factor that affects Kinnow procurement decision is the rainfall. In case there is rain during the season, the ripe fruit falls off the trees by itself which increases the supply of fruit in the market. This also sometimes leads to a drop in price which affects the procurement decision of the processing factories.

Sometimes, there is a situation in which the customer is willing to buy product with lower brix-acid ratio. In that case, the processing may be started earlier with the Kinnow fruit with a lower ratio. However, this needs to be done with due consideration to the fact that lower brix also means a lower final juice recovery which is directly linked to the profitability of the business. Therefore, the pricing of the final product has to be done keeping in view all these factors.

Smaller size is not considered a rejection criterion by the juice factories if other attributes and the overall quality of the fruit are generally satisfactory. The quality inspections carried out by the processing unit ensures that the procured fruit is ripe, not rotten and has the desired brix-acid ratio. Any low quality fruit coming in the overall batch sold by the supplier is separated at the sorting stage and returned to the supplier as part of the tare weight of vehicle. The price of the fruit procured by the processing factories is the lowest of all the three market segments. The Kinnow processing businesses derive their profitability from this lower fruit price since it constitutes the major share of the final product's total cost.


Refractometer

The procurement teams keep visiting fruit orchards and markets to assess the situation of brix-acid ratio of Kinnow. For that, single strength juice of the fruit is extracted and brix is measured using a refractometer. As the desired ratio is achieved and the physical attributes of the fruit are considered satisfactory, the procurement decision is signaled green and the processing facilities are made operational. Major share of the fruit bought by the factories is usually through prior contracts with the Kinnow farmers and traders. However spot procurement is also practiced and the factories also buy Kinnow from the farmers/traders directly bringing their fruit to sell to the factory without any prior contract. In both the cases, the decision to accept or reject the fruit is made in line with the quality checks carried out on the fruit brought into the factory.

9.5 Kinnow Availability for New Processing Facility

Kinnow production in Pakistan has been increasing over the years. Growing demand of fresh fruit in local and export markets has been the main driver for this growth. This rising production has also led to increasing the supply of fruit for processing. Overall fruit supply always has a certain share which does not have market as table fruit. Consequently, that can only be sold as raw material to the processing industry. In case there is no processing sector, the fruit of lower grade would be wasted. Thus the processing sector acts to reduce the fruit losses and increase the profitability of the farmers.

However, such a situation does not mean that there is an unlimited supply of Kinnow for processing. With an increased number of factories established during the past years, there is an environment of competition to get access to better quality Kinnow at affordable prices. Some indicators in this regard are discussed below:

- The factories located away from main Kinnow growing areas have to offer a price premium to the farmers to bring Kinnow to their processing sites. This, on one hand, covers the additional transportation cost while on the other, acts as an incentive to prefer the distant factory over the ones in closer proximity.
- The payment terms between the farmers and the processing factories have also changed over the years. Previously, with lesser number of factories, the factory owners were able to dictate their own payment terms. Kinnow was procured on credit and the grower was paid after many months. However, currently, the factories have to pay the farmers without any delay. Payment of the Kinnow sold by the farmer is done either on the same day or within one week of supplying the fruit. This has led to increasing the working capital requirements of the processing sector. The decreased bargaining position of the processing factories against the farmers is an indicator that there is not an unlimited supply of Kinnow for processing.

- Another factor related to fruit supply is in terms of its quality. Existence of competition to access raw material sometimes leads to a situation where the processing factories may have to buy fruit of size which is lower than their quality standards. This may include fruit of very small size or lower juice percentage fruit or others. Lower quality fruit leads to lower FCKJ yield; which reduces the profitability of the processor.
- A limited supply of fruit also acts as a factor towards increasing its price. In addition to the routine inflationary increase, higher demand from the juice factories results in some table grade fruit moving towards factories. This fruit is sold at higher price compared to the standard juice grade fruit.
- Another factor in determining the supplies and the price of Kinnow is the availability of picking labor. Kinnow picking in Sargodha and other districts is usually not carried out by the local labor. Labor from districts of South Punjab is generally engaged for this purpose. Any shortage in labor supply results in reducing Kinnow picking and consequently the supply of fruit in the market. This factor contributes towards increasing the price of Kinnow for the juice factories.

While, the above-mentioned factors do indicate that there is an increased demand for Kinnow for juice making, it does not mean that a new processing facility will not be able to get raw material.

Using the installed processing capacities, Kinnow requirement of FCKJ manufacturing sector was assessed. In 2001, there were three manufacturing units (Cargill, Sunflo and Fresh) which had total installed capacity of crushing 1400 tons Kinnow per day. With an average of 100 days production during the season, Kinnow requirement come out to be 140,000 which was 7.7% of the total citrus production of Punjab in that season. In 2016, the installed capacity increased to 1900 tons fruit per day. Using the same assumptions, the Kinnow requirement was 190,000; which was 8.3% of the total citrus fruit produced in Punjab during that season. These results are almost in line with the estimates provided in a previous report as per which the sector consumes about 10% of the total crop production each year. The calculations are shown in Table 10.

	2001	2016
Installed Capacity (Tons fruit per day)	1,400	1,900
No. of Processing Days	100	100
Kinnow Required	140,000	190,000
Available Production	1,813,000	2,276,000
Percent Fruit Used for FCKJ	7.7%	8.3%

Table 10 – Fruit Consumption for FCKJ

The analysis shows that the demand of Kinnow for FCKJ manufacturing sector has increased during the past years. Fruit procurement thus should be one of the basic considerations before investing in the business of FCKJ manufacturing.

For assessing the availability of fruit for any future investment in FCKJ manufacturing unit in Sargodha, it is important to view the situation in the perspective of Sargodha. In 2016-17, total Kinnow production in district Sargodha was 1,077,139 tons. As per the estimates of sector stakeholders, the share of 'C' grade fruit in the total production is around 25-30%. Therefore the total fruit availability can be estimated (at 25%) to be 269,000 tons. Thus it can be inferred that fruit availability will not be an issue for any new investment in FCKJ manufacturing in Sargodha. As per these calculations, the surplus volumes of 'C' grade Kinnow comes out to be 60,000 tons which is sufficient for another facility with a capacity of processing 500-600 tons of fruit per day.

Moreover, there is also the possibility of getting Kinnow from other districts. Mandi Bahauddin is the third largest district that borders with district Sargodha. In 2016-17, total Kinnow production in Mandi Bahauddin was 116,356 tons. 25% of this production is around 29,000 tons which can offer a good support to provide raw material to processing facilities in Sargodha. Toba Tek Singh, Khanewal and Sahiwal respectively are the second, fourth and fifth largest Kinnow producing districts. However these three districts do not border with district Sargodha and the probability of Kinnow coming from these districts to processing facilities in Sargodha remains low. Higher cost to transport Kinnow from these districts will reduce the business profitability.

Another positive sign about availability of fruit is the fact that new Kinnow orchards are being established on large areas. As per the sector sources, the supply of Kinnow will continue to increase in the coming years. A simple analysis was conducted to assess the situation in this regard. Citrus production growth in Punjab during the past sixteen years (2001-2016) by taking averages of the four year brackets. This was done to smooth out the fluctuations during individual years. Figure 94 shows the average production trend.

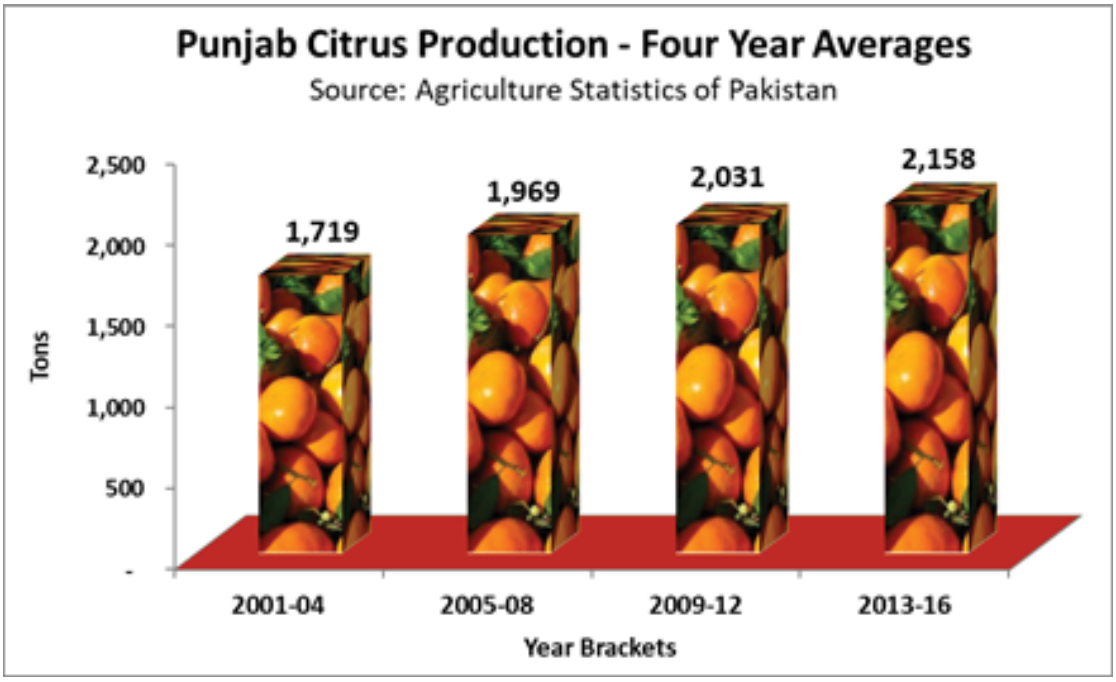


Figure 94 – Punjab Citrus Production – Four Year Averages

Average citrus production of Punjab during the four years from 2001 to 2004 was 1.72 million tons which increased to 2.16 million ton during the four year period from 2013 to 2016. That represents an increase of 26% during the sixteen year period.