

KEY POINTS

- Pakistan's fruit and vegetable sector is underperforming due to constraints that are (i) institutional—with operational inefficiencies, weak coordination, and poor enforcement of rules and regulations; (ii) functional—with inefficient handling, transportation, storage, and trading; and (iii) structural—with concentrated market power, unsuitable roads, equipment, and market facilities.
- Postharvest losses are significant in apples (25%), potatoes (20%), and chilies (15%) and are mainly due to manual and improper postharvest management practices.
- To reduce postharvest losses, modern standard facilities and norms are needed to improve (i) production—with mechanized harvesting and handling, standard weight and packing practices, and commodity-specific transportation; (ii) wholesaling—with infrastructural improvements and labor training for proper commodity handling; and (iii) allied support facilities—with paved roads, scientific storage, and continuous electricity supply.

Building Horticulture Value Chains and Reducing Postharvest Losses in Pakistan

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BACKGROUND

Value chain management is a development paradigm vigorously pursued by private and public sectors worldwide. The businesses involved in value chains include input suppliers, producers, processors, distributors, and retailers. They perform different activities related to input procurement, production, processing, distribution, and retailing (Kaplinsky and Morris 2001).

These activities are generally designed and performed to deliver value to consumers. Various technical, business, and financial service providers also support businesses operating along the value chain in delivering value to consumers (Haq 2012). Across the globe, greater emphasis is being laid on promoting efficient value chains. These require well-integrated and coordinated relationships among the chain actors so that consumer preferences are known to all stakeholders and activities can be aligned accordingly (Trienekens 2011). However, value chain actors often face challenges such as resource constraints, institutional flaws, poor infrastructure, limited market access, inappropriate governance, weak relationships, and imperfect forward and backward linkages (Martinez and Poole 2004; Memedović and Shepherd 2008; Fernandez-Stark et al. 2011). By overcoming these challenges, value chain actors can capture opportunities that arise due to income increase, globalization, urbanization, and lifestyle

changes (McCullough et al. 2008; Albajes et al. 2013). It is believed that efficient value chains deliver more significant benefits at less cost to all stakeholders due to higher productivity, value addition, and loss management at different stages (Ruben et al. 2007; Trienekens 2011).

In Pakistan, the agriculture sector plays a key role in the economy by contributing 19.3% to the national GDP (GoP 2020b). Most of the population living in rural areas depends on agriculture for their livelihood. The agriculture sector has forward and backward linkages with other industries as the supplier and consumer of inputs. The country has vast natural resources, including water and fertile land. Several major and minor crops, including fruits and vegetables, are grown, traded, and consumed (Azam and Shafique 2017). The demand, as expressed in the cumulative agricultural growth ratio for fruits and vegetables in Pakistan, has increased from 5.6% in 2016 to 5.9% in 2020 (Rizvi et al. 2020; Mordor Intelligence 2021). Pakistan's horticulture sector is not realizing its full potential (Rizvi et al. 2020). The value chains of fruits and vegetables in Pakistan face several challenges and constraints, such as low yields, postharvest losses, inadequate grading and packaging, poor logistics, lack of technical information, and absence of quality and safety standards (Collins and Iqbal 2011; Nafees et al. 2013; Badar et al. 2019; Mazhar et al. 2019). As a result, the contribution of fruits and vegetables to the economy is below its potential.

This brief investigates the value chains of apples, potatoes, and chillies, analyzing and identifying strategies for postharvest loss management and value chain development.

SELECTION AND PRIORITIZATION OF VALUE CHAINS

Commodities were selected by identifying the top five fruits and vegetables in terms of area under cultivation. This yielded a list of five fruits, including citrus,¹ mangos, dates, apples, and bananas, while the top vegetables were potatoes, onions, tomatoes,² chillies, and peas. An index was created, based on these criteria: (i) value chain size (production volume and value), (ii) growth potential (over the next five years), (iii) infrastructural and logistical support, (iv) postharvest management practices, and (v) government priorities (strategic alignment). This analysis was discussed with a peer group of experts who emphasized the importance of exploring those commodities which had historically received less attention but were important for the country. Hence, chillies, potatoes, and apples were selected for detailed investigation. The argument was based on the potential of commodities and valuable investment of resources to meet the research gap and enhance the utility of resources.

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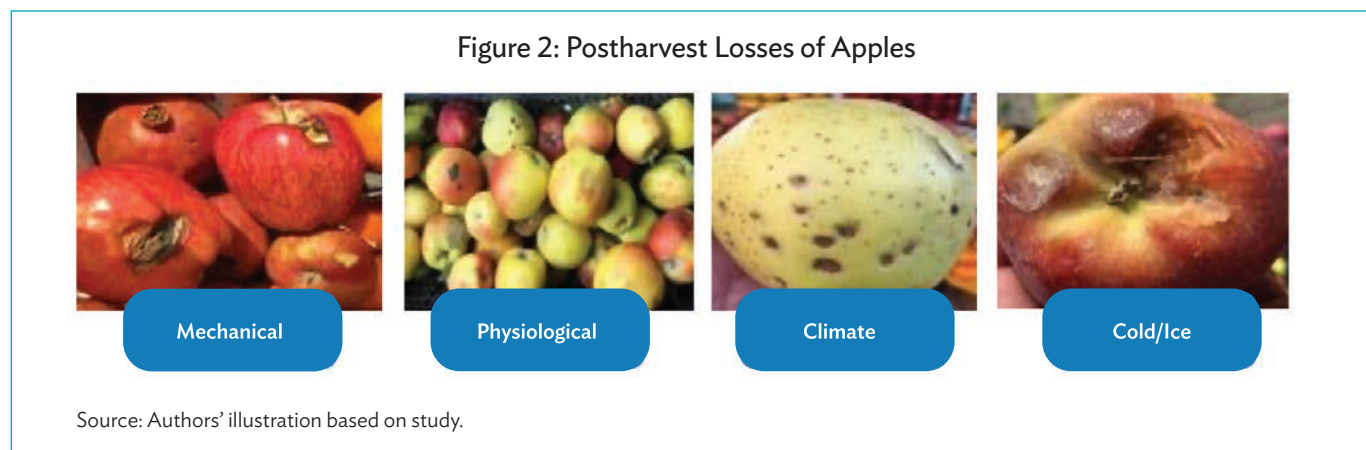
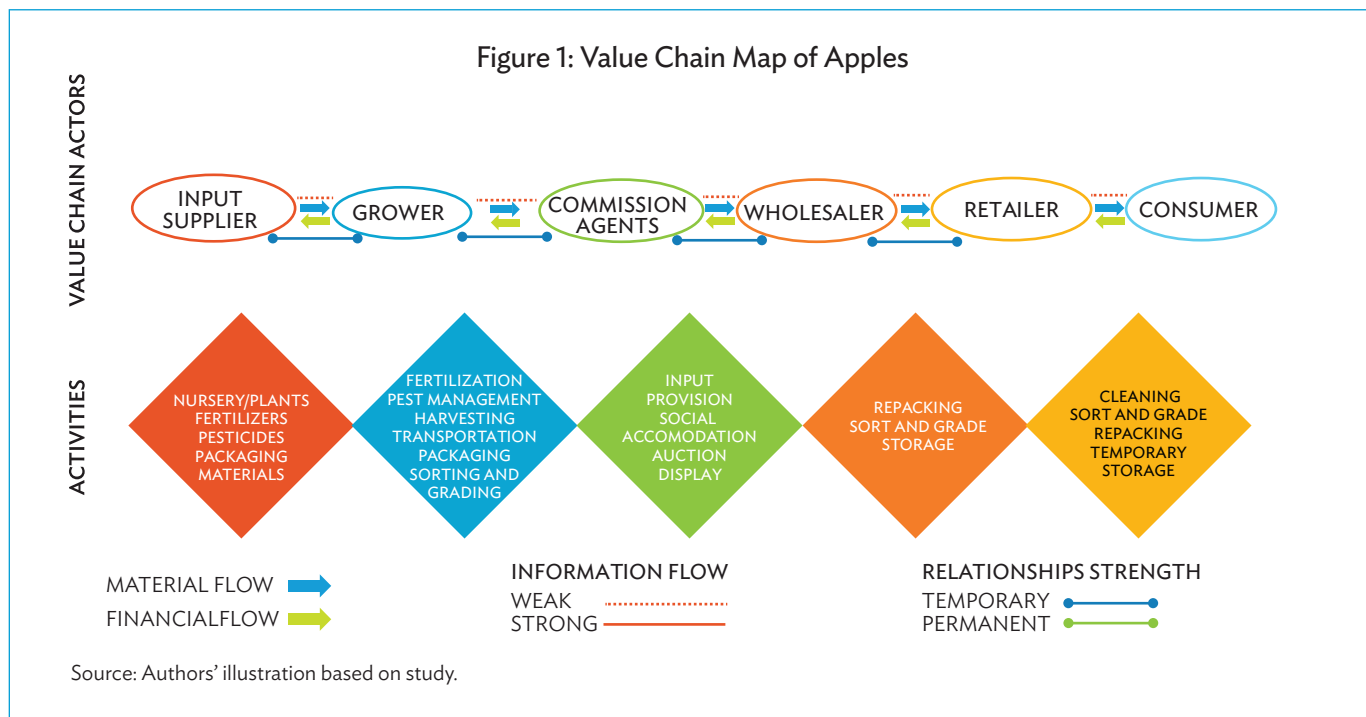
VALUE CHAIN ANALYSIS OF COMMODITIES

A. Apples

Market Analysis. In Pakistan, apples are the fourth major fruit after citrus, mangoes, and dates. Most of the hilly areas of Balochistan and Khyber Pakhtunkhwa (KPK) provinces have suitable soil and climatic conditions for apple cultivation. Among several varieties grown, Kala Kulu, Chitta Kulu, and Gacha are prominent due to their commercial value in local as well as export markets. In 2019–2020, the total area under apple cultivation in Pakistan was 75.77 thousand hectares, with a production of 572.56 thousand tons. The average yield of apples was around 7.56 thousand tons/hectare. The area under apples has gradually decreased from

¹ Citrus includes mandarins (kinnows), oranges, grapefruits, lemons, and lime.

² Biologically, tomatoes are fruits. However, they are used like vegetables in cooking and are commercially identified as vegetables.



110.41 thousand hectares in 2011–2012 to 75.55 thousand hectares in 2019–2020 (GoP 2020a). The major reason for this decline is a shift in growers' interest toward more profitable crops such as cherries and grapes. The shortage of irrigation water and the import of apples, particularly from Afghanistan and Iran, also contributed to the reduction of apple area in Pakistan. More than 80% of apple production comes from two major districts of Balochistan province: Qila Saifullah and Ziarat (GoP 2019). The per capita consumption of apples in Pakistan is about 3.5 kilograms (kg)/year, which is less than the world's per capita consumption of around 8.6 kg (Bossi et al. 2020).

Value Chain Mapping of Apples. Various stakeholders, including input suppliers, growers, preharvest contractors/local traders, commission agents, wholesalers, and retailers, participate in the flow of apples toward consumers (Figure 1). Consumers vastly

prefer to buy apples from traditional retailers such as street vendors and roadside fruit shops. The retailers usually buy from wholesalers who directly purchase from preharvest contractors or growers at auctions. The commission agents arrange auctions to sell apples to wholesalers and other chain actors. The auction process is conducted in the traditional way in wholesale markets, where buyers can see the apple crates offered for auction. The commission agents usually charge 7%–8% commission on sale value from growers or contractors. The growers occasionally sell their produce directly. Mostly, growers depend on preharvest contractors to sell their produce because of weak market access and linkages, financial constraints, and incomplete information. The preharvest contractors and commission agents have a strong connection and are more influential in the chain.

Table 1: Volume and Value of Postharvest Losses in Apple Value Chains

Levels	Gacha				Kala Kulu			
	Quantity handled		Postharvest losses		Quantity handled		Postharvest losses	
	Volume (kg) A	Value (PKR)	Volume (kg)	Values (PKR)	Volume (kg) B	Value (PKR)	Volume (kg)	Values (PKR)
Farm	11,364.50	682,324.60	1591.00 (14% of A)	95,525.40	15,548.60	97,3811.30	2,021.30 (13% of B)	126,595.50
Market	9,773.50	807,972.80	527.80 (5% of A)	4,3630.50	13,527.30	1,127,231.30	730.50 (5% of B)	60,870.50
Retail	9,245.70	952,307.40	554.70 (6% of A)	57,138.40	12,796.80	1,254,090.40	767.80 (6% of B)	75,245.40
Consumer	8,691.00	1,068,988.10	86.90 (1% of A)	10,689.90	12,029.00	1,455,512.70	120.30 (1% of B)	14,555.10
Total		3,511,592.90	2760.40 (7.06% of A)	206,984.30		4,810,645.70	3,639.90 (6.75% of B)	277,266.50

Notes: kg = kilograms, PKR = Pakistan rupees.

Source: Authors' compilation based on study.

Identification of Constraints on the Value Chain Through Postharvest Loss Analysis.

a. Postharvest Losses in Terms of Volume and Value—

Around 26% of *Gacha* and 25% of *Kala Kulu* apples were lost at different value chain stages. The main causes of these losses included temperature fluctuation, unexpected rainfall, flooding, improper harvesting, poor handling, inefficient transportation, and inadequate storage facilities. Physical losses reducing apples' market values are depicted in Figure 2.

b. Distribution of Postharvest Losses Among Different Stages of the Value Chain—

The study estimated that 2,760.4 kg (worth PRs206,984.3) were lost from 11,364.5 kg of *Gacha* apples produced at the farm level; while 3,639.9 kg (worth PRs277,266.5) were lost from 15,548.6 kg of *Kala Kulu* apples produced at the farm level. Table 1 shows the highest percentage of postharvest losses were at the farm level: 14% of *Gacha*, and 13% of *Kala Kulu* apples were lost.

c. Availability and Quality of Support Services—

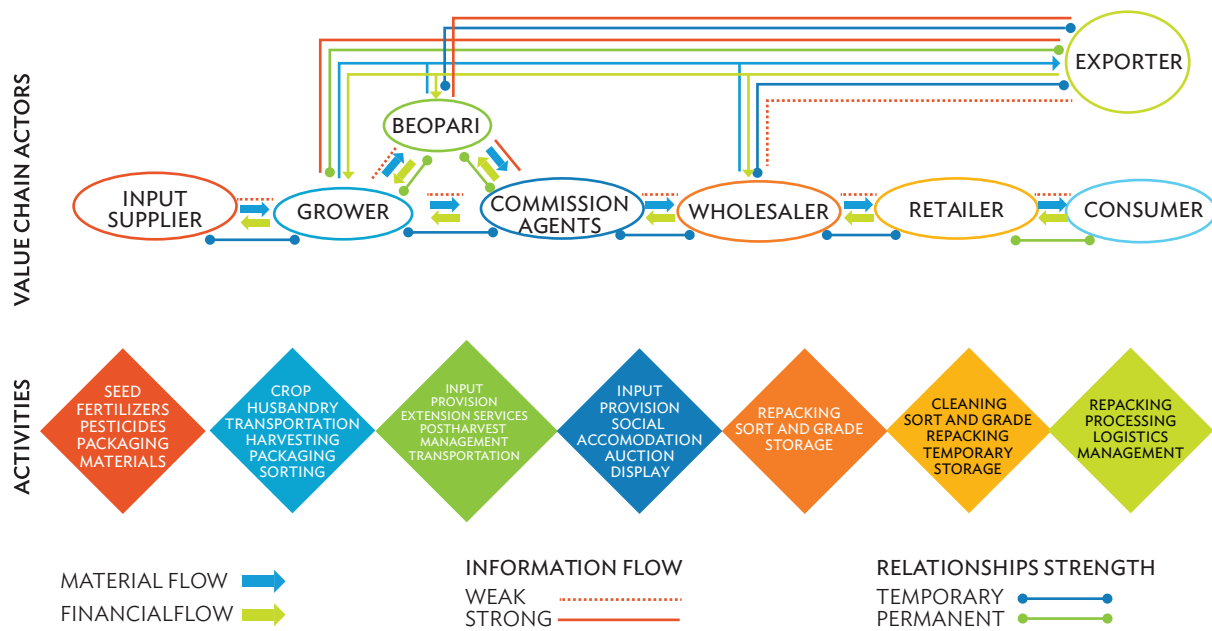
The quality of required services was unsatisfactory at the farm level. These included limited availability of cold storage, poor and narrow roads linking farms to the urban market, inefficient transportation, and a lack of good quality packaging material such as corrugated boxes. According to the cold storage survey, apples are stored for 3–6 months in a season. The private sector operates cold storage houses, which are usually found near regional wholesale markets.

In production areas, the lack of cold storage facilities forces farmers to sell their produce immediately, and lowers their value gains. During visits to the wholesale markets in Lahore, Karachi, Islamabad, and Faisalabad, the physical conditions and facilities available were found to be very poor. These markets were working beyond their capacity with outdated facilities such as open auction platforms without sheds, unpaved and congested roads, no parking facilities for transporters and buyers, poor sanitary and drainage conditions, unscheduled electricity breakdowns, security threats, and limited cold storage facilities. Growers bring apples in trucks from production areas to wholesale markets in big cities. These apples are usually packed in wooden boxes of around 16 kg/box. For transportation from markets to retail centers, retailers use different traditional vehicles such as loaders or rickshaws (60%), vans (37%), and others (3%).

B. Potatoes

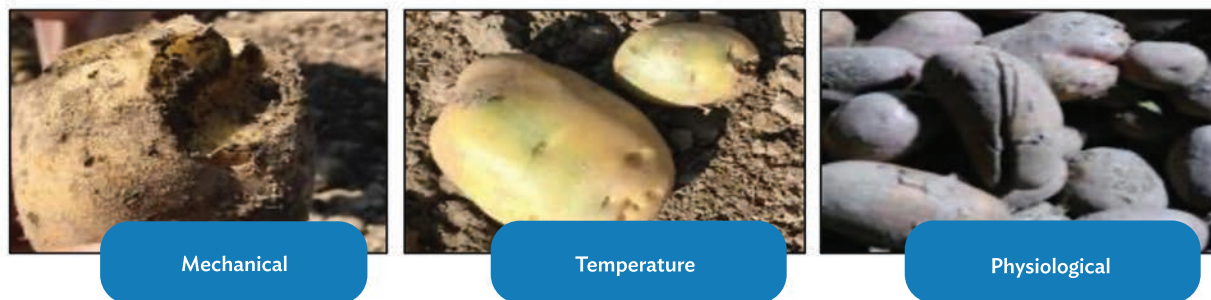
Market Analysis. For production and consumption, potatoes are an important crop. Per capita consumption was around 14.4 kg/year in 2018–2019, which has increased from around 13.2 kg in 2010–2011 (GoP 2019). About 4,552.66 thousand tons of potatoes were produced in Pakistan on 172.39 thousand hectares, with an average yield of 26.41 tons/hectare in 2019–2020. The province of Punjab contributes 93.6% of the total national production, followed by Khyber Pakhtunkhwa (5.17%), Balochistan (1%), and Sindh (0.33%). The major potato-producing areas are Okara and Sahiwal in the Punjab province of Pakistan. Generally, potato varieties are categorized as red and white. Both the red (*Asterix* and *Santé*) and white varieties (*Kuroda* and *Lady Rosetta*, *Mozika*) have high commercial value in the local and export markets.

Figure 3: Value Chain Map of Potatoes



Source: Authors' illustration based on study.

Figure 4: Postharvest Losses of Potatoes



Source: Authors' illustration based on study.

The red skin potato variety “Asterix” has higher export potential as it has more nutritional and market value. Pakistan exported 402.113 thousand tons of potatoes in 2019–2020. Major potato export destinations included Afghanistan, Sri Lanka, Malaysia, Iran, United Arab Emirates, and the Russian Federation (GoP 2020a).

Value Chain Mapping of Potatoes. The potato value chains comprise input suppliers, growers, local contractors (*beoparies*), commission agents (*arhti*), wholesalers (*pharia/mashakhore*), exporters, retailers, and consumers. In the surveyed wholesale markets of Karachi, Lahore, Faisalabad, and Islamabad, the supplies of potatoes mostly came from Punjab (Figure 3). Growers had strong connections with local contractors and commission

agents. They preferred to sell their produce through the wholesale markets. Most growers (97%) used manual harvesting, assembling, and packaging methods. Commission agents (58%) were the main source of financing for growers and influenced farmers’ selling decisions. Local contractors were their main source of information and connection with growers. Local contractors visited farmers’ fields before the harvesting, and facilitated pre- and postharvest crop selling. Most (58.3%) paid advance payments to growers during the different production phases, and 41.7% reported full payment after harvesting. In the wholesale market, commission agents held auctions where wholesalers bought and performed various activities such as sorting, grading, and repacking before selling to customers. Retailers usually procured supplies from wholesalers and performed activities like cleaning, grading, and

Table 2: Volume and Value of Postharvest Losses in Potato Value Chains

Levels	Red skin potatoes				White skin potatoes			
	Quantity handled		Postharvest losses		Quantity handled		Postharvest losses	
	Volume (kg) A	Value (PKR)	Volume (kg)	Values (PKR)	Volume (kg) B	Value (PKR)	Volume (kg)	Values (PKR)
Farm	10,800	368,280	864.00 (8% of A)	29,462	12,000	394,800.00	1,080.00 (9% of B)	35,532
Market	9,936	447,120	794.90 (8% of A)	35,770	10,920	478,296.00	873.60 (8% of B)	38,264
Retail	9,141	548,467	274.20 (3% of A)	16,454	10,046	582,691.20	301.40 (3% of B)	17,481
Consumer	8,867	691,617	15.10 (0.17% of A)	1,176	9,745	584,700.00	18.50 (0.19% of B)	1,111
Total		2,055,484	1,948.20 (5.03% of A)	82,862		2,040,488.00	2,273.50 (5.33% of B)	92,387

Notes: kg = kilograms, PKR = Pakistan rupees.

Source: Authors' compilation based on study.

arranging displays before selling to consumers. Consumers bought potatoes according to their requirements from retailers. Nearly half of these consumers reported buying up to 3 kg of potatoes at a time, while 36.1% bought more than 3 kg. Medium-sized potatoes (80–110 g) were preferred by 83.3% of consumers.

Postharvest Loss Analysis.

a. Postharvest Losses in Terms of Volume and Values—

The study found that 19.17% of red and 20.19% of white potatoes were lost at different stages of value chains. Major reasons for these losses included soil-borne diseases, insect damage, temperature variation, moisture loss, and mechanical damage during harvesting—as well as physiological damage due to cold, greening, growth cracks, loose skin, enlarged lenticels, malformation, sprouting, and vascular browning (Figure 4).

b. Distribution of Postharvest Losses Among Different Stages of Value Chain—

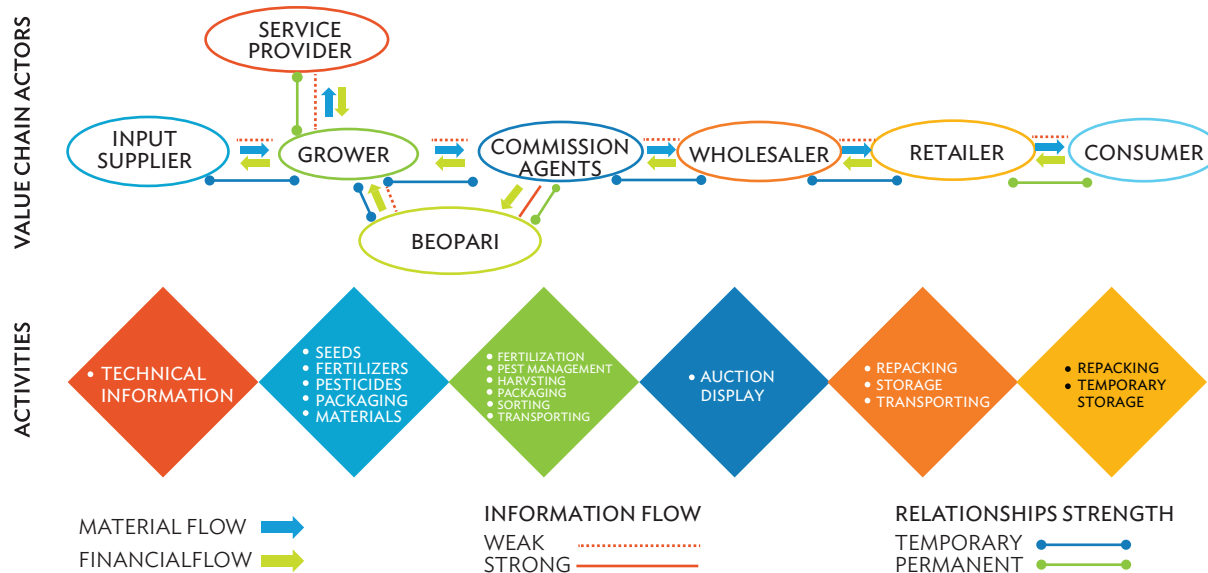
The study found that 1,948.2 kg worth PKR82,862 were lost out of 10,800 kg of red potatoes produced at the farm level. Around 2,273.5 kg worth PKR92,387 of white potatoes were lost. If these losses are managed, the profitability of value chain actors can increase (Table 2). Most losses occurred at the market level, followed by the farm and retail levels. Inappropriate handling, transportation, and storage were the major reasons for losses at the market level, whereas rough harvesting was the reason at the farm level. Mostly, drivers of harvesting machinery were not adequately trained and equipped.

c. Availability and Quality of Services—

At the farm level, growers pointed out the inadequate and poor quality of various services, such as finance, storage, packaging, and transportation. Growers usually avoid institutional sources of credit due to the lengthy application processes and requirements. The access of growers to inputs, including seeds, fertilizer, chemicals/spray, and packaging material, is highly dependent on the financing facility extended by local contractors and commission agents. The availability of good quality certified seeds in potato farming is a major issue for low productivity. Imported seed is more productive and available in the local market but at a high cost. Locally manufactured sowing and harvesting machines and equipment cause mechanical damage, as reported by nearly 77% of the growers.

The survey of markets revealed that auction platforms in many places did not have sheds. The roads were unpaved and lacked proper sanitary and drainage conditions. In Pakistan, both traditional and specialized fruit and vegetable vendors work at the retail level. Although specialized retailers are available in high-end markets and are increasing in number, traditional retailers such as street vendors, roadside stallholders, and weekly markets still dominate in Pakistan. The vegetable vendors use different modes, such as loader/rickshaw (46.4%), vans (42.9%), and others (7.1%), for transporting potatoes from the markets to their shops. Most of the vegetable vendors (84.7%) displayed the official price list provided by the local administrative government price control committee. However, the open market prices at the retail level were higher than those listed. This indicates weak governance by the price control committee deputed by the government to

Figure 5: Value Chain Map of Green Chilies



Source: Authors' illustration based on study.

Figure 6: Postharvest Losses in Green Chilies



Source: Authors' illustration based on study.

monitor daily price variations. During the coronavirus disease (COVID-19) pandemic, there was a rise in online selling in Pakistan. However, only (10.7%) of vegetable retailers, mainly supermarkets/stores, provided online services for selling fruits and vegetables.

C. Green Chilies

Market Analysis. Pakistan is among the five major chili-producing countries and supplies around 7.2% of the international market (Arin, 2019). Chilies are an economically important and valuable cash crop in Pakistan and are grown widely. (Khan et al. 2020). They contributed around 18.71% of total vegetable production and were cultivated in an area of 60.75 thousand hectares, producing 141.54 thousand tons in 2019–2020. The average yield is around

2.33 tons per hectare (GoP 2020a). The major chili-producing areas are in Sindh province. Generally, the green chili varieties are classified as “desi” or “local,” and “hybrid” types. The major local varieties include “Ghotki,” and “Bareek,” while “Kaali Shahzadi” and “Hari Shahzadi” are the major hybrid varieties.

Value Chain Mapping of Green Chilies. In surveyed cities, consumers bought from retailers who procured supplies from wholesalers in their cities’ wholesale markets (Figure 5).

Consumers had different preferences when purchasing chilies. The retailers usually purchased green chilies from the wholesalers who traded in the main vegetables wholesale market and used

Table 3: Volume and Value of Postharvest Losses in Green Chili Value Chains

Levels	Local				Hybrid			
	Quantity handled		Postharvest losses		Quantity handled		Postharvest losses	
	Volume (kg) A	Value (PKR)	Volume (kg)	Values (PKR)	Volume (kg) B	Value (PKR)	Volume (kg)	Values (PKR)
Farm	1,960	117,600	118.00 (6% of A)	5,880	2,160	114,480	130.00 (6% of B)	6,869
Market	1,842	143,676	55.00 (3% of A)	4,310	2,030	138,040	81.00 (4% of B)	5,522
Retail	1,787	160,830	71.00 (4% of A)	5,575	1,949	165,665	58.00 (3% of B)	4,970
Consumer	1,716	171,600	34.00 (2% of A)	3,432	1,891	179,645	38.0 (2% of B)	3,593
Total		593,791	278.00 (3.8% of A)	19,197		597,830	307.00 (3.82% of B)	20,954

Notes: kg = kilograms, PKR = Pakistan rupees.

Source: Authors' compilation based on study.

various modes of transport, such as loaders, rickshaws, minivans/pickups, and public transport to transfer the produce from markets to their retail shops. Wholesalers bought their supplies by participating in auctions arranged by commission agents (*arhi*). Growers, their representatives, or *beoparies* (who buy from growers) take or send their chilies to commission agents.

Postharvest Loss Analysis.

a. Postharvest Losses in Terms of Volume and Value—

The study estimated 15% postharvest losses in the green chili value chain at different stages. According to the survey respondents, the postharvest losses were mainly due to discoloring, shrinkage, blemishes, rotting, and physical damage, like cuts and broken pods (Figure 6).

b. Distribution of Postharvest Losses Among Different Stages of the Value Chain—

Postharvest losses were incurred due to various activities performed carelessly along the chain. The study found that 278 kg worth PKR19,197 were lost out of 1,960 kg of local chilies produced, while 307 kg worth PKR20,954 were lost out of 2,160 kg of hybrid chilies produced at the farm level. The highest percentage of postharvest losses occurred at the farm level (6%), followed by the market (4%), retailer (3%), and consumer (2%) levels. These losses were due to poor harvesting, improper handling and sorting, inappropriate packaging, and inefficient transportation. The details of the postharvest losses in terms of value and volume are presented in Table 3.

c. Availability and Quality of Services—

The growers did not store green chilies at their farms or in the market or cold storage facilities. Most farmers (93%) reported manually packaging, with around 61% using traditional jute bags and 21% packing in polypropylene bags. The average weight packed by 43% of the farmers was 50–60 kg/bag. The growers used different modes of transportation, mostly rented (89% of growers), such as loader rickshaw (73% of farmers), mini-truck (7%), and tractor trolley (7%) to deliver their products to the markets. The capacity of these transportation modes ranged from 15 to more than 50 bags. Most traders operating in markets did not store green chilies for a long period. A smaller percentage of traders (8.3%) reported holding for around 1–3 days in a private storage facility. Most of the traders (43%) pack in jute bags, followed by 30% of the traders packing in polypropylene bags and 27% in polyethylene bags.

RECOMMENDATIONS FOR AN UPGRADING STRATEGY

1. Institutional and Financial Support

The following recommendations and strategies are suggested for effective institutional arrangements and financial support.

a. The average yield of apples, potatoes, and chilies is low due to poor seeds and traditional production practices. Several public sector institutions produce and multiply seeds, engaging progressive farmers. The private sector also performs these

activities. The Federal Seed Certification and Registration Department needs to improve governance mechanisms with effective coordination among private seed companies and public organizations, such as agricultural universities, the Pakistan Agriculture Research Council (PARC), Ayub Agriculture Research Institute (AARI), the Nuclear Institute for Agriculture and Biology, and the National Institute for Biology and Genetic Engineering.

b. Postharvest losses are due to traditional practices performed carelessly. Inappropriate equipment and technology, along with unskilled labor, also contribute. Agricultural equipment service centers should be introduced to provide equipment to farmers with easy rental conditions. The private sector should be encouraged to manufacture small economical equipment using reverse engineering techniques. The Punjab Institute of Agriculture Marketing should strengthen its education of technicians and supporting staff, by introducing short training courses.

c. The government should promote a competitive environment in agricultural markets. There is a dire need to establish new modern agricultural markets. The existing markets cannot be replaced at once, and plans should be developed to renovate and improve the effectiveness of the current wholesale markets. In addition, model wholesale markets should be set up first at the provincial headquarters and later in all districts. Private and farmers' markets should be encouraged under the *Punjab Agricultural Marketing Regulatory Authority (PAMRA) Act 2018*.

d. Agricultural finance is much debated but has not improved over time in Pakistan. It is a common observation that growers hesitate to apply for institutional support due to their complicated requirements and lengthy application process. "One window" operation has been suggested and started many times, but its actual working mechanism and efficacy are not satisfactory. There is a need to revamp the agricultural finance system by introducing innovative products like *kissan* cards, agricultural insurance, and mobile credit units from commercial banks.

2. Infrastructure Development (Collection and Distribution Centers)

a. Growers are exploited by market agents mainly due to their inability to store produce and a lack of market information. In such situations, local collection points should be established in production areas where the farmers can bring their produce and sell it at market prices. Such interventions have already been identified by the Government of Punjab in the form of the Farmers Trading Platform but have not been appropriately implemented. With a mutual ownership structure, the government, over time may withdraw, transferring all rights to farmers. These collection points should be equipped with all required facilities, such as storage, processing, value addition, and transportation.

b. The development and maintenance of necessary infrastructures, such as roads, are highly recommended. The current poor condition of roads and inefficient transportation contributes significantly to postharvest losses in quantity and quality. The absence of basic facilities such as water and sewerage disposal in the markets further exacerbates these losses.

c. Proper infrastructure in terms of the development of climate-controlled cold storage near the production areas is recommended to increase the shelf life of all the commodities and to reduce postharvest losses. Using efficient packaging materials like perforated card boxes will also reduce postharvest losses.

d. With the involvement of the private sector, postharvest management centers can be developed to focus on efficient postharvest handling, processing, and management. Such centers can support growers, particularly smallholders, in preparing their produce efficiently and effectively according to the needs of different markets. These centers need proper harvesting, grading, packing, processing, and storage facilities that interested growers can use for a service fee. These centers can create a new services business in production areas. Large and resource-rich farmers should be encouraged to step into this business, particularly those involved in exporting fruits and vegetables. They can earn more money through these centers by securing larger export volumes.

3. Governance and Private Sector Participation

a. Postharvest losses are mainly due to poor linkages or weak interrelationships among value chain actors. Integrating these actors is recommended through better associations based on coordination and cooperation. Regulatory authorities' weak role and a casual price monitoring system were evident in the field. This is exacerbated by noncooperative behavior and low adherence to legal formalities and other requirements. All of these, including the monopolistic attitude of intermediaries and the abusive behavior of authorities, deter the private sector from investing. It is strongly recommended to direct regulatory authorities to facilitate and motivate the private sector to take initiatives to develop integrated value chains in Pakistan.

b. The involvement of the private sector is highly recommended to improve the situation. Government alone cannot do anything due to the scarcity of resources. The private sector has been competitive and efficient. This joint venture will also increase working capabilities and improve confidence in the stakeholders, as it will dilute central power and decentralize the working environment.

c. The shortage of good quality seeds can be addressed through plant breeding entrepreneurship. Private sector involvement would motivate the chain actors to follow international

standards by adopting modern technology and uniform practices. The same process can be pursued for storage, processing, and transportation services.

4. Commodity-Specific Issues and Intervention

a. Apples

This study identified the lack of certified apple nursery plants as a major constraint on the quality and productivity of apple orchards. At least one certified apple nursery should be established in each apple-producing district. The provincial agriculture department can facilitate the setting up of private certified nurseries and provide requisite facilitation and training. The shortage of irrigation water is another major constraint in apple-producing areas. The water table varies from around 120 meters to more than 200 meters, and the installation and operation of tube wells are very costly. These tube wells are powered by either solar energy or diesel due to the limited availability of electricity. Subsidized solar panels should be provided to apple growers. Relevant government departments should build mini dams to store irrigation water for apple production. Some growers also complained about inappropriate soil and water testing facilities. At least one lab/mobile lab in each district is required to provide soil and water testing facilities to growers.

Cold storage facilities are needed in the production areas, particularly in Qila Saifullah and Ziarat districts. Currently, cold storage facilities mostly exist near the wholesale markets where commission agents or wholesalers hold their produce. These facilities lack modern technologies, particularly mechanical logistic arrangements. Most of the loading and stacking is done by unskilled labor which is one of the reasons for postharvest losses at this stage. For this, the private sector should be encouraged and incentivized. Traditional packaging materials and practices are the major cause of postharvest losses. The use of unstandardized wooden crates with holding capacities varying from 15–20 kg and belly packing³ is common. Wooden crates should be replaced with 8–12 kg corrugated boxes for packing. This will help to reduce postharvest losses and save wood. To facilitate this, wholesale market managers should work with the economics and marketing teams of provincial agricultural departments. These institutions should also help growers and traders in the scientific grading and branding of apples.

Major wholesale markets are far from the apple-producing areas. Growers must immediately transport their apples to these markets. This affects their bargaining power because, once apples are in markets, they must be sold at the prevailing prices. The wholesale markets lack basic facilities, proper hygienic conditions, and standardized practices. Thus, modern fully equipped markets are needed near the apple-producing areas so the growers can maximize their share of the consumer rupee. Relevant provincial departments should plan such wholesale markets along with requisite infrastructural facilities.

b. Potatoes

Pakistan's potato industry relies heavily on seeds imported from the Netherlands, United Kingdom, France, and Germany. Although seeds of some local varieties are also produced, these cannot compare with the productivity and quality of imported seeds. Government agencies and research institutes such as the Federal Seed Certification and Registration Department, PARC, and AARI should develop good quality local seeds to reduce reliance on imports. Enforcement measures are also needed to curb the supply of low quality or adulterated seeds to growers.

Lack of modern machinery and improper practices are the major cause of potato losses which can be significantly reduced through better postharvest management practices. Federal and provincial institutions concerned with farm mechanization should develop and promote low-cost and affordable farm machinery.

There is also a need to train labor in the use of modern technology, and vocational training institutes can be mandated for this. The potatoes are traded in large-sized jute bags, usually carrying 110–120 kg of potatoes. These bags also transport a lot of mud because the potatoes are not washed. These heavy bags are difficult to lift and cause problems during transportation. A uniform packaging size (50–55 kg) is needed in all local and feeder markets. This will help promote investment in the packaging industry, and reduce postharvest losses. Provincial departments such as PAMRA in Punjab can play a key role in introducing and supporting this intervention.

In markets, there are no specified grades and standards to differentiate the quality of potatoes. The related government institutions should develop and enforce quality standards in Punjab's wholesale and retail markets. Wholesale markets in production areas are poorly managed and lack adequate infrastructure, such as roads, sheds, and security walls. Relevant public institutions should upgrade these wholesale markets and ensure basic facilities, including sewerage, security, and sanitation.

c. Chilies

In the case of chilies, the lack of good quality seeds is a major issue. At least one certified nursery should be established through public-private sector engagement. The lack of irrigation, a major limiting factor, can be addressed by promoting water conservation practices. The provincial irrigation department should encourage chili farmers to adopt such practices. Investment is also needed in research and development to preserve the germplasm of local/indigenous varieties. Both federal and provincial research institutes and seed departments must come forward to address this issue. The traditional drying of chilies on the ground causes quality and quantity losses and is a significant source of aflatoxin infestation. To minimize this problem, the public and private sectors need to collaborate to provide postharvest management machinery, such as customized solar dryers and color sorters for chili growers.

³ Overfilling wooden crates due to which the top side of the box bulges upwards.

Controlled-atmosphere storage and efficient transportation facilities are required in order to increase the productivity and quality of chilies. Private sector investment in storage facilities and transportation systems should be encouraged by relevant public sector institutions.

The malpractices of mixing and adulteration are common in chili value chains. This affects the quality delivered to consumers and negatively impacts growers' profitability. As such, there are no uniform local grades and standards. The joint effort of the federal and provincial organizations governing quality, such as the Pakistan Standards and Quality Control Authority, provincial food authorities, such as the Sindh Food Authority, and agriculture departments, can contribute to developing local grades and standards and curbing the malpractices of mixing and adulteration. The use of 25 kg net bags can help maintain the quality and reduce postharvest losses mainly incurred during transportation, handling, and storage. The public sector needs to join hands with the private sector to produce innovative packaging materials like net bags.

CONCLUSION

The study findings suggest that improving the performance of horticultural value chains could contribute to the socioeconomic development of Pakistan. Postharvest losses, particularly at the farm level, are the major constraint on the performance of these value chains, significantly reducing the marketable value of the fruits and vegetables. Major reasons for postharvest losses are (i) poor harvesting and packing practices; (ii) inadequate grading; (iii) limited cold storage; (iv) poor, narrow roads linking farms to urban markets; (v) inefficient transportation; and (vi) a lack of good quality packaging material, such as corrugated boxes. There is a dire need to address these issues along the horticultural value chains. This can be accomplished by strengthening support services and institutional and policy frameworks, improving value chain governance, and upgrading infrastructure. To this end, private sector engagement is critical because the public sector alone cannot upgrade the performance of value chains on a sustainable basis.

REFERENCES

- R. Albajes, C. Cantero-Martínez, T. Capell, P. Christou, A. Farre, J. Galceran, and J. Voltas. 2013. Building Bridges: An Integrated Strategy for Sustainable Food Production Throughout the Value Chain. *Molecular Breeding*. 32 (4). pp. 743–770.
- S. Arin. 2019. Scenario of Chili Production and Hindrances Faced by the Growers of Sindh Province of Pakistan. *Modern Concepts & Developments in Agronomy*. 4 (3). pp. 436–442.
- A. Azam and M. Shafique. 2017. Agriculture in Pakistan and its Impact on Economy—A Review. *International Journal of Advanced Science and Technology*. 103. pp. 47–60.
- H. Badar, A. Ariyawardana, and R. Collins. 2019. Dynamics of Mango Value Chains in Pakistan. *Pakistan Journal of Agricultural Research*. 56 (2). pp. 523–530.
- H. Badar, Z. Mohsin, K. Mushtaq, B. Ahmad, M. Mehdi, and A. Rasool. 2020. An Assessment of Consumer Preferences for Fresh Potatoes in Punjab, Pakistan. *Pakistan Journal of Agricultural Sciences*. 57 (3). pp. 773–778.
- V. Bossi Fedrigotti and C. Fischer. 2020. Why Per Capita Apple Consumption is Falling: Insights from the Literature and Case Evidence from South Tyrol. *Horticulture*. 6 (4). p. 79.
- R. Collins and M. Iqbal. 2011. Integrating Postharvest, Marketing and Supply Chain Systems for Sustainable Industry Development: The Pakistan Mango Industry as Work-In-Progress. *Acta Hort.* 895. pp. 91–97.
- K. Fernandez-Stark, P. Bamber, G. Gereffi, G. Ahmed, S.J. Heiland, and C. Root. 2011. *The Fruit and Vegetables Global Value Chain: Economic Upgrading and Workforce Development*. Center on Globalization, Governance & Competitiveness (CGGC). Duke University: North Carolina.
- Government of Pakistan (GoP). 2019. *Agricultural Statistics of Pakistan 2017–18*. Ministry of National Food Security and Research. Islamabad.
- GoPa. 2020. *Fruit, Vegetables and Condiments Statistics of Pakistan 2018–19*. Ministry of National Food Security and Research. Government of Pakistan. Islamabad.
- GOPb. 2020. *Pakistan Economic Survey 2019–20*. Finance Division, Government of Pakistan. Islamabad.
- Z.U. Haq. 2012. *Food Value Chain Analysis: A Review of Selected Studies for Pakistan and Guidelines for Further Research*. International Food Policy Research Institute. Washington, DC.
- R. Kaplinsky and M. Morris. 2000. *A Handbook for Value Chain Research. Vol. 113*. Institute of Development Studies. The University of Sussex, UK.
- A. Khan, M. Ali, and A. Yasin. 2020. *Chili Cluster Feasibility and Transformation Study*. Planning Commission of Pakistan. Islamabad.
- M.G. Martinez and N. Poole. 2004. The Development of Private Fresh Produce Safety Standards: Implications for Developing Mediterranean Exporting Countries. *Food Policy*. 29 (3). pp. 229–255.
- M.S. Mazhar, B.E. Bajwa, G. McEvilly, G. Palaniappan, and M.R. Kazmi. 2019. Improving Vegetable Value Chains in Pakistan for Sustainable Livelihood of Farming Communities. *Journal of Environmental and Agricultural Sciences*. 18. pp. 1–9.
- E.B. McCullough, P.L. Pingali, and K.G. Stamoulis, eds. 2008. *The Transformation of Agri-Food Systems: Globalization, Supply Chains and Smallholder Farmers*. Food and Agriculture Organization (FAO). Rome, Italy.
- O. Memedović and A. Shepherd. 2008. *Agri-Food Value Chains and Poverty Reduction: Overview of Main Issues, Trends and Experiences*. United Nations Industrial Development Organization (UNIDO). Vienna.
- Mordor Intelligence. 2021. *Pakistan Fruits and Vegetables Market: Growth, Trends, COVID-19 Impact, and Forecasts (2021–2026)*. Mordor Intelligence. Hyderabad, India. <https://www.mordorintelligence.com/industry-reports/pakistan-fruits-and-vegetables-market>

- M. Nafees, S. Ahmad, R. Anwar, I. Ahmad, and R.R. Hussnain. 2013. Improved Horticultural Practices Against Leaf Wilting, Root Rot and Nutrient Uptake in Mango (*Mangifera indica* L.). *Pakistan Journal of Agricultural Sciences*. 50 (3). pp. 393–398.
- S.A.A. Rizvi, M. Asim, and S. Manzoor. 2020. Issues, Challenges, and Scope of Supply Chain Management in Fruits and Vegetables in Pakistan. *IEEE-SEM*. 8 (1). pp. 20–30.
- R. Ruben, M. van Boekel, A. van Tilburg, and J. Trienekens, eds. 2007. *Tropical Food Chains: Governance Regimes for Quality Management*. Wageningen Academic Publishers. The Netherlands.
- J.H. Trienekens. 2011. Agricultural Value Chains in Developing Countries: A Framework for Analysis. *International Food and Agribusiness Management Review*. 14 (2). pp. 51–83.

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