



A STUDY ON THE HORTICULTURE SECTOR OF PAKISTAN

Understanding the Bottlenecks and Opportunities in Value-Added Exports of Fruits and Vegetables

 The
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FOSTERING ECONOMIC GROWTH

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List of Acronyms

AEC	Agricultural Export Council
AFP	Agro Food Processing
BoI	Board of Investment
BMR	Balancing, Modernizing and Refurbishment
BRI	Belt and Road Initiative
CFC	Common Facility Center
CMEC	China Machinery Engineering Corporation
DPP	Department of Plant Protection
DUS	Distinctness, Uniformity, and Stability
EU	European Union
EWHR	Electronic Warehouse Receipt
FAO	Food and Agriculture Organization
FSC&RD	Federal Seed Certification and Registration Department
GAP	Good Agriculture Practices
GM	Genetically Modified
GMS	General Marketing Standards
HACCP	Hazard Analysis and Critical Control Points
HEIA	Horticulture Export Improvement Association
HWT	Hot Water Treatment
HYV	High Yielding Varieties
IMF	International Monetary Fund
IPM	Integrated Pest Management
MALR	Ministry of Agriculture and Land Reclamation
MNC	Multinational Company
MNFSR	Ministry of National Food Security and Research
MoC	Ministry of Commerce
MRL	Minimum Residue Level
NFL	National Foods Limited
NPK	Nitrogen Phosphorus and Potassium
NSC	National Seed Council
PAC	Pakistan Agriculture Coalition
PARC	Pakistan Agriculture Research Council
PBDAC	Principal Bank for Development and Agricultural Credit
PBC	Pakistan Business Council
PHDEC	Pakistan Horticulture Development & Export Company
PMEX	Pakistan Mercantile Exchange
R&D	Research and Development
SAP	Structural Adjustment Programme
SPS	Sanitary and Phytosanitary
UHDP	Ultra-High Density Plantation
UNECE	UN Economic Commission for Europe
VCU	Value for Cultivation and Use
VHT	Vapor Heat Treatment

Foreword

This study entitled “Understanding the Bottlenecks and Opportunities in Value-added Exports of Fruits and Vegetables: A Study on the Horticulture Sector of Pakistan” has been completed by The Pakistan Business Council (PBC) as part of its “Make-in-Pakistan” initiative.

While cotton, rice, and fish have conventionally contributed the largest share in Pakistan’s agricultural exports, the contribution of the horticulture sector has been noticeably low. Given the increasing demand in the global market for horticultural produce and processed products, there is a need for Pakistan to prioritize improving the quality and quantity of fruits and vegetables grown in the country. Furthermore, Pakistan needs to upgrade and install new capacity for packaging, processing and securely transporting fruits and vegetables for export. This study is intended to provide directional guidance to policy-makers and businesses on the topic.

Pakistan’s is an agrarian economy and therefore leveraging the potential of agriculture in export, is indispensable. From this perspective, value-addition in agricultural commodities, especially cash crops, of which horticulture is an integral part, is important. The PBC’s “Make-in-Pakistan” advocates all initiatives which help Pakistan grow its local manufacturing base, resulting in growth in exports, substitution of imports and jobs creation in the real sector of the economy.

The PBC is a business policy advocacy platform, established in 2005 by Pakistan’s prominent private-sector businesses and conglomerates, including multinationals. PBC businesses cover nearly all major sectors of the formal economy.

The PBC is a not-for-profit entity, registered under Section 42 of the Companies Ordinance 1984. Though it is not required under the law to do so, the PBC follows to the extent possible, the Code of Corporate Governance as applicable to listed companies. The PBC is a pan-industry advocacy group. It is not a trade body nor does it advocate for any specific business sector. Rather, its key advocacy thrust is on easing barriers to allow Pakistani businesses to compete in regional and global arenas. The PBC conducts research and holds conferences and seminars to facilitate the flow of relevant information to all stakeholders in order to help create an informed view on the major issues faced by Pakistan.

The PBC works closely with the relevant government departments, ministries, regulators and institutions, as well as other stakeholders including professional bodies, to develop consensus on major issues which impact the conduct of business in and from Pakistan. The PBC has submitted key position papers and

recommendations to the government on legislation and other government policies affecting business. It also serves on various taskforces and committees of the Government of Pakistan as well as those of the State Bank, SECP and other regulators with the objective to provide policy assistance on new initiatives and reforms.

This sector report is intended to inform Pakistan's overall industrialization policy.

Ehsan A. Malik

CEO, The Pakistan Business Council



Executive Summary

This report examines the value chain of fruits and vegetables in Pakistan and unbundles the factors impeding productivity at the farm level, the weaknesses in the local market systems and maintaining quality standards while exploring the potential for exporting fresh and processed fruits and vegetables to the global market. Evidence suggests that by improving productivity and expanding the associated downstream industry, Pakistan can increase its horticulture exports of the following fruits and vegetables:



**Citrus and
its juices**



**Potatoes, fries
and chips**



**Tomato and
its paste**



Bananas



Mangos

Despite its agriculture based economy, Pakistan is a net importer of fruits and vegetables. In 2018, Pakistan exported USD 674 million, and imported USD 870 million worth of horticultural commodities. In terms of market share, Pakistan retains 1.5% share in world exports of citrus fruits and 2.8% share in world exports of potatoes, the two main commodities with the potential for increasing exports in the future. Pakistan's export share of food products such as orange juice, potato chips and fries, and tomato ketchup is below half a percent in each category, against a global trade value of USD 7 billion, USD 10.8 billion, and USD 6.4 billion for each category respectively. This highlights the unrealized potential, and an opportunity for Pakistan to invest in improving its production and value addition, build global brand recognition and increase export volumes.

Global trade in horticulture commodities has increased four times over two decades from USD 51 billion in 2001 to USD 200 billion in 2018. Benchmarking with its peer producing countries, should Pakistan have kept pace with upgrading its production methods, seed varieties, processing infrastructure and produce quality, it could have exported USD 2.2 billion worth of horticulture commodities in 2018, three times the actual level. Egypt provides a good case study for Pakistan to learn from. By implementing a Sustainable Agricultural Development Strategy since 2009, Egypt has focused on capturing export markets for its horticulture commodities and currently exports about USD 3.1 billion worth of oranges, grapes, potatoes, strawberries and onions to the Russian Federation, European Union and the Middle East.

Global trade in horticultural food products, mainly grape based juices and wines, potato fries and chips, citrus juices and jams, tomato paste, pulp and juices, packaged mushrooms, frozen strawberries and preserved fruits, vegetables and nuts amounted to USD 81 billion in 2018. Of these Pakistan has the potential to export processed citrus products and potato fries and chips, however the unavailability of industrial grade varieties, surplus production, and processing capacity have been the binding constraints for making export quality food products.

Pakistan needs to increase its output by improving yields and attaining exportable surplus crops. There is currently an emphasis on catering to the domestic market. The impediments contributing to Pakistan's inability to increase its horticultural exports include weaknesses at all stages of production i.e. on-farm production, on-farm harvesting, post-harvest marketing, processing and quality control for export. Pakistan's horticulture suffers from low-yields as compared to its peer countries, unavailability of the necessary seeds for industry grade produce of fruits and vegetables, weak contract enforcement for contract farming, poor on-farm sanitary and phytosanitary standards (SPS) enforcement, inadequate post-harvest infrastructure for packing, handling and transportation, lack of protocols for certifications of health and safety standards, and unassured supply of raw material to processors.

Non-tariff trade barriers also need to be overcome to enable exports of fruits and vegetables from Pakistan. China is potentially a large export destination for Pakistan's fruit commodities, but exports are restricted due to stringent SPS compliance requirements enforced by China. For instance, citrus trade is not permitted via land and air routes to China, and therefore Pakistan has to transport its mandarins by sea to the eastern Chinese ports, increasing cost and time. It would be cheaper and easier to export via land through the Sost border crossing or by air to Urumqi, the permission for which is pending a quarantine agreement between Pakistan and China.

Summary of Recommendations •

Pakistan has the potential to achieve significant growth in horticultural exports by focusing on growing fruits and vegetables which have global demand. This would require developing a concerted policy in resolving bottlenecks responsible for low yields, poor quality of crops, and constraints hindering the production of packaged and processed fruits and vegetables. This report recommends that the federal government, in consultation with the provincial governments and the private sector, develop a National Horticulture Development Framework which prioritizes upgrading the value chain for high potential fruits and vegetables, focusing on export. The objectives of the framework should be to improve yields, acquire better quality seeds, and upgrade technologies for food processing, by prioritizing the following actions:

- Legal instruments and mechanisms should be developed to enable the enforcement of contract farming agreements between food processing units and farmers.
- Revamp and implement a hassle-free system for delivering SPS certifications to farm-owners for export.
- Enforce intellectual property rights of seed producers and penalize back-crossing, unregistered sale, and multiplication of registered seed varieties.
- Establish common facilities with modern technology and infrastructure, similar to the Agro-Food Processing plant established by the government in Multan.
- The Civil Aviation and Sea Port authorities should either invest in, or provide space to the private sector to construct cold storages for fresh produce, at the exit terminals.
- In the provincial extension services departments, induct dedicated technical staff for horticulture, as requirements for horticulture crops are different than staple food commodities such as wheat and rice. The staff should be trained and should serve as a link between farmers, horticultural research institutes, processors, and exporters.
- Offer tax rebates to companies which export over a pre-determined threshold level, and allow R&D and balancing, modernizing and refurbishing (BMR) incentives to help companies upgrade and install cold chain and high-end processing facilities.
- The government and the private sector should work to attract large international companies which process food products from potatoes, citrus, and tomatoes. The Board of Investment (BoI), as part of its Foreign Direct Investment Strategy must take into consideration input from international companies which have the potential to invest in Pakistan's horticulture sector.
- Horticulture commodities should be removed from the ambit of the price control regime. Such restrictions can result in losses to farmers, which discourages them from cultivating horticulture crops, and investing in technology and good agricultural practices (GAP). Price control is equally a disincentive for companies looking to invest in the horticulture sector.
- The State Bank of Pakistan should establish a credit line at concessional rates for establishment of new medium size pack houses, processing units, cold storages, reefer trucks, etc., and for replacing obsolete and inefficient processing machinery with efficient processing lines.

The recommendations are explained in Section 3.

Background

The discourse on developing the horticulture sector in Pakistan has been limited to exploring marginal value-addition, by focusing on exporting commodities to international destinations where Pakistan's own diaspora reside. In other words, Pakistan's export of fruits and vegetables do not in general meet the consumer preferences and quality standards of the developed markets.

By undertaking this study, The Pakistan Business Council (PBC) has analyzed the possibilities to redirect Pakistan's policy focus toward exploring higher value-addition in food commodities; identifying the bottlenecks in local sourcing of fruits and vegetables for food processing; and adopting strategies to tailor food products to the standards of global consumers, similar to the products of the known global food brands.

Despite its natural endowments, Pakistan's exports from the sector are limited. Pakistan's horticulture exports are less than even countries which lack the resources such as the availability of land and irrigation systems¹, diverse agro-climatic conditions ranging from tropical to sub-tropical climate, and a sizable agrarian workforce. Despite the favorable resource base, Pakistan's share of horticulture exports in the total global trade in horticulture commodities is less than half percent (0.34%). Figure 1 shows the marginal growth in the global share of Pakistan's horticultural exports.

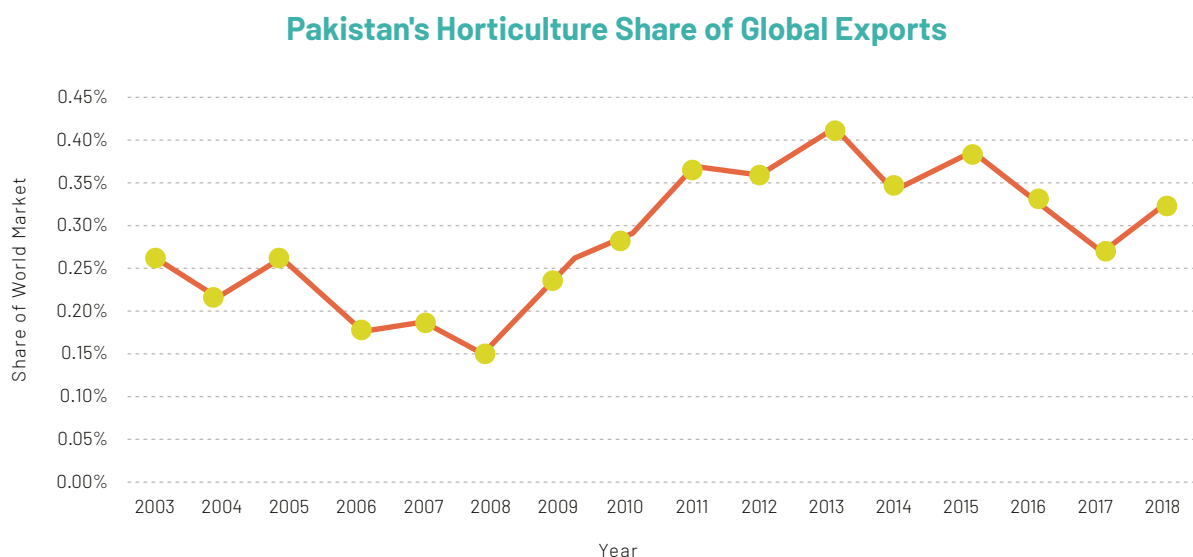


Figure 1- Pakistan's horticulture share of global exports
Source: Database sourced from ITC Trade Map

¹Canal irrigation system from 19 barrages on the rivers, supplemented by fresh ground water in many parts of the country.

Pakistan has the potential to achieve significant growth in horticultural exports by focusing on growing fruits and vegetables which have global demand. This would require a concerted policy aimed at resolving bottlenecks responsible for low yields, poor quality of crops, and constraints hindering the production of packaged and processed fruits and vegetables. Anecdotal evidence suggests that by growing fruits and vegetables, farmers can increase their incomes by up to two and half times as compared to field crops.

The findings of this study suggest that the most promising horticultural crops for exports include: citrus, potato, tomato, banana and mango. The figure below maps the trade data for four of these five commodities.

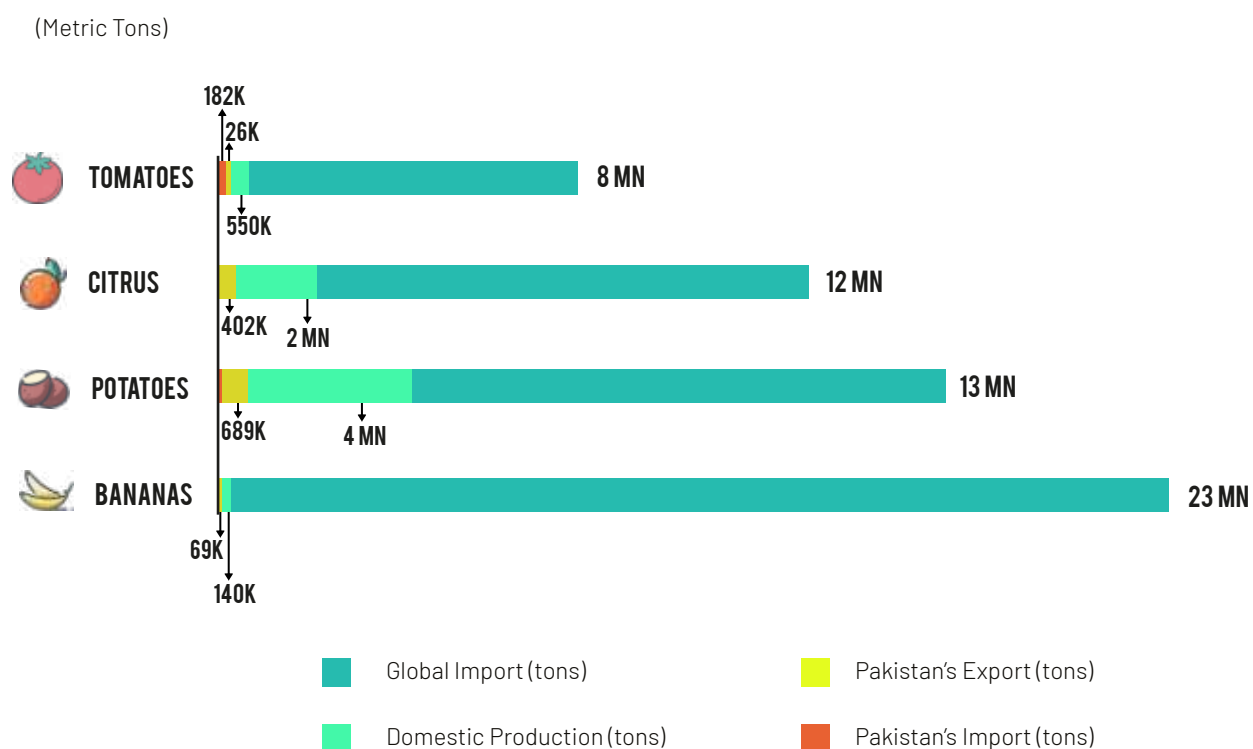


Figure 2 - Mapping domestic consumption and global demand for high potential commodities

Source: Calculations based on database sourced from ITC Trade Map and Agricultural Statistics of Pakistan 2017-18, Ministry of National Food Security and Research (MNFSR), Government of Pakistan

As the figure suggests, export of a commodity is possible when there is sufficient domestic production along with global demand for the commodity. In Pakistan's case, citrus and potatoes have significant domestic production and the surplus is exported. Exports of banana and tomato are insignificant, partly because of limited domestic production. Demand for mangos has not been mapped due to paucity of data. Conventionally, Pakistan's focus has been on self-sufficiency in food, rather than becoming a player in the food global value chain.

With crop yields being discernibly lower than international benchmarks, Pakistan's farm production has limited space for exports. There is evidence to suggest that Pakistan should focus on improving its crop productivity, increasing acreage under horticultural crops, upgrading market systems, and expanding the associated downstream industry. By doing so, it can become an exporter in the following:



**Citrus and
its juices**



**Potatoes, fries
and chips**



**Tomato and its
paste and puree**



Bananas



Mangos

In addition, onions, apples, and strawberries may have export potential in the future, given the global demand and domestic production in Pakistan, however at the moment Pakistan does not produce enough quantity of these commodities.

Furthermore, while dates are grown in Pakistan, the production volume is low and the global demand not so attractive. The demand for dates is regional, emanating pre-dominantly from the Middle East, and hence the overall global import demand for dates is low. This means that while the private sector can explore opportunities for exporting dates, its overall impact on national exports will remain proportionally small.

The sections which follow discuss the overall trends in the domestic and global markets for horticulture products and commodities, the state of the production system of fruits and vegetables in Pakistan, strategies to address bottlenecks, and the way forward.



SECTION 1

The Marketplace for Horticultural Products and Commodities

Pakistan's Horticulture Production and Exports

Pakistan's horticultural exports are limited to a few commodities and the global market share for these exports is very low. Despite the optimism to see fruits and vegetables become export earning commodities, Pakistan continues to be a net importer of horticultural commodities. Figure 3 below shows Pakistan imported 2.5 times more vegetables than it exported, primarily due to USD 550 million in import of legumes.

Pakistan is a Net Importer of Horticulture Commodities

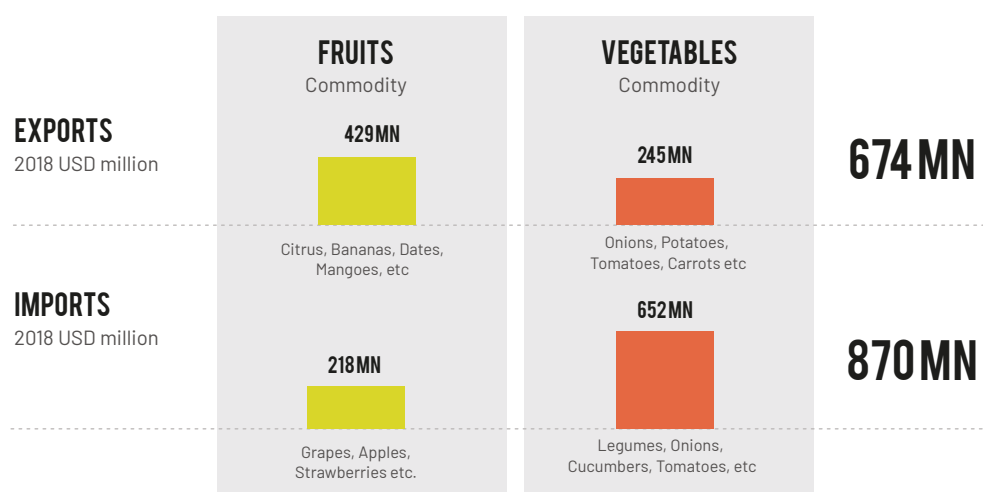


Figure 3 – Pakistan's trade balance in horticulture
 Source: Database sourced from ITC Trade Map

The top six commodities, namely citrus, dates, mango, potato, onion and tomato which are presently being exported from Pakistan constitute roughly 80% of the total exports of the horticulture sector. Figure 4 shows that citrus (orange) is the highest exported commodity in value terms, followed by potato and dates. While for citrus and potato, Pakistan's share in world exports is 1.5% and 2.8% respectively in 2018, for dates the share stands higher at 5.8% because overall global trade for dates is low. Furthermore, frequent regional trade disruptions with India, a major export destination for dry dates, results in volatility in its exports².

The global market share for mangos cannot be ascertained since mango is clubbed together with guava under a single HS Code, HS-080450. Mango is a niche commodity in the global market, whereby mango production is not as ubiquitous as, for example, citrus and banana. The global share of guavas and mangos is USD 3.2 billion, which is 1.6% of the global trade in horticulture. Pakistan can only achieve marginal gains by exporting mango as a commodity. However, since Pakistan is a grower of mango, and continues to make efforts to bring its mango to the world market for its distinct flavor and aroma, this study suggests mango as one of the products for export.

² Based on ITC Trade Map data accessed in January, 2020.

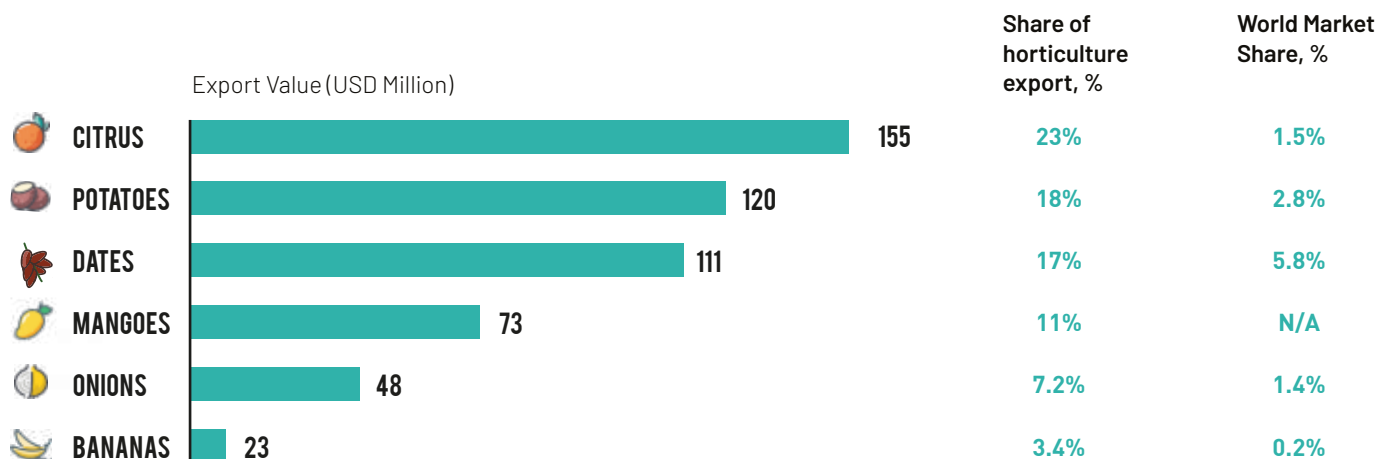


Figure 4 - Pakistan's exports of horticulture commodities in 2018

Source: Database sourced from ITC Trade Map

In Pakistan, most of the horticulture produce is consumed domestically, and its domestic demand is increasing with the growing population and rising disposable incomes. Approximately, 91% fruit is consumed locally, 6% is exported, and the remaining 3% is processed into value added products such as pulps, juice, concentrates, frozen and preserved products including drinks, jams, jellies and pickles. Figure-5 shows Pakistan's export by processed food products. The global market share for each category is also given.

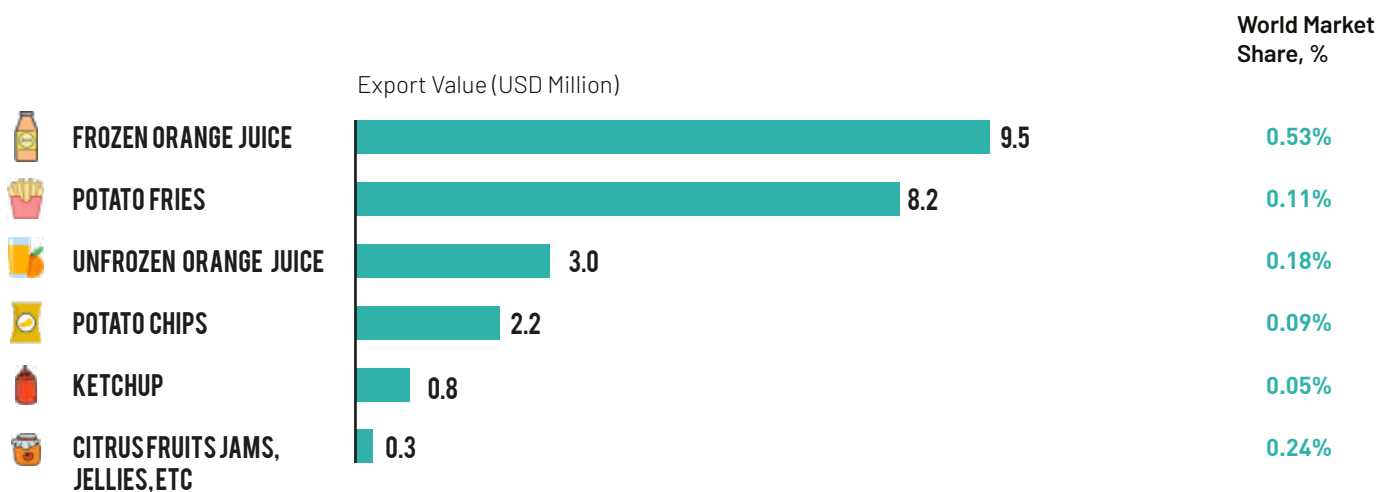


Figure 5 - Export of horticulture products from Pakistan in 2018

Source: Database sourced from ITC Trade Map

Data in this section suggests that Pakistan has a negligible footprint in the global market for horticultural commodities and processed products. In order to make an entry into the global value chain, the first step is to identify the exportable products which may provide appreciable export earnings. Without choosing a mix of fruits and vegetables which have a global demand, it may be difficult for Pakistan to increase its horticultural exports.

Global Trends in Horticulture

It is important to note that the global volume of trade in horticulture commodities is higher than that of horticultural processed food products. Whereas the demand for horticulture commodities is diversified, there are only a small number of processed products which have an extensive global demand. Of the top ten globally traded horticulture commodities, Pakistan exports only citrus and potatoes in reasonable quantities. Processed food products of both of these commodities have a high international demand.

Commodity Trade •

The overall global trade and demand for horticulture commodities has increased over time. It has quadrupled, from USD 51 billion in 2001 to USD 200 billion in 2018 as shown in Figure 6. Trade has grown six times for fruits and three and a half times for vegetables. The cumulative growth was higher between 2001 and 2010 at 157%, after which it slowed down to 51%. Table 1 shows the most traded horticulture commodities across the globe in 2018.

Increase in global demand for fruits and vegetables from 2001 to 2018

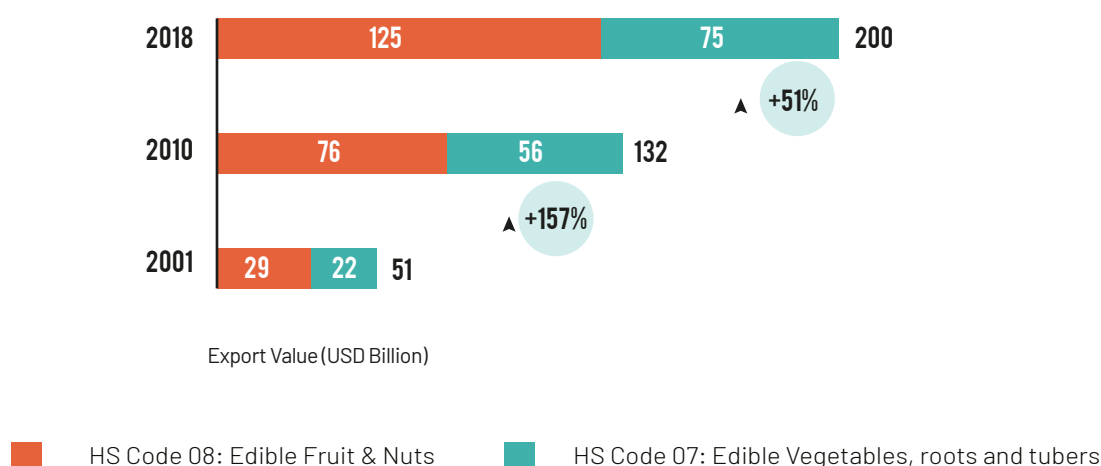


Figure 6 - Global Trade in horticulture commodities

Source: Database sourced from ITC Trade Map

USD Million			
Top 5 Fruits Exported	Exports	Top 5 Vegetables Exported	Exports
Bananas	12,945	Tomatoes	9,524
Citrus	10,856	Capsicum / Pimento	5,426
Fresh Grapes	8,564	Onions and shallots	3,546
Apples	7,633	Potatoes	3,308
Avocados	5,551	Cucumbers and gherkins	2,720

Table 1 – Highest exported horticulture commodities by world in 2018

Source: Database sourced from ITC Trade Map

Pakistan has been unable to capitalize from the growth in global demand due to a lack of focus and inadequate investment in requisite infrastructure such as cold chain, packing houses, proper logistics, and processing units. Most of the cold storages and processing units are based on inefficient technology and machinery.

Amongst the top five traded fruits in the world, Pakistan exports only two, orange and banana. Apple and grape plantations in Pakistan lack the quality and variety required for exports and are suitable only for domestic consumption.

Tomato is the most traded vegetable commodity in the world. Pakistan grows a significant quantity of table tomatoes, just enough to keep up with the domestic demand. It does, however, produce a surplus of potatoes and onions which are exported.

Performance comparison with Peer Producing Countries ●

Figure 7 shows Pakistan's comparison with countries having similar horticultural exports. In comparison to Viet Nam, Egypt and Peru, which grew their exports of fruits and vegetables since 2003 by about 12.8 times on average, while in the same time period Pakistan's exports grew only threefold i.e. from USD 171 million to USD 674 million. Should Pakistan have kept pace, its horticultural exports would have increased to USD 2.2 billion by the year 2018, hence losing an opportunity of USD 1.5 billion in annual exports.

Export Value (USD Billion)

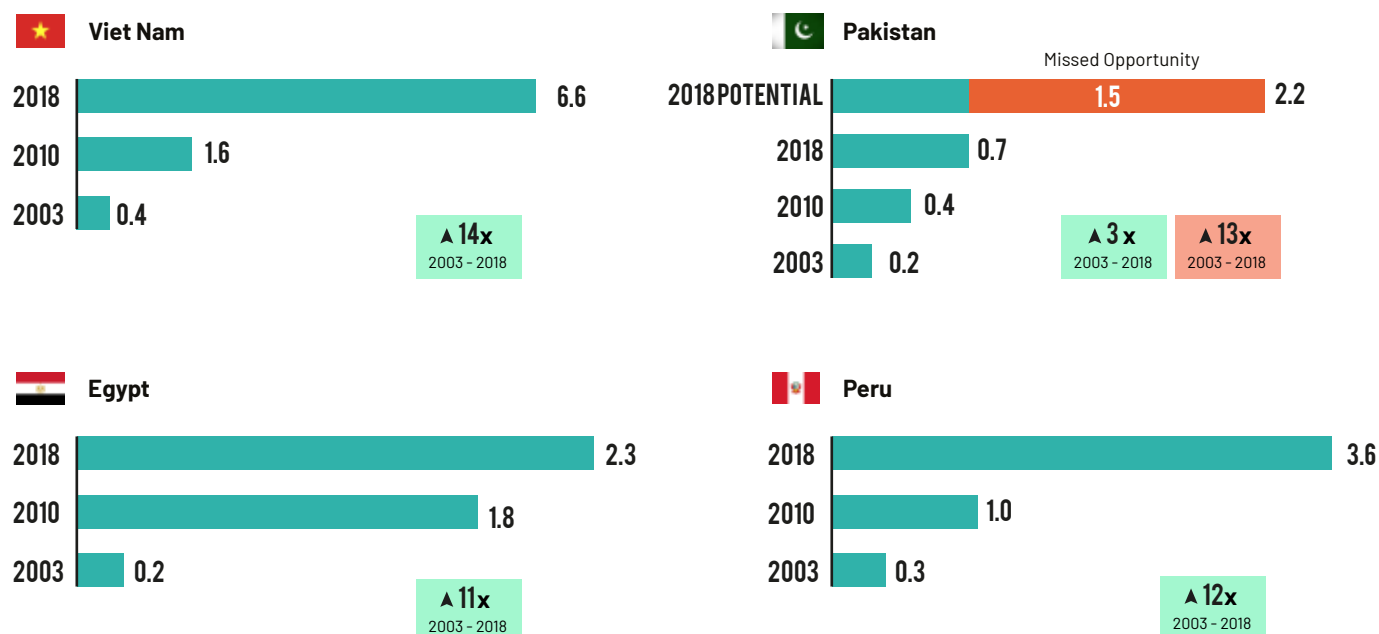


Figure 7 - Lost potential in horticulture export

Source: Database sourced from ITC Trade Map

The five top commodities exported by Pakistan's peers in 2018 are listed in Table 2.

USD Million

Viet Nam		Egypt		Peru	
Commodity	Exports	Commodity	Exports	Commodity	Exports
Fresh or dried cashew nuts	3,133	Oranges	770	Fresh grapes	763
Fresh tamarinds, cashew apples, jackfruit, lychees, sapodillo plums, passion fruit and carambola	1,561	Grapes	221	Fresh or dried avocados	722
Fresh or dried guavas, mangoes and mangosteens	330	Potatoes	206	Fresh cranberries, bilberries and other fruits of the genus Vaccinium	548
Fresh durians	266	Frozen strawberries, uncooked or cooked by steaming or boiling in water, whether or not sweetened	152	Asparagus	378
Fresh, chilled, frozen or dried roots and tubers of manioc "cassava"	151	Onions	131	Fresh or dried guavas, mangoes and mangosteens	247

Table 2- Export basket of Peru, Egypt, and Vietnam

Source: Database sourced from ITC Trade Map

Egypt has positioned its exports to cater to global demand, by prioritizing production of commodities which have global buyers. Vietnam produces a large quantity of cashew nuts, exporting USD 3.1 billion worth of the commodity, while Peru produces a range of niche fruits and vegetables.

Egypt's policies to promote horticulture exports •

Similarities between Egypt and Pakistan make it a pertinent case study to understand how Egypt increased exports in horticulture commodities. Egyptian agriculture is based on the canal network along the Nile River, similar to the Indus River in Pakistan. Egypt also underwent a structural adjustment, trade liberalization, and privatization programme in the 1990's just as Pakistan did. Furthermore, similar to Pakistan's practice, Egypt implements support prices for sugarcane and subsidizes domestic staples. Egyptian cotton competes with Pakistan's cotton in the global market. Egypt, however, exports a higher volume of horticultural commodities than Pakistan, which makes it a good example to learn from.

Increase in Egypt's horticultural exports can be attributed to reduction in state ownership of agricultural land and liberalization of price determination by market forces by discontinuing price fixing by the government, hence aligning production to both local and international demand, while bolstering productivity. Egypt underwent a Structural Adjustment Programme (SAP) with the International Monetary Fund (IMF) in 1991, which resulted in the removal of direct government interventions in the form of farm input subsidies, farm level price controls, and quotas of private sector licenses. The reduction in the role of government intervention brought changes in the crop selection and volumes planted. Previously, the government had mandated crop rotation cycles, delivery quotas below international prices, and subsidized consumer prices.³

The Egyptian Ministry of Agriculture and Land Reclamation (MALR) developed and implemented a Sustainable Agricultural Development Strategy in 2009, which amongst other objectives, developed targets and implementation plans to achieve horticulture productivity and exports from the country. Since then the Egyptian farming sector has developed strong institutional networks which encourage market based decision-making by farmers also keeping in view export demand.⁴

There are over six thousand agricultural cooperatives with four million members which can access credit through the Principal Bank for Development and Agricultural Credit (PBDAC).⁵ Furthermore, these associations are helpful in the dissemination of market information, providing extension services, and improving the supply chain for exports. In doing so, the Egyptian government has provided assistance in

³ Pautsch, G.R., and Abdelrahman. (1998). Effects of Egyptian Economic Reforms: the horticulture sector. Center for Agriculture and Rural Development, Department of Economics, Iowa State University.

⁴ Ministry of Agriculture and Land Reclamation, Government of Egypt. (2009). Sustainable Agriculture Development Strategy towards 2030. Cairo, Egypt.

⁵ Kassim, et al. (2018). An Agricultural Policy Review of Egypt: First Steps Towards a new Strategy. Regional Program, International Food Policy Research Institute.

establishing a cold chain system. There are also other private sector bodies such as the Horticulture Export Improvement Association (HEIA) and Agricultural Export Council (AEC) which play a supportive role in export promotion. For example, in 2003, HEIA established a dedicated Airport Perishable Terminal for storing export goods with limited shelf life.⁶

Egypt has been exporting its horticulture commodities to the Russian Federation, the European Union and the Middle Eastern markets for over fifteen years. Egypt's top export destinations for horticulture produce for the year 2003 and 2018 are listed in the table below:

		USD Thousand	
Country	Export Value 2018	Country	Export Value 2003
Russian Federation	344,118	Russian Federation	27,366
Saudi Arabia	300,405	Italy	21,821
Netherlands	175,556	Saudi Arabia	19,740
United Kingdom	131,694	Germany	17,365
United Arab	101,249	Greece	12,108

Table 3 – Egypt's top five horticulture export destinations

Source: Database sourced from ITC Trade Map

Recently, Egypt has started exporting its horticulture produce to China. In 2018, Egyptian horticulture exports to China were valued at approximately USD 64 million, but stringent sanitary and phytosanitary (SPS) requirements by China remained a hurdle. In 2018, the Egyptian government and the Agricultural Export Council held talks with their Chinese counterparts to ease restrictions of horticultural exports from Egypt. Box 1 below highlights collaboration between Chinese firms and Egypt in agricultural production.

⁶ Fitch, J. et al. (2005). Horticulture Export Improvement Association Final Evaluation. Development Associates Inc.

BOX 1

Egypt's Green House Project with China

Land reclamation is an integral part of Egypt's agricultural policy since ninety percent of its land is desert. Greenhouses provide an alternate technology for land reclamation and result in improved efficiency of water utilization, a scarce resource in Egypt.

Under the Belt and Road Initiative (BRI), Egyptian Government partnered with a Chinese firm, China Sinomach Heavy Industrial Corporation, for construction of 2,390 greenhouses covering an area of 3,900 hectares. It is a part of the Egyptian Government's National Greenhouse Project to construct 10,000 greenhouses – making it the biggest greenhouse project in the Middle East and North Africa. The joint project will cost USD 400 million. At the end of its first phase, six hundred greenhouses are now operational. These largescale greenhouses produce commodities ranging from tomatoes, cucumber, peppers and beans. Apart from constructing greenhouses, the Chinese company has provided technical support for better production techniques. The greenhouses also have attached modern service stations for sorting, packing and grading the produce. The target of the project is to produce exportable surplus for regional economies.⁷

It is important to note that China Machinery Engineering Corporation (CMEC), a subsidiary of Sinomach is operating in Pakistan and has shown interest in agricultural projects. The company is collaborating with Fatima Fertilizer to produce seeds, agricultural inputs and processed food in Pakistan.

Box 1 – Egypt's Green House Project

⁷ Liangyu, (10th April, 2019). China's greenhouse technologies turn Egypt's deserts green, Xinhua. Retrieved 27th April, 2020 from: http://www.xinhuanet.com/english/2019-04/10/c_137966152.htm

Processed Horticultural Food Trade •

Processed horticulture food products have shown a marginal increase in global trade between 2014 and 2018. The market size grew cumulatively from USD 75.8 billion to USD 80.9 billion, or by 6.7%. During the same time period, horticulture commodity trade increased by 15.7%, from USD 173 billion to USD 200 billion. The product space for processed horticulture food segment is concentrated in the following categories.

Product	USD Million				
	2014	2015	2016	2017	2018
Grapes juices, alcohol and wines	35,859	32,777	33,466	35,706	37,452
Potatoes preserved, fries and chips	9,385	8,556	9,341	10,072	10,773
Citrus juices, frozen and non-frozen, and jams	6,964	6,346	6,386	6,837	7,030
Tomatoes preserved, juices, and pulp	7,196	6,522	6,230	6,181	6,366
Mushrooms and truffles, cooked, sliced, and powdered	2,802	2,785	2,963	3,500	4,136
Frozen Strawberries	1,166	1,100	1,121	1,195	1,382
Various preserved categories of fruits, vegetables and nuts	7,452	7,215	7,373	8,025	8,807
All other products	4,959	4,899	4,823	4,806	4,939
Total	75,783	70,201	71,705	76,323	80,883

Table 4 – Global trade of horticulture products

Source: Database sourced from ITC Trade Map

Table 4 shows that the largest global share of horticulture products is of grapes and its alcohol based derivatives. In fact, over half the total global trade is made up of grape based products such as juices, wines, and alcohol. Pakistan has limited grape production and its socio-religious norms do not permit producing alcohol for consumption by its Muslim population.

Pakistan however has domestic capacity to produce other major value-added categories. Pakistan's top two exported horticultural commodities are citrus and potato, which means that Pakistan can explore value addition in these two commodities for increasing exports. Pakistan should channel its resources and prioritize higher production of citrus and potato.

Amongst the other top categories of products in demand across the globe, Pakistan produces a significant volume of tomatoes and bananas. Keeping in view the existing commodities grown, Pakistan should also encourage plantations of better quality bananas and tomatoes for export.

Citrus

Pakistan's exports of citrus grew almost nine-fold between 2003 and 2014, from USD 22.6 million in 2003 to USD 192.6 million in 2014, following which growth declined before recovering marginally, as seen in the figure below. The decline in exports in the period of 2013–2017 can be attributed to the increase in pest infestation, fall in productivity, and supply of better quality produce from competing countries.

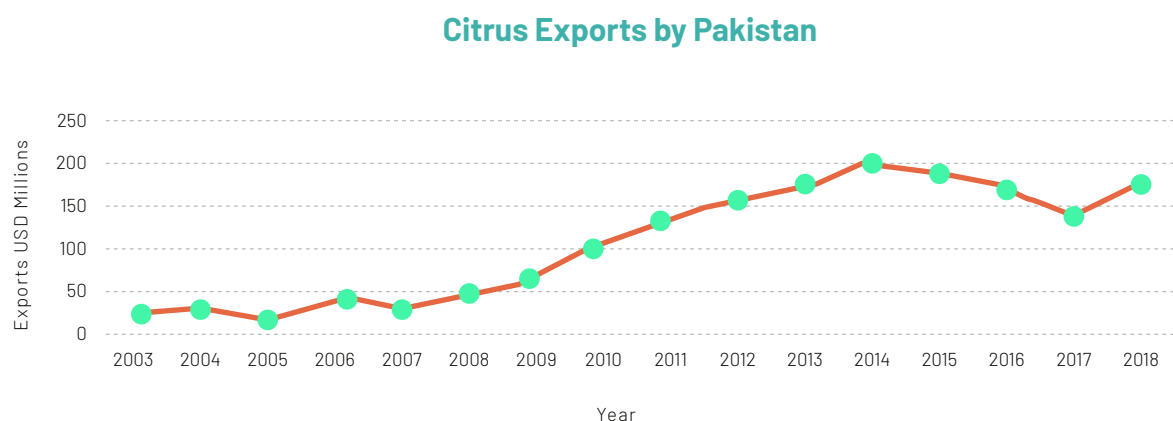


Figure 8 – Pakistan's export of citrus since 2003
Source: Database sourced from ITC Trade Map

Although citrus has a significant share in Pakistan's horticulture production, its share in global trade is only 1.5%. Pakistan's total exports of citrus in 2018 were roughly USD 155 million and the global trade was about USD 11 billion.

USD Million		
Product	Pakistan's Exports 2018	Global Imports 2018
Citrus	155	10,856

Table 5 – Pakistan's citrus exports in 2018
Source: Database sourced from ITC Trade Map

Figure 9 shows the top five export destinations for Pakistan's citrus in 2018. Pakistan exported citrus primarily to its regional neighbors, the largest buyer being Afghanistan.

Pakistan's top five export destinations for citrus in 2018

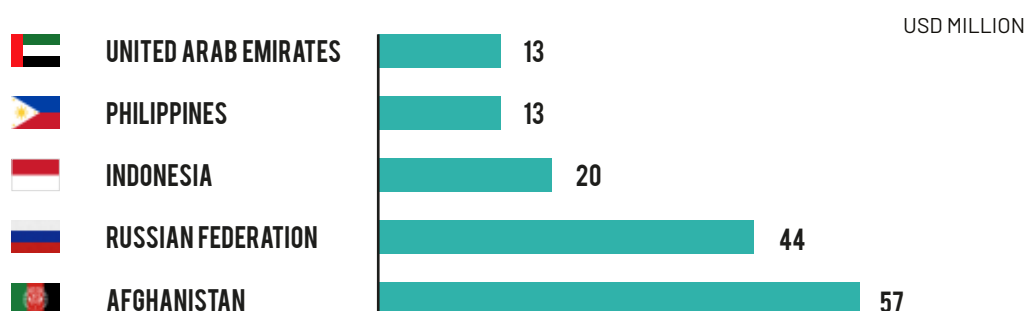
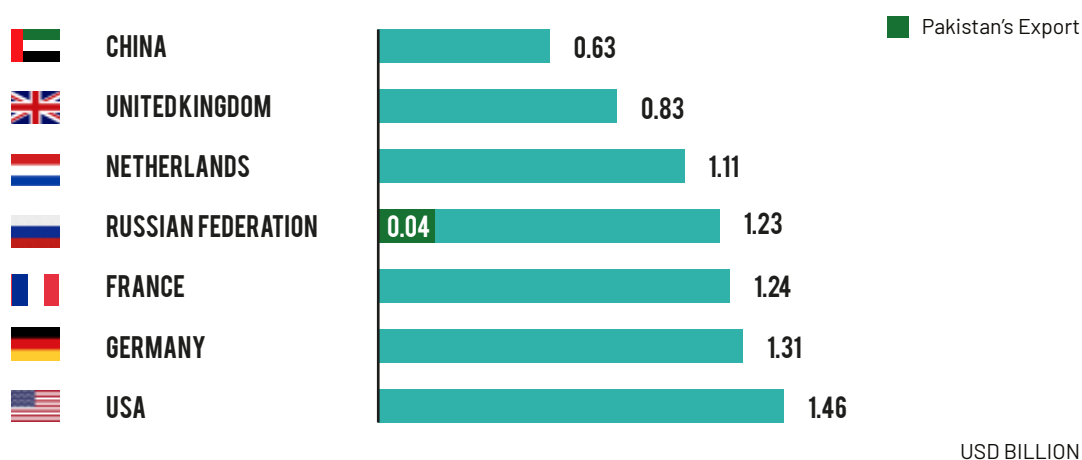


Figure 9 - Pakistan's export destination for citrus in 2018
Source: Database sourced from ITC Trade Map

Pakistan has been unable to export citrus to the major importing countries of the fruit. Therefore, there is a need for Pakistan to diversify its export destinations for citrus to include Europe, USA and China. As shown in Figure 10, amongst the top seven importers of citrus, Pakistan only exported to Russia, accounting for 3.5% of Russia's import demand for citrus valued at USD 1.23 billion in 2018. Pakistan did not export to any other of the top seven largest importers, which imported USD 6.6 billion worth of citrus in 2018. With its current exports of citrus amounting to under USD 200 million, even a marginal increase in the global market share can increase Pakistan's overall export earnings significantly from the horticulture sector.

Largest global importers of Citrus in 2018



Pakistan has not been able to export citrus fruit to any of the largest global importers of citrus fruit, other than to Russia

Figure 10 - Top importers of citrus globally in 2018
Source: Database sourced from ITC Trade Map

In order to increase its international outreach, Pakistan will need to diversify and upgrade its citrus orchards to grow a wider range of varieties. Punjab produces 97 percent of total citrus fruits in Pakistan.⁸ The main variety of citrus grown in Pakistan is Mandarin “Kinnow”, which accounts for 90 percent of the total harvest. The other variety of Mandarin cultivar in Pakistan is Feutrell’s Early. Other than Mandarin, Pakistan grows sweet oranges, most prominent of which is Musambi.⁹ The high number of seeds in domestically produced Kinnow is a binding factor in the export of the variety. There is consumer preference for the seedless hybrid mandarin variety, which is not cultivated in Pakistan. While data on international demand by fruit varieties is unavailable, therefore using production volumes as an indicator of demand, the two most popular varieties grown by the top orange producing countries, namely USA, Spain and Egypt, are the Navel orange and the Valencia orange. Pakistan has limited harvest of both these varieties of oranges.

Pakistan should make efforts to access markets which import significant volumes of citrus. Issues pertaining to fruit-fly and compliance of international standards hamper Pakistan’s entry into these markets. More detail regarding impediments is given in Section 2 of this report.

In addition to exporting citrus commodities, Pakistan also exported processed citrus products. These included orange juice (frozen and unfrozen) and jams, jellies and marmalades. Exports from citrus products in 2018 was about USD 12.9 million as shown in Table 6 below.

Product	Pakistan's Exports 2018	USD Million
		Global Imports 2018
Frozen orange juice	9.6	1,812
Non-frozen orange juice	3.0	3,885
Citrus fruit jams, jellies, marmalades, purées or pastes	0.3	124
Preserved citrus fruit	-	846
Total – Products	12.9	6,667

Table 6 – Pakistan’s export of citrus products
Source: Database sourced from ITC Trade Map

⁸ Based on data from Ministry of National Food Security, Government of Pakistan and Punjab Agricultural Statistics, Government of Punjab, Pakistan.

⁹ Siddique, I. M., and Garnevska, E. (December, 2017). Citrus Value Chain(s): A Survey of Pakistan Citrus Industry, Agriculture Value Chain, Gokhan Egilmez, IntechOpen

The figure below shows Pakistan's export trend for frozen and non-frozen orange juice between 2003 and 2018, which shows that the export volumes are low. Over the last five years, approximately half the exports of frozen orange juice were made to the Netherlands and the rest to Spain, India, Thailand, Sri Lanka and China. Varying volumes of non-frozen orange juice was exported to Afghanistan, United States of America, United Kingdom, United Arab Emirates, Germany, and Canada.

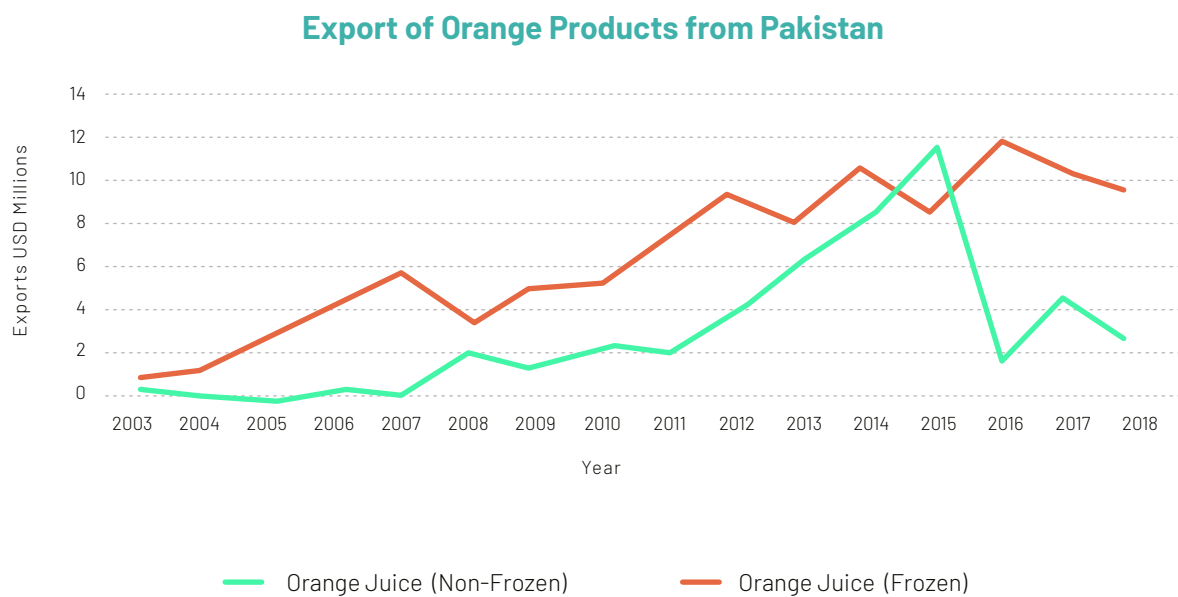


Figure 11 - Export of Orange Products from Pakistan
Source: Database sourced from ITC Trade Map

The overall trade market for orange juice is close to USD 6.7 billion. It is the third largest horticulture product that has a global market after grape and potato based products. Pakistan has the production base for citrus, and should therefore focus on increasing citrus based product exports.

Pakistan already has two of the world's largest orange juice manufacturing companies, including PepsiCo (Tropicana) and Coca-Cola (Minute Maid). These firms should be encouraged to source inputs for production locally and to export products from Pakistan. Bottlenecks pertaining to production are detailed in Section 2 of this report.



Potato

Potato is the largest vegetable commodity exported from Pakistan. Pakistan's export share in the global commodity market for potatoes was 2.8% in 2018, twice that of citrus. The global demand for potatoes was USD 4.6 billion in 2018, much lower than citrus, which was USD 11 billion in the same year. However, the global market of processed potato products (fries and chips) at USD 10.4 billion is much higher than it is for potato exported as a commodity.

	USD Million	
Product	Pakistan's Exports 2018	Global Imports 2018
Potatoes, fresh & chilled	121	4,587

Table 7 – Exports of potatoes from Pakistan in 2018
Source: Database sourced from ITC Trade Map

Exports of potato have increased by sixteen-fold in the last fifteen years, from USD 7.2 million to USD 121 million in 2018. In 2013, exports touched USD 130 million but then stagnated. Figure 12 below shows exports of potato from Pakistan since 2003.

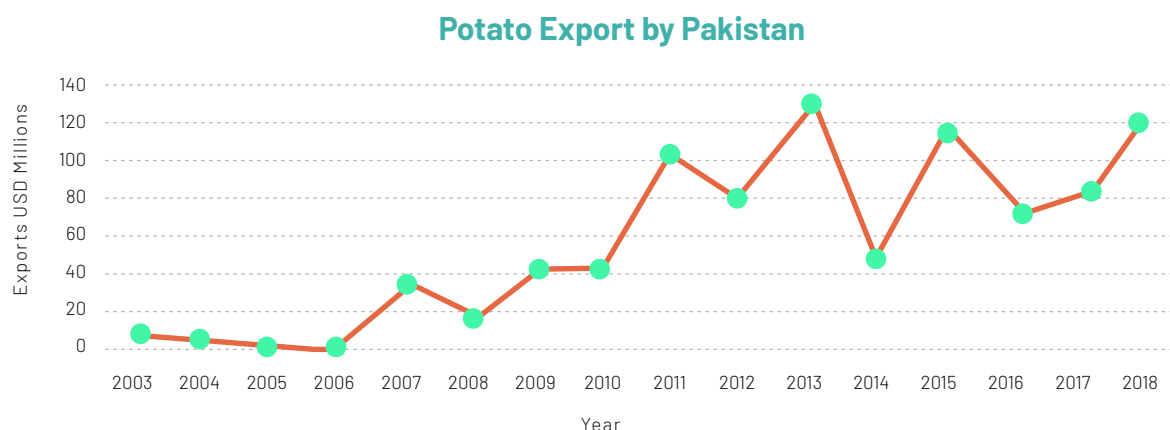


Figure 12 – Export of potatoes from Pakistan
Source: Database sourced from ITC Trade Map

Figure 13 shows the top five export destinations for Pakistan's potato. Afghanistan is the largest export market having bought USD 60 million of the commodity in 2018.

Pakistan's top five export destinations for Potatoes in 2018

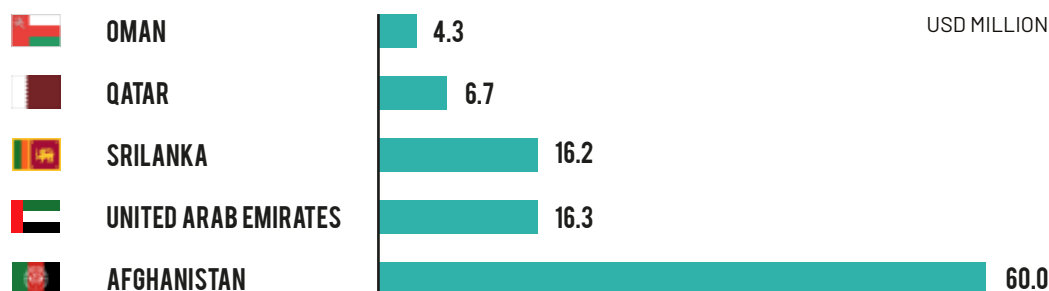
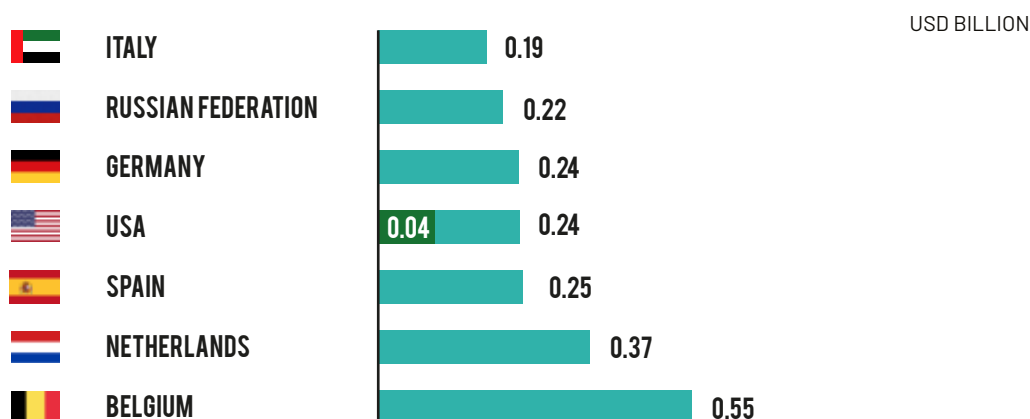


Figure 13 – Export Destination for potatoes from Pakistan in 2018
Source: Database sourced from ITC Trade Map

Similar to citrus, Pakistan does not export potatoes to any of the world's largest importing markets, and most of Pakistan's potatoes are exported to its regional neighbors. Figure 14 shows the seven largest global importers of potato.

Largest global importers of Potatoes in 2018



Pakistan has not been able to export potatoes to any of the largest global importers.

Figure 14 - Top importers of potatoes globally in 2018

Source: Database sourced from ITC Trade Map

In processed potato products, potato fries and chips are exported by Pakistan. The exports of potato products from Pakistan are mainly to Afghanistan, followed in limited amounts to the UAE, Qatar and Oman. As noted above, the share of potatoes in global trade as food products is higher than as commodity. The global trade amounted to USD 10.4 billion in 2018, USD 3 billion more than citrus based processed products.

USD Million		
Product	Pakistan's Exports 2018	Global Imports 2018
Potato Chips	2.2	2,513
Potato Fries	8.3	7,871
Total Products	10.5	10,384

Table 8 - Pakistan's export of potato products and global demand in 2018

Source: Database sourced from ITC Trade Map

Only a limited number of companies dominate the frozen potato industry globally. The largest company is the Canadian firm, McCain Foods, which has an estimated global share of 31% followed by two companies from the United States of America, namely Lamb-Weston and J.R. Simplot with 22% and 17% global share respectively. Two Dutch companies, Aviko and Farm Frites follow these firms with 11% of global market share.¹⁰

¹⁰ Makki, S.S., and Plummer, C. (2005). Globalization of the Frozen Potato Industry. Journal of Agribusiness. Agricultural Economics Association of Georgia.

Fauji Fresh 'n Freeze is the only company in Pakistan which has installed a plant for processing frozen packaged potato fries, but does not match the quality of fries produced by the international firms, as they use patented varieties of potato. Therefore, it is indispensable for Pakistan to invite the international manufacturers of potato fries to Pakistan in collaboration with local companies. Issues relating to scaling manufacturing of potato fries will be highlighted in subsequent sections.



Tomato •

Tomatoes are cultivated on over 60,000 hectares in Pakistan with an annual output of 620,000 tons. However, Pakistan is unable to meet its domestic demand for fresh tomatoes. Tomato is cultivated in both Kharif and Rabi seasons, with availability in the domestic market throughout the year. To bridge the gap between domestic production and demand, Pakistan imports tomatoes. Globally, tomato is the most traded vegetable commodity after potatoes and citrus. Despite its export potential, tomato has not been given its due importance for increasing exports, both as a commodity and its derived products.

Tomato Commodity and Product Imports by Pakistan

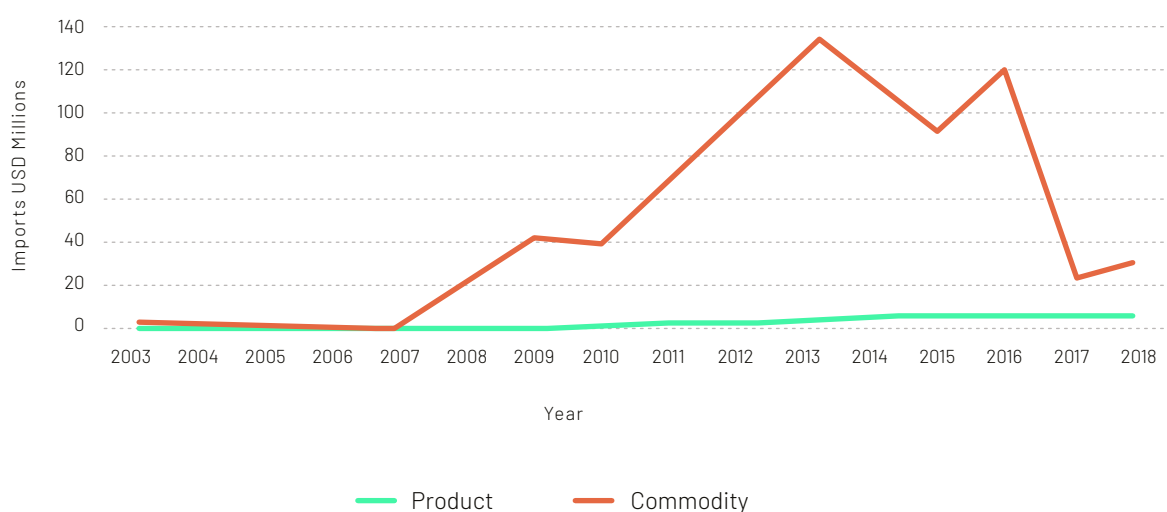


Figure 15 - Import of tomatoes in Pakistan
Source: Database sourced from ITC Trade Map

Pakistan imported a negligible quantity of tomatoes before 2007. Thereafter, imports of tomatoes grew up to USD 132 million in 2013 after which it has gradually reduced to USD 30 million. However, there has been an increase in the import of processed tomato products in Pakistan, from USD 0.37 million to USD 6.43 million, during the same period.

Increasing production of tomato will help substitute imports, and it can be used in making processed food, potentially for exports. In 2018, Pakistan exported USD 0.8 million worth of ketchup to a number of countries. Table 9 below shows the main export destinations. While the volume is very low, the range of export destinations proves that given the right environment and surplus raw material, Pakistan can increase its processed tomato exports.

Product	USD Thousands				
	2014	2015	2016	2017	2018
Canada	39	135	75	72	189
Kuwait	99	233	210	327	144
Afghanistan	119	93	153	81	135
United States of America	43	98	19	40	91
Australia	20	15	49	57	69
United Kingdom	19	55	59	43	55
Rest of the World	62	120	156	416	133
Total	401	750	721	1,036	816

Table 9 - Export destinations of ketchup from Pakistan

Source: Database sourced from ITC Trade Map

Pakistan currently imports tomato paste, which is the main raw ingredient used to produce ketchup. Tomato is processed into two forms, either into paste or puree. The paste is used in ketchup while the puree is used for home based cooking; there is little domestic demand for puree in Pakistan, but there is a growing demand for tomato paste.

The main hurdle in increasing capacity for tomato paste production is the unavailability of the required tomato varieties in Pakistan. Tomatoes required for making the tomato paste should have uniform ripening, with a homogeneous and intense color, a high solids content (brix level), low content of peel and seeds, low pectin levels and a pH level of about 4.3. The local variety of tomatoes grown in Pakistan do not meet these criteria, with low red color pigmentation and brix level.

The yield ratio for tomato paste from tomatoes is 1 Kg paste produced from 8 Kg tomatoes. Firms find it difficult to ensure a steady supply from local farmers, because a significant amount of additional land needs to be brought under tomato cultivation before tomato paste processing plants can operate. The tomato paste processing facility needs to be located close to the farms since the shelf-life of tomato is low without cold storage, and the paste also needs to be stored in a cool environment.

There are three major domestic producers of ketchup in Pakistan, National Foods Limited (NFL), Unilever, and Shangrila of which only NFL exports from Pakistan. NFL mainly exports to diaspora markets given its brand loyalty and recall, halal accreditation, and price competitiveness.¹¹

¹¹ Based on interview with representative of NFL

Tomato is the most traded vegetable commodity in the global market. In order to generate exports from the sector, Pakistan will benefit from producing more varieties of tomatoes. The cultivars of tomatoes grown in Pakistan are Money Maker, Roma and Rio-Grande which are cultivated globally as well. But these varieties are not suitable for industrial production and hence there is a need to introduce appropriate new varieties for processing tomatoes in Pakistan.



Banana •

Banana is the commodity with the highest demand in the global market. Pakistan's export of bananas has increased 22 times since 2003 from USD 1 million in 2003 to USD 22 million in 2018. Pakistan's banana exports are only to Afghanistan. The banana grown in Pakistan is of low quality, only suitable for low income countries. The production and quality of banana and its harvesting and post-harvest practices need significant improvement in order to compete in the global market. At the moment, the export potential of banana is low.

This section highlighted that Pakistan should focus on producing crops which have high global demand. These include citrus, potato, tomato and banana, and to an extent mango. Amongst these commodities, greater emphasis should be placed on developing and exporting citrus and potato.



SECTION 2

State of the Horticulture Sector: Impediments and Strategies for Improvement

Horticulture in Pakistan

Horticulture development can be categorized into five stages; subsistence, semi-commercial, commercial, value addition through processing, and value addition for high end products (Figure 16). Of the five stages, Pakistan falls in the third stage. It has graduated from semi-commercial scale farming and is currently in between commercial scale farming and value-added inputs for processing stage.

Stages of Horticulture Development



Subsistence Level

In this stage, fruit and vegetable production is in a low-productivity trap because of conventional technological level. The produce is sold in the domestic markets, and shortages are met with imports. Pakistan has achieved this stage.



Semi-commercial Level

In this stage, production practices are based on improved agricultural practices. High yielding varieties, and application of agrochemicals are adopted.

Fresh produce and some small scale preserved items are sold in the domestic market, with some unorganized sale of fresh produce surpluses in the region. Pakistan has achieved this stage.



Commercial Level

This stage involves improved harvest and postharvest handling with the advent of cold chains, improved grading, washing, waxing, Hot/Vapor Water Treatment, better packaging, improved transportation.

Pakistan has not witnessed much change in quality of supplies to the domestic market, but there has been some improvement in the postharvest handling of fresh fruits and vegetables for export market. Significant progress has been made, but there is still much room to develop in this stage.



Value addition through processing

In this stage, some basic level processing of fresh fruits into pulp and concentrates, and production of dehydrated and frozen vegetables takes place, due to sporadic growth in the number of processing units.

Pakistan is processing limited quantity of pulp – some of which is being exported. Production done is to meet the domestic requirements for reconstitution in juices and drinks, and of IQFed vegetables.



Value addition for high end products

This level involves production of reconstituted juices and nectars, baby food, preserved items (jams and jellies), canned fruits and fruit halves, halves, dry powder and chips, frozen food platters, kernel/stone oils, etc. There is also a steady growing demand for organic products.

Pakistan seems to be far off in reaching this stage, unless the local production of processed commodities is established, and joint ventures are negotiated with the leading food processors in the world market.

Figure 16 – Stages of horticulture development

At the existing stage of development, production of fruits and vegetables can be improved by adopting better practices in harvest and postharvest handling, grading and packaging, and use of better logistics to reduce losses during transportation. Currently, farm to market losses range from 30 to 40 percent for semi-perishable and perishable horticultural crops. While Pakistan is struggling in the third stage due to inadequate technological and managerial upgradation at the farm, there is a dearth of necessary infrastructure for grading, packaging, transport, storage and cool chains, and appropriate sanitary and phytosanitary (SPS) handling and processing techniques. Moreover, the absence of well integrated value chains linking the producers, market functionaries, exporters and processors has constrained investments in the horticulture processing sector development.

There are various methods to achieve value addition in horticulture production. Figure 17 below, details the value addition activities at each step of the value chain:



Figure 17 – Value addition at each stage of production

Impediments to Horticulture Exports

There are a number of issues pertaining to the development of the horticulture sector. The most critical is to achieve higher per hectare productivity to lower the cost of production and produce surplus for exports. Pakistan needs to address the following impediments in order to increase export of horticulture commodities and products:

Low yields and small exportable surplus: Pakistan's yield of horticulture crops is lower than its peer countries; without improving yields and overall production, it is difficult to envisage a substantial increase in export volume. The on-farm productivity can be discernably increased by cultivating better quality seeds and adopting modern techniques such as high density farming.

Inadequate knowledge base and poor farm management: Poor farm management results in inefficient use of resources, and significant wastage and harvest and postharvest losses. Antiquated methods of harvesting, postharvest handling, packaging and transporting results in 30 to 40 percent losses.

Introducing better quality seeds: Pakistan needs to introduce high yielding varieties (HYV) of seeds. The present boot strapped allocation for both public and private sector investment in research and development (R&D) is inadequate to develop high yielding seed varieties in line with emerging demands by the processing industry. The varieties of crops grown are suitable for domestic consumer preferences but there is a need to diversify production to cater for industrial needs and international preferences. The international firms are also hesitant to provide better seeds to Pakistan due to weak enforcement of the intellectual property rights and the practice of back crossing patented seed varieties.

Weak contract enforcement: Weak contract enforcement for contract farming discourages domestic and international investors in the agricultural sector. Without reliable supply by farmers at a pre-agreed price, a food processing enterprise cannot function reliably. In Pakistan the traditional Arthi centered market system is inefficient and does not offer a mechanism to industry for assured supply at a future price.

Price distortion: Government price control mechanisms distort market prices and serve as a disincentive to the farmers. Price controls by governments on fruits and vegetables also discourages farmers from growing horticulture crops, particularly vegetables.

Poor on-farm sanitary and phytosanitary (SPS) standards: One of the factors which inhibits the export of farm produce is the present level of health and hygiene conditions at the farm level. The absence of clean farmworker apparels, facilities for cleanliness such as washrooms and toilets, disposal of packing material of hazardous agrochemicals, etc. discourage foreign buyers from importing fresh and processed horticulture commodities and products from Pakistan.

Inadequate post-harvest physical infrastructure: Pakistan does not have cold-chain infrastructure which can cater to an export oriented fruits and vegetables processing industry. Since most fruits and vegetables

are perishable, they require a robust cold-chain to be transported from the farm to the factory gate. Significant physical and quality losses are due to the absence of cold chains, from producing centers to; wholesale and retail markets; processing and export exit points; packing houses; and facilities for complying with health and safety protocols required by importing countries such as hot water/vapor treatment, irradiation, etc.

Lack of protocols for certification of health and safety standards: Although the Plant Protection Department requires the exporters to procure their produce from SPS certified farms approved by them, the enforcement of health and safety protocols (such as HACCP, EuroGAP, Minimum Residue Level (MRL)) for pesticide, and its certification mechanism is almost non-existent. Pakistan's access to international markets are limited due to weak mechanisms to ascertain compliance with SPS standards. Furthermore, lack of protocols, traceability, prevalence of diseases, and unchecked use of pesticides prevents commodities to reach countries with higher standards' requirements.

Traditional informal crop contracting system: Most farmers sell their produce to farm contractors (thekedars) through verbal or written contracts. There is a need to standardize the written contracts and its compliance mechanism in case of breach by either party. This will provide protection to contracting parties in case of disagreement and disputes.

Absence of assured supply of raw material to processors: One of the constraints faced by the processors is the lack of a mechanism for smooth and uninterrupted supply of raw material for processing. This could be achieved through introduction of contract farming which binds the farmers to supply and the processor to procure contracted quantities at a predetermined price. Although some processors, particularly potato and maize products processors, are entering into such agreements with success, there is need to develop and standardize such contracts.

Other factors negatively impacting the farmer's decision to plant horticultural crops: The water requirement for horticulture crops is higher compared to the typical field crops such as wheat. Since the irrigation system is supply based rather than demand based, the system cannot allocate any additional water supplies for horticulture crops. Secondly, fruit trees require four to five years to mature and produce fruits. Only farmers with significant investment capacity prefer investment in fruits. Given the bootstrapped investment capacity of most farmers and the gestation time of the orchards, only financially sound farmers tend to invest in fruits and vegetables over field crops. Thirdly, uncertainty caused by weather patterns makes risk averse farmers prefer field crops. Untimely precipitations, hailstorms, windstorms, frost, and temperature variations can depress output. Furthermore, erratic market prices due to over or undersupply of commodities in the market influence farmer preferences towards non-perishable field crops.

The remaining section reviews each of the impediments mentioned above in detail and suggests solutions to overcome them.

Improving yields

The yields of horticulture commodities in Pakistan are well below the international averages. Figure 18 highlights this gap. In almost all commodities, the yield is about three times lower than the average of top three producing countries (with the exception of potatoes for which the yield is approximately half the world's average). Competing globally with such low yields is impossible.

Yield comparison of Pakistan's major horticultural commodities with that of global economies.

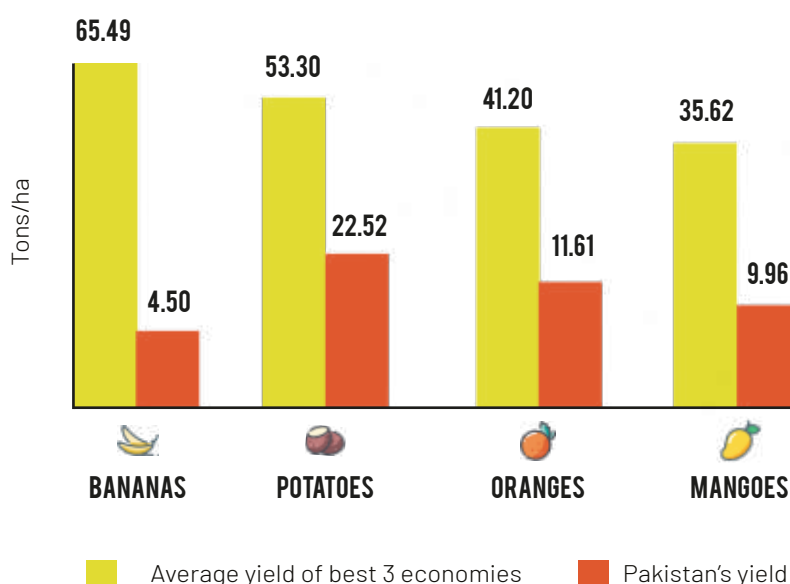


Figure 18 – Yield comparison of Pakistan horticulture with best three economies
Source: FAOSTAT Database

Yields can be improved by a number of methods, mainly by using technology and better farm management practices. Two methods which would be applicable in Pakistan are discussed below.

Ultra-High Density Plantation •

As the name suggests, Ultra High Density Plantation (UHDP) involves adoption of densely planted trees, spaced closer than in traditional farming methods. This method allows better allocation of resources by reducing per ton water usage and uses lesser inputs. UHDP, in conjunction with other sustainable agriculture techniques, can yield up to 300% more output than the traditional method of cultivation. Using UHDP method, on average 1,665 trees can be planted per hectare, whereas in the traditional method 170 trees per hectare are planted.

Densely populated trees in UHDP makes orchard management more efficient, since farmers can tend to more trees per hectare. The method requires that the height of each tree be limited to a maximum of seven feet, while trees in conventional methods can grow up to 100 feet. The key element to managing the height

and spread of trees in UHDP is to prune them regularly, especially when the tree produces new shoots.

Table 10 below compares the traditional, medium density and high density methods of orchard management.¹² Implementation of this technique for cultivation results in three times higher yield, reduces the use of water by output for irrigating by up to fifty percent, and increases the effectiveness of fertilizer during fertigation. Adopting UHDP in Pakistan will increase farm output and help make more produce available for processing and export.

Particulars	Traditional (69 trees/hectare)	Medium density (200 trees/hectare)	Ultra-high density (1665 trees/hectare)
Gestation period (years)	9	5	4
Duration for full potential (years)	15	8	5
Yield potential	Medium	High	Very high
Pruning	Very difficult	Manageable	Easy
Spray operation	Difficult	Manageable	Easy
Harvest	Very difficult	Manageable	Very Easy
Control on fruit quality	Impossible	Possible	Easy
Commercial orchard life (years)	Up to 50	30-35	20-25

Table 10 - Advantages of UHDP

There are two challenges in adopting this method. Sufficient water is required for the higher number of trees, which can be a binding factor for many farms under UHDP. Furthermore, it will require farmers to replace their existing orchards and wait for years before harvest, unless the transition is staggered by replacing old and inefficient trees first. The gestation period for UHDP is a disincentive to farmers because there is:

1. An Opportunity Cost (loss of income) for five years before high-productivity harvest.
2. No domestic model farms to validate effectiveness of switch-over to UHDP.
3. Fear of excess supply in domestic market resulting in low prices, unless surplus is processed or exported to maintain profitability.

¹² Kumar, N. (January, 2019). High Density Planting in Mango – Prospects and Problems. Advanced Agricultural Research & Technology Journal, Volume III, Issue I. India.

Better Seeds

Increasing yields by introducing pure seeds of high yielding varieties (HYV) is the most effective method to increase output. At present, there are a limited number of domestic seed companies. Because of variation in quality, most farmers rely on imported vegetable seeds. The yield and quality of imported seeds is variable.

The market size for vegetable seeds in Pakistan is small, which does not encourage reputed international firms to undertake R&D for the domestic market. Moreover, large international companies are reticent to introduce new varieties in Pakistan due to the weak enforcement of intellectual property rights.

There are two mechanisms for seed supply in Pakistan – the formal and informal networks. In the informal network, farmers rely on word-of-mouth and are careful in shifting to new varieties. They use seeds from the previous harvest, or purchase from seed shops or through the Arthi. Arthi is the market functionary who procures commodities from farmers to sell in the market and farmers often rely on Arthi as a source of seeds.

The traditional system of seed application needs to be overhauled gradually in order to provide farmers better seeds which generate better quality and higher output. There is hesitation by farmers to adopt Genetically Modified (GM) seeds since they are expensive compared to domestic seeds. While it is a valid concern, the increase in output supersedes the cost of procuring new seeds. Additionally, GM crops carry certain risks, in particular the issue of backcrossing. It refers to migration of genes from GM plants to conventional crops, which may affect food safety or security. Countries have adopted strategies to have a clear separation of fields where GM and conventional crops are grown to reduce cross pollination.

The registration of new seeds, whether developed by public or private sector is a time consuming process. The breeder seed is evaluated by the provincial and federal agriculture research and extension departments, and provincial and federal seed councils based on three-year data. A firm developing a new seed has to follow a sequence of steps:

- A breeder seed is developed and the firm/institute conducts in house micro trials.
- After successful trials, zonal trials are undertaken.
- Federal Seed Certification and Registration Department (FSC&RD) conducts Distinctness, Uniformity, and Stability (DUS) tests on the seeds' morphological characteristics. Simultaneously, Pakistan Agriculture Research Council (PARC) reviews its Value for Cultivation and Use (VCU) to ascertain its agronomic characteristics such as resistance to diseases and defects.
- Upon successful evaluations, FSC&RD takes further input from Federal Seed Registration Committee and Provincial Technical Expert Sub-Committee.
- After further reviews from committees, it is then submitted to Provincial Seed Council (PSC) and National Seed Council (NSC) which reviews and tests it. The NSC provides final approval and release for commercial seed production.
- The approval process takes a minimum of four years after which a seed can go into commercial production through seed multiplication, which also takes additional time.

The process of seed development is costly and requires R&D. Public investments made into R&D in Pakistan are undertaken by educational and research institutes. The Government funded institutes develop new varieties, but the transfer of knowledge to farmers is limited, and these institutes are unable to scale production to meet demand. There is an issue of asymmetric information between these institutes and farmers.

Commercial import of seeds is also a prolonged process. Two years of testing needs to be undertaken to check for adaptability on multiple locations before allowing commercial import. The seeds are then approved and notified by the FSC&RD. Tests and trials on VCU are undertaken by PARC before import is permitted. Imported seeds have to comply with labeling and marking requirements of the Federal Government before sale to registered seed dealers and companies.¹³

Pakistan should prioritize domestic seed development of the identified fruits and vegetables, by developing seed varieties which are most suited to its agronomic characteristics. At the same time, it should import seeds which have high yields from the international markets. R&D should be undertaken in conjunction with international institutes and firms that have access to greater technological facilities and expertise. Although, international firms are hesitant to supply seeds to Pakistan, and their concerns will have to be allayed.

Enforcement of Seed Breeders Act •

PepsiCo has over 80,000 variants of potato seeds, yet the company is hesitant to bring its varieties to Pakistan. Bayer, parent company of Monsanto has a similar approach. Multinational Companies (MNCs) are wary of introducing new seed varieties in Pakistan due to a lack of intellectual property rights for registered seeds. Local producers use methods to illegally back-cross seeds to develop local varieties, compromising intellectual property ownership rights. While it is beneficial to producers in the short run, in the long run it causes harm to agricultural development and output, since Pakistan loses out on accessing new technologically improved seeds.¹⁴

With the introduction of Plant Breeder Rights Act 2016, the Government provided the framework needed for intellectual property rights. The Act provides protection to new plant variants, while protecting farmers' rights to save and re-sow harvested seed. This is a positive step in building confidence of firms to import high grade seeds and invest in domestic R&D. However, due to the absence of an enforcement mechanism of the Act, firms are still hesitant to deploy new seed varieties. There is a need to establish and execute proper screening processes, registration procedures and enforcement. Since the license issuance authority vests with the Ministry of National Food Security and Research, it needs to take a lead in prescribing rules and mechanisms for grievance redressal as well as enforcement of the law. The rules developed by the Ministry should include a procedure which provides mechanisms for lodging complaints, arbitration and effective enforcement.

¹³ Ali, M.A., (October, 2018). Seed System in Pakistan (Standards and Procedures). Presentation at International Rice Training Workshop for Agriculture Professionals, Plant Sciences Division, Pakistan Agriculture Research Council.

¹⁴ Based on interviews carried out by the research team with representatives of Bayer (formerly Monsanto) and PepsiCo.

Contract Enforcement

The lack of contract enforcement and prevalence of informal networks in Pakistan has dissuaded investments and upgradation in horticulture. Manufacturing operates through formal channels and needs assured supply of raw material. Without binding legal instruments that have an inbuilt grievance redressal mechanism, firms are unwilling to invest capital. Firms that have invested in manufacturing, find it difficult to procure commodities at predetermined prices. Despite difficulty in navigating through informal channels, a couple of companies in Pakistan have successfully implemented contracts with farmers.

Honoring contracts between manufacturing firms and suppliers/vendors allow buyers and sellers an assured market at pre-existing prices. Interestingly, it also helps increase yields of crops. A Food and Agriculture Organization (FAO) study on potato farms in India calculated the yield on farms that contracted with PepsiCo and adopted the prescribed practices. Yields in some farms went up to 44 tons/ha while the average yield in India is 19 tons/ha.¹⁵ PepsiCo is the largest procurer of potatoes in Pakistan and buys around 25 percent of all potatoes produced in Pakistan through contract farming.¹⁶

Potato tubers provided to farmers by PepsiCo have been multiplied for domestic production, used by other firms for manufacturing, and are also sold in the open market. While it has helped the economy in the short run, it has dissuaded PepsiCo to introduce further and better varieties. This also damages Pakistan's international reputation and it will be harder now to attract other international food companies to invest capital and introduce new seeds. A similar case occurred in India, where PepsiCo sued farmers in Gujarat unlawfully selling potato seeds registered with PepsiCo.¹⁷

Traditional collection mechanism •

Agglomeration of commodities is essential for industrial manufacturing and processing, which is difficult to achieve through traditional systems. The wholesale markets in Pakistan are antiquated and operate informally. Horticulture collection system is dominated by the Commission Agents (Arthis), who also act as wholesalers. The Arthi also acts as a financier to farmers and provides them with credit.

A small share of the produce is procured directly by pack houses for packing and grading. In rare cases, orchards and farms are able to export their commodities to international buyers. This structure discourages advanced production methods. Outmoded systems of agricultural practices empower Arthi as the dominant market intermediary. Lack of formal channels of financing and credit at the farm level further provides leverage to the Arthi.

¹⁵ Punjabi, M. (2015). The Potato Supply Chain to PepsiCo's Frito Lay. Food and Agriculture Organization. India

¹⁶ Based on Ministry of National Food Security data and PepsiCo figures of potato procurement

¹⁷ Dave, A. and Bhardwaj, M. (26th April, 2019). PepsiCo sues four Indian farmers for using its patented Lay's potato, Reuters. Retrieved 27th April, 2020 from: <https://www.reuters.com/article/us-india-pepsi-farmers/pepsico-sues-four-indian-farmers-for-using-its-patented-lays-potatoes-idUSKCN1S21EL>

Since Arthis do not have the incentive to add value through packing, sorting, and grading produce, the commodities are hauled in rudimentary manner from farms to consumers. Resultantly, there is a significant loss of fruits and vegetables during this process. By an estimate, between 30 to 40 percent of the produce is lost in harvest and post-harvest operations from farms to consumers. Without a cold chain and processing units in the value chain, produce is hauled to the market place and quickly disposed. Poor packaging and transportation further damages and bruises the produce, reducing another ten percent quantity.

Contract Farming •

At present farmers do not adopt good agricultural practices, due to i) lack of knowledge base for high productivity production practices, such as high yielding varieties; ii) access to good seed and quality inputs, particularly agrochemicals; iii) erratic prices often lower than cost of production; iv) exploitation by market functionaries; and v) bootstrapped investment capacity.

Large scale companies entering into contract farming agreements provide seed and technical knowledge for crop tending, use of agrochemicals, harvesting methods, and on farm postharvest handling, etc. Farmers are obligated to transport the produce to pack houses, managed by processing units or registered procurement agents/vendors. The agreement specifies contracted volume of the produce at a pre-determined unit price, binding on both the parties, irrespective of the prevailing prices. This ensures fair returns to farmers, without the risk of price fluctuation, and ensures constant supply of consistent and uniform quality for processors.¹⁸

Advantages of contract farming •

Contract farming provides a number of advantages over the informal farming mechanism. Most importantly, it bypasses the wholesale market system dominated by market functionaries and lowers prices. A caveat to this mechanism is that most domestic farmers receive advances (pre-harvest contracts) particularly in form of inputs, and it may not be within the capacity of the processing units to finance farming operations.

There has already been some headway made into contract farming in Pakistan by a couple of large companies as highlighted in Box 2 below. For instance, Rafhan has been able to contract standardized maize production in the Faisalabad belt for processing a variety of starches, dextrans, adhesives, and syrups.

¹⁸ FAO, IFAD and UNIDROIT. (2017). Legal aspects of contract farming and agreements. Synthesis of the UNIDROIT/FAO/IFAD Legal Guide on Contract Farming. Rome.

Contract farming provides the following advantages to farmers:

- Availability of improved seed and inputs at controlled prices provided by the contracting agency on credit.
- Farmers are insulated from erratic price fluctuations.
- Farmers have access to knowledge of good agricultural practices.

Contracting agency benefits by:

- Assured and smooth supply of the produce.
- Quality control
- Long term planning and formulation of business models.
- Opportunities for crop diversification and introduction of new varieties.

An agreed upon contracted price benefits both the food processor and the vendor (either farmer or pack house). The incentive for vendors to break contract occurs when the market price rises significantly. Figure 19 depicts this scenario. Based on potato price in Lahore in 2018 over the year, it shows farmers incentive structure. Farmers will be content when they have contracted on a higher than market price rate. But as the market price keeps rising above the contracted price, their incentive to renege from the contract will increase. In the long run, a constant price benefits both producers and suppliers as it hedges them both from the risk of price volatility.

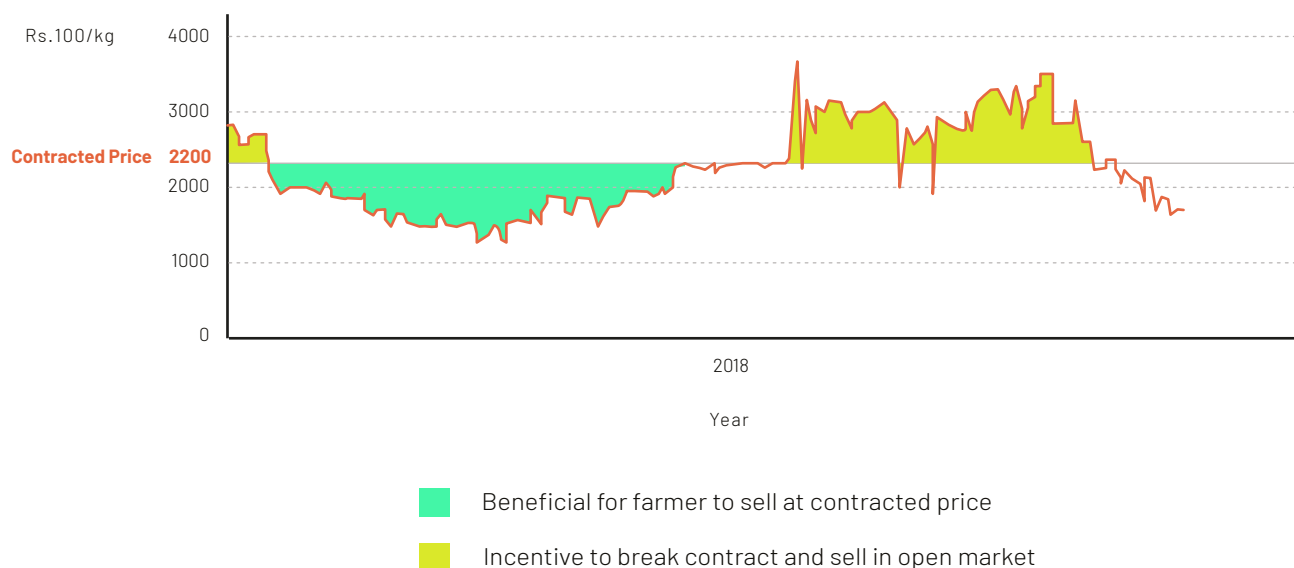


Figure 19 – Contract farming, incentives to farmers

Source: Annual potato price acquired from Agri Marketing Information Service, Directorate of Agriculture, Lahore, Punjab.

BOX 2

Successful examples of contract farming in Pakistan

Contract farming presents an alternative arrangement for supply chain of horticulture commodities to processors. Contract farming has been successfully undertaken by two companies in Pakistan, namely PepsiCo and Rafhan. Each company procures a sizeable quantity of commodity for its processing requirements and follows a different approach.

Rafhan is the largest maize processor in Pakistan, procuring approximately 10 percent of the total maize produced in the country. Rafhan initiated its maize contract farming project in the early 1970s. In order to ensure consistent supply of raw material and reduce the cost of procurement, Rafhan started this practice. As part of Rafhan's contract, it provides extension services, transportation support, and packaging material. Rafhan does not provide seed, fertilizers and pesticides, since these are available in the market. In contrast to split or delayed payments to farmers in spot markets, Rafhan ascertains full and immediate payments through an electronic payment system. Farmers choose to join the maize contract program mainly because of their confidence in the company as a reliable buyer. As a result, the company currently procures about 40 percent of its maize requirement through contract farming.

With a state-of-the-art potato chip plant in Lahore, PepsiCo caters to markets in both Pakistan and Afghanistan. Quality potato chip production requires special variety specifically suited to chips production. Lays introduced a potato variety of "Lady Rosetta" in Pakistan. To ensure stable supply of potatoes, PepsiCo prefers contract farming instead of procurement from open market. PepsiCo carefully selects contract farmers based on their land holdings, knowledge of potato cultivation, and market reputation. The Depalpur tehsil has the largest number of the company's contract farmers, accounting for approximately 55 percent of its potato supply. In addition to PepsiCo providing appropriate seed for "Lady Rosetta" to the contract farmers, PepsiCo also provides regular extension services by sending extension specialists. Furthermore, the pre-cultivation contract specifies the number of acres to be cultivated by the farmer for the company and fixes the price of the crop, which is usually much higher than the market price of potatoes because of the difference in variety. In order to ensure consistent quality of produce, PepsiCo employs strict quality checks at the farm gate before granting permission to its storage facility; in case of breach of contract, farmers are permanently blacklisted. Through this mechanism, potato contract farmers for PepsiCo are able to produce high quality potatoes, and earn significantly higher income than they would have, had they continued with traditional farming.¹⁹

Box 2 – Successful Examples of Contract Farming in Pakistan

¹⁹ Khan, M.F., Nakano, Y., Kurosaki, T. (May 2019). Impact of contract farming on land productivity and income of maize and potato growers in Pakistan. Elsevier, Food Policy, Volume 85.

Industrial supply needs

Resolving bottlenecks in horticulture supply chain is important. Without resolving issues pertaining to reliable supply, Pakistan will find it hard to graduate from its current stage of horticulture production and move to the next frontier. In order for Pakistan to increase its exports from the sector, it needs to be able to make produce available to the processors, efficiently and effectively. Large scale processing units need availability of uniform quality of fruits and vegetables which comply with international health and safety standards. This can be ensured through backward integration with the supply chain and contract farming.

Horticulture commodities as raw material •

In Pakistan, horticulture commodities are not viewed as raw material for processing. Rather, manufacturing is a by-product of lowest grade horticulture commodities. Pakistan will not be able to export large volumes of value added products until commodities have the following attributes:

- **Characteristics of produce:** The characteristics of produce grown in Pakistan are not tailored to processing needs. Characteristics needed in commodities which are viable for processing for value added products include:
 - **Nature:** The commodity needs to be of specific nature in order for it to be utilized as raw material for industrial processing. For instance, table variety of potatoes and tomatoes cannot be utilized to manufacture french fries or tomato paste.
 - **Color:** There is consumer preference for color of a particular commodity and the ensuing product. For instance, a particular shade of yellow is preferable for mango products.
 - **Brix Content:** There is a minimum brix level ideal for processing fruits²⁰. Unless fruits do not attain a minimum brix threshold, they cannot be used for manufacturing effectively.
 - **Grade and shape:** Processed commodities need to have certain physical shape and texture in order for them to be utilized for processing. For instance, a supplier is expected to provide uniform six peas in a pod. Similarly, undented and consistent color is expected of all produce – bananas need to be of uniform shape and color.

The Indian Alfonso mango variety is apt for food processing – its texture, shape, pulp, and most importantly color is suitable for processing and pulping. The competing variety in Pakistan, Anwar Ratol is significantly higher cost per unit. Until and unless horticulture produce is cultivated as industrial inputs offered at internationally competitive prices, processing commodities for value added products will not be effective.

- **Constant Supply:** Processing cannot take place without assured supply of raw material. Since firms do not have access to raw material consistently, it becomes unfeasible for them to export products.

²⁰ Governed by Codex General Standard for Fruit Juices and Nectars (Codex Stan 247-2005). For instance, the Brix level is expected to be a minimum of 50% for orange juices and nectars, while it is supposed to be a minimum of 25% for mangoes.

- **Seasonality:** There are short seasons for each product which necessitates the processors to establish plants that can process multi-line products. In the USA for instance, there are oranges available all year round in Florida, which makes it easy for firms to invest in a single line of product (for orange juice) and build efficiencies.

Without availability of these commodities, firms will confine themselves to the domestic market. In order to overcome these issues, investments need to be made in producing varieties that are competitive in international markets.

Market distortions

Government interventions create distortions by incentivizing or discouraging market behaviors and activities. In the case of horticulture, there are two policies which disincentivize farmers to produce horticulture commodities.

Price controls ●

The government has established price controls for essential commodities under the Price Control and Prevention of Profiteering and Hoarding Act, 1977. After the 18th Amendment, price control of food commodities became a provincial subject and enforced by District Magistrates. The price control mechanisms and price determination is arbitrary. Producers, wholesalers and retailers can be forced to set prices, which are otherwise established through a Mandi (wholesale market) bidding mechanism, determined by market forces of demand and supply. Through price control measures, the government discourages production of commodities and distorts the open market price determination mechanism. These measures should be discouraged for horticulture produce, which should not be categorized under essential items.

Support prices ●

While price controls discourage production of horticulture, support prices for wheat and sugarcane encourage farmers to grow selected crops. Wheat is a strategic crop for food security and the government procures 40 percent of national produce to ensure there is an assured supply of the staple commodity in the market. This is equivalent to a subsidy to wheat producers. Sugarcane is also given a support price, but the government does not procure this commodity. Sugarcane cultivation is a matter of political economy. Despite low returns, farmers minimize risks by cultivating sugarcane since they have surety that the local sugar-mill will purchase the crop at, equal or above, the support price.

Improving on Farm Practices and Logistics

Adopting Good Agricultural Practices (GAP) and improving farm management techniques will increase farm output and crop yields. This section elaborates the GAP and farm management improvements which need to be adopted at fruit and vegetable farms respectively.

On-farm Production System of Fruits •

The issues faced in optimally managing fruit orchards are detailed below.

Lack of good agricultural practices •

- Fruit trees are old, unhealthy, and orchards have mixed varieties, often low yielding indeterminate output. Many trees are prone to diseases, for instance citrus canker.
- The number of trees per unit of land are based on outdated practices. Other countries have moved to high density planting. Over a thousand trees in a hectare makes canopy management and pruning easier, and reduces damage while harvesting, and pest management simpler.
- There is a proliferation of nurseries producing substandard and unhealthy saplings, and with off-type varieties. It comes with a sunk cost, since it takes farmers between three to five years to realize output.
- Canopy management is poor without regular pruning to remove dead and unhealthy branches and shoots.
- Lack of adequate fertility management in terms of use of organic manure, application of balance fertilizer (N, P, K) and micronutrients, all at the proper time and doses.
- Heavy weed infestation, and over use of farm machinery to remove weeds, and excessive or lack of use of weedicide depresses the yield.
- Lack of knowledge of integrated pest management (IPM), and indiscriminate use of plant protection agrochemicals, such as insecticides, pesticides, and fungicide, disturbs the natural balance. Farmers also use cheaper and adulterated agrochemicals.
- Mismanaged irrigation of orchards.

Harvesting and postharvest management •

- Harvesting of fruits is mainly done by unskilled and semiskilled labor through handpicking and hooked sticks. In the process, a significant quantity of plucked fruits are bruised and damaged, which leads to damaged flesh. Fruits are heaped on the ground and transported in baskets to the grading and packing yard without providing time for de-sapping and or cooling.
- To fetch better prices from early harvest, fruits are harvested before they are ready to be plucked, i.e. the brix level is not enough for proper ripening.
- Fruits are not pre-cooled after harvest and before packing/crating.
- The sorted fruits are packed in wooden crates which can hold about 10 to 12 kg of fruit. These are low grade containers which cause damage to the produce.

- The crates are loaded into non-refrigerated trucks. During transportation fruit gets further bruised and damaged. Delays during transportation causes fruits to be over-heated in the truck and lose their quality.

Orchard Management •

- Pakistan has an issue of the absentee landlord, that is, many farm owners are not directly present on farm. Predominantly, orchard management is in the hands of untrained and uneducated farm managers, with low skill level. Only a handful orchards are managed by owners themselves or trained farm managers (with high school education or agriculture diploma).
- Majority of the orchard owners, lease out the orchards to contractors (the kedars) almost between three to eight months prior to harvesting. In these cases, the responsibility of all the agricultural practices, and its financing, rests on the contractor. This practice has negative long term consequences on the health of trees.
- The contractors in turn, depend on the Commission Agents (Arthis) to finance advances to the orchard owners. In this case, they are obliged to sell their crops through the Commission Agent to whom they are indebted.

On-farm Production System of Vegetables •

The productivity levels of vegetables are also far below international levels. Some of the factors responsible for low productivity are as under:

Lack of good agricultural practices •

- Farmers use seeds either from previous crop, or purchase new seeds from merchants. Seeds are generally purchased based on hearsay and, often turn out to be of nondescript variety. Since seeds used are either impure with admixtures or degenerated, the produce is not uniform in size and shape. Though agriculture research institutes and the agriculture extension department recommend improved and high yielding varieties, yet they are mostly inaccessible, as the seed multiplication system is not adequate to meet the demand.
- Similar to orchards, farmers do not have adequate knowledge of applying balanced fertilizer (N, P, K) and micronutrients, hence the yield response to fertilizers is quite poor.
- Excessive use of farm machinery to remove weeds, and mismanaged use of weedicide is another issue. It causes harvested vegetables to have high level of residual pesticide contents.
- Similar to fruits, the lack of knowledge of integrated pest management (IPM), and indiscriminate use of plant protection agrochemicals, such as insecticides, pesticides, and fungicide, disturbs natural balance of the soil.

Harvesting and postharvest management •

- Postharvest handling at the farm level is primitive and a major cause of postharvest losses. Harvesting of vegetables is done by unskilled labor. Harvested vegetables are dumped on the ground.
- Perishable vegetables are mostly washed with running canal water, and occasionally with tube well

water, if available. They are then filled in jute or plastic bags, and transported to the market in open trucks and are exposed to dust and other air pollutants. The semi-perishable vegetables, potato and onions are mostly transported to wholesale market in used jute bags or plastic bags in open pickups/trucks.

- There is no or very little sorting or grading of both perishable and semi-perishable vegetables.

Vegetable Cultivation Management •

- Vegetables are a labor-intensive crop. They are mostly grown by small farmers. Farmers prefer to sell perishable vegetables directly to the nearest wholesale vegetable market, or the nearest vegetable market. On occasions a small truck, or a ten-ton truck is used to transport the goods to the market.
- Most vegetable growers, particularly small farmers, at the time of sowing get cash advances from the Commission Agents (Arthis) to finance the seed or nursery cost, followed by funds to purchase fertilizers, pesticides, weedicides, harvest labor, and packing material. Seldom, growers finance the production cost themselves.

As evident from the practices on fruit orchards and vegetable farms, upgrading skills and technical knowledge will be a difficult task to undertake. The Arthis form an integral part of the agricultural system and act as financiers as well as buyers. Contracts of firms with farmers will help establish an alternative to the existing traditional system.

Upgrading Logistics Infrastructure •

Limited access and availability of refrigerated trucks damages 10 percent of the produce during transportation. Key reasons for losses include long travel times due to poor road network, poor packaging, unhygienic carrying conditions and inadequate facilities (temperature control, etc.). While transporting commodities via railroad is cheaper, the limited availability of space and long delivery times do not make it a preferred mode of transportation.

Transportation of horticulture commodities is done through open-body pickups and trucks. During long distance travels, produce is subjected to high temperatures. Delays caused by road congestions cause produce to lose its freshness, resulting in spoilage. There is a need to introduce temperature controlled vehicles (reefers). However, the cost of transportation through reefers is significantly higher than open vehicles due to higher vehicle operating cost, and no load on the return journey. The open body trucks often find goods to carry back to the point of embarkation. This discourages the use of reefers/refrigerated vans for transporting horticulture produce due to high transportation cost.

An improved cold chain system will help reduce losses during transportation from farms to the market or to ports and improve the shelf life of the product. High upfront investment cost, and seasonal use does not justify investments into purchasing reefers by farmers and pack houses. There are reefers available for rent, but their payment structures are very expensive, making them unfeasible for most farmers and operators. The cold chain system will develop based on market forces and demand. Farmers and firms will obtain them when they find that the costs justify returns.

Increasing Access to International Markets

Pervasive outmoded production and marketing methods, poor agglomeration, and lack of traceability has made it difficult for Pakistan to comply with the stringent sanitary and phytosanitary standards (SPS) and traceability requirements by importing countries. The concerned government departments need to ensure that the horticulture produce supply chain is regulated to comply with international compliance protocols.

Compliance to International Health & Safety Protocols •

Given demanding SPS requirements to export horticulture commodities, Pakistan needs to improve its farming capabilities. It also needs to develop reliability in international markets, which will prove to be difficult to achieve with existing infrastructure. Lack of compliance is harmful for the whole sector. For instance, Russia imposed a blanket ban on imports of all agricultural commodities from Pakistan in 2013 after a couple of consignments of oranges with fruit flies were exported to Russia. This ban was lifted in 2014 after diplomatic resolution of the matter and assurance of compliance to Russian standards by Pakistan.²¹

Infestation of fruit fly is a hurdle in commodities reaching international markets. Most countries require fresh fruits to be disinfected through Hot Water Treatment (HWT) or Vapor Heat Treatment (VHT). Investments have been made by some pack houses and farmers to install facilities with HWT plants, graders, and cold stores. These processors are able to meet export requirements in the developed countries, but the overall capacity of HWT and VHT treatment facilities is limited. With limited access to such facilities and no access to capital, many export destinations are limited to countries with easier standards to comply with.

There are limited credible accreditation institutions to certify the minimum residual levels (MRL) on commodities. Their certification process is slow, which takes six weeks from the date the samples are provided for testing. In case of mangos, the cultivation season lasts eight weeks, which makes this testing time unfeasible. Very few farms qualify or have Global GAP, BRC and or Eurogap certifications, with majority of farms and producers unable to meet hygiene standards and risk assessment of Microbiological certification (such as HACCP), general compliance to the General Marketing Standards (GMS) in Europe, UNECE (UN Economic Commission for Europe), Codex Alimentarius, and traceability of fresh fruits and vegetables.

Irradiation facilities can help resolve issues relating to certification of commodities since the technology can be used to eliminate microbial pathogens (bacteria, viruses, and protozoa) and extend shelf-life of produce without having to rely on chemicals. Electron Beam processing is a non-thermal technology that

²¹ 18th February, 2014. Partial victory: Russia allows import of citrus fruits from Pakistan, Express Tribune. Retrieved 27th April, 2020 from: <https://tribune.com.pk/story/673301/partial-victory-russia-allows-import-of-citrus-fruits-from-pakistan/>

has the potential for use in the fresh produce industry. An irradiation facility, Electron Beam, has set up its operations in Karachi, which offers eBeam pasteurization, eBeam processing, eBeam treatment, eBeam technology, and electronic pasteurization. These processes make use of high energy electrons to disinfect, pasteurize, and sterilize a number of products. In addition, this technology is cost effective and its location near Karachi Korangi Port - accessible to exporters near sea and airport.

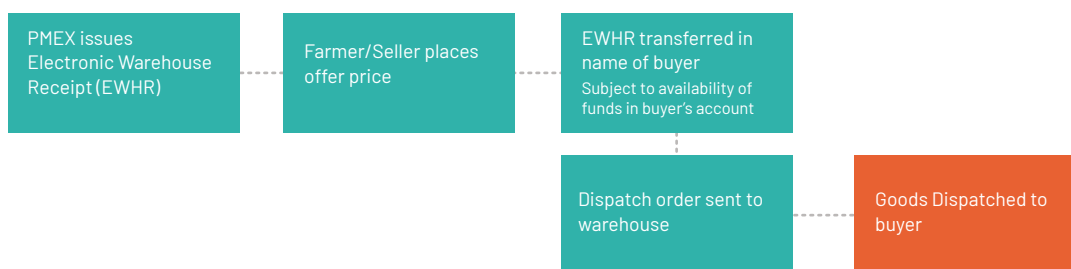
Having an online trading platform for commodities can be used as a tool to resolve issues pertaining to traceability, in the future. It is currently unfeasible for perishable horticulture commodities since a cold-chain infrastructure does not exist. Box 3 below showcases how Pakistan was able to resolve the issue of traceability, certification, and logistics by allowing trade on Pakistan Mercantile Exchange.

BOX 3

Online Trading of Red Chilies

As part of its traditional business model, National Foods Limited (NFL) purchased red chilies directly from Arthis. These middlemen bought chilies from farmers without any traceability. Resultantly, NFL faced issues of quality. For instance, in 2004, a consignment of chilies to Europe was blocked because of high levels of aflatoxin which resulted from poor on farm practices. Farmers and middle men lacked understanding of agronomics and followed practices which degraded both the farm and the produce. In addition, crop yield of red chilies was falling.

To resolve these issues, National Foods Limited (NFL) partnered with Pakistan Agriculture Coalition (PAC). Through this partnership, NFL was able to coordinate trading of dry red chilies on the Pakistan Mercantile Exchange (PMEX), an electronic trading platform, through a designated agent. It facilitated pre-test and weighing at warehouses, with quality assessments being performed.



NFL procured 32 percent (2017-2018) of pre-tested red chilies through PMEX. Through online trading of dry red chilies, NFL was able to reduce dependence on Arthis and ensure quality control and traceability by having a reliable certifying body on board. In addition, testing time for chilies was also reduced. Moreover, farmers who benefitted from these changes evolved into vendors, supplying directly to NFL obtaining a better price.²²

Box 3 - Online Trading of Red Chili's

²² The Pakistan Business Council. (2019). Case Study on Value Chain Sustainability Model in support with National Foods Limited. Karachi.

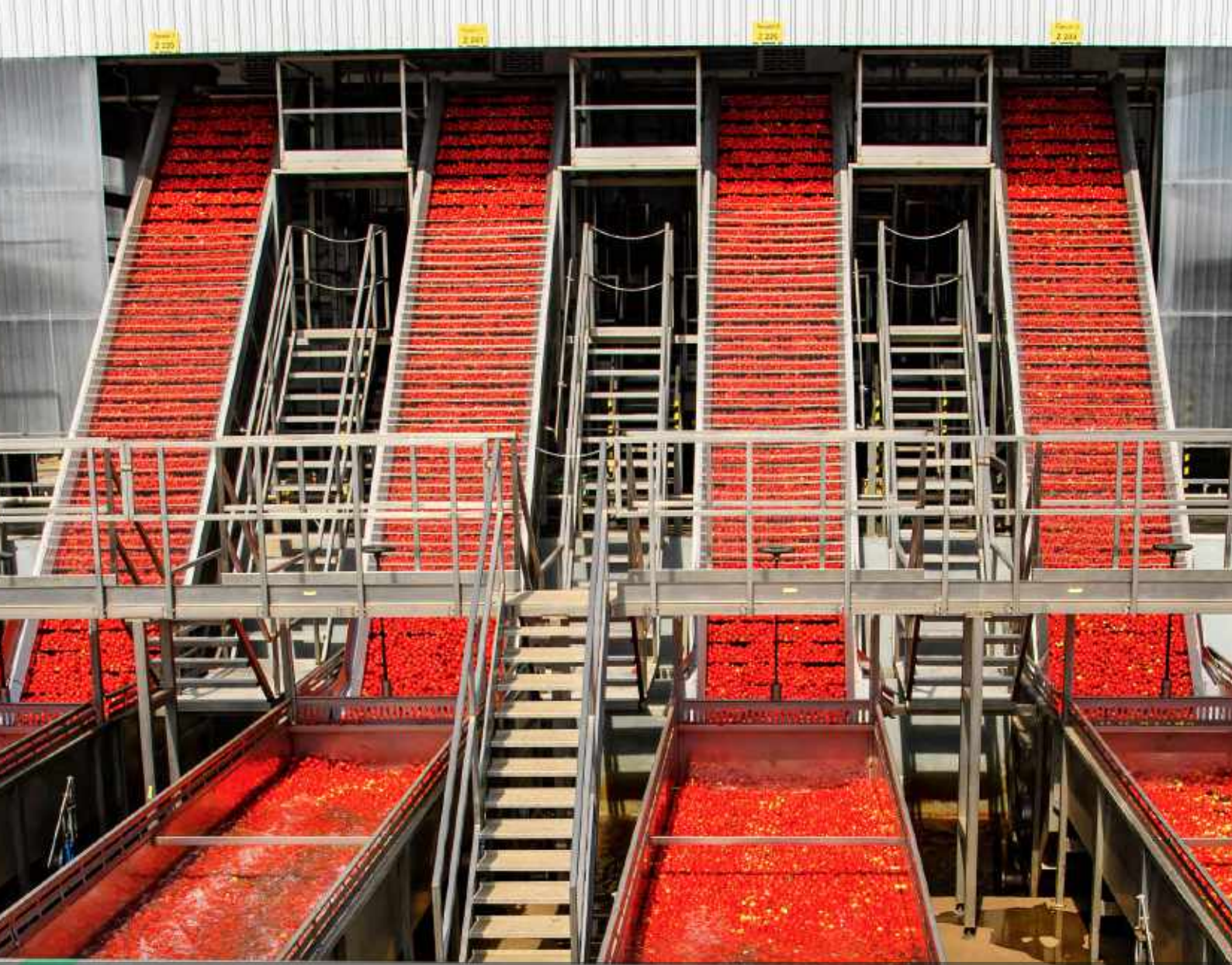
Market Access to China •

China's imports of fruits and vegetables from Pakistan was USD 14.5 million in 2018, while its total imports of horticulture were USD 10.7 billion. While China does not import a significant volume of vegetable commodities which Pakistan exports, it imported roughly USD 1.8 billion worth of mangos, oranges, and bananas in 2018. There is a year on year growth in imports of fruits by China, a trend which is likely to continue. Pakistan should work with China to improve market access for its fruits which can significantly boost Pakistan's exports. Currently, China does not allow imports of most fruits and vegetables due to its stringent SPS requirements. Installation and accreditation of irradiation facilities could help overcome this barrier. Under the China Pakistan Free Trade Agreement-II:

- Citrus falls under A-0 (tariff immediately reduced to 0) with base tariff rate of 0%
- Mangos fall under A-0 (tariff immediately reduced to 0) with base tariff rate of 0%
- Bananas fall under category A-10 (tariff reduced to 0 in ten years) with base tariff rate of 5%.

The duty structure for exporting the above fruits to China is favorable for Pakistan. There are a few non-tariff barriers which restrict entry of Pakistan's horticulture commodities and products to China. Resolving these issues will require concentrated efforts by the government and private sector. Citrus trade is not permitted via land and air routes to China and Pakistan has to ship its mandarins to eastern Chinese ports, hence increasing cost and time. It would be cheaper and easier to export via the Sost border crossing by land, or to Urumqi by air, which is not permitted due to a pending quarantine agreement between Pakistan and China. Otherwise, China's quarantine requirements are very stringent and can be considered a non-tariff barrier. For instance, oranges have to be kept in a cold storage for a specific number of days before they can be offloaded onto a port, and the shipping containers have to undergo cold treatment throughout the journey. If at any point, the cold treatment breaks for a short period, the process has to be re-initiated from the start. While it is a general consensus that SPS requirements for processed fruit juices are easier to overcome, market intermediaries and producers find it difficult to ascertain requirements to enter the Chinese market.²³

²³ Consortium for Development Policy Research. (January, 2018). Agriculture sector opportunities in the context of China-Pakistan Economic Corridor. Lahore, Pakistan. Reference Number: S-37414-PAK-1



SECTION 3

Developing Processing Capacity and Recommendations



Mapping Existing Processing Infrastructure

There are about 40 horticulture food processing units in Pakistan, primarily catering to domestic needs and only a handful of them export. Many fruit and vegetable processing units utilize indigenous technology. In order to achieve efficiencies for exporting and for meeting international quality standards, most existing processing units will require balancing, modernizing and refurbishment (BMR). Small scale processors install locally fabricated low-tech machinery, with some refurbished imported parts. Manufactured products from some of these firms utilize chemically preserved pulp, which is non-compliant with food laws and regulations. Only about half a dozen processing units produce products, including aseptically processed and frozen pulp and concentrates, in accordance with the international health safety standards. Most units process multiple fruits such as mango, citrus, guava, apples and other fruits to ensure maximum capacity utilization.²⁴

Amongst vegetables, tomato and potato are processed into puree, pulp, and ketchup, and fries and chips respectively. Despite domestic and international demand, tomato production is limited in Pakistan. Firms base their formulation of ketchup and sauces on the imported tomato paste. More recently, processing of vegetables based on IQF technology has been introduced by Fauji Fresh 'n Freeze to produce frozen peas, potato fries, strawberry, and some leafy vegetables. The firm is facing constraints in obtaining quality raw material suitable for industrial processing.²⁵

Potential Investment Options in Food Processing

To achieve the potential of value addition in horticulture food processing from the identified commodities in earlier sections, Pakistan will need to encourage large scale investments in downstream production. Pakistan must encourage international firms to set up manufacturing units for processing fruits and vegetables. As mentioned earlier, large scale global players are able to upgrade upstream supply chains to meet their requirements of raw material. Pack houses become more viable if they have a buyer for their products, and farmers find it feasible to invest in improved production technologies and adopt good agricultural practices, if they have buyers willing to pay the price to justify the investment.

There are a number of downstream industries in which investing will provide export opportunities for Pakistan. These include:

1. Fries and crisps
2. Orange juices
3. Tomato puree and paste

²⁴ Based on field interviews, data compilation, and assessment of market practices carried out by the consultant.

²⁵ Based on interview with a representative of Fauji Fresh n Freeze.

In order to serve the global market, large scale investments are needed to cover the expenses needed to provide international grade juices and pulps. Multinational companies like Nestle follow international protocols while procuring, pulping, and processing the fruit. This includes Hazard Analysis and Critical Control Point (HACCP) compliance and other audits relating to purchase and processing of fruits. Multinationals companies cannot purchase pulp and concentrate from unauthorized and undocumented vendors since they are unable to fulfill compliance standards required for accredited suppliers. Since measures required for international compliance are stringent, ensuring compliance is an additional cost, which becomes a major barrier to entry for companies. These include having a minimum criteria for aseptic packaging, and MC2 microbial level compliance for air, amongst a number of other processing protocols.²⁶

Some companies have developed international grade food processing facilities in Pakistan which are compliant with international protocols. CitroPak, a subsidiary of Cargil produces a wide range of products from citrus. These include various forms of juices, concentrates and oils. Investment by this facility, for example, has helped develop a wide range of products and generate exports for Pakistan.

Box 4 below shows a noteworthy initiative of the Government of Pakistan with positive outcomes in promoting agro-food processing.

²⁶ Based on an interview with representative of Nestlé, Pakistan

BOX 4

Agro Food Processing Facilities (AFP) Multan

Agro Food Processing Facility (AFP) is a government managed facility in Multan which runs under a public-private partnership model. The founding objective of AFP was for the government to facilitate local farmers by establishing the Common Facility Center (CFC) for value addition to the local produce, primarily mangos. The AFP was unable to manage sales with local produce and meet its operating costs. Therefore, it formed partnerships with the large scale manufacturers by outsourcing its production facilities during harvesting season to process fruit pulp. By operating through this model, AFP was able to become profitable and companies had access to its facilities without investing capital.

The AFP facility has an operational throughput capacity of 90 tons per day (5 tons/hour) and it is operational 24 hours during the mango and guava harvest season. Companies rent the government plant at an hourly rate when available, since it operates at capacity. The high quality production line has interested several domestic and multinational companies such as Nestle, PepsiCo, Coke, Engro, Shezan, and Shangrila and they use the facilities at AFP for processing.

AFP runs at full capacity during season highlighting a need for the development of more of such facilities. However, the AFP model highlights the following challenges for food processors:

1. Downtime of the facility for over six months a year makes investments tricky. Mangos, guavas, and oranges are available for a limited time period (3– 4 month), during which the factory runs at full capacity and remains idle for the remaining part of the year. To increase viability of pulping units, fruit variants which are available all year round can be introduced, and more types of commodities be planted. For instance, in Florida USA, the harvesting season for oranges can last from September to July (up to 11 months), whereas in Pakistan, harvesting season for oranges is approximately only three to four months.
2. Limited domestic demand does not make it feasible for individual companies to invest in large processing units. Third-party facilities help in lowering the risk which is associated with investing extensive capital. In AFP's case the government took the risk to establish the plant as a pilot project.²⁷

AFP's example proves that downstream investments in processing units increase farmer incomes and lower overall prices by reducing the role of middle men. Some farmers sell their produce to companies at the factory gate in AFP at a higher price than in the open market. The example also validates the benefits of contract farming which provides an assured price to the farmer and an assured rate of return.

Box 4 – Government Common Facility Example

²⁷ Based on interviews with representative of AFP and its website.

Recommendations

Develop a National Horticulture Development Framework which prioritizes productivity and exports •

Increasing exports from the horticulture sector will require Pakistan to develop a cohesive horticulture policy framework. There is currently no provincial or federal policy which promotes horticulture production and exports. The existing agricultural policy environment is fragmented with provincial governments pursuing various province specific developmental priorities without a cohesive national framework. The National Food Security Policy, released in 2018, mentions horticulture but does not provide a plan to increase production of fruits and vegetables or policies for value chain infrastructure related development. In consultation with the provincial governments and the private sector, the federal government should develop a National Horticulture Development Framework which will give priority to fruits and vegetables with export potential. The key objectives of the policy should be to improve yields, acquire better quality seeds, and upgrade technologies for food processing, packaging and transportation. The salient features of a future National Horticulture Development Framework are discussed below.

1. Recognizing Contract Farming Agreements as Legal Instruments •

Sale of crops between farmers and processors should be enforced through contract farming agreements. Pakistan's legal system does not treat contract farming as a special contractual category and agreements are drawn from rules governing general contract law. As part of a legal framework, legal instruments and mechanisms should be developed and enforced to facilitate these agreements. Having enforceable contract agreements in Pakistan will provide an impetus to companies and farmers to engage in contracts which will ensure supply of fruits and vegetables for food processing, packaging and export.

2. Fast tracking of Quality and Health Safety Standards Protocols with Importing Countries •

At present the Department of Plant Protection (DPP) is mandated to inspect the orchards to issue certification of SPS. The list of orchards is provided to the exporters, who can procure their produce for export only from those orchards which have been approved by the DPP. Due to the shortage of trained staff and transportation, it is difficult for the DPP to inspect and register all qualifying orchards in a timely manner. Technology should be applied to develop efficient solutions to facilitate exporting farmers in acquiring SPS certifications, minimizing the need for unnecessary physical inspections. Furthermore, the process for certifying farms based Minimum Residue Level (MRL) is also time consuming and the capacity of the present authorized laboratories is limited.²⁸ The government should authorize certified private

²⁸ There are only two authorized laboratories to conduct MRL; Hussain Ebrahim Jamal (HEJ) Laboratories in Karachi, Pakistan Council of Scientific and Industrial Research (PCSIR) in Lahore and Karachi.

laboratories to provide services in carrying out such tests to improve process efficiency. The delay in test results can lead to loss in export orders for crops with limited shelf life.

Apart from having the appropriate certifications, stringent quality and health safety protocols restrict export of fresh and frozen fruits and vegetables, and processed food products to a number of countries. The Pakistan Horticulture Development & Export Company (PHDEC) under the Ministry of Commerce (MoC) should engage respective foreign governments which restrict import of Pakistan's horticulture commodities, particularly countries with high demand for commodities identified in this report. MoC should coordinate a process with the private sector and other stakeholders to resolve specific issues related to accessing foreign markets for horticulture exports. While the market players and government may independently be aware of issues hindering exports, a coordinated action led by the government will help find solutions. The countries of particular interest for horticulture exports include United States of America, China, Germany, United Kingdom, France, Netherland and Belgium.

3. Protecting Intellectual Property Rights of Seed Producers •

The government must enforce intellectual property rights of seed producers and penalize backcrossing, unregistered sale, and multiplication of registered seed varieties. If such measures are not undertaken, Pakistan will lose access to HYV seeds which have been developed after extensive research carried out by seed producing companies. This report provides specific examples of two companies, interviewed, including Bayer (formerly Monsanto) and PepsiCo, both of which highlighted this bottleneck. Furthermore, the enforcement mechanism for Plant Breeder Rights Act should be prioritized, particularly by strengthening the recourse mechanism for companies whose intellectual property rights of registered seeds are violated. At the moment, such violations are treated by the civil procedure court, which does not prescribe specific penalties, hence legal recourse is difficult to obtain.

4. Establishment of model processing facilities in the main production clusters •

The Government can establish common facilities with modern technology and infrastructure for domestic and export markets. These facilities provide the private sector an opportunity to increase value addition through food processing and developing a business case for future investments. Through investments in such facilities, the Government assumes the risk of capital which companies are unwilling to take by installing food processing plants. Subsequently, successful companies can set-up independent processing units.

The Agro Food Processing (AFP) plant in Multan established by the government has encouraged developing a supply chain for fruits processing in the southern districts of Punjab and has shown good results. The AFP facility runs at capacity during the harvesting season, demonstrating the available demand for such a facility. Facilities can be established in other locations to encourage pulping, dehydration, IQF, and aseptic packing. These plants can be rented out to fruits and vegetable growers (on batch basis) and the private sector. After a certain time period, facilities can also be divested to the private sector.

5. Establishment of Cold Chain Infrastructure •

Pakistan has limited reefer trucks which are expensive to operate, rent and purchase. The high cost associated with reefers along with quality constraints limits their adoption for the domestic market. It is not financially viable for farmers to purchase trucks during harvest. It can be expected that once there are more companies which invest in exporting horticulture commodities and processed food, the cold chain for transporting perishable and non-perishable commodities will develop alongside. At the moment, there is limited domestic demand and the margins to justify investment in a high quality cold chain are unavailable. In order to grow exports of commodities, the Civil Aviation and Sea Port authorities should either invest in, or provide space to the private sector to construct cold storages for produce in transit at the exit terminals.

6. Establishment of Technical Support Capacity in Horticulture Commodities •

A key constraint in developing the horticulture sector is the declining productivity at the farm level due to inadequate and inaccurate technical knowledge of farmers, and the lack of commitment to adopting good agricultural practices (GAP). Most farmers continue to follow traditional methods because they do not find guidance to improve productivity.

At present, the provincial agriculture extension departments are responsible for providing technical support to farmers. While the staff of extension department deals with all aspects of crops, there is a need for establishing dedicated wings where extension service providers have technical knowledge on production and postharvest handling. There should be dedicated technical staff for horticulture as its requirements are different than staple food commodities such as wheat and rice. They should serve as a link between farmers, horticultural research institutes, processors, and exporters. The extension staff should also be responsible for offering courses in GAP to farmers.

7. Export Incentives •

The policy should have specific incentives to encourage exports, both for commodities and products. It can offer tax rebates to companies that export over a certain threshold, and R&D and balancing, modernizing and refurbishing (BMR) incentives to help companies upgrade and install cold chain and high-end processing facilities. Many processing units are domestically manufactured with inefficient machinery or outdated imported machinery. To encourage investments in BMR and expansion, exemptions on import of plants and machinery can be offered.

8. Attract Investments by International Market Leaders •

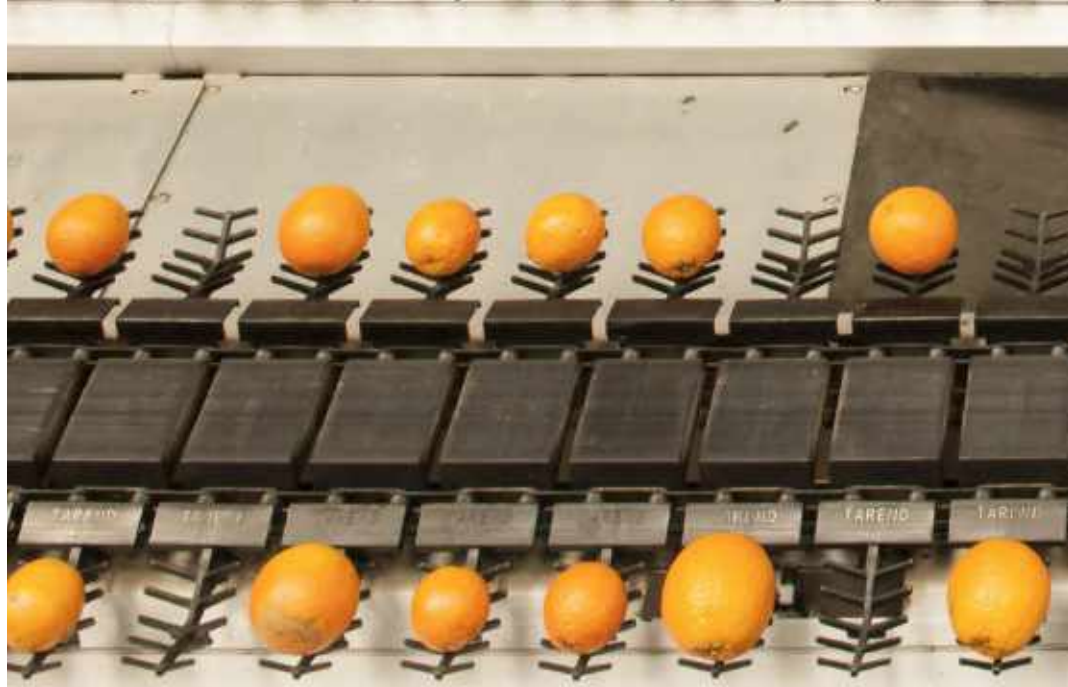
Multinational companies have the capacity, resources, and technology to improve yields of crops used in food processing. The government and the private sector should work to attract large international companies which produce food products from potatoes, citrus, and tomatoes. Board of Investment (BoI), as a part of its Foreign Direct Investment Strategy must take into consideration input from international companies which have the potential to invest in Pakistan's horticulture sector.

9. Discontinuing Price Control of Horticulture Commodities •

Horticulture commodities should be removed from the ambit of the price control regime. Such restrictions can result in losses to farmers, which discourages them from cultivating horticulture crops, GAP, and investing in technology. Price control is also considered a hurdle by the food processing industry, and a disincentive for companies to invest in the sector. While the political economy to discontinue price controls might be challenging in Pakistan, nevertheless the merits of having a market led price determination system, which translates into higher investments in horticulture, is recommended. The example of price deregulation in Egypt discussed in this report supports this recommendation.

10. Credit Line for Processing Units •

The State Bank of Pakistan should establish credit lines at concessional rates for establishment of new medium size pack houses, processing units, cold storages, reefer trucks, etc., and for replacing obsolete and inefficient processing machinery with efficient processing lines.



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