PACE Assessment Study:

Assessment of Value Chain System for Horticulture in Khyber Pakhtunkhwa including Newly Merged Districts (Former FATA)

Prepared as part of the Technical Assistance to Agriculture Department, Government of Khyber Pakhtunkhwa

September 2021

Abdul Wajid Rana, Dr. Zahoor-ul-Haq, Dr. Sobia Asghar, Zeeshan Haider, Stephen Davies

Prepared by
Pakistan Agricultural Capacity Enhancement Program (PACE)

In collaboration with
Pakhtunkhwa Economic Policy Research Institute (PEPRI)

Implemented by
International food Policy Research Institute – Pakistan (IFPRI)

Funded by
United States Agency for International Development (USAID) Pakistan

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

The International Food Policy Research Institute (IFPRI), established in 1975, provides research-based policy solutions to sustainably reduce poverty and end hunger and malnutrition. IFPRI's strategic research aims to foster a climate-resilient and sustainable food supply; promote healthy diets and nutrition for all; build inclusive and efficient markets, trade systems, and food industries; transform agricultural and rural economies; and strengthen institutions and governance. Gender is integrated in all the Institute's work. Partnerships, communications, capacity strengthening, and data and knowledge management are essential components to translate IFPRI's research from action to impact. The Institute's regional and country programs play a critical role in responding to demand for food policy research and in delivering holistic support for country-led development. IFPRI collaborates with partners around the world.

AUTHORS

Abdul Wajid Rana (A.W.Rana@cgiar.org**)** is the Program Leader of Pakistan Agriculture Capacity Enhancement project (PACE)in the Development Strategy and Governance Division of the International Food Policy Research Institute (IFPRI), Islamabad, Pakistan

Prof. Dr. Zahoor ul Haq (zahoor.haq@awkum.edu.pk**)** is the Vice Chancellor and Head of PEPRI, Abdul Wali Khan University, Mardan, Khyber Pakhtunkhwa, Pakistan.

Dr. Sobia Asghar (sobia.asghar@awkum.edu.pk) is Research Fellow, PEPRI, Abdul Wali Khan University, Mardan, Khyber Pakhtunkhwa, Pakistan

Zeeshan Haider (Z.Haider@cgiar.org) is a Research Analyst-I in Pakistan Agriculture Capacity Enhancement project (PACE), International Food Policy Research Institute (IFPRI), Islamabad, Pakistan.

Stephen Davies (S.Davies@cgiar.org**)** is a Senior Research Fellow in the Development Strategy and Governance Division of the International Food Policy Research Institute (IFPRI), Washington, DC.

Notices

[1] IFPRI Discussion Papers contain preliminary material and research results and are circulated in order to stimulate discussion and critical comment. They have not been subject to a formal external review via IFPRI's Publications Review Committee. Any opinions stated herein are those of the author(s) and are not necessarily representative of or endorsed by IFPRI.

[2] The boundaries and names shown and the designations used on the map(s) herein do not imply official endorsement or acceptance by the International Food Policy Research Institute (IFPRI) or its partners and contributors.

Table of Contents

Boxes

List of Figures

List of Tables

Annexures

1. Introduction

Rapid urbanization and rising income levels in developing countries, such as Pakistan, changing diet habits[1], **information and communication technologies, structural transformation in retail markets as well as export market opportunities are catalyzing dynamic change in horticulture value chains.** This is causing a paradigm shift in the way horticulture products are produced, processed, and sold, both within domestic markets and in export markets across the globe. The emergence of local, regional, and global value chains is contributing to increasing engagement of the private sector in horticulture, as these firms and markets look for better quality, greater productivity, efficiency, and market penetration. At the same time, consumers demand for safety, quality, convenience and affordable prices is underlining the role of the private sector in the efficacy of the value chains.

Gereffi, *et al.* (2005) distinguish five general types of value chains, each with a different "governance" and role of firms: (*i*) ***Market-driven*** **chains** in which both buyers and suppliers have multiple sources of transactions, the price is fully market determined, and the cost of switching to new partners is low; an example is commodity markets; (*ii*) ***Modular*** **chains** in which suppliers produce to the specification of the buyers using generic technology; examples can be found in the electronics industry; (*iii*) ***Relational*** **value chains** in which interactions between buyers and sellers are mutually dependent, usually have sustained involvement over time, and are based on family or ethnic ties that tend to cement business relationships; an example is many apparel chains; (*iv*) ***Captive*** **chains** in which the lead firm controls a highly differentiated product, the key technologies, and/or product standards; suppliers have little incentive to move outside the production chain to work with the competitors; leading electronic firms such as Apple have these types of supplier relationships; and (*v*) ***Hierarchical*** **chains** in which the buyer-supplier relationship is internal to the firm; auto companies have many suppliers that are internal to the firm; all intra-firm trade falls into this category.

Recent literature reflects that addressing the cultural constraints and upgrading skills of women can increase female participation in all stages of the value chains. Urban migration of young men from rural areas has provided an opportunity to women taking over their family land in horticulture production (Chan 2010).

Today, producers and consumers are connected through a value chain including various stakeholders. The horticulture value chain ecosystem (Figure 1), in a broad sense, is comprised of farmers, input suppliers, traders, processors, distributors and marketers, who function to deliver higher quality and higher valued products to satisfy consumer demand (World Bank, 2018). There are interdependencies that affect performance of the value chains, but each segment may have its own unique constraints and enabling conditions.

[1] Evident from last three Household Integrated Economic Surveys of Pakistan.

Figure 1. Ecosystem of Horticulture Value Chain

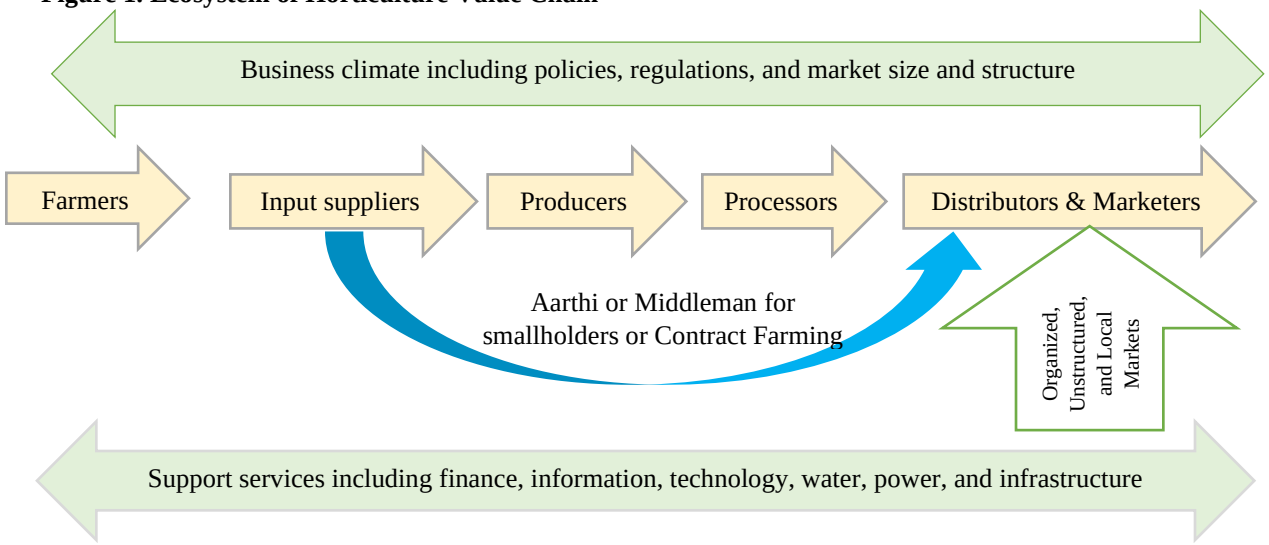
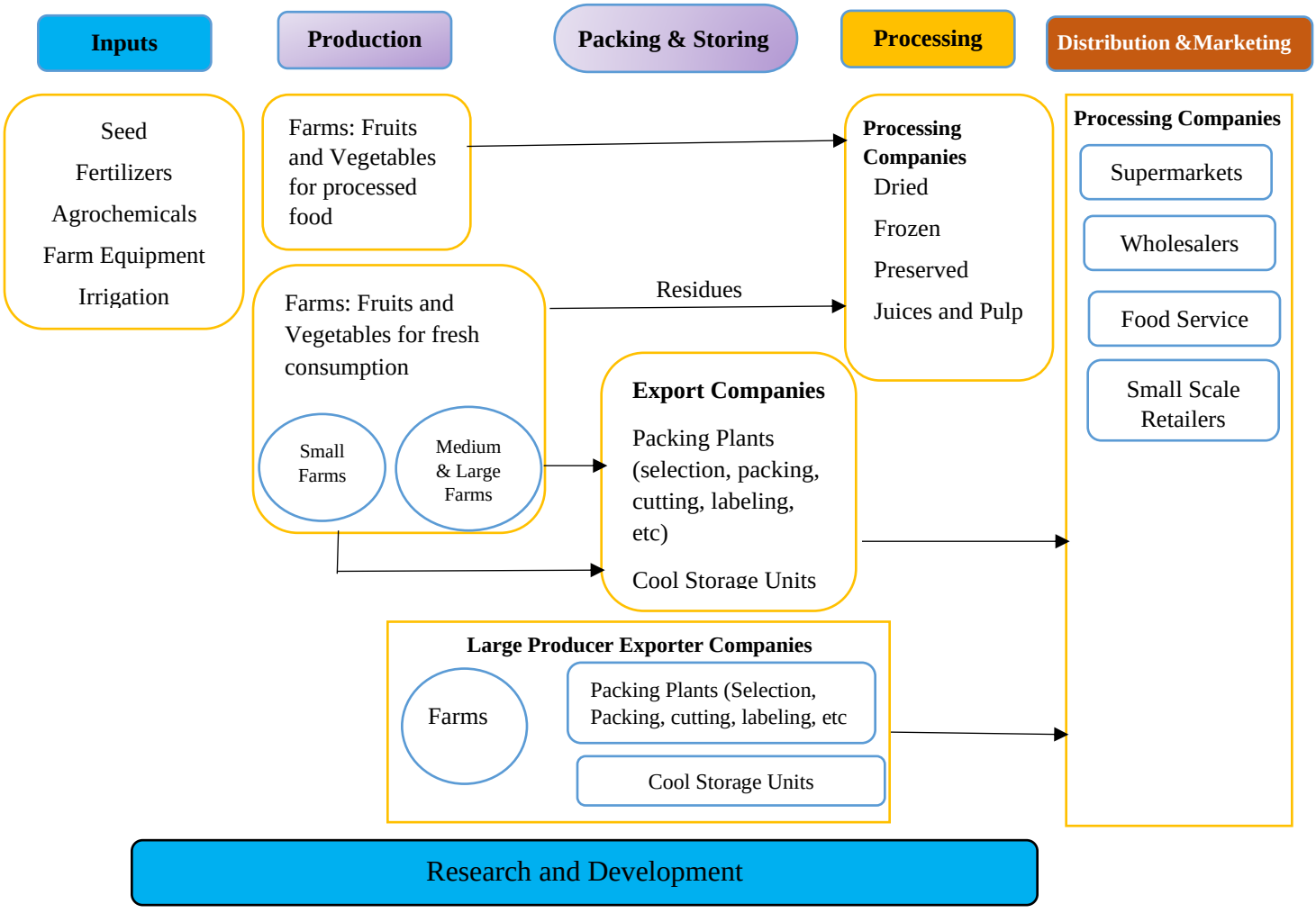


Figure 2. Global Value Chain for Horticulture



Source: World Bank, Cornelia Staritz and José Guilherme Reis (Eds. 2013).

The Global Value Chain (GVC) includes several segments (see **Figure 2**)**:** inputs, production, packing and storage, processing, and distribution and marketing. Logistics and transportation fulfill key supporting functions, and due to the fragile and perishable nature of the product, a high degree of coordination among different actors along the chain is required. This ensures that the perishable product reaches its destination in good condition. Cold storage is used throughout the chain to keep produce fresh, and both air and sea freight are key elements to ensure timely delivery.[2]

While horticulture can be a major contributor to national employment and income (Mallawaarachchi, et al. 2020)**, profitability on investment depends on transaction costs and risks.** The spatial dispersion of producers and consumers; lags between input application and harvest; sensitivity to weather extremes, pests and disease; liquidity constraints; variable perishability and storability of agricultural products; and political sensitivity of basic food staples makes agricultural markets prone to high transaction costs and significant production, market, climate, and enabling environment risks (Barret and Mutambatsere, 2005).

To maximize the benefits of horticulture, it is important to address the enabling conditions and constraints for the entire ecosystem including business environment and support services to ensure the value chains thrive. It requires better understanding of the nature and extent of market imperfections, managing transaction costs and risks, availability of financing to smallholder producers and market information, development of small and medium enterprises, and job creation along the value chain

While many producers in developing countries are competitive at the farm gate, a range of constraints undermine their competitiveness in regional and global markets and thus limit their potential for growth (OECD, WTO, 2013). These barriers in the developing countries include: inadequate infrastructure, limited access to finance, standards compliance (**see Table 1**)**,** lack of comparative advantage**,** market entry costs, structure of value chains**,** lack of labour force skills, cumbersome border procedures, inability to attract foreign direct investment, trade restrictions, and burdensome documentation. The findings of Chang *et al.* (2009) largely confirmed that the positive impact of trade on growth is greater if it is accompanied by improved economic infrastructure, increased education and skills, and deeper financial markets, but also institutional and regulatory reforms. Partner countries perceive that these types of programs are particularly effective. Initiatives to foster growth in the industry can help drive upgrading, enhance competitiveness, and facilitate an increase in international trade. Examples include the provision of training to meet standards, facilitating access to information on potential markets, increasing availability of appropriate financial instruments, improving institutional frameworks such as the regulation of sanitary and phytosanitary conditions, and improving infrastructure.

[2] Cornelia Staritz and José Guilherme Reis (Eds. 2013), Global Value Chains, Economic Upgrading, and Gender Case Studies of the Horticulture, Tourism, and Call Center Industries, The World Bank.

Table 1. Key Standards in Horticulture Sector

	Public		Private	
	Mandatory	**Voluntary**	**Individual**	**Collective**
National	• National legislation (pesticide use, labor regulations, sanitary inspections, and so forth) • USDA standards • China AQSIQ[3] registration	•HACCP[4] certification •USDA[5] National organic program	• Nature's Choice (Tesco) • Field-to-Fork (Marks & Spencer) • Terre et Saveur (Casino) • Conad Percorso Qualità (Italy) • Albert Heijn BV: AH Excellent (The Netherlands)	• British Retail Consortium (United Kingdom) • Assured Foods Standards (United Kingdom)
Regional	European Union Regulations		Filieres Qualite (Carrefour)	• EurepGap • Dutch HACCP • Qualitat Sicherhiet (QS)—Belgium, Holland, AustriaInternational Food Standard (German, French, Italian)
International	• World Trade Organization • IPPC[6] • ISPM	ISO 9000 • ISO 22000	SQF certification 1000/2000/3000 (United States)	• GlobalGAP • Global Food Safety Initiative • Social Accountability International, SA8000® Certification • IFOAM Standard

Source: Gereffi and Lee 2009; Henson and Humphrey 2009; Jaffee and Masakure 2005

The purpose of this paper is to explore the potential of horticulture sector in Khyber Pakhtunkhwa (KP) including Newly Merged Districts (NMDs) and opportunities as well as gains that it can bring through sector reform and the possibility of establishing an Agri-Business Authority/Board. Section 2 outlines the agro-ecological zones and their characteristics and landscape of Pakistan as well as KP's agriculture sector; Section 3 provides an overview of horticulture in Pakistan and global trend including demand and potential opportunities for Pakistan and KP; Section 4 highlights the food demand pattern and food expenditure in Pakistan; Section 5

[3] General Administration of Quality Supervision, Inspection and Quarantine

[4] HACCP (Hazard Analysis and Critical Control Point) is a system that helps food business operators look at how they handle food and introduces procedures to make sure the food produced is safe to eat.

[5] United States Department of Agriculture

[6] IPPC= International Plant Protection Convention; ISPMs= International Standards for Phytosanitary Measures; IFOAM= International Foundation for Organic Agriculture; ISO= International Organization for Standardization; SQF= Safe quality Food

identifies the major areas of fruit and vegetable production in Khyber Pakhtunkhwa; an evaluation of horticulture supply chain in KP including challenges facing the supply chain is presented in Section 6; Section 7 deals with evaluation of horticulture value chain in KP; Section 8 discusses the price formation in fruit and vegetable markets; Section 9 assesses the access to finance and agriculture loans for farming; Section 10 underlines the role of women in agriculture and farming in KP; and Section 11 briefly describes the agriculture extension and advisory services for horticulture available in KP. Section 12 provides some concluding remarks and underscores the policy recommendations that needs to be implemented to modernize the horticulture value chain in KP and creating opportunities for income growth by integrating to global value chain of horticulture.

2. National and Khyber Pakhtunkhwa's Agriculture Landscape

2.1 Geography of Khyber Pakhtunkhwa

Khyber Pakhtunkhwa (KP) is the smallest province, in terms of area of Pakistan, covering about 74,521 square kilometers but is the third largest province with a population of 37 million. It lies at the junction of three mountain ranges: Himalaya, Karakorum, and Hindukush. Kashmir and Punjab are located to its east and Afghanistan to its west; Afghanistan also bounds the province on the north, Baluchistan and the Dera Ghazi Khan District of the Punjab lie on its south. It is separated by a narrow strip Wakhan from Central Asia and China. Geographically, the province is divided into two zones: northern zone extending from the Hindu Kush range to the border of Peshawar basin and a southern zone extending from Peshawar to the Derajat basin with three distinct divisions**:** (i) the Cis-Indus division of Hazara, (ii) the comparatively narrow strip between the Indus and the hills, constituting the settled divisions of Peshawar, Mardan, Kohat, Bannu and D.I.Khan, (iii) and the rugged mountainous region located between these divisions and the border with Afghanistan (Durand line) including newly merged districts (erstwhile Federally Administered Tribal Areas).

Box 1. Integration of FATA with Khyber Pakhtunkhwa

The integration of the FATA, comprising 7 tribal agencies and 6 frontier regions, into KP added another 5 million people and approximately 2.72 hectares of mostly mountainous terrain. Towards fulfilling its commitment for development, the Government has approved a 10-year Tribal Decade Strategy (TDS) combined with first phase of 3-years Accelerated Implementation Program (AIP) starting 2019-2020. To operationalize AIP, an allocation of PKR59 billion (PKR48 billion in Federal PSDP and PKR11 billion in provincial ADP) was made for 2019-2020.

The AIP focuses on five priority areas: (i) building responsible and accountable institutions (23%); (ii) enhancing human potential (38%); (iii) expanding economic infrastructure (22%); (iv) creating sustainable economic opportunities (13%); and (v) instituting sustainable natural resource management (4%).[1] The Provincial Government has established an AIP Unit in the Planning and Development Department to monitor implementation of this program.

Based on the recommendations of the FATA Reforms Committee[7], the enactment of the 25th Constitutional Amendment on May 31, 2018 formally merged the erstwhile Federally Administered Tribal Areas (FATA) with the adjoining province of Khyber Pakhtunkhwa. Given the historic lags in socio-economic development in the Merged Districts (MDs) as compared to other regions of Pakistan, the Federal and Provincial Governments declared their commitment to sustained accelerated development in merged areas (MA) to address these lags (**see Box 1).**

[7] The Federal Government constituted a Committee on FATA Reforms on November 2nd, 2015, under the Chairmanship of Mr. Sartaj Aziz, Advisor to the Prime Minister for Foreign Affairs, to propose a way forward for political mainstreaming of the FATA Areas, which submitted its recommendations on August 8th, 2016. The Federal Cabinet approved these recommendations on March 2nd, 2017.

2.2 Agriculture Sector

Agriculture continues to be central to the livelihoods of almost half the population of Pakistan and to the future of rural areas, despite a structural transformation of Gross Domestic Product (GDP). It now accounts for 19 percent of GDP, down from 52.5 percent in 1950-51, but the sector still employs 44 percent of the labor force. It is also important for many parts of the industry and services sectors, providing markets for industrial products, farm machinery and other critical inputs including fertilizer and pesticides. Moreover, agriculture provides 43 percent of the country's export earnings, directly or indirectly, notwithstanding persistent decline in agriculture sector growth relative to its potential.

In Khyber Pakhtunkhwa (KP), the agriculture sector provides livelihoods to 85 percent of the population. Agriculture accounts for 14 percent of the provincial GDP and employs 37 percent of the labor force.[8] The total cultivated area in KP including the NMDs is 1.9 million ha[9] (8 percent of the country's total), 50 percent of which is irrigated, with the remaining half being rainfed. KP produces about 75 percent of the country's tobacco, 17 percent of maize, 16 percent of barley, and 8 percent of sugarcane. However, the province is a net importer of agricultural produce and depends heavily on production from other provinces – especially from Punjab – for important food commodities such as wheat (64 percent import share), rice (74 percent), citrus (75 percent) and vegetables (90 percent). Most of the cropped area in the NMDs is planted with wheat, barley, maize and rice. Fruits are also abundantly grown. South Waziristan and Kurram agencies are among the top apple and peach producing areas, while North and South Waziristan and Kurram agencies are famous for apricot production. Bajaur and North Waziristan are ranked among the top plum producing areas while pomegranate, pears, grapes, ground nuts and walnuts are grown in variable amounts in the different areas of the NMDs. Thus, promoting agricultural development and creating a vibrant rural economy is crucial for KP's economic and social progress.

The districts of Peshawar, Mardan, Charsadda and Swabi are fertile lands surrounded by hills. Towards the South, Kohat, Bannu and Dera Ismail Khan are now undergoing gradual change because of Gomal Zam Dam and Chasma Right Bank Canal. Heading north, the mountain terrain has more inaccessible valleys. Hazara is mountainous, with fertile agricultural and forest lands. In NMDs, only 8 percent of the land is suitable for farming. Agricultural production is constrained by small landholdings (85 percent of farmers have less than 2 hectares), a weak irrigation system, poor marketing opportunities, droughts, floods, and depletion of natural resources leading to soil infertility.[10] Irrigated and non-irrigated areas constitute about 0.083 million hectares (38.42 percent) and 0.133 million hectares (61.58 percent), respectively. The non-irrigated land is mainly used for fodder, grazing animals, agro-forestry and forests. The estimated area under forestation is

[8] Khyber Pakhtunkhwa Irrigated-Agriculture Improvement Project (KIAPIP) Project Appraisal Document (PAD), the World Bank

[9] Government of Khyber Pakhtunkhwa, Crop Statistics 2018-19.

[10] UNFAO, Women in Agriculture in Pakistan, p.53

885,605 acres of which south Waziristan, north Waziristan and Kurram have the largest forest cover. These are utilized for timber, firewood, fodder, soil conservation, flood control and promotion of biodiversity.

2.3 Irrigation System

The country is categorized into three hydrological units including (i) Indus basin, (ii) Karan desert, and (iii) arid Makran coast.[11] The Indus-basin covers 71 percent of the territory including more than 566,000 km^2in the provinces of Khyber Pakhtunkhwa, Punjab, Sindh, and the eastern parts of Balochistan. The Karan desert covers the western parts of Baluchistan accounting for 15 percent of the territory. The arid Makran coast along the Arabian Sea covers southwestern parts of Baluchistan province. The major rivers that criss-cross the KP province are Kabul, Swat, Chitral, Kunar, Siran, Panjkora, Bara, Kurram, Dor, Haroo, Gomal, and Zhob.

While water availability has increased from 64.87 million acre feet (MAF) in 1965/66 to 130 MAF in 2019/20, it is facing serious challenges including lack of water storages, inefficient use of water, poor infrastructure and low productivity. The total water withdrawal was estimated at 160 cubic km, accounting for 95.6 percent of water utilized for agriculture, 4.4 percent for domestic, and 1.6 percent for industrial use. Groundwater has been estimated at 63 cubic km/year through more than 500 thousand tubewells. Cotton, rice, sugar cane, and wheat are the main irrigated crops. The water storage capacity is for 30 days.

Agriculture is largely dependent on timely availability of water. More than 82 percent (19.32 hectares) irrigated agriculture while remaining (4.13 hectares) is rainfed**.**[12] About 2.8 million hectares of irrigated land is saline, ranging from sporadic to dense saline-sodic soils (FAO, 2004). Approximately, 90 percent of agricultural produce comes from irrigated lands. Annual rainfall in most parts of the country is less than 150 mm, with high evaporation rates ranging from 1,250 mm to 2,800 mm per annum. The sector consumes around 95 percent of the country's water resources.

KP's agriculture sector faces a water shortage due to the resource's spatial and temporal distribution. This situation is further exacerbated by: (a) low surface water conveyance efficiency with most losses occurring in watercourses (W/Cs); (b) low on-farm water use efficiency; (c) poor cost recovery and operation and maintenance (O&M); (d) water distribution inequities; (e) lack of storage capacity and control structures; and (f) limited public investment. The result is low water productivity and environmental challenges including water-logging and salinity. The situation improved somewhat with the operationalization of Gomal Zam Dam and Chasma Right Bank Canal (Gravity). However, paradigm shift in irrigated agriculture is expected following completion of Chashma Right Bank Lift Canal, Kurrum Tungi Dam and Mohammand Dam.

[11] http://www.fao.org/3/y5460e/y5460e06.htm accessed on July 1, 2020

[12] Economic Survey of Pakistan Supplement 2020-21

2.4 Climate

The climate of KP varies immensely from region to region. The climate varies from cold frosty winters (occasional snowfall) and mild summers in the valley floors to freezing winters and hot summers in open glens. Rainfall, in most parts, is satisfactory, but often not well distributed suffering from long intervals of dry periods. On the other hand, torrential rains may cause severe floods and damage to valuable crops, which is the only source of income for some farmers. The average rainfall varies from 25 to 60 inches. Heavy snowfall in Chitral and Kaghan Valley and a large glacier feature predominantly. Dir and Hazara are among the wettest places in Pakistan. The region south of the Himalayas and the Hindu Kush foothills has a dry and hot climate. It is found that the melting of the Hindu Kush-Karakoram-Himalayan glaciers could affect water flows into the Indus.[13] Climate change in KPK heightens the vulnerability for water availability for agriculture.

The altitude of Khyber Pakhtunkhwa province varies from 400 meters in the South and central parts to well above 3,000 meters in the North, allowing a great biological diversity of crops— ranging from tropical to temperate. Annual rainfall varies from 150mm in the South to about 1600 mm in the North. Generally, 50-60 percent of rainfall occurs in the main Rabi season (winter) from November to May and the rest is received in the Kharif season (summer) from June to October. Supplemental irrigation is often necessary for all cereals, fruits, and vegetables. The Northern parts experience extremely cold winters, with heavy precipitation (rains and snowfall) and pleasant summers. The Southern parts experience moderate winters with fewer rains and scorching summers. Renewable resources in the north help create economic opportunities in the central valley and the rest of the province. The cycle starts with melting snow in the north, and the snowmelt water flows to the central valley through a network of rivers that irrigate fertile farms. The same water is used to generate electricity and provide vital power to all sectors of the economy. The topography of hilly areas and fertile lands in the valley floors opens into wide fertile plains towards the south of Khyber Pakhtunkhwa province.

Pakistan ranks amongst the top 10 most climate-vulnerable countries. Pakistan is regularly affected by extreme weather events – floods in 2010 caused damages of around US$10 billion in Pakistan and US$300 million to KP's agriculture sector. Addressing climate change risks necessitates a more resilient agriculture sector and increasing water use efficiency. By better managing water demand (and helping to produce more crop per drop) and creating a system that can convert the seven-day turn system into a regular supply system, the resilience of KP's agriculture sector will be significantly improved.

[13] Winston Yu, Yi-Chen Yang, Andre Savitsky, Donald Alford, Casey Brown, James Wescoat, Dario Debowicz, and Sherman Robinson (2013). The Indus Basin of Pakistan – The Impacts of Climate Risks on Water and Agriculture. Washington, DC, World Bank.

2.5 Agro-Ecological and Crop Production Zones of Khyber Pakhtunkhwa

Pakistan is divided into ten agro-ecological zones based on physiography, climate, land use and water availability (Figure 3) **and fifteen crop production regions** (**Figure 4).** It includes five in Punjab, three each in Sindh and Khyber Pakhtunkhwa and four in Balochistan. Two of ten agro-ecological zones are located in KP including NMDs as below:

Southern KP*: *Peshawar, Kohat, Hangu, Karak, D.I. Khan, Tank, Bannu, Lakki Marwat, Mohmand Agency, Northern Waziristan, Southern Waziristan, F.R. Peshawar, F.R. Kohat, F.R. Bannu, F.A. D.I. Khan

***Plains/foothills KPK:** Charsadda, Nowshera, Mardan, Swabi, Mansehra, Battagram, Abbottabad, Haripur, Kohistan, Malakand, Swat, Bunir, Shangla, Dir Lower, Dir Upper, Chitral, Khyber, Kurram, Orakzai, Bajour*

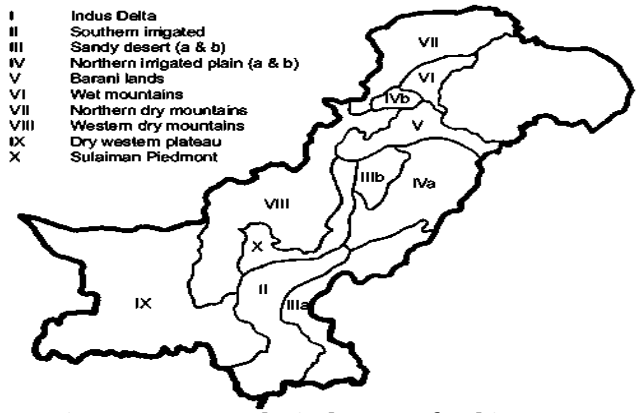


Figure 3. Agro-ecological Zones of Pakistan

Source: PARC,

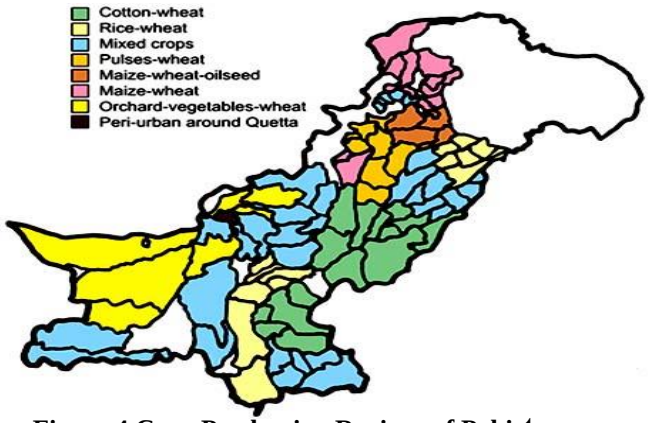


Figure 4 Crop Production Regions of Pakistan

Source: NFDC

Table 2. Agro-Ecological Zones of Khyber Pakhtunkhwa Province

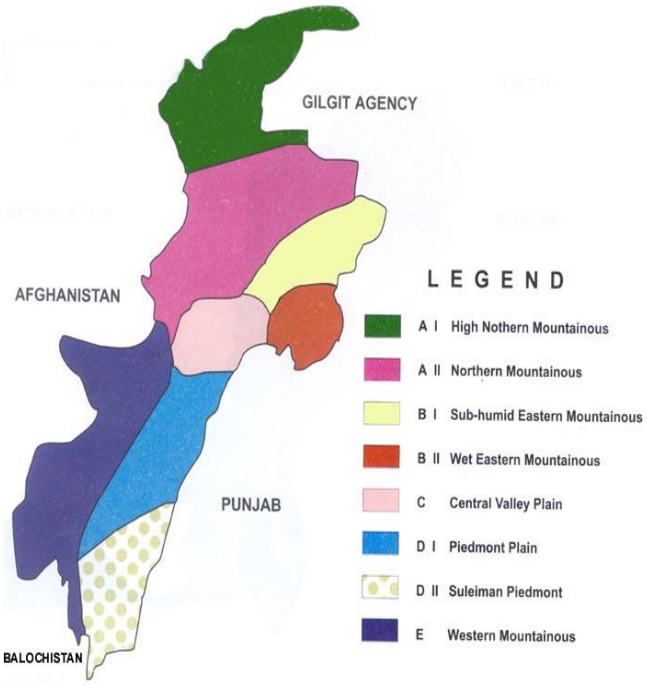
Zone	Sub-Zone	Description	Areas
A	(2)	Northern Dry Mountains	
	A-1	Very Dry, Very Cold Mountains	Chitral
	A-2	Dry, Cold Mountains	Dir (U), Dir (L), Swat, Shangla, Buner, Upper part of Malakand Agency
B	(2)	Eastern Wet Mountains	
	B-1	Sub-Humid Mountains (less than 1000mm rainfall)	Mansehra, Battagram, Kohistan
	B-2	Wet Mountains (rainfall more than 1000mm)	Haripur, Abbottabad
C	(0)	Central Valley Plains	Peshawar, Mardan, Swabi, Charsadda, Lower part of Malakand Agency
D	(2)	Piedmont Plains	
	D-1	Southern Piedmont Plains	Kohat, Karak, Bannu
	D-2	Suleiman Piedmont Plains	DI Khan, Lakki, Tank
E	(0)	Western Dry Mountains	FATA (NMDs)

Source: ARP-II Diagnostic Survey, 1994

The agro-climatic conditions vary from tropical and sub-tropical in the South and central parts, which then sharply alters in the North and East. Therefore, the Province has been

divided into five distinct Agro-Ecological Zones (AEZs). Each AEZ (see **Figure 5)** has different conditions concerning climate, soils, agriculture, and socioeconomic indicators of its population (**Table 2**). Characteristics of these zones is included in Annex-II.

Figure 5. Agro-Ecological Zones of Khyber Pakhtunkhwa



The diverse agro-climatic conditions of Khyber Pakhtunkhwa provide a basis for cultivation of all types of horticulture and field crops. The cropping production zones are at **Table 3.** The climatic conditions and availability of irrigation water influence the variations in crops grown, ranging from drought-tolerant species in the southern region (wheat and gram) to exhaustive crops in the central region (sugarcane and maize). In the north, cultivation of a variety of crops including cereals, oilseeds, and high-value crops such as fruits and vegetables is common. This diversity decreases the dependency of farm households on a single crop.

Table 3. Crop production regions in Pakistan

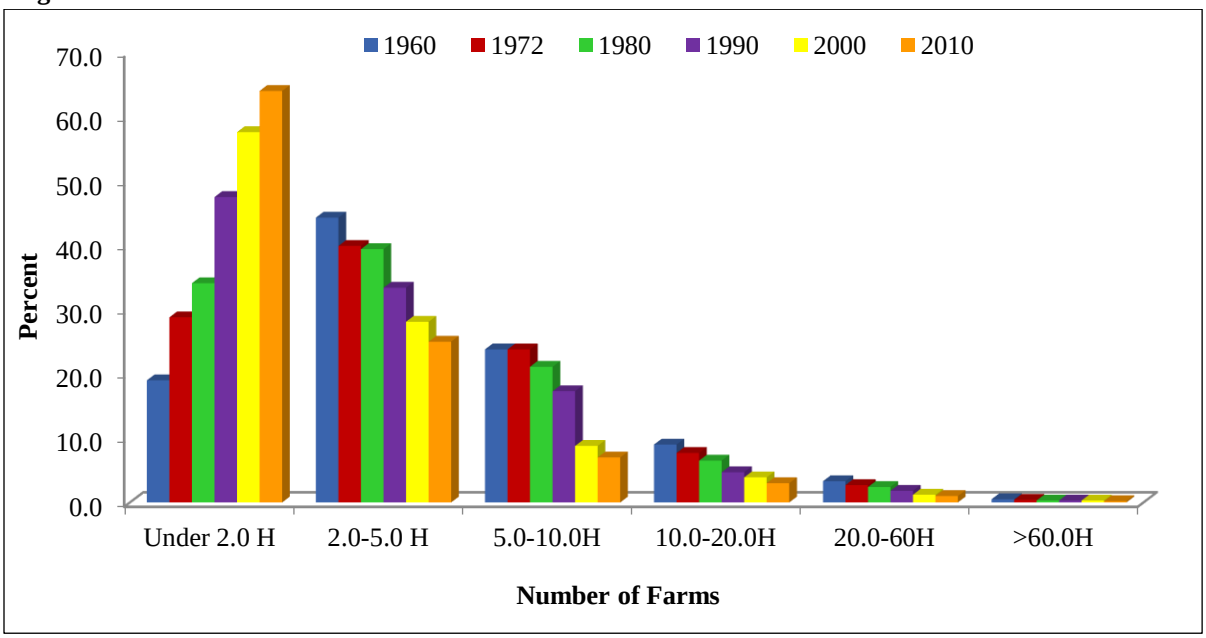
No.	Region	Cropping pattern	Agricultural area (million ha)	Irrigation source	Rainfall (mm)	
					Average	Range
1	Punjab I	Cotton-wheat	5.5	Canal, tubewell	156	55-247
2	Punjab II	Rice-wheat	2.8	Canal, tubewell	800	600-1100
3	Punjab III	Mixed crops	4.1	Canal, tubewell	446	240-688
4	Punjab IV	Pulses-wheat	1.9	Canal, rainfed	300	200-550
5	Punjab V	Maize/wheat-oilseeds	1.2	Rainfed	900	700-1 200
6	Sindh I	Cotton-wheat	1.6	Canal	50	43-70
7	Sindh II	Rice-wheat	1.1	Canal	58	40-78
8	Sindh III	Mixed crops	1.3	Canal, dry	123	62-200
9	**Khyber Pakhtunkhwa I**	**Maize-wheat**	**0.9**	**Rainfed**	**1050**	**240-1700**
10	**Khyber Pakhtunkhwa II**	**Mixed crops**	**0.53**	**Canal**	**520**	**400-670**
11	**Khyber Pakhtunkhwa III**	**Pulses-wheat**	**0.36**	**Canal, dry**	**500**	**300-600**
12	Baluchistan I	Mixed crops	0.4	Tubewell	180	65-3405
13	Baluchistan II	Orchards/vegetables/wheat	0.3	Tubewell	115	27-290
14	Baluchistan III	Rice-wheat	0.35	Canal	-	-
15	Baluchistan IV	Peri-urban	0.02	Tubewell	167	167

Source: ARP-II Diagnostic Survey, 1994

2.6 Distribution of Farmland in Pakistan

Figure 6 indicates rising trend in number of farms falling in the category of less than 2 hectares size, increasing from 19 percent in 1960 to 65 percent of total farms in 2010. while This increase farms of 5 hectares decreasing from 44 to 24.8 percent and farms of 10 hectares decreasing from 23.8 to 6.8 percent during the same period. Thus,small landholders owning less than 5 hectares of land (subsistence holding) now constitute 89.5 percent of farms. The average farm size has declined to 2.6 hectares. Only 1.4 percent of farms are larger than 20 hectares, but they account for 22 percent of total farm area; while 9 percent of farms larger than 5 hectares but less than 20 hectares manage only 9 percent of the farm area (**Table 4).**

Figure 6. Distribution of Number of Farm Size between 1960-2010



Source: Pakistan Agriculture Census 2010

Table 4. Farms, Farm Size and Farm Area, 1960-2010

Farm size in acres (Hectares)	Number of farms (%)						Farm area (%)					
	1960	1972	1980	1990	2000	2010	1960	1972	1980	1990	2000	2010
<5 (<2)	19.0	28.2	34.1	47.5	57.6	64.7	3.0	5.2	7.1	11.3	15.5	19.2
5-12.5 (2-5)	44.3	39.9	39.4	33.4	28.1	24.8	23.6	25.2	27.3	27.5	27.9	28.8
12.5-25 (5-10)	23.8	21.1	17.3	12.2	8.8	6.8	27	26.6	24.7	21.5	19.1	17.7
25-50 (10-20)	9.0	7.7	6.5	4.7	3.9	2.6	19	18.8	17.8	15.8	16.3	12.7
50-150 (20-61)	3.3	2.7	2.4	1.8	1.2	1.0	16	15.1	14.7	13.9	9.6	10.5
>150 (>61)	0.5	0.4	0.3	0.3	0.2	0.2	11.5	9.1	8.5	10.1	11.6	11.1
Total	100	100	100	100	100	100	100	100	100	100	100	100

Source: Pakistan Agriculture Census, 2010

2.7 Farming in Pakistan and Khyber Pakhtunkhwa

The farms with less than 5 hectares (90 percent) comprise 48 percent (11.3 hectares) of the cropped area in the country. The average land holdings in KP is much smaller than the national land holdings. The proportion of small farms in KP is higher than Pakistan (**Table 5**). These account for 95 percent of farms comprising 62 percent of the farm area and 67 percent of cultivated area. Likewise, the proportion of large farms, with more than 20 hectares, in KP is less than the national percentage and correspondingly these hold less area compared to the national average. National and KP comparison is at **Figure 7.** Farmers, irrespective of their farm size, produce major crops along with minor crops, vegetables, and fruits and raise trees for fuel or timber. They also keep large and small ruminants and raise poultry for personal or commercial use. The farming systems of an area depend on the availability of irrigation water, type of land, micro-climate, population density, transport infrastructure and market access, and cultural aspects.

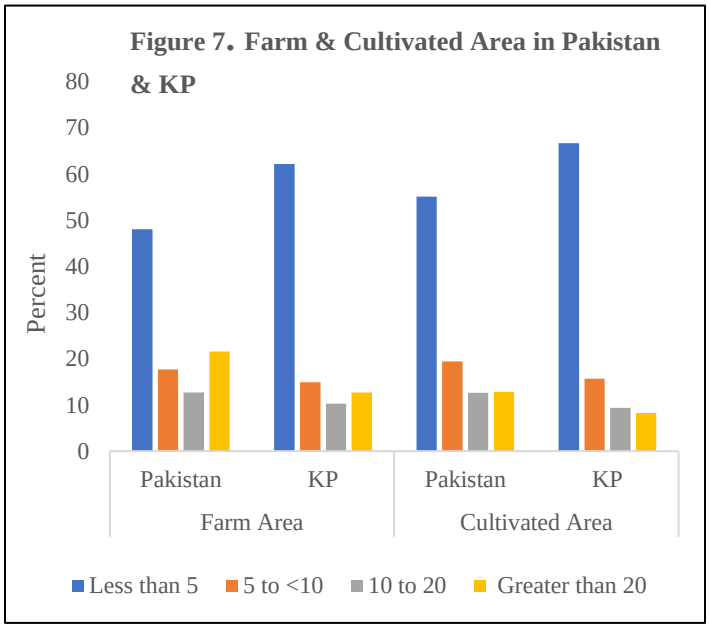


Table 5. Farm Size and Cultivated Area in Khyber Pakhtunkhwa (Hectare)

Farm Size (Hectare)	Number of Farms	%	Farm Area	%	Cultivated Area	%	Average Farm Area	Average Cultivated Area
Less than 5	1,465,433	95	1,401,007	62	1,201,747	67	0.96	0.82
5 to <10	49,221	3	335,780	15	281,961	16	6.82	5.73
10 to 20	18,181	1	231,534	10	168,990	9	12.73	9.29
Greater than 20	7,010	>1	285,708	13	149,437	8	40.76	21.32
Total	1,539,845	100	2,254,029	100	1,802,135	100	1.46	1.17

Source: Pakistan Agricultural Census

2.8 Agriculture Produce Marketing System

The Government of KP enacted Agriculture and Livestock Produce Markets Act in 2007 replcaing the Agriculture Produce Markets Act, 1839. Currently, KPK has only 2 government notified and designated wholesale markets: Peshawar and other in Dera Ismail Khan, whereas rest of the markets are privately-run wholesale markets. It is quite apparent that these private markets are freely functioning outside the regulatory regime without any issue due to lax implementation regime in KPK. KP agricultural marketing system had long been governed by the Agricultural Produce Marketing Act of 1939 and dominated by vested interests and lack of transparency, unfair

treatment to farmers or producers and losses to consumers. The new law was expected to bring more transparent legal regime to market agricultural produce to facilitate free flow of crops and stimulate food supplies, ensuring better income for the producers and better deal for the consumers. It still misses to build backward-forward linkages with farm producers to add value in response to demands of different market segments in the form of processing, export and food supply to high-end markets, thus creating market efficiency. Most markets, both public and private sector, in the province are unregulated. There is general perception that the market committee are generally dominated by political interference and Commission agents.[14] Likewise, the KP Government introduced Farm Service Centers Act, 2014.

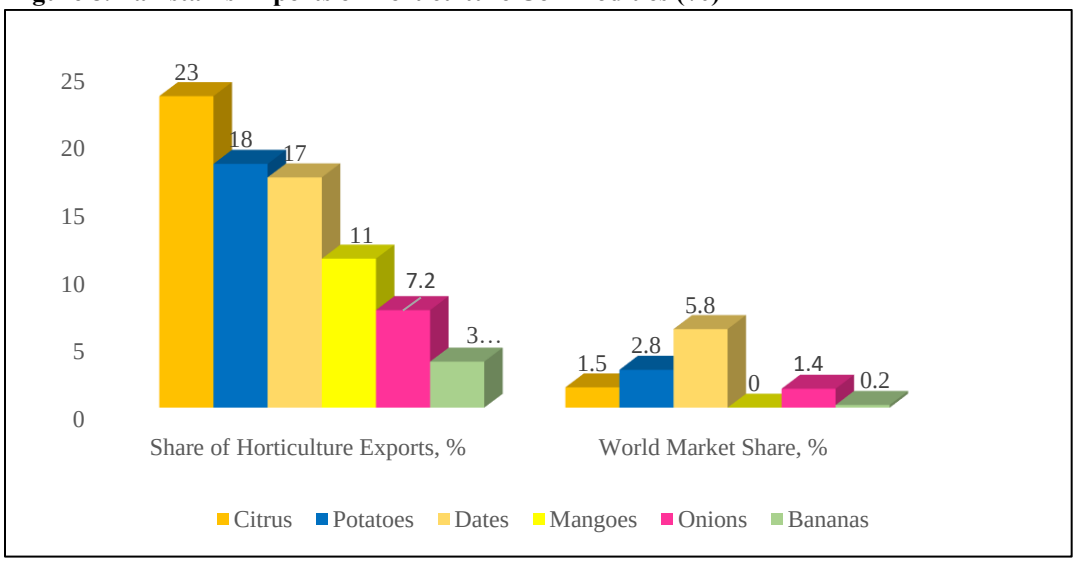
[14] http://www.transparency.org.pk/political-interference-crippling-market-committees-in-punjab/

3. Pakistan's Horticulture and Global Trend

Pakistan is producing temperate (apple, grape, peach, pear, raspberry, strawberry, etc.) as well as tropical (banana, guava, kiwi, mango, papaya, pineapple, etc.) fruits. The climate of the country also suits the production of a variety of vegetables. Summer vegetables include arum, bitter gourd, bottle gourd, brinjal, cucumber, ginger, hot pepper, mint, okra, potato, pumpkin, sponge gourd, squash gourd, sweet pepper, sweet potato, tomato, turmeric, etc. While, beets, broccoli, cabbage, carrot, cauliflower, coriander, garlic, lettuce leaf, mustard, onion, peas, potato, radish, spinach, turnip, etc. are produced in the winter season. These fruits and vegetables are not only produced for domestic consumption but also international consumption through export.

Nevertheless, Pakistan is a net importer of horticultural commodities. Its horticulture imports in 2017/2018 were US$ 870 million (fruit: $218 million, vegetables, $652 million) while it exported commodities of US$ 674 million (fruit: $429 million, vegetables: $245 million). So, the country imported 2.5 times more vegetables than it exported. The top six commodities, namely citrus, dates, mango, potato, onion and tomato presently being exported from constitute roughly 80% of the total exports of the horticulture sector. **Figure 8** 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 exports[15]. Pakistan can only achieve marginal gains by exporting mango as a commodity.

Figure 8. Pakistan's Exports of Horticulture Commodities (%)



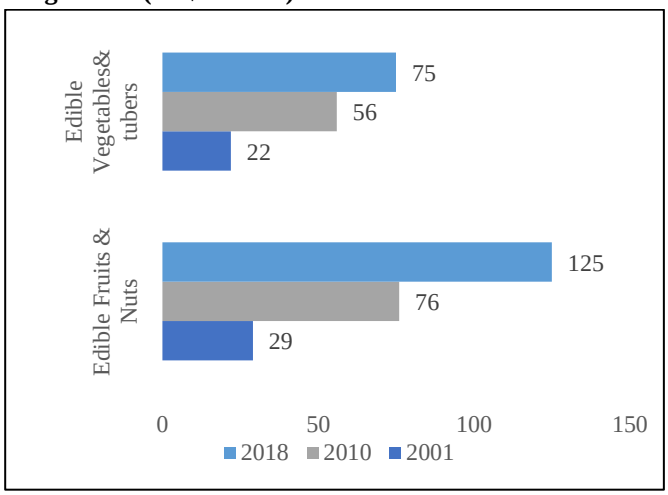
Source: International Trade Centre Statistics 2020

[15] ITC Statistics

3.1 Global Demand for Horticulture Products

The global demand for horticulture commodities has increased substantially. It has quadrupled, from US$ 51 billion in 2001 to US$ 200 in 2018 (**Figure 9).** Trade has increased by 331 percent for fruits and 241 percent for vegetables. The cumulative growth was higher between 2001 and 2010 at 157 percent after which it has slowed down to 51 percent. **Table 6** shows the most traded horticulture commodities across the globe in 2018.

Figure 9. Increase in Global Demand for Fruit and Vegetables (US$ million)



Source: International Trade Centre Statistics 2020

Table 6. Highest Exported Horticulture Commodities by world in 2018 (US$ Million)

Top 5 Fruits Exported	Exports	Top 5 Vegetables Exported	Exports
Bananas	12,945	Tomatoes	9,524
Citrus	10,856	Capsicum/Pimen	5,426
Fresh Grapes	8,564	Onions and Shallots	3,546
Apples	7,633	Potatoes	3,308
Avocados	5,551	Cucumber and Gherkins	2,720

Source: International Trade Centre Statistics 2020

Pakistan has not capitalized on this global growth in horticulture products because of inadequate investment in required infrastructure. This includes variety diversification aligned with global demand, grading and standardization, packaging houses, cold chain, marketing, proper logistics and processing units. Of the top 5 fruits exported globally, Pakistan has an export share only in citrus and banana. Apple and grape plantations lack the quality and variety demanded in the export markets and are generally just suitable for domestic consumption. Similarly, among the top 5 vegetables exported globally, Pakistan shares export of potatoes and onions. Tomatoes are enough to meet the domestic demand. Nevertheless, Pakistan exported tomatoes in 2019/2020. Similarly, the cumulative market size of processed horticulture food products trade has reached US$ 81 billion in 2018.

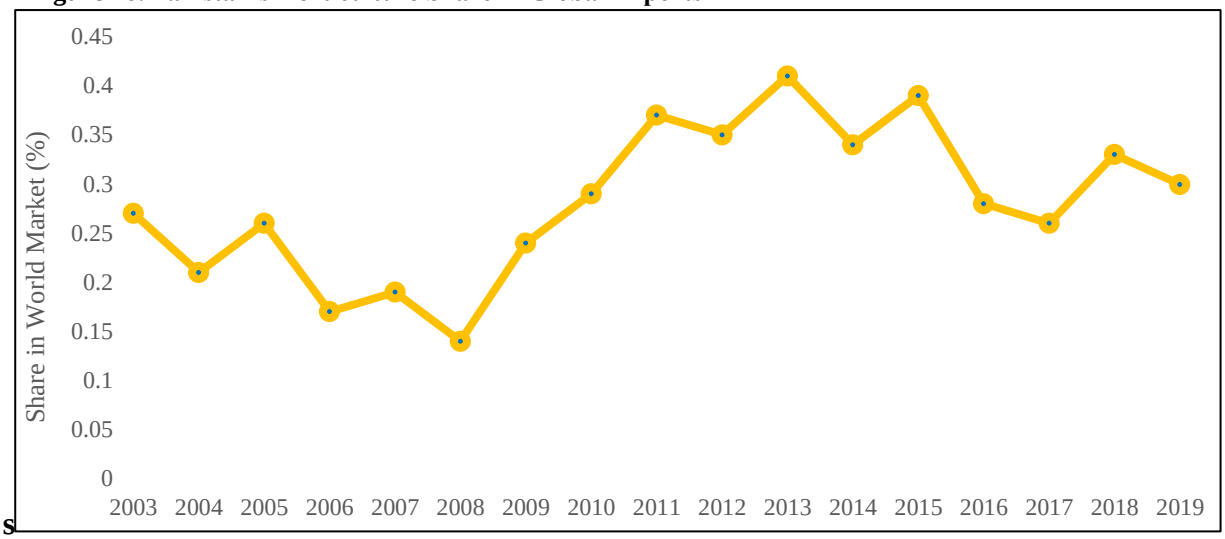
3.2 Pakistan's Share in Global Exports of Horticulture

Pakistan's horticulture exports are less than even countries which lack natural endowments, such as, availability of land, irrigation system[16], diverse agro-climatic conditions and sizeable

[16] A vast canal irrigation system exists, with 19 barrages on the rivers and a huge network of distributaries and branch canals, which is supplemented by fresh ground water in many parts of the country.

agrarian workforce. Pakistan's share in total global trade in horticulture commodities is around 0.34 percent (**Figure 10**). While Pakistan's horticulture exports grew threefold since 2003, from US$ 171 to $674 million in 2018, the exports of its peer group countries (Vietnam 14 times, Egypt 11 times, and Peru 12 times) increased by 12.8 times on average. It means if Pakistan had kept similar pace, its horticulture exports would have been US$ 2.2 billion by 2018. The top 5 commodities exported by these countries are shown in **Table 7.** These countries positioned their exports to cater to global demand and shifting to production of commodities which have global buyers.

Figure 10. Pakistan's Horticulture Share in Global Exports



s

Source: ITC Statistics, https://www.intracen.org/itc/market-info-tools/statistics-export-product-country/

Table 7- Export basket of Peru, Egypt, and Vietnam (US$ million)

Vietnam		**Egypt**		**Peru**	
Commodity	Export	Commodity	Export	Commodity	Export
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

Source: ITC Statistics, https://www.intracen.org/itc/market-info-tools/statistics-export-product-country/

4. Food Demand Patterns in Pakistan

Pakistan has attained notable improvement either from local production or imported edible product to maintain food stock, but food shortage is a repeated phenomenon and the government is facing increasing challenge of feeding its population. The mismatch between population and availability of food also affected the food pattern in the country. Worldwide food price inflation and recurring natural disasters in Pakistan, have revealed warnings for food security (WFP 2011). Both the United Nations Food and Agriculture Organization's (FAO) Hunger Map and the International Food Policy Research Institute (IFPRI) Hunger Index suggest a serious prevalence of undernourishment and hunger in Pakistan (Nazli *et al*. 2012). Safe and nutritious food is necessary for individuals to fulfil their human potential and for nations to meet targets for growth and prosperity. In developing countries including Pakistan, consumption and production decisions are the results of government policies like fixing production targets, imposing taxes, announcing incentives (subsidies) to promote production and sometimes intervene in the market to regulate prices. These decisions have a decisive influence on consumers, producers and traders alike and different stakeholders respond differently to such decisions.

Demand studies typically used a system of equations estimated using the Seemingly Unrelated Regression technique. The technique helps implement the restrictions of the homogeneity, adding up and symmetry as required in economic theory. Some of these studies are discussed here. Haq *et al.* (2011) estimated a flexible LA/AIDS model to examine food demand patterns for urban and rural households in the Punjab province of Pakistan by using the Household Integrated Economic Survey of Pakistan. Food products were categorized into eight groups including wheat, rice, fruits, vegetables, milk, cooking oil, meat, and other food products. The findings showed that households in both rural and urban areas with the head of the family having agriculture as a profession consume less of all foods except for wheat. Whereas, households in both rural and urban areas with the literate head of family consume more of all food products except for vegetables and wheat. Both compensated and uncompensated own price and expenditure elasticities are significant and have the expected signs for both rural and urban consumers. The demand for all eight food groups is price inelastic with wheat having the most price inelastic demand. All of the expenditure elasticities are positive suggesting that all goods are normal with the largest expenditure elasticities found for milk followed by fruits, other food products, meat, rice, vegetables, wheat and cooking oil.

Burki (1997) studied consumer behaviour by using time series disappearance data from 1972 to 1991 and confirmed that food consumption patterns in Pakistan cannot fully be explained by changes in relative prices and expenditures. By using both the first difference LA/AIDS model and GARP the existence and the nature of structural changes in consumers was tested. The estimated price and income elasticities were also consistent with the economic theory. The statistically significant and positive intercept term for mutton (0.04), fish (0.02) beef (0.017), chicken (0.009) and other (0.016) showed an exogenous growth. Gram (split) having a negative intercept of -0.017 showed an inferior nature. Changes in taste resulted in the increase of chicken,

other meat and gram demand after 1982 to 83. Except for rice, all of the own-price elasticities are reasonable in sign and magnitude. The own-price elasticities for rice (-0.03), chicken (-0.022) and gram (-0.012) are not statistically different from zero. The complementary relations between chicken and mutton and between dish and mutton were hard to explain while the substitution between beef, mutton and chicken was fairly large and significant in most cases. The estimated expenditure elasticities for all commodities, except chicken and gram were positive and less than one while, that of chicken (1.15) was greater than unity. All of the estimated price elasticities were negative and consistent with the economic theory as per prior expectation.

Mudassar *et al*. (2012) used LA/AIDS model to estimate consumer demand and their responsiveness to prices change and income for meat group using Pakistan's time-series data from 1950-51 to 2003-2004. A shift in the demand for fish in 1991-92 was supported by tests of the structural change. A decline in the exogenous growth in the share of fish demand after 1991-92 was indicated by negative and significant dummies used. The decrease in demand for fish was due to a change in the taste of the consumers. Negative but significant own-price elasticities for beef, chicken and fish were recorded except the positive own price elasticity for mutton is caused by the violation of negativity conditions. Beef and mutton were recorded as substitutes whereas all other pairs were considered as complements through their cross-price elasticity analysis. Expenditures elasticities for all the commodities were positive and less than unity identifying them as normal goods.

Haq *et al*. (2008) estimated the impacts of rising world food prices on poverty in rural and urban areas of Pakistan. Data on household income and expenditures for 2004-05 was used to calculate price and expenditure elasticities both uncompensated and compensated thorough Linear Approximate Almost Ideal Demand System. The higher unexpected domestic prices component for the year 2007-08 was used to derive the changes in food expenditures, quantity consumed and its impact on poverty by considering that food crises happened in 2004-05. All of the calculated uncompensated and compensated expenditure and price elasticities significant as per prior expectation. Except for rice, all of the food commodities were price inelastic. Urban meat consumers were less elastic to price as indicated by Marshallian price elasticities than rural rice consumers with values of -0.198 to -1.521 respectively. Also, urban wheat consumers showed an inelastic (-0.243) response to price. The low-level income consumers were more vulnerable to poverty and their consumption changes relatively little with an increase in food prices affect their required expenditure level. The expenditure elasticities of fruits, milk and rice were more than unity categorizing them as luxuries, while the remaining food groups were classified as normal goods. The estimated result showed that poverty increased in both urban and rural areas. A review of various studies estimating food demand in Pakistan is at **Table 8.**

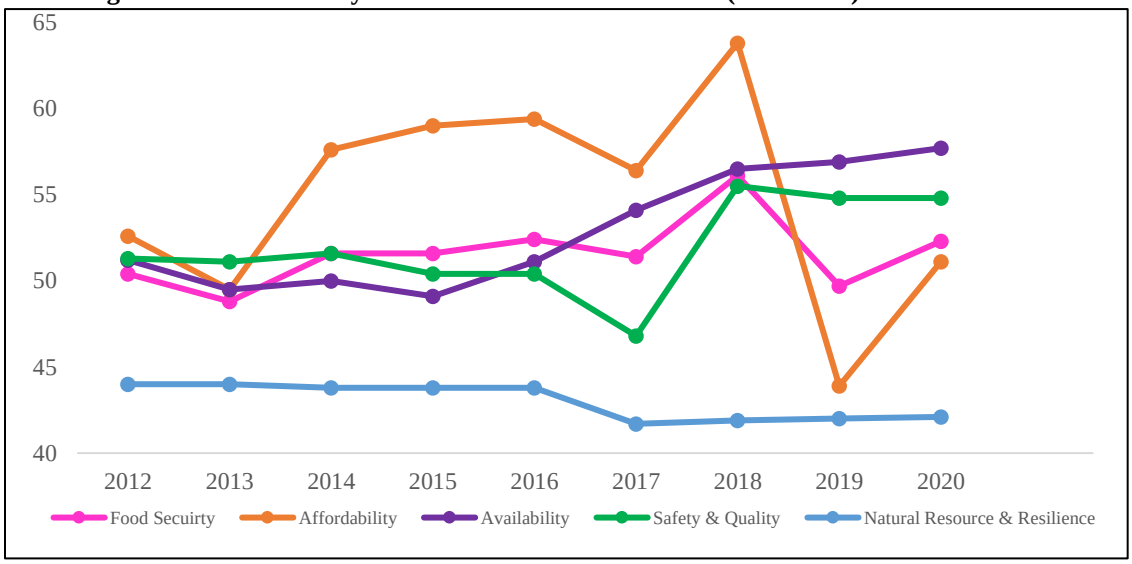
Table 8. Review of the selected studies estimating food demand in Pakistan

Sr. No.	Name	Year	Model	Data Source	Commodity/Elasticity
1.	Burney and Khan	1991	Linear, double-logarithmic using OLS	HIES data 1984-85	• Expenditure elasticity < 1 for food and drink
2.	Malik	1992	Expenditure elasticities	HIES data 1972-73, 79, 1984-85, and 1986-87	• Low income HH spend 42.8% of their income on cereal, pulses and vegetables • High income HH spend 38.2% on meat, fish, eggs, fruits, milk and milk products
3.	Aziz	1997	LA-AIDS Generalized Axiom of Revealed Preferences (GARP) for meat demand equation	Time series data 1972-73 to 1994-95 on meat group	Expenditure elasticities: • Mutton 0.614 • Fish 0.790 • Chicken 0.646 • Beef 0.661 Own Price elasticities: • Fish -0.182 • Beef -0.477 • Mutton 0.099
4.	Ahmad	2004	Engel Curve	HIES data 1998-99	• Percentage share of expenditure on food decline with a rise in income • Expenditure elasticities are higher for the lower-income group as compared to the higher-income group • Expenditure elasticities for meat and fish, poultry, and fruits > 1 for rural areas • Expenditure elasticities for poultry, and fruits > 1 for urban areas
5.	Malik and Babar	2006	LA-AIDS model	Time series data 1950-51 to 2003-04	• Own price elasticities for beef chicken and fish < 1 • Expenditure elasticities < 1
6.	Haq et al	2008	LA-AIDS model	HIES 2004-05	• All food commodities were price inelastic except for rice • The food consumption of low-income consumers changes relatively little with an increase in food prices. • Expenditure elasticities of fruits, milk and rice were more than unity- luxuries
7.	Haq and Cranfield	2011	A levels version of Barten's general model	HIES 2004-05	• Own-price elasticities for food were inelastic except for meat and poultry and cooking oil • Expenditure elasticities for milk and dairy products and fruits and vegetables were more than unity
8.	Haq et al	2011	Flexible LA-AIDS model		• Demand for most of the food items is more price inelastic in urban areas than in rural areas (except milk which is price elastic in rural areas) • Expenditure elasticities are greater than one for fruits, milk, and meat • In urban and rural Punjab, the growth in demand for fruits, milk, meat and other food will outpace growth in income
24.	Mudassar *et al.*	2012	LA/AIDS model	Time series data 1950-51 to 2003-2004 for meat group	• Expenditures elasticities < than unity-normal good

4.1 Food Expenditure Pattern in Pakistan

Pakistan is ranked as the sixth most populous country in the world with a population growth rate of 1.92 percent. The estimated population is 212.2 million of which 63.6 percent reside in rural areas (GoP, 2018). Food security is when people have physical and economic access, at all times, to sufficient, safe, nutritious food to maintain a healthy and active life. Despite Pakistan's strong agricultural base, food insecurity is widespread. Pakistan is ranked 80th out of 113 countries in terms of overall food security environment, 82nd in affordability, 60th in availability, 80th in quality and safety and 91st in natural resource and resilience (see Trend at **Figure 11**).[17] According to The State of Food Security in Pakistan, 18 percent of the population in the country is undernourished and 44 percent of households consume less than the recommended standard of 2,350 Kcal per adult equivalent per day.

Figure 11. Food Security Index Score Trend of Pakistan (2012-2020)



Source: https://foodsecurityindex.eiu.com/Country/Details#:~:text=82,-32.7%25

Relevant literature shows that food inflation has resulted in a rise in food expenditure by a higher proportion than nonfood expenditure. Food inflation affects the well-being of poor and non-poor households differently, as the poor households devote a reasonably sizable share of their income on food, they have also larger family size and have lower assets endowments to cope with temporary shocks (De Janvry & Sadoulet, 2009).

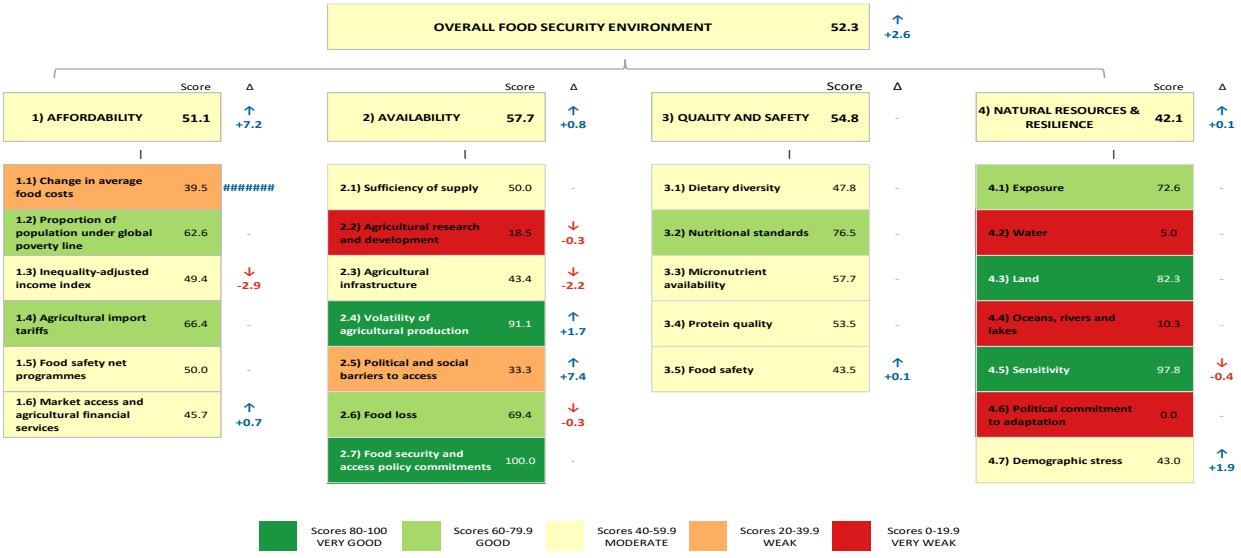
In Pakistan, a large fraction of total household expenditure is spent on food, and inequalities continue to persist in consumption across income groups and between urban and rural areas. Fruits and vegetables are an essential component of the food basket consumed in the country. Consumption and production decisions of fruits and vegetables are also influenced by government price policies just like other farm products. Understanding consumer behaviour

[17] Global Food Security Index Rankings, 2020,

explains how consumers' respond to changes in relative prices and real income due to government policies and other factors. Specifically, price and income/expenditure elasticities explain the changes in quantity demand due to changes in own prices and income/expenditure. Although not in the context of fruits and vegetables, demand analysis is used for sales forecasting, pricing decisions, firm's budgeting and other marketing decisions. Since a bigger proportion of income in Pakistan is spent on food expenditure, therefore, the importance of demand analysis increases many-folds.

According to the latest published report of Household Integrated Economic Survey (HIES) 2018-19, expenditure on food and non-alcoholic beverages accounts for 36 percent of the total consumption expenditures. Further 20 food items contribute 87 percent of the total expenditure on food (GoP, 2020). To estimate the demand for selected fruits and vegetables for Pakistan and Khyber Pakhtunkhwa, per capita consumption data of HIES (2018-19) are used. Of the selected fruits and vegetables, monthly per capita consumption data are available for banana, citrus (*mossaumi* etc), apple, other fruits, potato, tomato, onion, chilly and other vegetables. At the Pakistan level, total demand for Banana and citrus (*mossaumi* etc) is estimated as 11,662 and 4533 thousands with the production of 135.1 and 2351.4 thousand tons, respectively. While apple demand is estimated at 662,06 thousand tons against the production of 649.3 thousand tons and other fruits are demanded at 1476.91 thousand tons with the production of almost 1476.91 thousand tons. Similarly, potato, tomato, onion, chillies, and other vegetables are annually demanded at 3233.93, 1298.66, 2419.08, and 5653.00 thousand tons, respectively. While potato, tomato, onion, chillies, and other vegetables produce in the country are 4584.3, 620.1, 2115.2, 148.3, and 3314.0 thousand tons, respectively (see **Figure 12 from Global Food Security Index**).

Figure 12. Changes in Average Food Cost in Pakistan



For the province of Khyber Pakhtunkhwa, the total demand for Banana and citrus (mossaumi etc) is estimated as 1389.93 and 848.46 thousand number, respectively against the

production of 13 thousand banana and 30.3 thousand tons of citrus. Demand for apple is estimated at 110.85 thousand tons and for other fruits, the demand is 225.97 thousand tons. Apple production in the province is 69.3 thousand tons and production of other fruits is 384.2 thousand tons. Similarly, potato, tomato, onion, chillies and other vegetables are annually demanded at 486.05, 349.62, 328.30, and 856.98, against the production of 152.6, 124.8, 222.4, 0.4, and 410.1 thousand tons, respectively (see **Table 9).**

Table 9. Consumption and Production of Selected Fruits and Vegetables in Pakistan and Khyber Pakhtunkhwa

Items	Pakistan				Khyber Pakhtunkhwa			
	Per Capita Consumption (Kg)		Total Demand 000 Tons	Total Production 000 Tons	Per Capita Consumption (Kg)		Total Demand 000 Tons	Total Production 000 Tons
	Monthly	Annual			Monthly	Annual		
Apple	0.26	3.12	662.06	649.3	0.26	3.12	110.85	69.3
Banana (No)	4.58	54.96	11662.51	135.1	3.26	39.12	1389.93	13.0
Citrus Fruit (No)	1.78	21.36	4532.59	2351.4	1.99	23.88	848.46	30.3
Other Fruit	0.58	6.96	1476.91	7048.2	0.53	6.36	225.97	384.2
Dry Fruits	0.02	0.28	59.79		0.05	0.58	20.76	
Potato	1.27	15.24	3233.93	4584.3	1.14	13.68	486.05	152.6
Tomato	0.51	6.12	1298.66	620.1	0.82	9.84	349.62	124.8
Onion	0.95	11.40	2419.08	2115.2	0.77	9.24	328.30	222.4
Chillies	0.06	0.73	154.16	148.3	0.03	0.30	10.82	0.4
Other Vegetables	2.22	26.64	5653.01	3314.0	2.01	24.12	856.98	410.1

Sources: Consumption data extracted from HIES 2018-19, and production data obtained from Agricultural Statistics of Pakistan 2016-17

5. Major Areas of Fruit and Vegetable Production in Khyber Pakhtunkhwa

Diversified agro-climatic condition of KP is conducive for producing varieties of crops, fruit and vegetables, floriculture, and medicinal herbs. The diverse variety of fruits and vegetables produced in KP creates the need to identify the major fruits and vegetables and also study the potential for new ones. This is particularly important for investment in their value chains, both horizontally and vertically, directly improving the livelihoods of farmers, processors, and marketers. Towards this end, analysis is carried and presented in the next section to identify three major fruits and vegetables at the provincial and regional levels. The regional analyses show the importance of areas of production are important for a fruit and vegetable and what is its relative importance among the fruits and vegetables produced in the region.

5.1 The Search for Top Three Fruits and Vegetables: A Provincial Analysis

An analysis of KP is presented in this section to help in identifying the three major fruits and three vegetables in settled areas, and additionally, in merged districts of KP. The analysis utilizes the area, production, and market value of fruits and vegetables as the source indicators.

Using these indicators, fruits and vegetables are first identified at the provincial level and then at the regional level. The next section presents a provincial-level analysis of this identification process using data for 2016. It is important to mention that 2016 is the most recent comprehensively available picture for all fruits and vegetables and hence used in this report.

5.1.1 Fruits

The total area under fruits was 36.2 thousand hectares in 2016 (Figure 13, Table 10), producing 339.4 tons of fruits (Figure 14). The settled areas account for 86 percent of fruit area while merged districts contribute the rest (14 percent). Similarly, settled areas and merged districts account for 80 and 20 percent of the production of fruit, respectively. Major fruits include peach, apples, melons, and guava, while banana, mangoes, pomegranate, figs, etc. are the minor fruits. Peaches and persimmons, plums, dates, and apples are the leading fruits in the province accounting for 22.1 and 21.4 percent of the fruit area and 15.3 and 26.3 percent of total production. No other fruit contributes more than 20 percent to this level of area and production in the province. These fruits are equally important in the settled and merged districts.

Figure 14. Output of Major Fruits in KP (%)

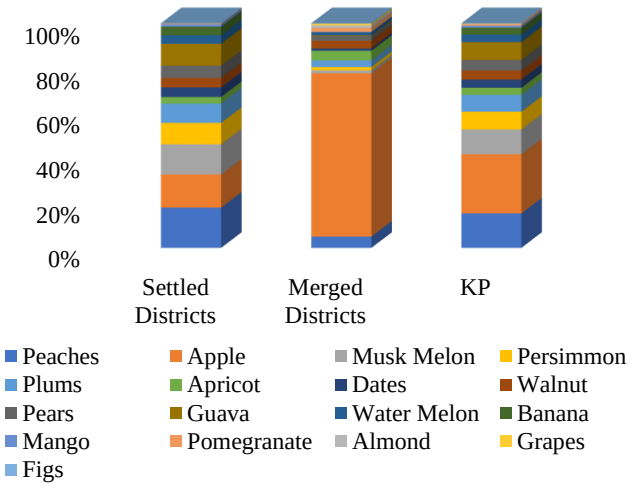
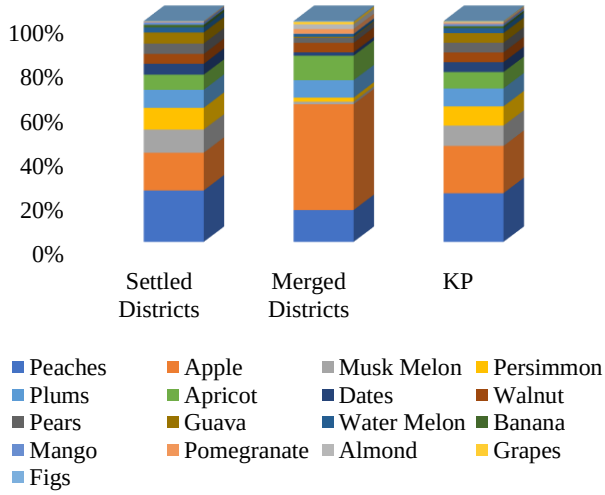


Figure 13. Area Under Major Fruits in KP (%)



Peaches are grown on 23.3 percent of the fruit area in the settled districts, while peaches in merged districts account for 14.4 percent of its area, and apples are grown on 17.1 percent in settled areas but half (47.9) of the fruit area in the merged districts. Similarly, the production of these two fruits collectively accounts for 41.6 percent of the fruits produced in KP (**Figure 14)**. The major and startling difference between the merged and settled districts in apple production is notable: apples in merged areas account for 72.6 percent of the merged areas' fruit production, by far the major fruit in those districts. The same is true for production. The Table 10 shows that apple yield is very high in merged districts as compared to settled areas.

Table 10. Fruit area, production, and yield across settled and merged areas in KP, 2016

Fruits	Area (Hectare)			Production (Tons)			Yield (Kg per Hectare)		
	Settled Districts	Merged Areas	KP	Settled Districts	Merged Areas	KP	Settled Districts	Merged Areas	KP
Peaches	7,253	731	7,984	48,605	3,400	52,005	6,701	4,651	6,514
Apple	5,315	2,426	7,741	40,026	49,307	89,333	7,531	20,324	11,540
Musk Melon	3,269	59	3,328	36,497	910	37,407	11,165	15,424	11,240
Persimmon	3,063	93	3,156	25,874	1,005	26,879	8,447	10,806	8,517
Plums	2,541	399	2,940	23,415	2,012	25,427	9,215	5,043	8,649
Apricot	2,120	563	2,683	7,857	2,924	10,781	3,706	5,194	4,018
Dates	1,542	77	1,619	11,626	693	12,319	7,540	9,000	7,609
Walnut	1,385	218	1,603	11,393	2,358	13,751	8,226	10,817	8,578
Pears	1,472	117	1,589	14,808	1,279	16,087	10,060	10,932	10,124
Guava	1,551	22	1,573	26,536	249	26,785	17,109	11,318	17,028
Watermelon	712	64	776	10,297	1,027	11,324	14,462	16,047	14,593
Banana	369	---	369	10,485	---	10,485	28,415	---	28,415
Mango	340	7	347	3,028	70	3,098	8,906	10,000	8,928
Pomegranate	68	106	174	546	1,188	1,734	8,029	11,208	9,966
Almond	60	107	167	188	810	998	3,133	7,570	5,976
Grapes	30	60	90	116	469	585	3,867	7,817	6,500
Figs	37	17	54	189	171	360	5,108	10,059	6,667

Source: Crop Statistics, Government of KP, 2016

While it is very difficult to characterize yield differences, the data certainly show the potential of apple farming in the area. There is a lack of local research to help us understand differences in apple yield in the two regions, yet generally, environmental factors such as precipitation, temperature, and solar radiation are some of the major environmental factors directly affecting apple yield (Pu et al. 2008; Fujisawa and Kobayashi 2011). In a study, Li et al. (2011) showed that variation in environmental factors substantially influences changes in apple yield. Studies have also indicated that decreased winter temperatures, spring frosts, and high temperatures and aridity in summer and autumn are the major factors negatively affecting the growth and hence yields of apple trees. The effects of these factors are significant during the flowering and maturity stages (Eccel, et al., 2009; Qu, et al., 2013).

The search for the third most important fruit is challenging. Musk melons are third in KP using both area (9.2 percent) and production (11 percent). The merged districts have apricots as number three based both on the area (11.1 percent) and production (4.3 percent). Therefore, another indicator is needed to identify the third fruit. Hence, a market value analysis is carried out to get the required insights into fruits that might be taking much area and contributing heavily to fruit production, but given low market prices, their financial contribution to the KP economy may not be significant.

The nominal value of fruits produced in KP is has been determined using market prices of 2016. The calculated nominal value is then used to rank the fruits produced in settled and merged districts (**Figure 15, Table 11**). The total value of fruits in 2016 in KP was Rs. 22.6 billion. Settled areas account for 73 percent while merged districts account for the rest. **Table 11 and Figure 16** show that apple and peach contribute about 45 percent to the total value of fruits produced in the settled districts of KP, while the merged districts account for 9 percent, but they account for 78 percent in the merged districts alone. Plums make the third biggest fruit produced in settled areas accounting for 14.4 percent. The third-largest fruit produced in merged districts is almonds accounting for 7.3 percent of the total value produced in merged districts.

Table 11. Nominal value of fruit produced in settled and merged areas of KP in 2016

Fruits	Settled Areas (Rs. Million)	Percent	Merged Areas (Rs. Million)	Percent	KP (Rs. Million)	Percent
Apple	3682	22.4	4536	73.8	8219	36.3
Peaches	3737	22.7	261	4.3	3998	17.7
Plums	2366	14.4	203	3.3	2570	11.4
Guava	1618	9.8	15	0.2	1633	7.2
Pears	1294	7.9	112	1.8	1406	6.2
Dates	1277	7.8	76	1.2	1353	6.0
Musk Melon	1213	7.4	30	0.5	1243	5.5
Apricot	640	3.9	238	3.9	878	3.9
Almond	103	0.6	446	7.3	549	2.4
Watermelon	215	1.3	21	0.3	236	1.0
Mango	227	1.4	5	0.1	232	1.0
Pomegranate	72	0.4	158	2.6	230	1.0
Grapes	10	0.1	42	0.7	53	0.2
Banana	17	0.1	0	0.0	17	0.1
Persimmon	0	0.0	0	0.0	0	0.0
Walnut	0	0.0	0	0.0	0	0.0
Total	16473	100	6145	100	22618	100

Figure 15. Area & Production of Leading Fruits in Settled and Merged Districts of KP

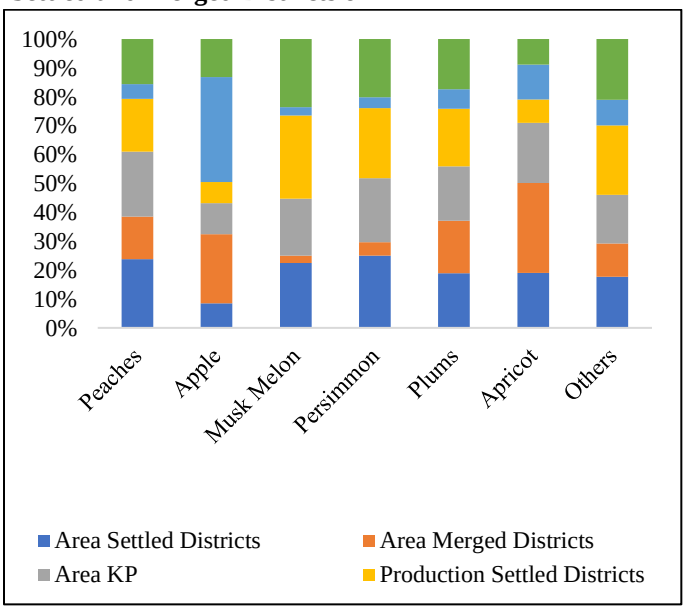
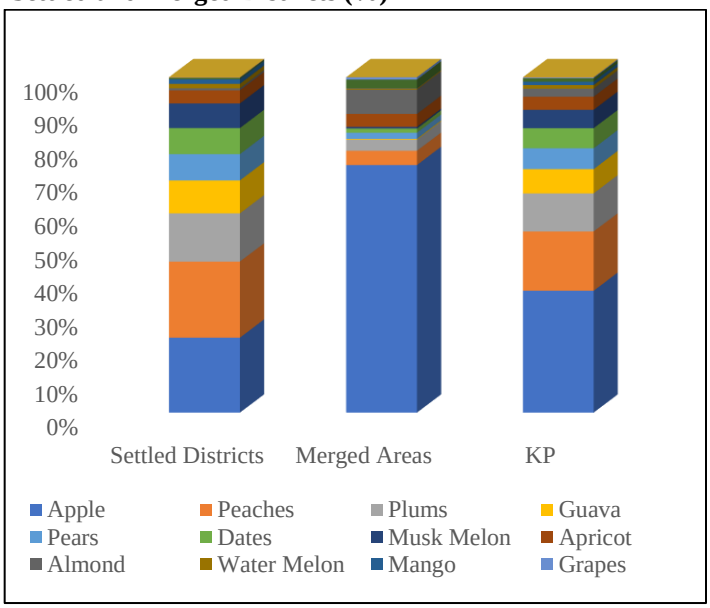


Figure 16. Nominal Value of Fruits Produced in Settled Settled and Merged Districts (%)



From the above analysis, it is concluded that peaches and apples are the leading fruits, using the three criteria of area, production, and market value in both the settled and merged areas. However, their contribution to the fruit area in the settled and merged areas are quite different, as apple is overwhelmingly produced in merged districts and is the single biggest contributor to its area, production, and market value. Nevertheless, 3rd ranking in fruits varies in settled and merged districts as discussed *supra*. Using market value, plums number three at the KP level, but it falls behind almonds in the merged districts. However, musk melons are number three based on area and production.

5.1.2 Vegetables

The agroclimatic condition of KP is conducive to the production of a variety of vegetables. Vegetables were grown on 14.2 and 17.9 thousand hectares during 2016-17, producing 167.6 and 166.3 thousand tons in Rabi and Kharif seasons, respectively. The settled areas of the province account for 80 and 83 percent of the total area for vegetables in Rabi and Kharif season, while the rest come from the merged districts (**Table 12**). The settled areas account for 86 percent of vegetable production in Rabi season and 88 percent in the Kharif season (**Table 13)**. The major Rabi vegetables grown in KP include tomato, turnip, peas, spinach, and cauliflower while turnip, spinach, cauliflower, tomato, radish, and carrot are the main Kharif vegetables.

The production of both of tomatoes and turnips during the Rabi season accounts for 56 percent of vegetable production during the season (Table 13, Figures 17 and 18). Tomato is the leading Rabi vegetable in the settled districts, followed by turnips and peas. However, turnip is the leading Rabi vegetable in the merged areas, followed by spinach and tomato. Similarly, tomatoes and okra jointly account for 56 percent of the area in the Kharif season, accounting for 52 and 73 percent of the area in the settled districts, and 11 and 13 percent respectively in the merged areas of the province. Hence, based on the area and production, tomatoes, turnips, and okra are the leading three vegetables produced in the province.

Figure 17. Proportion in Output of Vegetables in Rabi Season in KP (%)

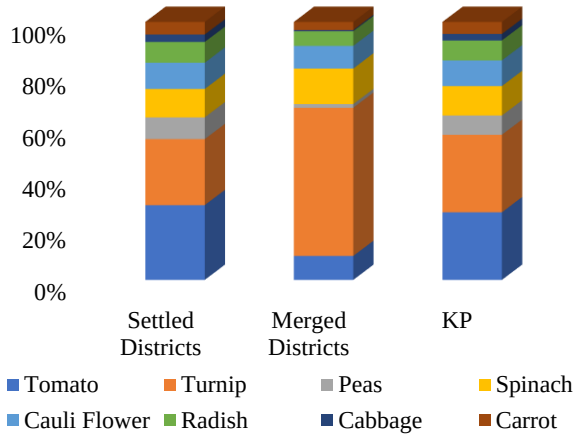


Figure 18. Proportion in Output of Vegetables in Kharif Season in KP (%)

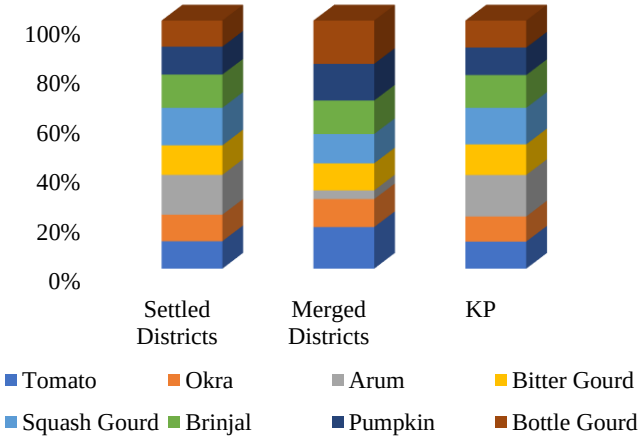


Table 12. Vegetables area, production, and yield across settled and merged areas and seasons of KP, 2016

Vegetables	Area (Hectare)			Production (Tons)			Yield (Kg per Hectare)		
	Settled Districts	Merged Districts	KP	Settled Districts	Merged Districts	KP	Settled Districts	Merged Districts	KP
Major Rabi Vegetables									
Tomato	3,381	327	3,708	41,742	2,189	43,931	12,346	6,694	11,848
Turnip	2,027	1,325	3,352	36,866	13,539	50,405	18,187	10,218	15,037
Peas	1,781	71	1,852	12,166	335	12,501	6,831	4,718	6,750
Spinach	1,196	498	1,694	15,855	3,251	19,106	13,257	6,528	11,279
Cauli Flower	1,113	336	1,449	14,640	2,070	16,710	13,154	6,161	11,532
Radish	858	200	1,058	11,596	1,339	12,935	13,515	6,695	12,226
Cabbage	502	16	518	4,134	104	4,238	8,235	6,500	8,181
Carrot	454	107	561	7,056	745	7,801	15,542	6,963	13,906
Major Kharif Vegetables									
Tomato	7,670	2,213	9,883	70,944	15,089	86,033	9,250	6,818	8,705
Okra	1,677	406	2,083	14,948	1,861	16,809	8,914	4,584	8,070
Arum	1,338	7	1,345	17,924	10	17,934	13,396	1,429	13,334
Bitter Gourd	1,206	21	1,227	11,980	93	12,073	9,934	4,429	9,839
Squash Gourd	960	124	1,084	12,126	596	12,722	12,631	4,806	11,736
Brinjal	765	102	867	8,564	560	9,124	11,195	5,490	10,524
Pumpkin	661	129	790	6,217	775	6,992	9,405	6,008	8,851
Bottle Gourd	498	32	530	4,373	227	4,600	8,781	7,094	8,679

Government of KP, 2016-2017

Table 13. Proportion of Area and Production of Rabi and Kharif vegetables in KP, 2016-17

Vegetables	Settled Districts	Merged Districts	KP	Settled Districts	Merged Districts	KP
	Area			Production		
Rabi Vegetables						
Tomato	29.9	11.4	26.1	29.0	9.3	26.2
Turnip	17.9	46.0	23.6	25.6	57.4	30.1
Peas	15.7	2.5	13.0	8.4	1.4	7.5
Spinach	10.6	17.3	11.9	11.0	13.8	11.4
Cauli Flower	9.8	11.7	10.2	10.2	8.8	10.0
Radish	7.6	6.9	7.5	8.0	5.7	7.7
Cabbage	4.4	0.6	3.6	2.9	0.4	2.5
Carrot	4.0	3.7	4.0	4.9	3.2	4.7
Kharif Vegetables						
Tomato	51.9	72.9	55.5	11.1	16.8	10.9
Turnip	11.4	13.4	11.7	10.7	11.3	10.1
Peas	9.1	0.2	7.6	16.0	3.5	16.7
Spinach	8.2	0.7	6.9	11.9	10.9	12.3
Cauli Flower	6.5	4.1	6.1	15.1	11.8	14.7
Radish	5.2	3.4	4.9	13.4	13.5	13.2
Cabbage	4.5	4.3	4.4	11.3	14.8	11.1
Carrot	3.4	1.1	3.0	10.5	17.4	10.9

Government of KP, 2016-2017

5.1.3 Market Value Analysis of Vegetables Produced in KP

The market values and contribution of different vegetables to the provincial economy are obtained by using wholesale prices of 2016-17 and are presented in Table 14 and Figures 19 and 20. As mentioned earlier, being the major Rabi vegetables of the province, tomato and turnip jointly account for 56 percent of the value of Rabi vegetables. Tomato alone accounts

for 34 percent and turnip 20 percent of that value in the settled districts of the province. Turnip accounts for 54 percent of the total value of Rabi vegetables in the merged areas, which is followed by spinach (14 percent) and tomato (13 percent).

Table 14. Nominal value (Rs. million) of vegetables produced in settled and merged areas in Rabi and Kharif Seasons in KP, 2016-2017

Vegetables	Settled Districts	Percent	Merged Districts	Percent	KP	Percent
			Rabi Vegetables			
Tomato	1,615.8	34.0	84.7	12.8	1,700.5	31.4
Turnip	973.3	20.5	357.4	54.0	1,330.7	24.6
Peas	816.9	17.2	22.5	3.4	839.4	15.5
Spinach	472.4	9.9	96.9	14.6	569.2	10.5
Cauli Flower	414.5	8.7	58.6	8.8	473.1	8.7
Radish	187.9	4.0	21.7	3.3	209.5	3.9
Cabbage	101.5	2.1	2.6	0.4	104.1	1.9
Carrot	169.3	3.6	17.9	2.7	187.2	3.5
Rabi Vegetables	**4,751.5**	**100.0**	**662.2**	**100.0**	**5,413.7**	**100.0**
			Kharif Vegetables			
Tomato	2,746.1	51.8	584.1	85.5	3,330.2	55.6
Okra	563.8	10.6	70.2	10.3	633.9	10.6
Arum	981.5	18.5	0.5	0.1	982.0	16.4
Bitter Gourd	625.0	11.8	4.9	0.7	629.8	10.5
Squash Gourd	---	---	---	---	---	---
Brinjal	240.1	4.5	15.7	2.3	255.9	4.3
Pumpkin	---	---	---	---	---	---
Bottle Gourd	144.9	2.7	7.5	1.1	152.5	2.5
Kharif Vegetables	**5,301.4**	**100.0**	**682.9**	**100.0**	**5,984.3**	**100.0**
Both Seasons	10,053	---	1,345	---	11,398	-

Figure 19. Value of Rabi Vegetables in Settled and Merged Districts of KP (Rs in Million %)

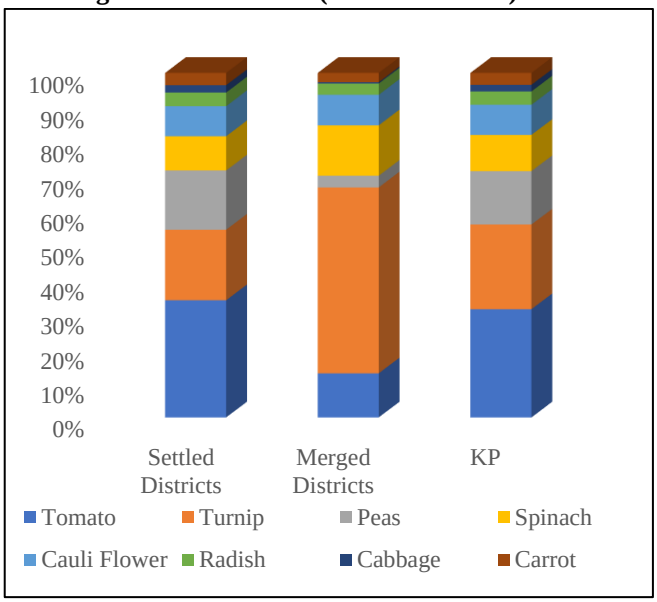
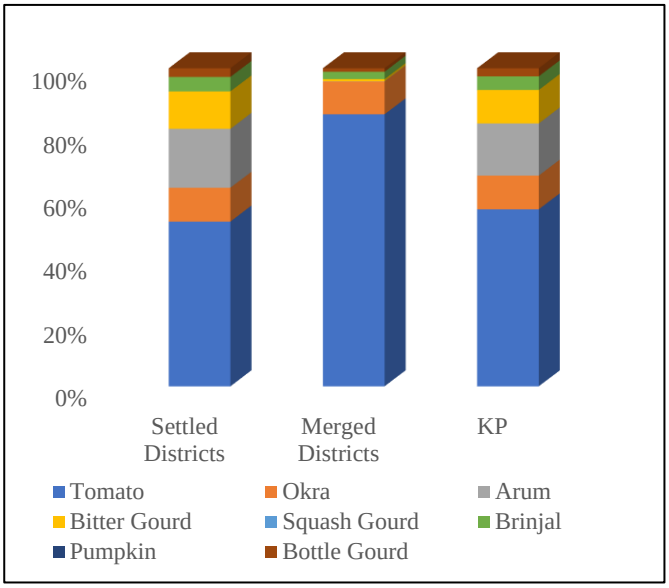


Figure 20. Value of Kharif Vegetables in Settled and Merged Districts of KP (Rs in Million, %)



Tomato substantially contributes to the value of vegetables and accounts for 56 percent of the total value at the provincial level, followed by arum (16 percent) and okra (11

percent) in Kharif season. Though the area and production of okra are high, arum fetches more per unit than okra and therefore the total value of arum is higher. In settled districts, tomato accounts for 52 percent of the total value of Kharif vegetables followed by arum (19 percent) and okra (11 percent). In the merged areas of the province, tomato is the major contributor and accounts for 86 percent of the total value obtained from Kharif vegetables, and is followed by okra, with merely 10 percent.

Based on area and production, tomatoes, turnips, and okra are the leading vegetables, while the market value analysis adds arum to the list at number two, replacing turnips, while okra still holds the third position.

5.2 The Regional Analysis of Fruits and Vegetables

The previous two sections identified the three major fruits and vegetables produced in KP using area, production, and nominal market value as the three criteria. This section extends the discussion by considering the areas/regions where these leading fruits and vegetables are produced in KP. The major identified fruits are apple, peach, plum, and musk melons while the major vegetables are tomatoes, arum, okra, and turnips.

Table 15 below provides details of the area, production, and value of identified fruits and vegetables across regions in KP. The total area of apples in KP is 7741 hectares. Swat (46%), Mansehra (9%), and South Waziristan (29%) collectively account for 84 percent of the apple area and hence are the major regions in KP producing apples. The province produces 89.33 thousand tons of apple mainly contributed by South Waziristan (52%), Swat (29%) and Mansehra (6%), which collectively account for 87 percent of the apple production in the province. Similarly, peaches are produced on a total area of 7,984 hectares in KP, primarily contributed by Swat (72%), South Waziristan (7%), and Buner (4%). These three regions collectively account for 82 percent of the peaches area in KP.

The province produces 52 thousand tons of peaches, mainly contributed by Swat (66%), Buner (5%), and South Waziristan (2%) and account for 73 percent of the peaches produced in KP. The total area of plum in KP is 2940 hectares. Swat (21%), Peshawar (13%), and Nowshera (9%) collectively account for 43 percent of the plum area and hence are the major regions in KP producing plum. Total plum production in KP is 25.4 thousand tons mainly produced in Peshawar (17%) Swat (15%) and Nowshera (12%). These regions are the main plum producing areas and collectively account for 44 percent of the plum production in KP. Musk melons are primarily produced in the southern region, Lakki Marwat (50%) and DIK (17%), and the central valley (Mardan, 17%) of the province. The three regions collectively account for 75 percent of the area and --- percent of the melons production in the KP. The total production of musk melon in KP is estimated at 37.41 thousand tons mainly produced in Lakki Marwat (58%) and DIK (10%) and the central valley (Mardan, 13%) of the province. The three regions collectively account for 81 percent of the total production of musk melon in the province.

Table 15. Major Fruits and Vegetables Producing Districts of Khyber Pakhtunkhwa

	District	Area (Hectare)	Production (Tons)	Value (Rs. In million)
Fruits				
Apple	Swat	3580 (46.25)	26250 (29.38)	3543.75
	South Waziristan	2280 (29.45)	46700 (52.28)	6304.50
	Mansehra	677 (8.75)	5303 (5.94)	715.91
	Total	7741 (100.00)	89333 (100.00)	12059.96
Peaches	Swat	5735 (71.83)	34100 (65.57)	2429.63
	South Waziristan	547 (7.07)	1206 (2.32)	85.93
	Buner	300 (3.88)	2907 (5.59)	207.12
	Total	7984 (100.00)	52005 (100.00)	3705.36
Plum	Swat	630 (21.43)	3750 (14.75)	3750.00
	Peshawar	382 (12.99)	4420 (17.38)	4420.00
	Nowshera	252 (8.57)	2956 (11.63)	2956.00
	Total	2940 (100.00)	25427 (100.00)	25427.00
Musk Melon	Lakki Marwat	1662 (49.94)	21790 (58.25)	699.10
	Mardan	576 (17.31)	4999 (13.36)	160.38
	D.I. Khan	264 (7.93	3696 (9.88)	118.58
	Total	3328 (100.00)	37407 (100.00)	1200.14
Rabi Vegetables				
Tomatoes	Malakand	782 (21.09)	8375 (19.06)	324.18
	Swat	700 (18.88)	7790 (17.73)	301.54
	D.I. Khan	451 (12.16)	7117 (16.20)	275.49
	Total	3708 (100.00)	43931 (100.00)	1700.50
Turnip	Kurram	623 (18.59)	5630 (11.17)	148.63
	Swat	440 (13.13)	8440 (16.74)	222.82
	Bajaur	440 (13.13)	6180 (12.26)	163.15
	Total	3352 (100.00)	50405 (100.00)	1330.69
Peas	Swat	1120 (60.48)	8990 (71.91)	603.61
	Chitral	205 (11.07)	1280 (10.24)	85.94
	Swabi	172 (9.29)	706 (5.65)	47.40
	Total	1852 (100.00)	12501 (100.00)	839.35
Kharif Vegetables				
Tomatoes	Swat	4360 (44.12)	44495 (51.72)	1722.33
	Mohmand Agency	820 (8.30)	6520 (7.58)	252.38
	Charsadda	756 (7.65)	6355 (7.39)	245.99
	Total	9883 (100.00)	86033 (100.00)	3330.19
Okra	Mardan	205 (9.84)	1860 (11.07)	175.37
	Swat	180 (8.64)	1655 (9.85)	156.04
	Dir Lower	126 (6.05)	1643 (9.77)	154.91
	Total	2083 (100.00)	16809 (100.00)	633.90
Arum	Mardan	481 (35.76)	4844 (27.01)	265.24
	Peshawar	450 (33.46)	2250 (12.55)	123.20
	Nowshera	98 (7.29)	1252 (6.98)	68.56
	Total	1345 (100.00)	17934 (100.00)	982.01

Crop Statistics, Government of KPK 2016-17

In the Rabi season, tomatoes turnip, and peas are identified to be the major vegetables. The total area of tomatoes grown in Rabi in KP is 3.71 thousand hectares mainly accounted by Malakand (21%), Swat (19%), and DIK (12%) collectively account for 52 percent of the tomato area and hence are the major regions in KP producing tomatoes. The province produces 43.93 thousand tons of tomatoes in Rabi season. This production is mainly contributed by Malakand (19%), Swat (18%), and DIK (16%) collectively account for 53 percent of the tomatoes production in the province. Turnip is produced on a total area of 3.35 thousand hectares in KP, primarily contributed by Kurram (19%), Swat, and Bajaur (each 13%).

These three regions collectively account for 45 percent of the area under turnip crop in KP. The province produces 50.4 thousand tons of turnip, mainly contributed by Swat (17%), Bajaur (12%), and Kurram (11%). These three regions collectively account for 41 percent of the turnip produced in KP. The total area under the pea crop is 1.85 thousand hectares. Peas are mainly grown in Swat (61%), Chitral (11%), and Swabi (9%). These areas collectively account for 81 percent of peas area in KP and hence are the major regions in KP producing peas. Total pea production in KP is 12.5 thousand tons mainly produced in Swat (72%), Chitral (10%), and Swabi (6%). These regions are the main pea producing areas and collectively account for 88 percent of the pea production in KP.

Table 16. Major Fruits and Vegetables Producing Districts of Khyber Pakhtunkhwa

Major Rabi Vegetables

	Tomato	Turnip	Peas
Area (Hectare)	Malakand (782)	Kurram (623)	Swat (1120)
	Swat (700)	Swat (440)	Chitral (205)
	D. I. Khan (451)	Bajaur (440)	Swabi (172)
Production (Tons)	Malakand (8375)	Swat (8440)	Swat (8990)
	Swat (7790)	Bajaur (6180)	Chitral (1280)
	D.I. Khan (7117)	Bunir (5920)	Swabi (706)

Major Kharif Vegetables

	Tomato	Okra	Arum
Area (Hectare)	Swat (4360)	Mardan (205)	Mardan (481)
	Mohmand (820)	Swat (180)	Peshawar (450)
	Kurram (770)	Peshawar (150)	Nowshera (98)
Production (Tons)	Swat (44495)	Mardan (1860)	Mardan (4844)
	Mohmand (6520)	Swat (1655)	Peshawar (2250)
	Kurram (5390)	Peshawar (825)	Nowshera (1252)

Major Fruits

	Peaches	Apple	Musk Melon	Persimmon
Area (Hectare)	Swat (5735)	Swat (3580)	LakkiMarwat (1662)	Swat (1860)
	S. Waziristan (547)	S. Waziristan (2280)	Mardan (576)	Dir Upper (262)
	Buner (300)	Mansehra (677)	D.I. Khan (264)	Charsadda (197)
Production (Tons)	Swat (34100)	Swat (26250)	LakkiMarwat (21790)	Swat (12715)
	S. Waziristan (1206)	S. Waziristan (46700)	Mardan (4999)	Dir Upper (2616)
	Bunir (2907)	Mansehra (5303)	D.I. Khan (3696)	Charsadda (2268)

Source: Government of Khyber Pakhtunkhwa, 2016

In Kharif season Tomatoes, Okra and Arum are the major vegetables produced in the province. The total area of tomatoes grown in the Kharif season in KP is 9.88 thousand hectares mainly accounted by Swat (44%), Mohmand, and Kurram (each 8%) collectively account for 60 percent of the area under crop in KP. The province produces 86.03 thousand tons of tomatoes in the Kharif season. This production is mainly contributed by Swat (52%) and Mohmand (8%) and Kurram (6%). These regions collectively account for 66 percent of the tomatoes production in the Kharif season in KP. Okra is produced on a total area of 2.1 thousand hectares in KP, primarily contributed by Mardan (10%), Swat (9%), and Peshawar (7%). These three regions collectively account for 26 percent of the area under Okra in KP.

The province produces 16.8 thousand tons of Okra in the Kharif season, the production is mainly contributed by Mardan (11%), Swat (10%), and Peshawar (5%).

About half of the tomatoes produced in Swat are grown in Barikot and Kabal Tehsil, where almost 5000 farmers are indulged in cultivating tomato. The sandy fields of tomato crop in Swat usually remains free from any major disease due to the continuous cool breeze of Swat's River[18]. Chitral also contributes a reasonable share in tomato production, where around 3,000 households are engaged in tomato farming for their sustenance.

Mardan, Swat and Peshawar collectively account for 26 percent of the total okra produced in KP. The total area under the arum crop is 1.34 thousand hectares. The area under arum crop is mainly contributed by Mardan (36%), Peshawar (34%), and Nowshera (7%). These areas collectively account for 77 percent of the arum area in KP and hence are the major regions in KP producing arum. Total arum production in KP is 17.9 thousand tons mainly produced in Mardan (27%), Peshawar (12%), and Nowshera (7%). These regions are the main arum producing areas and collectively account for 46 percent of the arum production in KP (**Table 16** above).

6. Evaluation of Horticulture Supply Chain in Khyber Pakhtunkhwa

6.1 Per Capita Consumption of Fruits and Vegetables in Pakistan

Fruits and vegetables have been one of the key driving forces in stimulating growth in the agricultural sector of Pakistan. The country produces 30 different types of fruits (Siddique & Garnevska, 2018). Pakistan's share in exports of fruits and vegetables has increased since 2007, and its exports during 2019-20 were US$ 731.3 million, including fruits for US$ 300 million. Per capita consumption of fruits and vegetables in Pakistan is low compared to Europe, America, Central Asia, Middle East, and Southeast Asia, but it is approximately at par with South Asia comparators like Afghanistan and Bangladesh. Consumption of vegetables in India and Nepal is higher because of the high vegetarian population. Per capita consumption of vegetables was 21 kg in Pakistan compared to 254 kg in Turkey, 377 kg in China, and 192 kg in Kazakhstan in 2017 (**Figure 21)** indicating a high potential for exports**.**

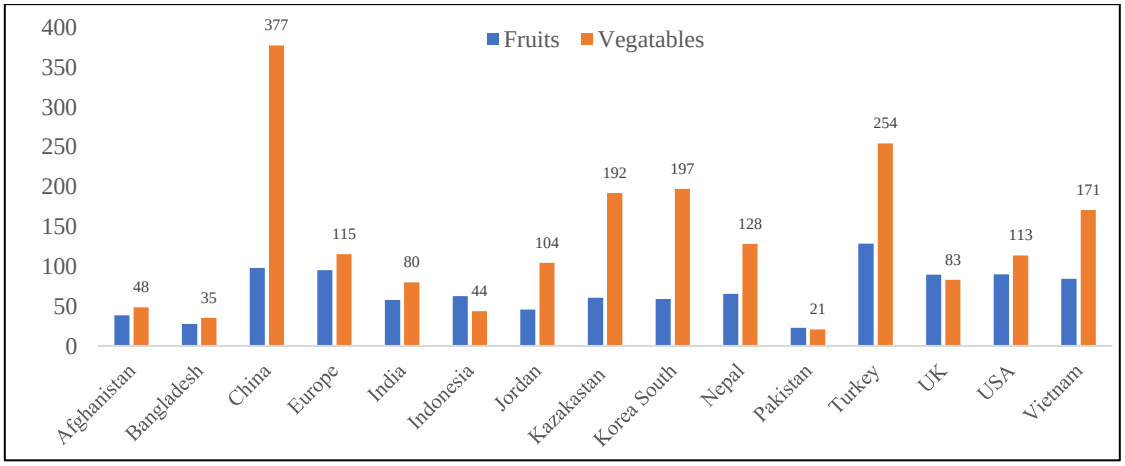
In Pakistan, tomato is found to have high income elasticity, thus, increase in the per capita income has resulted in increased demand from consumers[19] . Tomato is one the staple items in Pakistani kitchen, used in the cooking of almost every curry. The high demand for tomato can be partly explained by the shift in consumption pattern of the urban population especially the increased preference for fast food that is related with increased incomes and rapid urbanization.

[18] Dawn. (2015). Tomato growers in Barikot earning handsome profits, available at https://www.dawn.com/news/1220191

[19] Fateh, M.M. (2009): Structure and efficiency analysis of vegetable production and marketing in Sindh, Pakistan. Unpublished PhD Thesis in the Department of Agricultural Economics, Sindh Agriculture University, Tando Jam.

The per capita consumption of tomato in KPK remains almost three times higher than that of national average. The per capita consumption of tomatoes in Pakistan was on increasing trend from 2004-05 to 2011-12 after which it dropped from 0.38 kgs per month in 2011-12 to only 0.26 kgs per month in 2018-19. The per capita consumption dropped post-2011, a period marked by significant demand-supply imbalance and volatile tomato prices. Whereas, in KPK, the per capita consumption rose from 0.60 kg per month in 2004-05 to 0.82kg per month in 2018-19.

Figure 21. Per Capita Consumption of Fruit and Vegetables (2017 kg/year)



Source: https://ourworldindata.org/ accessed on July 27, 2021

6.2 Horticulture Value Chain in KP

The horticulture value chain typically involves various layers of intermediaries between growers and retailers: (i) Contractor or *Aarthi* who pre-purchases the produce from growers in lieu of credit advanced to them; (ii) commission agents who transport and sell the produce in wholesale markets[20]; and (iii) wholesaler then auction or sell it to various retail outlets including informal vendors, formal shops, supermarket chains, hotels, restaurants. The Contractor is responsible for harvest labor, packing, and transporting to wholesale markets. Some of the contractors also manage export of horticulture produce. The marketing of fruits and vegetables varies by the nature of the commodity and, naturally, the marketing cost increases at each level of intermediation as they add their share of the profit. Large growers, generally, accomplish all functions themselves from harvest, grading, packaging and transportation to wholesale and retail level or export.[21]

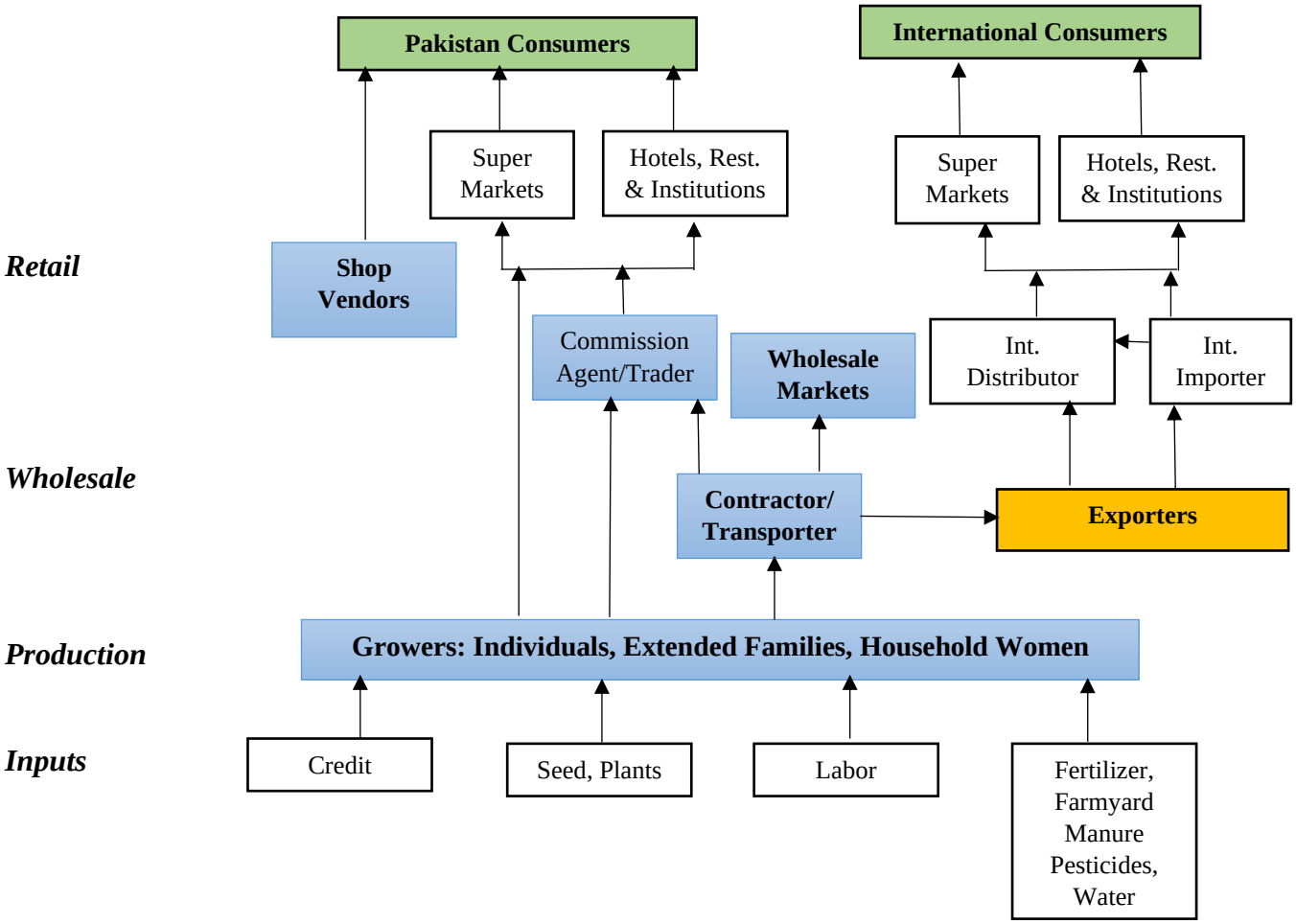
Figure 22 above illustrates the horticulture value chain in KP. Most farmers sell their produce at wholesale markets or contract out their fruit orchards during flowering stage to the *Aarthis (*middlemen), Commission Agents or wholesalers who provide them credit for production**.** The unsold or unauctioned produce in one market is sent to other markets in the

[20] Four main categories of wholesale markets exist: primary, secondary, district assembly, and rural assembly.

[21] M.H. Memon, K. Khan, M.Y. Abbass, G. Khan, and M. A. Kamal (n.d.) Impediments to Technology Adoption: A Case Study of Peach Production in District Swat, Pakistan. *Journal of Managerial Sciences*, IX (2), 226-242.

same locality. Fruits and vegetables are packaged using local materials before shipment. In most cases such packaging fails to preserve the freshness and quality of the products.

Figure 22. Horticulture Value Chain in KPK



6.3 Challenges to Horticulture Sector in KP

The horticulture value chain in KP faces various challenges during flow of product from farm to consumer at different stages: (i) pre-planting, (ii) growing, (iii) post-harvesting, (iv) technology, (v) agro-processing, and (vi) transportation, marketing and export. Each of these challenges are discussed below:

6.3.1 Pre-planting Stage

Non-Availability of Germplasm (seed): Horticulture in KP mostly relies on years old plant varieties, leading to a lack of crop diversity that limits product varieties for marketing. Global demand has shifted to newer planted fruit varieties. This puts the horticulture sector of KP at a serious competitive disadvantage compared to other countries, including the neighboring competitors of China, Iran, and India. It is important that the Federal Government

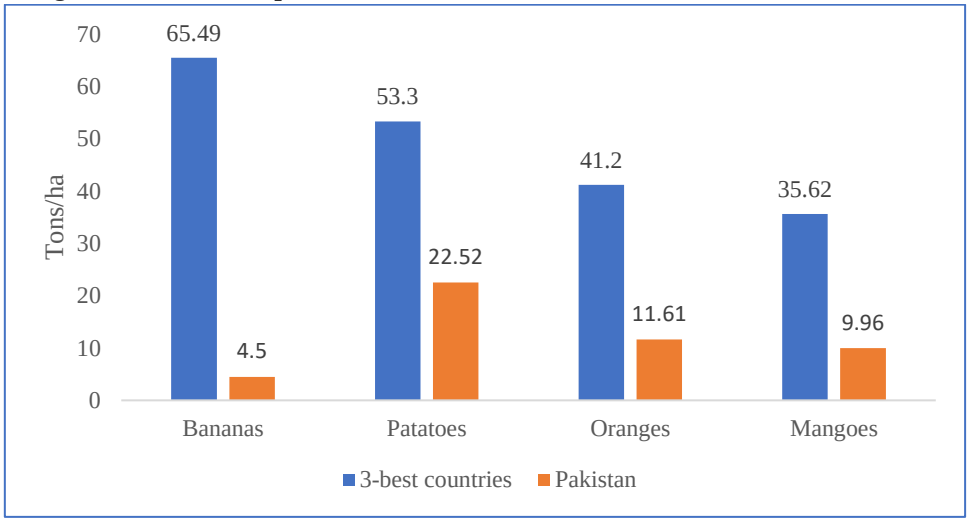
may consider loosening restrictions on import of germplasm, of course, with necessary safeguards as prescribed under various international conventions.

Intellectual Property Rights: Ineffective intellectual property rights regimes and institutional weaknesses are restricting access to newer plant varieties. International companies are reluctant to provide private-domain cultivars because of insufficient intellectual property rights assurances in Pakistan and ranked low on plant variety protection despite enactment of Plant Breeders' Rights Act, 2016.[22]

Inefficiencies in Input Markets: The approval process of new varieties is time consuming and at times, takes many years, so international horticulture producers start commercial planting in other countries leaving Pakistan behind. It is important for KP to have access to and plant the appropriate varieties which have strong global demand to be competitive internationally. For this to happen, latest developed and globally planted fruit and vegetable varieties may be experimented in both the government research stations and private sector Model Farms.

Low Yield: Insufficient availability of disease-free certified fruit and vegetable seeds and certified nursery plants is a key issue. It compromises the yield and crop quality. Stronger certification and effective extension services are important for better yield and globally competitive crop quality. **Figure 23** indicates that the yield in key commodities is about three times lower than the average of top three producing countries, with the exception of potatoes, which is approximately half the world's average. Yield can be improved mainly by using technology and better farm management practices.

Figure 23. Yield Comparison of Pakistan Horticulture with 3 best countries



Source: FAOSTAT Database

[22] For example, East-West Seed Company, winning World Food Prize in 2019 and ranked first in Seed Index 2019, which produces best quality seed for horticulture focusing on tropical regions and smallholder farmers has very small outlet in Lahore but is reluctant to expand its market share because of IPR issues. https://www.accesstoseeds.org/index/global-seed-companies/

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. Given its high cost, the Government may design an incentive package to encourage the farmers to follow these standards.

The challenges at farm production stage can be summed up: (i) old and unhealthy fruit trees prone to disease; (ii) low density of trees per unit of land as opposed to high density planting in many countries; (iii) proliferation of nurseries with substandard and unhealthy saplings; (iv) inadequate fertility management and application of balanced fertilizer and micronutrients; (v) lack of knowledge of integrated pest management and indiscriminate use of plant protection agrochemicals; and (vi) other issues discussed above.

6.3.2 Growing Stage

The vital support elements during growing stage include: (a) effective extension services (growing skills, pruning, pest management); (b) orchard and vegetable management; (c) irrigation management; and (d) post-harvest care (waxing, grading, cooling, packing). The water requirement for horticulture crops is higher compared to field crops such as wheat. Supply based irrigation system (*Warabandi*) is not adjusted to allocate additional water suppliers for horticulture crops. Therefore, technical assistance and effective extension services are vital at the growing stage. The cultural practices of rootstocks, soil preparation, plant establishment, irrigation method, fertilization, pollination and pest management, modern technology and information about domestic and global demand, need substantial improvement. Extension Services department also requires horticulture specialist as fruit and vegetables crop issues are unique and requires services of specialists rather than agriculture specialist. It is also equally important to establish a formal link between the agriculture university, research institutes and provincial government's extension programs.

Orchard management is predominantly in the hands of untrained farm managers with low skill level at some places. There is a general trend to lease out the orchards to contractors who in turn depend on the Commission Agents (*Arthis)*.

Capital Investment and Uncertain Whether: Horticulture, more so, fruits cultivation requires significant investment as fruit trees require four to five years to mature and produce fruits. Given this gestation period, not all farmers have the capacity to invest in fruits and vegetables, which is a major hurdle to significant expansion of horticulture area and increasing produce. It certainly needs an effective credit system. Whether uncertainly, such as, untimely rains, hailstorms, windstorms, frost, and temperature variation as well as erratic market prices also restrain the smallholder farmers' choice to shift to horticulture.

6.3.3 Post-Harvest Losses

Post-harvest losses are a critical issue across the value chain of fruits and vegetables. These losses not only have financial costs for the actors in the value chain but are also responsible for malnutrition and reduced national income (Hussain, 1993). The magnitude of losses in different fruits was reported by various researchers (Hussain, 1993; Khan et al., 2008; Sabir et al., 2009; Ahmed, 2010; Shahzad et al., 2013; Ahmed et al., 2015; Khan et al., 2016; Yousaf, 2017). It is estimated that reducing post-harvest losses can increase the income of various actors involved at various stages of the value chain by 40 percent (Badar, 2014).

Hussain (1993) conducted a study to calculate the losses in non-perishable, semi-perishable, and perishable crops and estimated losses of 10-15, 15-30, and 25-40 percent, respectively in these categories. The analysis clearly shows that postharvest losses increase with the perishability of the commodity. Hence, there is more potential for horizontal and vertical value chains in perishable crops. Vertical integration involves more control by either farmers or marketeers over the steps in the production and/or distribution chains. Naturally, it increases the margins for firms accumulating such powers. Vertical integration could be backward, gaining control of an input supplier/company; forward controlling the postproduction areas, and balanced mix of the two. Horizontal integration involves increasing market share. It could potentially involve acquisitions/collection of products to create monopoly/monopsony powers in output/input markets, respectively.

Yousaf (2017) studied the value chain of peaches in Swat and assessed a high level of losses and wastage. He estimated losses of 23 percent in the supply chain of peach in Pakistan. Khan (2017) reported post-harvest losses of 7 percent in peach at the farm level, while 3 percent, 6 percent, and 7 percent, respectively at wholesale, retail, and consumer levels, in the supply chain of peaches. Peaches are a major fruit in KP and require investment at appropriate levels to decrease the losses.

Post-harvest losses in the distribution chains were also reported by many researchers. Ilyas et al. (2007) reported losses of 25 percent in apple transportation from Muree to Faisalabad. They also reported losses of 23 percent during transportation of apple from Quetta to Faisalabad and 20 percent from Swat to Faisalabad. Ilyas et al.in their research reported losses of 28 percent during the span of 22 days cold-storage of apple. Ilyas et al. (2007) also explored losses during the transportation of bananas. In their research, they reported the highest losses of 43 percent for banana transported from Hyderabad followed by losses in banana transported from Mirpur Khas (39 percent) and Nawab Shah (37 percent). These post-harvest losses occurred in fruits and vegetables due to a lack of proper knowledge and improper handling at various levels of the marketing chain. According to Osman et al. (2009) improper infrastructure, resources, knowledge, and attitude are the factors which contribute to postharvest losses by 52 percent, 39 percent, 37 percent, and 50 percent, respectively. According to an estimate, these losses can be reduced by 24 percent by adopting proper packaging techniques and materials. Saeed and Khan (2010) showed that poor packaging contributed most to the deterioration of tomato, at 25 percent, followed by transportation which

led to a further 10 percent deterioration, while distribution further contributed to losses of 5 percent.

Ahmed et al., (2015) estimated the total post-harvest losses of 45 percent in kinnow. In his analysis, the highest losses were at the farm level (72 percent of the total losses) followed by the wholesale level (25 percent) and, then, the retail level (3 percent). Siddique and Garnevska (2018) reported almost 30 percent post-harvest losses in Kinnow while Khan et al., (2016) reported losses of 20 percent occurred during picking. Shahzad et al., (2013) presented the marketing channel of plums to quantify post-harvest losses in district Swat, with losses of 22 percent across the marketing channel. Out of these losses, 5 percent were reported at the farm level, 1 percent at wholesale, 6 percent at retail, and 9 percent at the consumer level.

The losses in vegetables were also reported by various researchers. Rehman et al., (2007) reported postharvest losses of 20 percent occurred mainly during picking, handling, transportation, etc in tomato crops in Peshawar, while Awan et al., (2012) estimated that post-harvest losses of 24 percent in tomato crops were mainly caused by fungal and viral diseases.

Post-harvest activities include packaging, pre-treatment, pre-cooling, washing with water and sorting. Packaging protects the produce from physical injury, contamination, moisture loss, and helps in ethylene absorption. Pre-treatment protects the fruits from decay, chilling injuries, and ripening. Pre-cooling reduces temperature of fruits and slowing metabolism resulting in extended shelf life. Cleaning removes foreign materials such as dirt, soil, pesticides etc. from fruits and vegetables. Sorting involves removing the already injured and infected fruits and vegetables from the produce to limit extending their infection. It also helps in grading of the produce as well. The extent of use of these practices determines post-harvest losses occur at various stages of the value chain.

According to university and industry sources in KP, an estimated 30 to 40 % of the harvested fruits (quantity) goes waste during harvesting, handling, post-harvest care, transportation, packaging, and storage. Shehzad et. al., (2013) reported 21.5 percent post-harvest losses in plum produced in Swat, Khyber Pakhtunkhwa. The losses at the farm level were 5.1 percent, followed by 1.5 percent at the wholesale, 6.3 percent at the retail and 8.7 percent at the consumption levels. These losses are primarily contributed by inappropriate placing of the stair damaging fruits during picking, over maturity of fruit, hasty and inappropriate packing, exerting pressure on the box while nailing wooden packaging box damaging fruit, lack of cold storage facility and the rush to sell the product as the fear of product being left unsold grips producers. The study reports that storage facility is the single most important factor that could substantially reduce post-harvest losses in plum marketing. An incentive to labours for reducing the losses during picking of the plum will reduce losses as well. The study recommends proper grading before packing plum.

Saeed and Khan (2010) reported that packing, which is supposed to protect tomatoes from injury, is also the major cause of its damage and causes 27 percent post-harvest losses. Transportation cause about 10 percent of the losses while losses in storage, grading and at retail level are minimal and account for only 3 and one percent each, respectively.

Collectively these losses account for 42 percent of the post-harvest losses in tomatoes marketing in Lahore. Tomato primarily consists of water, and it cannot replace the lost water once harvested. High temperature, exposing tomato to sun and low humidity cause water loss and as a result marketable weight loss. Due to weak outer skin, tomatoes are also prone to physical injury, resulting in biological processes such as ethylene production at an increased rate causing deterioration of the produce.

Osman et al., (2009) identified factors responsible for increasing post-harvest losses. The activities and practices adopted in various zones responsible for post-harvest losses were also studied. The main factors responsible for losses in the marketing chain were inappropriate methods of harvesting, packaging material, infrastructure, non-availability of cold storages, and over maturity of the product (Shahzad et al., 2013). Ahmed et al., (2015) also observed that experience, picking time, and picking method were the significant factors effecting losses at the farm level. At the wholesale level, the loading technique, storage place, and experience showed a significant effect on losses while at the retail level, the type of retailers and the amount of left or unsold quantity were the significant factors. The handling of tomato is the main factor that is responsible for most of the losses. Bulk packaging in wooden crates and time lags in transportation are mainly responsible for the increased losses in tomatoes (Shahzad et al., 2013; Saeed & Khan, 2010). Iram and Ahmad (2013) and Shah et. al. (2014) also highlighted the role of diseases in the post-harvest chains, causing economic losses due to hurdles in the export at international level.

Compliance to safety standards and health certification protocols is essential to enhance market share. The Plant Protection Department requires the exporters to purchase their produce from SPS Certified farms approved by them, the enforcement of health and safety protocols, such as, HACCP, EuroGAP, Minimum Residue Level for pesticides (see the international and country. In addition, lack of traceability enforcement, prevalence of disease, and unchecked use of pesticides limits KP and Pakistan's access to international markets.

Packaging is a key contributor in marketing horticulture produce. Different packaging material, such as wooden and plastic crates, cardboard cartons, plastic bags, jute bags and baskets is used for fruits and vegetables.[23] Cardboard packaging is less costly and may earn 45 percent price premium for their fruits. The benefit cost ratio of a cardboard carton is 4.56 as compared to 3.49 of wooden box.[24] They further explored that post-harvest losses were less in cardboard cartons (10.49 percent) compared to wooden crates (14.24 percent). At the farm level, losses in cardboard cartons were 2.90 percent versus 6.10 percent in a wooden crate. At the wholesale level, losses occurred in cardboard carton were 1.45 percent as compared to 1.43 percent in wooden crates. While losses at the retail level were 6.14 percent in cardboard cartons

[23] M. Sharif, 2011, *Structure, Conduct and Performance of the Marketing Systems Margins and Seasonal Price variations of selected fruits and vegetables in Balochistan, NWFP, Northern Areas and Azad Jammu and Kashmir*, Pakistan Agriculture Research Council, Islamabad.

[24] Muhammad Shahzad, Ayesha Tahir, Naveed Jehan, and Anwar Shah, (2018), *Packaging Decisions In Horticulture Sector Of Khyber Pakhtunkhwa: A Province Of Pakistan*, Pakistan Journal of Applied Economics: Special Issue 2018, (481-491)

as compared to 6.71 percent in a wooden crate. Despite low losses at different stages, the cardboard carton is not good for storage because it tears easily after absorbing moisture (Shahzad et al., 2015; Khan, 2017). It requires development of packaging houses adopting modern packaging best practices and improvement in cardboard boxes quality with plastic coating to withstand storage atmosphere, fungus susceptibility, and moisture resistance at affordable cost. Nevertheless, it will remain a major challenge.

Post-harvest part of the value chain requires immediate focus. Lack of appropriate product grading, waxing, cooling, packaging, storage, cold-chain systems, temperature/humidity control, poor farm to market infrastructure in rural areas and an efficient collection system through proper scheduling of the harvest to ensure availability adequate transport severely limit the ability of fruit produce to sustain consistent supply of high-quality products and result in high losses. Controlling these losses has the potential to increase the income of farmers from fruits by at least 25 percent in KP. It not only needs investment by the government as a catalyst but also substantial engagement of the private sector. Since most fruits and vegetables are perishable, significant physical and quality losses at post-harvest stage lack of a robust cold-chains system from farm to wholesale and retail markets, and processing and export exit points.

6.3.4 Technology

The important role of technologies in the agriculture sector cannot be over emphasized. Understanding the factors determining the adoption and management of agricultural technologies is vital due to their impact on output and subsequently on income. Memon et. al., (n.d.) and Chohan and Ahmad (2008) investigated various technologies used in the supply chain. The quality of fruits and vegetables remains stable and postharvest losses are significantly reduced by supply chain technologies such as pre-cooling, grading, packaging, storage, and transportation. Khan et al., (2016) reported that the provision of storage is an important factor for reducing postharvest losses and stabilizing the price of horticultural crops, especially citrus. They reported that 70 percent of farmers did not have access to storage facilities and proper transport facilities. Memon et. al., (n.d.) focused on the factors which affect the use of available technologies in peach farming. Significant links were found between the adoption of appropriate technologies and a lack of funds, information, knowledge of and access to improved varieties, and the high cost of fertilizers. A Logit model analysis showed that education has a positive effect while age has a negative influence on the adoption or use of ICT at the production stage (Waqar et. al., 2018). Shahzad et al., (2018) revealed that the probability of adoption will increase with the size of the orchard, availability of packaging boxes in various sizes, and distance to the market. For cardboard packaging, experience and cost were significant factors for non-adoption.

In light of the findings of various studies on post-harvest losses, especially in fruits and vegetables, strategies and new tools have been developed to alleviate losses in the post-harvest chain of fruits and vegetables in Pakistan (Iram & Ahmad, 2013). Awan et al., (2012) analyzed various aspects with a focus on the use of technologies in the value chain of

tomato in Gilgit-Baltistan. Different varieties of tomatoes were used. Also, wooden crates were used by most farmers (76 percent) and traditional baskets by 24 percent of the tomato's farmers.

Haq et al., (2009) examined the effect of farmers' circumstances on onion yield. Farmers with more experience and frequent contact with the agriculture department for advanced technology obtained higher yields. Mobile phone is commonly used to get price information, but due to low education, internet is not used by producers or intermediary traders. At the production stage, ICT is not used extensively, although the export-oriented firms use both mobile phones and the internet. The export chain of onion is more connected with ICT compared to growers and intermediaries, showing the vast digital division among players involved in the chain (Waqar et. al., 2018).

6.3.5 Agro-Processing

Promoting agro-processing units in KP can stimulate and strengthen horticulture sector through value addition, steady demand, quality control and supply chain linkages. Establishment of small and medium-size agro-processing operations near fruit production areas are expected to generate employment, economic development of the rural locations and serve as market outlets for surpluses.

Pakistan has approximately 40 horticulture processing units and 2500+ food processing units. Most of the food industry in Pakistan is concentrated in Punjab (60%) followed by Sindh (30%), KPK (6%), Baluchistan (2%) and ICT (2%). Many of these units will need balancing, modernization and refurbishment (BMR) as these units installed low-tech indigenous machinery. Most units process multiple fruits such mango, citrus, guava, apples and other fruits to ensure maximum capacity utilization. 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. 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. The perishable nature of fruits and vegetables, lack of controlled atmosphere containers, poor transportation facilities, ineffective storage and packaging facilities are the major reasons for this under development of industry. Share of fruits' export from Pakistan in the world markets is increasing annually that shows that the industry needs to improve the working capacity of already existed fruit processing plants. 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]

[25] Syed Amanullah Husaini and Jawad Rehman, (2020). *Understanding the Bottlenecks and Opportunities in Value-Added Exports of Fruits and Vegetables*, Pakistan Business Council, Karachi.

KP has significant potential for development of agro-processing and frozen fruit industry to utilize the diverse raw material available. It will promote planting of high value fruits like raspberries, blueberries, strawberries, and blackberries. Fruit juices, nectars and other types of preserves (jams, jellies, and marmalades) are also widely consumed throughout the country. However, it will require strong grading system, labelling standards, processing, storage and packaging and continuous supply of fresh fruits.

The establishment of a dried fruit industry in NWFP may be the most logical type of value added. The technology for drying is quite simple and initial cost is not too high nor the supply of raw material is a constraint. The current technology use includes controlled temperature forced air ovens to maintain quality and freshness of the produce. Nevertheless, it needs timely information regarding potential markets, demand, technical know-how for drying process and a supply consolidation mechanism. A public-private sector initiative can pilot it using modern technology and ensuring international standards requirements.

A project for fresh fruit processing of citrus was evaluated to have an NPV around Rs. 39.22 million, with an IRR of 27% and a Payback Period of 4.84 years (SMEDA, 2014). SMEDA (2014) also reported that for commercial purposes, the establishment of processing for fruits has gained popularity among the business community. The medium size units for apple, citrus, and mangoes were proposed in the project area. The processing mainly involves waxing, polishing, grading, and packaging, which increases the quality of fruit and shelf life as well. The pre-feasibility estimates show that the processing unit will have three tons per hour and 6,696 tons annually on a seasonal basis. The SMEDA feasibility study identified Southern Punjab, Interior Sindh, and targeted areas of Khyber Pakhtunkhwa and Baluchistan for the establishment of processing facilities of fruits and vegetables.

6.3.6 High Production Cost

Ahmad et. al., (2019) estimated the production and marketing cost of conventional tomato produced in KP. They separately estimated nursery cost raised for one acre of farm area. The cost amounting to Rs. 17,423 per acre included seed bed preparation, seeds, irrigation, pesticides, and labour cost. Average production cost including nursery raising cost was Rs. 90,933 per acre. The marketing cost of tomato included transportation, loading, and unloading, packing and empty wooden boxes costs and amounted to Rs. 14,086 per acre. The total cost, including both the production and marketing cost was Rs. 105,019. Total revenue was Rs.198,166 per acre, and hence net revenue was Rs. 93,146 per acre, leading to a cost-benefit ratio of 1:0.53. Total revenue is calculated as farm price multiplied by quantity and net revenue is derived by subtracting both production and marketing costs from total revenue. Qasim et. al., (2018) estimated the production cost of tomatoes in Sind, Punjab, and Baluchistan as Rs. 121,106, 125,615 and 101,485 per acre, respectively. The estimated respective total revenue was 254,620, 226,848 and 262,600 resulting in cost-benefit ratio of 1:0.48, 1:0.55 and 1:0.39, respectively. Hene, the cost-benefit ratio of tomatoes in Sind, Punjab and KP are in in the same range while it is low in Baluchistan.

Recently, peach has been replacing apples in Swat. Apples have been facing pest infestation and the progressive producers searching for profitable crops shifted to peach due to suitable environmental features of the area. Khan and Khan (2014) reported that estimated the production and marketing cost for several peach varieties produced in Swat. The study reports that establishment of peach orchards require a sizeable investment. The average production cost was estimated as Rs. 34,100, marketing cost Rs. 94,955 and total revenue as Rs. 250,510 per acre. The estimated cost-benefit ratio was 1:0.38. The study shows that the revenue of early grand and carman varieties is higher as compared to others. The peaches of these varieties reach to market early when prices are higher. Production cost included pesticides, FYM, fertilizer, hoeing, pruning, irrigation and labour cost and marketing costs included empty cartons, picking and grading, transportation, loading and unloading, and commission agent charges. Hence, the production cost ignored orchard establishment cost and considering would reduce the cost-benefit ratio.

Khair (2020) estimated the production and marketing cost of apple low (less than 19000 meters) and high (more than 19000 meters) altitude apple producing areas in Baluchistan. Khair (2020) estimated gross margin (net revenue) by subtracting variable cost of apple production from gross income (total revenue). His analysis indicate that irrigation is the largest cost item followed by pesticides, labour, fertilizer and farm-yard manure. Khair (2020) reported that apple farming at high altitudes earns more net revenue as compared to lower altitudes as cost of production of apple in the former areas is low primarily to favourable climatic conditions. The cost of production and net returns of apple were respectively, Rs. 192,000 and Rs. 72,338 at lower altitude as compared to Rs. 330,000 and Rs.215,868 at higher altitudes. The per kg net revenue at farm was Rs. 11.30 at lower altitudes and 39.21 at higher altitudes indicating a difference of more than three times. The yield per acre was 6,400 kgs/acre in lower altitudes as compared to 5,500 kgs/acre on higher altitudes. The lower yields in the higher altitudes were compensated by higher prices in the higher altitude (Rs. 60/kg) as compared to lower altitude (Rs. 30/kg). The difference in price was also due to different varieties produced at the different altitudes. The cost-benefit ratios were 1:62 and 1:0.35 at the lower and higher altitudes, respectively.

6.3.7 Low Net Margins

Marketing margins are estimated as the differences between prices at farm and retails levels. Farm and retail prices are used to calculate the farm share of the retail price. The remaining share is attributed to the marketing system. Hence, for example, marketing margin in the case of apple, represents the difference between the price received by apple producers and the price paid by apple consumers. High marketing margins mean a low share for producers in the consumer price as compared to a high share for market intermediaries and vice versa.

Such an analysis helps in understanding that what proportions of the consumer rupee is kept by producer and marketing system including cost. A smaller proportion of market system shows their higher efficiency and adds value. **Table 17** shows the farm price, transportation cost, wholesale and retail prices and estimated proportions of producer and marketing system for fruits and vegetables reported by different studies. The table shows that

the share of persimmon producers in consumer price was 28.6 percent as compared to 71.4 percent of marketing system. Persimmon is a relatively perishable fruit and producers need to quickly sell these off. It gives more leverage to market intermediaries to take advantage and buy the produce at a low price. Hence, the persimmon marketing chain is extremely inefficient as producer gets a very smaller share of the consumer price. Banana is also a highly perishable fruit, and producers even get a smaller share of consumer rupee as compared to persimmon.

Table 17. Average prices of fruits and vegetables including transportation cost (Rs. Per Kg)

Commodity	Farm Price	Transportation Cost	Wholesale Price	Retail Price	Producer Share	Mark Share
Persimmon[1]	14.3	4.8	36.0	50.0	28.6	71.4
Pear[1]	17.5	3.4	33.0	40.0	43.8	56.3
Banana[1]	10.6	5.0	37.0	50.0	21.2	78.8
Guava[1]	18.1	5.6	36.0	50.0	36.2	63.8
Peach[2]	59.8	---	---	140.0	42.7	57.3
Peach[2]*	80.0	---	---	140.0	57.1	42.9
Peach[3]	15.0	---	---	63.8	23.5	76.5
Peach[3]*	39.3	---	---	63.8	61.6	38.4
Apple Farmer [4L]	30.0	---	74	95.0	31.6	68.4
Apple Contractor [4L]	74.0	---	---	95.0	77.9	22.1
Apple Farmer [5H]	60.0	---	112	137.0	43.8	56.2
Apple Contractor [5H]	112.0	---	---	137.0	81.8	18.2
Sweet lemon[1]	16.5	6.9	55.0	80.0	20.6	79.4
Potato[1]	19.0	4.6	31.0	35.0	54.3	45.7
Onion[1]	26.0	4.6	35.0	60.0	43.3	56.7

[1]Hassan et. al., 2012.
[2]Bajwa, 2012. Farmer sells peach to wholesaler who further sells it to other intermediaries.
[2*]Bajwa. 2012. Farmer (or contractor) directly sells in the market.
[3]Yousaf. 2017. Farmer sells to wholesaler, who further sells it to other intermediaries.
[3*]Yousaf. 2017. Pre-harvest contractor sells in the market.
[4,5]Khair (2020) while L and H respectively stands for lower altitude (more than 1400 and less than 1900 meter) and high altitude (more than 1900 meter). The superscript LH together shows that prices

Peach and apple are relatively fewer perishable fruits. These are also sold in various marketing systems. Both the fruits are not only directly sold by produces but also by contractors. Contractors buy orchards when fruits are at the flowering stage and then shortens the marketing chains and directly sell to the wholesalers, who then sell to retailers. As a result, they keep a bigger share of consumer rupee. Peach is a typical example, where producer share ranges from 61.6 percent for peach sold by contractors as compared to 23.5 percent for peach sold by producers. The estimates reported by Bajwa (2012) show the same trend, with different shares for both, producers, and contractors.

Khair (2020) estimated and compared marketing costs and margins at the low and higher altitudes. The lower altitude ranged from more than 1400 to less than 1900 meters while more than 1900 meters was considered as the high altitude. The share of producers in consumers rupee at the high altitude gets almost double the share of producers at low altitudes. The share of contractors in the consumer rupee is higher in both low and high altitudes, however, it is very high for contractors located at the high altitudes. Retails prices are high at the high altitudes due to favorable climatic conditions for apple production as the produce gets chilling

requirement. There is also less fruit drop, good color, less pest attack, more nutritional contents, and low post harvest losses at higher altitudes.

6.3.8 Market Distortions

Inadequate and timely market information in terms of demand for high quality fruit and value added fruit products in domestic as well as export markets and price available to farmers. The horticulture crop sector generally has a poor market information system and lack of transparency in the prices of fruits, vegetables, and their processed products as the prices of horticulture are rarely regulated and it largely depends on the marketing skills of the farmers. It is important to develop market intelligence information including new varieties in demand in domestic as well as international markets, sources of competition, consumer preferences, future outlook, and its timely dissemination to farmers as well as the private sector.

Access to the price information can also directly affect earnings and can distribute profits among the market intermediaries. Knowing prices in different markets can provide more powers to producers and bargaining power of market intermediaries can be reduced. It can also reduce wasteful expenditure made on transportation cost by avoiding adverse market selection as producer once transport produce to a market is unable to move it to another market where prices are high and hence is forced to sell produce on lower prices.

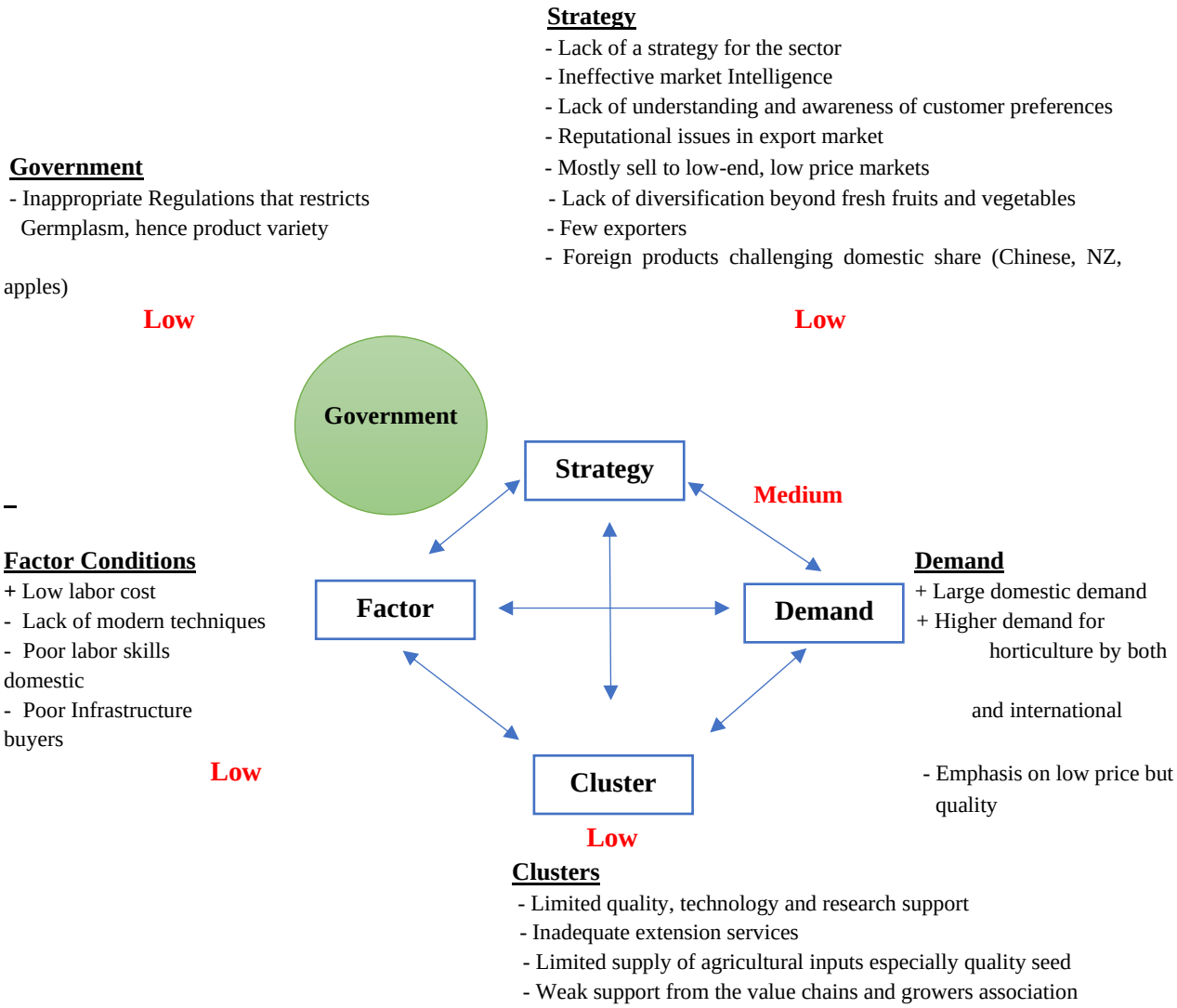
Yousaf (2017) reported that United States Agency for International Development in 2014 initiated a Firms Project named the "Pilot for Information and Financial Mobile Solutions" (PIFMS) in Northern Pakistan. The objective of the project was to improve the availability and communicate market and weather information to producers. The project was jointly launched with the provincial Agriculture Department and Mobile Network Operators in collection and dissemination of the information via mobile text SMS. The project was able to provide weather information but failed to disseminate market price. Such initiatives are vital in reducing information asymmetry and increasing producers' accessing price information in various markets of the country and hence helping them making an informed selling decision.

7. Evaluating Horticulture Value Chains in KP

An efficient marketing system is essential for sustained agricultural development (Chohan & Ahmad, 2008). It enables markets to perform its functions and at the same time offer and demand. Hence it provides a network to buyers and sellers starting from producers and end at consumers. The marketing channels start with the producer and end with the consumer. An agricultural marketing channel is based on the concept of a marketable surplus of farm commodities that enter the process of circulation and exchange. The purpose of the exchange of commodities for money and vice-versa is to have access to a variety of products (Barki et al, 1997 cited in Qasim, Farooq, & Akhtar, 2018). A value chain analysis helps in understanding the role of primary and support activities that add value to the product.

Value chain and marketing studies investigate the role of many factors affecting its performance including but not limited to perishability, seasonality, quality of the product, location, and prices (Kohls & Uhl, 1985; Chohan & Ahmad, 2008). Due to the perishable and sensitive nature of timeliness, the fruit and vegetable value chain requires a quick flow of information among the participants (Waqar et. al., 2018) and proper Supply Chain Management (Khan and Bae, 2017). Chohan and Ahmad (2008) estimated that 75 percent of the produce was marketed through the local system and the remaining 25 percent was marketed through the wholesale market. Waqar et. al. (2018) noted two marketing channels: the traditional one including contractors, commission agents, and wholesalers while the other one export-oriented involved processors and exporters (P&Es).

Figure 24. Competitive Environment for the Horticulture Sector in KP



Note: + (-) signifies a factor that strengthens (weakens) the competitiveness

For the purpose of evaluating environment for horticulture value chain in the KP, Michael Porter's Diamond model has been used (Figure 24) rather than factor endowments

(comparative advantage model) which are inherited. The Diamond[26] is based on four inter-connected competitiveness factors: (i) strategy, structure and intensity of local competition; (ii) factor conditions comparing low factor conditions (cheap labor, natural resources) with advanced factor conditions (academic institutions, knowledge, research, technology, international best practices); (iii) demand environment (intensity and sophistication of local demand and share in the international market; and (iv) availability of supporting and cooperation mechanisms.

7.1 Other Techniques for Evaluating Performance of Value Chains

Memon et al. (n.d.), Shahzad et al., (2015), Awan et al. (2011), Jariko et al. (2011), and Chohan and Ahmad et al. (2007) used uni- and bi-variate descriptive analysis in their studies. Percentages are primarily used in quantification of post-harvest losses at various stages of the supply chain (Ahmed et al., 2015; Abass et al., 2014; Shahzad et al., 2013; Saeed & Khan, 2010; Osman et al., 2009; Ilyas et al., 2007; Rehman et al., 2007; Hussain, 1993). Similarly marketing margins, cost, benefit, gross margins and revenue of production and marketing of fruits and vegetables are derived as means. Qasim et. al. (2018), Shahzad et al. (2015) and Hassan et. al. (2015), Khan and Khan (2014), and Iram and Ahmad (2013) also compared the estimated means between rural and urban areas using t-statistics.

Different regression techniques are used to evaluate the performance of value chains and adoption of different production and marketing processes. Ahmed et al. (2015) and Shahzad et al. (2013) used Ordinary Least Squares to estimate the determinants of post-harvest losses in fruits at different levels of value chains. Jariko et al. (2011) used Multinomial Logistic regression technique to examine the adoption of various varieties, packaging materials, and other technologies in the value chain. A Probit model was used to determine the factors affecting technology adoption (Memon et. al., n.d.) while both the Logit and Probit models were used to study the effect of different factors on the adoption of ICT at the production stage of value chains (Waqar et. al., 2018) and adoption of cardboard cotton at the marketing stage (Shahzad et al., 2018). SMEDA (2014) carried out a study for the establishment of processing plants for fruits and checked the feasibility of projects by deriving net present values and internal rate of returns. Hence, various techniques are used to investigate value chains. The choice of technique is mostly motivated by the type of question addressed in the study.

The horticulture value chain in the KP is characterized by low factor conditions, weak strategy, weak cluster system, and medium demand based on per capita consumption of fruits and vegetables and reputational risks in the export market. Horticulture sector is also suffering because of import restriction on germplasm (seed) from advanced countries or international suppliers compelling the growers to rely on easily imitable basic seed.

The negative impacts of the current value chain can be assessed in terms of the low share of farmers in consumer prices. Usually producers get 15% to 20% of the retail price. Production of perishables like potato, onion and tomato suffers from a major setback every 3–

[26] World Bank, Policy Note on Horticulture Value Chain in the KP

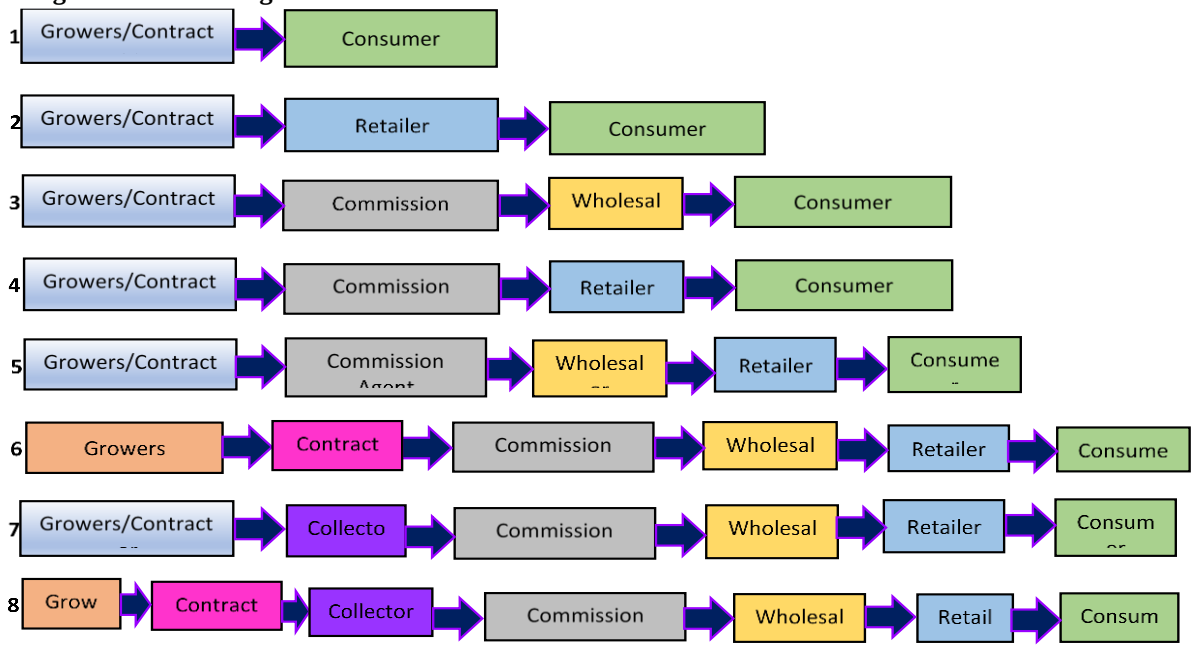
4 years. Usually two or three good harvests are followed by a bad harvest. Besides, natural factors like unfavorable weather also negatively affect production. Producers do not get price dividends when production is low, shooting the retail price. Benefits of high retail prices are disproportionately expropriated by the middlemen. When there is a market glut where perishables and their prices fall, producers suffer as their share in retail prices also falls significantly. Sometimes producers throw away their perishable produce to protest their low prices. It emerged from discussions with the traders in Badami Bagh Ravi Link wholesale market that producers' share in retail prices is inversely related with the perishability of the crop. Both seasonal and spatial price fluctuations of fruits and vegetables are high in Pakistan. For instance, in 2017, the price of 100 kg of tomato in Lahore fluctuated between 1,450 Pakistan rupees (PRs) to PRs13,150, or more than 800%. In the same year, price fluctuation for fresh potato was between PRs1,550 to PRs4,300 for 100 kg, or 177%. The annual cost of price fluctuations of fruits and vegetables is estimated to be about $825 million.

7.2 Marketing Channels

Khan (2017) identified and illustrated eight marketing channels for peaches in Pakistan (Figure 25). At the local level, the fruit was directly available for consumption, which is mainly fallen fruit while, all stakeholders starting from grower, contractor, commission agent, wholesaler, retailer, and consumer participated in the marketing chain.

In the citrus (Kinnow) marketing chain, most of the produce was sold to contractors (90 percent). It was further supplied to exporters and commission agents after washing, waxing, polishing, grading packing, etc. The commission agents sold their produce to wholesalers and retailers which was then supplied to consumers. The local industry also processed the fruits and then sold them through retailers in the form of juices.

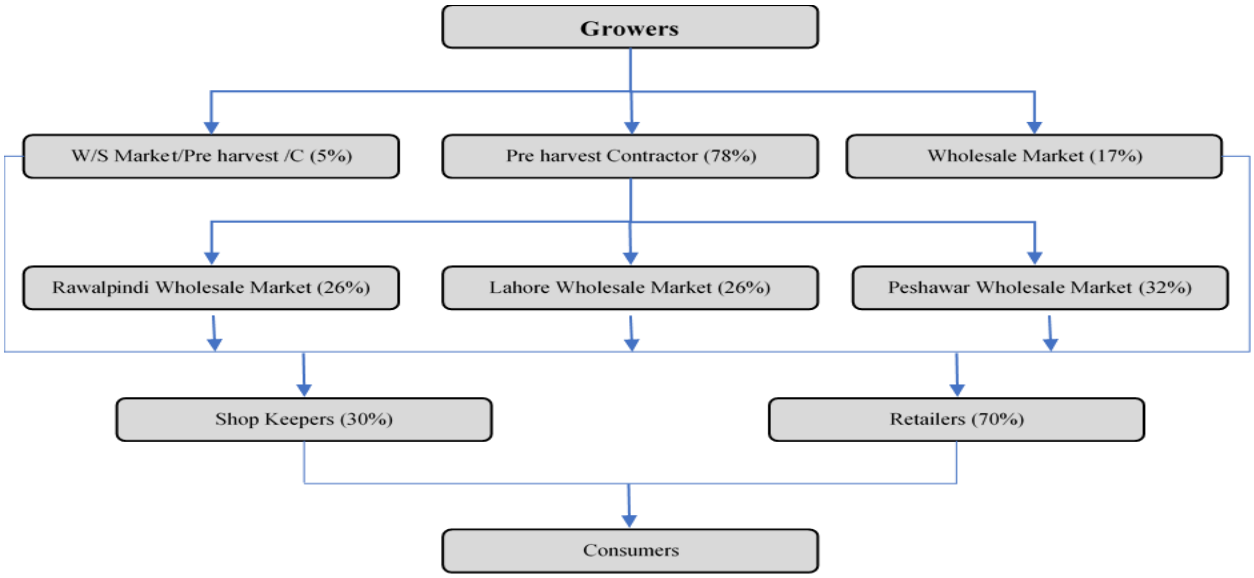
Figure 25. Marketing Channel of Peach in Pakistan



Source: Khan, 2017

Zeb and Khan (2008) also studied peach marketing and provided the details of proportions of quantity handled by each intermediary in the marketing system. Pre-harvest contractors handled 78 percent of the quantity and hence is the biggest supplier of the produce to the market. Wholesalers handles 17 percent of the produce. They supply to Rawalpindi (25%), Lahore (26%) and Peshawar (32%) markets, from where peach is ditributed to retailers and shopkeepers. The study did not report exporters and processors (see **Figure 26)**.

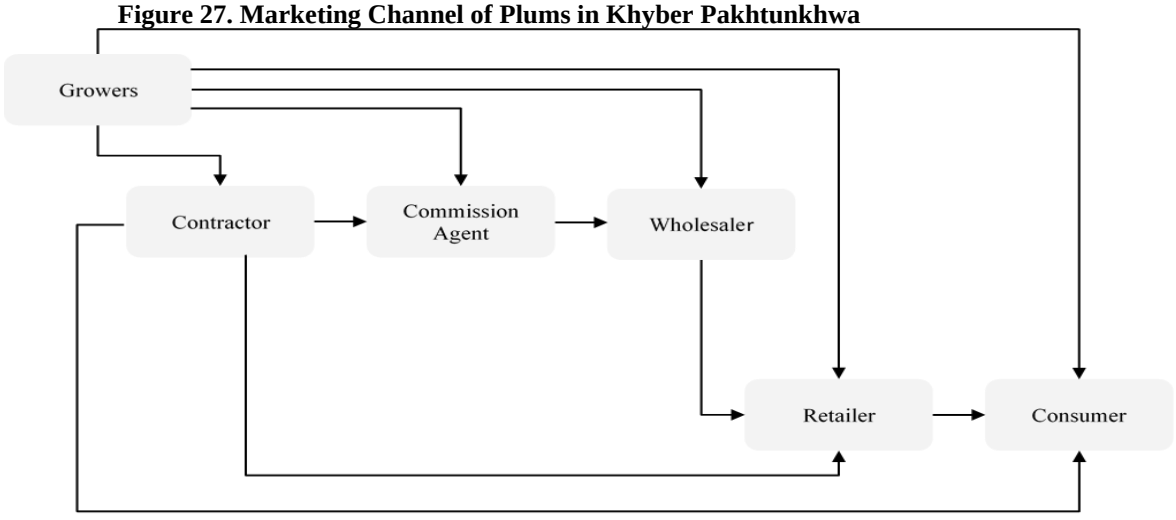
Figure 26. Marketing Channel of Peach in Khyber Pakhtunkhwa



Source: Zeb and Khan, (2008)

The marketing chain of plum indicates the supply of fruit through different market participants (Figure 27). Plum was supplied in various channels through the involvement of growers, commission agents, wholesalers, retailers, and consumers while it also reached directly to consumers from the grower. Sharif et al. (2009) estimated the financial viability of citrus orchards to generate valuable information for policymakers. They found that investment in citrus orchards was having a payback period from 5 to 6 years. Against the rate of interest on agricultural loans, return to investment on citrus was 33 percent in Punjab.

Figure 27. Marketing Channel of Plums in Khyber Pakhtunkhwa

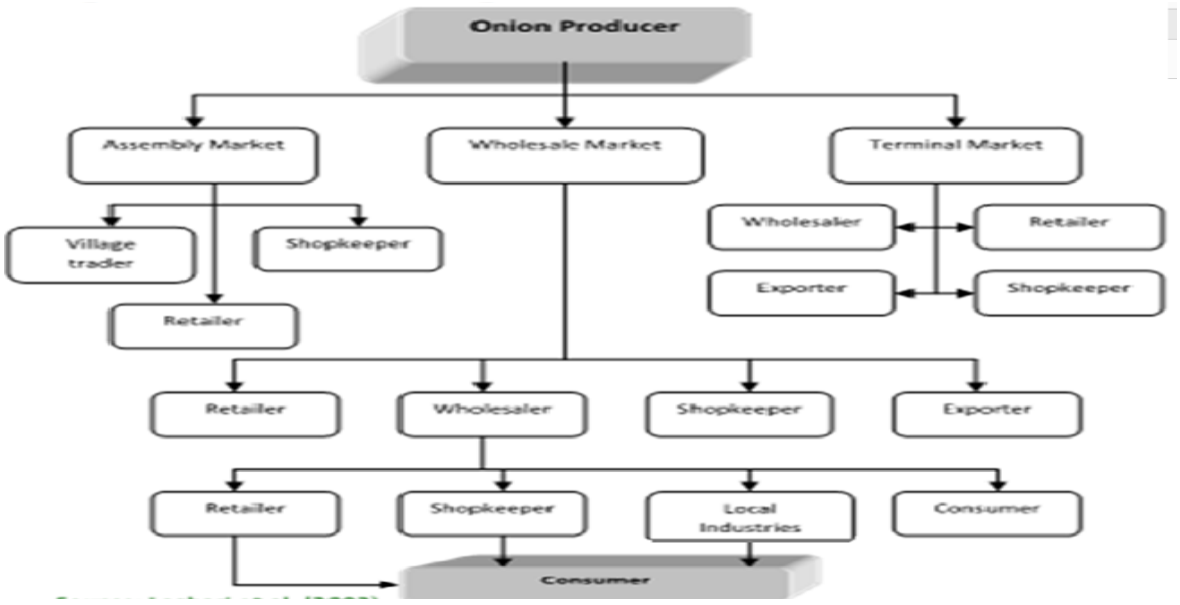


Khan and Bae (2017) conducted a detailed analysis with an environmental perspective for Supply Chain Management (SCM) of apple in Chitral. The study also developed a framework for understanding SCM. The study presented a hub and spoke logistic model of supply chain. The model is characterized by a centralized network to reduce marketing costs low. Typically, the Hub and spoke model is characterized by distribution centers, receiving apples, from different sources, and then send these to different destinations. Hence, famers transport Fruits logistic are in four phases. Farmers transport apple from farms to buying centers, from where these are transported to buying centers, followed to a hub, from where these are distributed to stores, customers and so on**.**

Haq (2012) reviewed and investigated the value chain of agri-food products from perspectives of national as well as international studies. Applying the framework suggested by Sanogo (2010), studies were classified into four categories. The first category focused on by the researchers in Pakistan highlighted characteristics, price, quantity, and quality. However, literature had ignored the second category which relates to policies, infrastructure, norms, laws, and regulations as well as the third category that focused on the linkages, information, networking among the value chain actors. The last category discussed the role of support markets like input markets, financial services, productivity growth, and research and development. The existing literature has ignored various other aspects including supermarket growth factors and hindrances, availability of local fruit in international markets/countries, processing food chain, etc.

In vegetable marketing, the onion marketing chain was directed through assembly markets, wholesale markets, and terminal markets (**Figure 28**). The assembly market further extended to village traders, retailers, and shopkeepers. The terminal markets reached wholesalers, retailers, exporter, and shopkeepers. The wholesale markets connected the retailers, wholesalers, exporters, local industries to reach consumers.

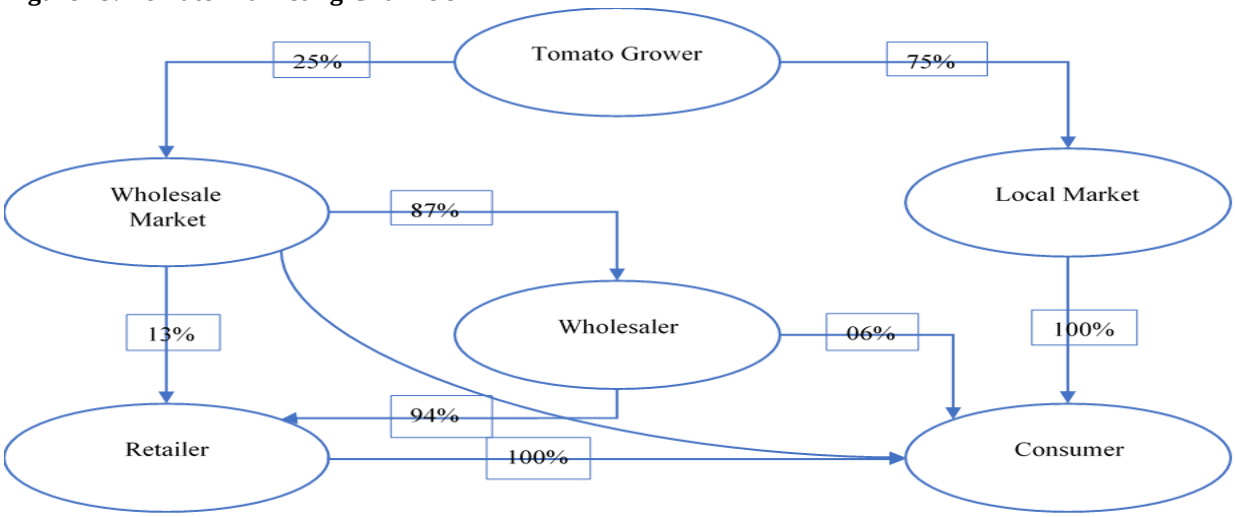
Figure 28. Onion Marketing in Pakistan



Source: Lashari et al, 2000

Marketing channels for fresh tomatoes is at Tables 18 and 19. Qasim et al., (2018) divided the marketing chain of fresh tomatoes into two main categories (**Figure 29**). In one way it was directly connected to consumers via local markets with 75 percent share while on the other way, 25 percent share went to the consumer via wholesalers and retailers.

Figure 29. Tomato Marketing Channels



Source: Chohan and Ahmad, 2008

Table 18. Marketing Channels for Tomato (Percent of Farmers)

	Province			
Selling Agency	Sindh	Punjab	Balochistan	Overall
Pre-Harvest Contractor	3.70	0.00	0.00	1.40
Local Dealer	41.70	0.00	12.20	14.70
Local Village Assembly Market	21.00	33.30	0.00	19.80
Wholesale Market	32.10	53.80	84.50	53.90
Others	2.50	12.80	3.40	6.50

Source: Qasim, Farooq & Akhtar, (2018)

Table 19. Marketing Channels for Tomato (Percent of Farmers)

Purpose	Frequency (Percent)
Not availed	3,712 (71)
HH expenditure	1,106 (20)
Others	391 (9)
Total	5,209 (100)

Source: Estimates of HIES 2015-16

8. Price Formation in Fruits and Vegetables Market

The major fruit and vegetable markets in the country are located in Islamabad, Lahore, Karachi, Peshawar, Faisalabad and Gujranwala. To study the role of different stakeholders dealing with fruits (peach, plum and citrus) and vegetables (tomato and onion) in Peshawar and Islamabad fruits and vegetables markets were informally interviewed in mid-November 2019. These stakeholders were asked about their functions and roles with respect to price formation, monopoly power, government regulations, demand & supply, technologies used/adopted by these stakeholders in their respective categories of the supply chain.

8.1 Price Determination

Fruits are supplied for auction to commission agent shops located at various fruit markets in the country. The price determination of fruits depends mainly upon the number of buyers (i.e., demand side) and the daily quantity supplied in the market. Due to the perishable nature of the product, high variations are observed in quantity demanded, supplied and resultant prices. For price formation of fruits and vegetables, an open bidding system/mechanism is prevailing in the whole country with the exception of secret bidding in Islamabad fruit *mandi* for citrus and fruits having high demand in comparison to supply. In open bidding, the bidding of fruit is conducted for consignment of different sizes (30- 50 boxes/consignment) depending on the quality of the fruit. From each consignment, two or three boxes are opened/checked randomly in front of the bidders and the initial price is determined, which is further pushed up by the bidders in competition. The highest bidder gets the consignment/lot which are delivered for auction by the Commission Agents/*Arthis*. Secret bidding takes place with the help of a handshake under a cloth covering locally known as *chaddar or shawl* which is recently introduced for fruits at some places. In secret bidding, the hand is shaken twice under a cover between the commission agents and buyers. The handshake is divided into 10 different units indicating figure of hundreds and tenth units. The first handshake indicates figures in hundreds (one hundred, two hundred and so on) while the second indicate the tenth units (ten, twenty, thirty and so on). When the tip of the fingers is held during the handshake, it indicates the initial unit of hundred/ tenth while full handshake indicates the thousand/hundred figures, respectively.

The bidding activities in the commission shop/*mandi* is taken place by the commission agent or they hire brokers for the said purpose which is conducted under the presence and supervision of the commission agents. Bidding of products starts at the dust time or after the Morning prayers and long before sunrise. The bidding process lasts for 2 to 3 hours normally. However, for some products and some cases, it may end around 10 am and 12 pm. Low-quality citrus is also supplied in vehicles without any packaging and sold on basis of price per basket or packed in sheets having a quantity of around 5-8 dozen. The price of this low-quality citrus is decided by the commission agents in consultation with and then the commission agents have limited influence on price to decrease/discount in price.

8.2 Monopoly of Brokers/Commission Agents

Commission agents are the most important stakeholders in the supply chain. Commission agent deal with limited products ranging from one to three fruits/vegetables at maximum. The market nature of commission agents or brokers can be identified as an oligopoly having some power on the supply and therefore an indirect influence on prices. For this purpose, they use cold storage facilities to store the product for some time depending on the market condition and on the perishability of the product. These commission agents also keep the produce in cold storage for the offseason to get a higher price. The commission agents also manipulate the supply at the farm to some extent depending on the nature of the product. If the price is

favorable, they call the farmers for more supply even at unripe condition while if the market is cold then they delay the supply for some days even if the produce is ready for harvesting.

Some of the commission agents/brokers have more hold/influence on the seasonal market supply by providing more advances/loans to farmers and contractors. These commission agents or *Arthis* provide loans to the farmers directly and through distributors and in return the growers/contractors sell their produce in their shops and they charge a high commission in case of loan is given to the farmer, because the growers/contractors are bound to sell in their place/platform. Only those commission agents who are conducting business in large fruit markets provide loans to the growers/contractors. The local commission agents situated in or near the producing area like Swat, Timargara and Batkhela are not providing loans to the farmers and receive low quality produce. To attract more farmers to supply produce, the commission agents of Islamabad fruit and vegetable markets do not charge any amount from farmers. They charge a 7 percent commission from the buyers while in other fruit markets in the country, the commission agents take his commission in percentage from the growers or contractors ranging from 5 to 7 percent while it charges the buyer with the absolute amount per box (10 rupees per box).

8.3 Government Regulation at *Mandi/Market*

The fruit and vegetable sector in Pakistan is informal in nature having negligible government regulations in KP. Only the suitable locations are allocated by the respective district administration for the markets which are near and outside the major cities. Price, quantity demand, quantity supply, quality of products etc. are determined by the market forces. Even though some commission agents have business in millions at multiple locations, they do not contribute to the national exchequer. Certain agreements take place between different stakeholders in the supply chain, especially between the commission agents, contractors/middlemen/distributors, and farmers. But there are no formal government regulations regarding these agreements thereby allowing opportunistic behavior by parties. In violation of the agreement, some of the farmers do sell a portion of their produce at the market where the return is high as compared to other markets in the country.

9. Assessment of Access to Finance and Agricultural Loans/Microfinance

Farming needs credit for smoothening out seasonal fluctuations in earnings and investment. Since cash flows and savings in rural areas for smallholder farmers is not sufficient, they rely on credit for inputs and other consumption needs, such as education, food, housing, household functions, etc., and get loans from both formal and informal sources. However, more recently, a greater part of the demand for credit has been met from formal sources, such as *Zari Taraqiyati Bank Limited*, commercial banks, microfinance banks, and RSPs. In certain cases, farmers obtain loans from more than one agency. The credit limits and multifarious needs are the main causes behind using alternative or multiple credit sources.

Governments through various policy initiatives are trying to improve credit availability to farmers to facilitate them to purchase inputs and services. It is also presumed that, with

better credit, modern input and technology use would be enhanced and lead to greater farm productivity and profitability. In this regard, the State Bank of Pakistan has advised all banks to advance loans to farmers for different farm-related operations, including plough, tubewell installations, purchase of tractors, establishment and development of orchards, transportation of farm output, cold storage, land improvement, purchase of other farm machinery, and procurement of quality seed, etc. According to the latest data (2017-18) provided by the State Bank of Pakistan (**Table 20**), total agricultural credit and development loans were Rs. 32,580 million in Pakistan. Out of this amount, Rs. 40.39 million was advanced for ploughing farmland, Rs. 188.8 million for tubewells, Rs. 5,971.94 million for the purchase of tractors, Rs. 931.15 million for the establishment and development of orchards, Rs. 51.02 million for transportation of farm output, Rs. 3,166.03 million for the establishment of cold storages, Rs. 136.93 million for land improvement, Rs. 108.37 million for purchase of other farm machinery, and Rs. 10,923.16 million for the procurement of quality seed, almost one-third of the total credit.

Table 20. Agricultural Credit - Development Loans (Rs. in Million) Advanced by All Banks

Province/ Year	Plough	Tubewells	Tractors	Orchards	Transportation	Cold storage	Land Improvement	Farm machinery	Quality seed unit	Total
Khyber Pakhtunkhwa										
2015-16	-	10.3	79.89	0.1	0.27	8.46	5.15	38.79	190	349.67
2016-17	23.7	20.09	113.92	8.35	0.58	94.7	2.64	10.37	4	371.98
2017-18	37.39	22.5	101.64	0.57	-	86.68	19.39	9.77	-	1,947.27
All Pakistan										
2015-16	4.54	121.11	4,854.77	1,106.98	22.1	2,224.60	187.03	273.17	5,843.48	17,151.25
2016-17	32.65	131.17	4,306.94	901.07	161.05	2,555.28	166.58	124.99	7,823.57	18,357.50
2017-18	40.39	188.8	5,971.94	931.15	51.02	3,166.03	136.93	108.37	10,923.16	32,580.01

Source: State Bank of Pakistan, Karachi

In Khyber Pakhtunkhwa, a total of Rs. 1,947.27 million in credit has been advanced by different banks during 2017-18. Of this total amount, Rs. 37.39 million was advanced for ploughing farmland, Rs. 22.5 million for tubewell installations, Rs. 101.64 million for the purchase of tractors, Rs. 0.57 million for the establishment and development of orchards, Rs. 86.68 million for the establishment of cold storages, Rs. 19.39 million for land improvement, and Rs. 9.77 million for the purchase of farm machinery. However, only six percent of the country's loans are advanced in KP, showing that this form of finance is not very popular.

Table 21 further shows that only a small proportion of all farmers apply for credit. Only a small proportion of tenants receive loans because they are mostly unable to meet the collateral requirements of banks. At the national level in Pakistan, during the year 2017-18, only 15,471 tenants received loans, amounting to Rs. 3.73 million from the Zarai Tarqiati Bank Limited (ZTBL) for agricultural purposes. Farmers with small landholdings of up to 5.06 hectares dominate the number of borrowers, and overall, 293,079 of those farmers received agricultural credit of Rs. 56.66 million, followed by farmers having farms of 5.06 to 20.23 hectares (as 54,490 farms borrowed Rs. 21.26 million). The same pattern is also observed in the case of Khyber Pakhtunkhwa. In KP, during 2017-18, only 2 tenants received loans amounting to Rs.

0.0004 million from Zarai Tarqiati Bank Limited (ZTBL) for agricultural purposes. Small farmers with landholdings of up to 5.06 hectares led the number of borrowers, as 8,554 small farmers (up to 5.06 hectares) received agricultural credit of Rs. 2.16 million, followed by farmers 5.06 to 20.23 hectares, where 2,435 farms received agricultural credit amounting to Rs. 0.99 million.

A study by Azeem et. al. (n. d.) on the welfare impacts of credit use on rural communities in Pakistan delineates that a huge proportion of borrowers were landowners, followed by owner-cum-tenants. These farmers had obtained a loan from commercial banks and the commission agents. Farmers prefer borrowing from the commission agent because of the lengthy processing time at banks compared to obtaining loans from commission agents. The largest amount of credit was obtained from commercial banks, followed by commission agents, ZTBL, Khushali bank and RSPs. The study further explained that clients of Khushali bank and RSPs had obtained loans from other agencies because of the insufficient amount to maintain the crop cycle. In terms of loans advanced across agencies, crop input financing was dominant by ZTBL, the commercial banks and commission agents. However, Khushali bank and RSPs had extended relatively more loans for livestock farming and small enterprises. It was also found that clients used borrowed money to meet social needs, including health, marriage expenses, debt servicing, and family education.

Table 21. Loans (Rs. in "000") Advanced by Zarai Tarqiati Bank Limited by Size of land Holding

Province/ Year	Land Less Tenant		Owner-size of holding (hectares)								Total
			Upto 5.06		5.06 to 20.23		20.23 to 40.47		Over 40.47		
	No.	Amount	No.	Amount	No.	Amount	No.	Amount	No.	Amount	Amount
Khyber Pakhtunkhwa											
2015-16	123	30.87	10819	2799.43	1788	783.09	22	9.46	3	1.40	3624.26
2016-17	4	0.95	9590	2388.63	1941	801.03	25	8.72	4	11.56	3200.867
2017-18	2	0.41	8554	2162.31	2435	992.41	22	7.96	7	3.34	3166.431
Pakistan											
2015-16	1450	453.59	282745	66448	50888	22146.01	2338	1090.58	508	229.809	90367.94
2016-17	9891	2430.79	325237	63479.46	64849	24866.66	2127	908.27	366	402470	91832.32
2017-18	15471	3732.69	293079	56656.9	54490	21260.43	1292	742.39	280	121.395	82513.8

Source: Zarai Tarqiati Bank Limited (ZTBL), Islamabad

Despite the exorbitant interest rate charged by commission agents, RSPs and the Khushhali bank, loan recovery was stronger for the RSPs, followed by commission agents, commercial banks and ZTBL. In case of crop failure or emergencies, some farmers had also sold assets to pay back borrowings from commercial banks, while the commission agent was more accommodative and extended payback periods. Because of higher flexibility in advancing and recovering loans, farmers prefer to borrow loans from commission agents. Therefore, they recommended modification of prevailing credit procedures to help include small, marginal, and remote areas in the borrowing base.

Smallholders account for most of the agricultural population in KP. They lack the required capital for the purchase essential inputs, resulting in low agricultural output and increased

vulnerability to food shortages and poverty. Access to adequate credit will play an important role in reducing rural poverty and enhancing food security, enabling them to adopt efficient technologies and create better resource allocation (WB 2008, Imai et al. 2010, Ellis 1992).

Data on loans owed, loans borrowed, repaid, and those loaned out specifically to farming are not available. However, overall data on loan owed, loan borrowed, loan repaid, and loaned out about KP are extracted from the Household Integrated Economic Survey (HIES) 2015-16 (**Table 22**). The sample contains data from 5,209 respondents. Of these respondents, only 29 percent received credit from different sources, mostly to meet household expenditures (20 percent) and other expenditures (8 percent) during the last year. A household who availed loan the facility on average owed Rs. 109,249.60, borrowed new loans of Rs. 69,701.12, and repaid loans amounting to Rs. 31,225.39. While respondents who availed of these loans to meet other expenditures, on average owed Rs. 326,519.60, borrowed Rs. 219,065.50, and repaid loans amounting to Rs. 78,476.59.

Table 22. Loans owed, borrowed annually and repaid annually for household and other expenditures

Variable	Observation	Mean	Std. Dev.	Minimum	Max
Household expenditure					
Loan owed	953	109,249.60	248,341.40	2,000	7,100,000
Loan borrowed	900	69,701.12	163,986.70	1,200	2,000,000
Loan repaid	272	31,225.39	56,413.38	1,000	500,000
Other expenditures					
Loan owed	385	326,519.60	601,316.30	8,000	5,000,000
Loan borrowed	269	219,065.50	466,122.50	5,000	5,000,000
Loan repaid	139	78,476.59	188,628.60	1,000	5,000,000

Source: Estimates of HIES 2015-16

10. Gender in Agriculture and Farming in KP

Women account for half of the population of the country, however their participation in fruit and vegetable value chains is not known. Samee et al., (2015) conducted a comprehensive study on women's role in agriculture of Pakistan. The study investigated and compared women role in agricultural production across the different regions of the country. The study reports that women solely manage livestock, poultry, vegetable production especially kitchen gardening, fuelwood collection etc.

Women are intensely engaged in the agriculture sector concentrated in husking and preserving produce besides caring and rearing domesticated livestock. Women in KP conduct around 70 percent of farm work.[27] Women in NMDs are mainly involved in tedious tasks such as land preparation, seed cleaning, sowing, applying manure, fertilizers, pesticides, weeding, transplanting, threshing, harvesting, cleaning and storing food grains. Women are also active in promoting horticultural activities and taking active part in kitchen gardening for growing seasonal vegetables. They are predominantly involved in livestock rearing because it is a source of livelihoods, social protection and income that can be used for supporting their

[27] The World Bank, Khyber Pakhtunkhwa Irrigated-Agriculture Productivity Improvement Project (KIAPIP) Project Appraisal Document, 2019

families. They have more control over sale of agriculture produce harvested in the kitchen gardens. They also *have the power to sell milk, chicken, eggs and homemade* processed and preserved fruits and vegetables. The income generated is either kept by them or handed over to the head of household and is normally spent on household expenditures. One assessment that seems very central is women's mobility, which appears to be quite limited and will have a major effect on their options for income generation and control over budgets, in addition to access to learning opportunities. However, with recent opening of the society and increasing access of selected NGOs in collaboration with the Security Forces, the situation is changing. According to literature, women do not have a say in buying/selling of agricultural inputs and produce though, they do have some control over produce from kitchen gardens.

The natural resource base of KP is small. The landholding is small and requires fewer members of the household to manage it. As a result, men migrated to other areas, both within and outside of the country, creating opportunities for women to work on the farm. The norms and customs are very different across regions in KP affecting the level of women participation in field crops production and fruits and vegetables value chain. Women are traditionally considered homemakers.

Table 23. Women's Perceived in crop production in KP

Cropping Activity	Northern Zone (%)	Central Zone (%)	Southern Zone (%)
Seed cleaning	60	90	90
Sowing	30	5	15
Weeding	75	10	30
Hoeing	70	2	5
Harvesting	65	10	20
Threshing	50	5	30
Drying	60	60	60
Seed Storage	70	50	50
Binding	50	10	40
Selling commodities	40	10	40
Packing	50	20	50
Sorting	50	25	55
Chemical Application	10	2	2
Cleaning Stores	35	80	80
Cleaning Fields	50	10	35
Irrigation	16	10	15
Thinning(vegetable)	80	30	40
Vegetable Picking	70	30	40
Storing food for home	70	80	50

Samee et. al., (2015)

Table 23 shows that activities carried at home (such as seed cleaning, drying, storage etc) have high participation of women in all three zones. Field activities such as weeding, hoeing, harvesting, threshing are more often carried out by women in the northern zone as compared to other areas. Value chain activities in fruits and vegetables are neither covered nor discussed in Samee et al., (2015). It shows that there could be potential to enhance sensitivities concerning women's participation in not only the fruit and vegetables value chains, but also their role in social, economic, and political activities, as there is a lack of gender mainstreaming in these areas. This mainstreaming will require improving their skills, bringing them into the fruit and

vegetable value chain but also allowing time for their home-making activities. In the long run, their ownership of assets, especially land, could potentially enhance their role.

Women are also observed to be more involved in the production of processed food like jams and marmalades, pickles, fruits and vegetables, oil, butter, and yoghurt on a small scale. Due to poor networking and lack of marketing facilities, these homemade products are not being properly marketed. Potential and resources exist to enhance agriculture productivity through a variety of interventions, including the provision of extension services, capacity building of female farmers in improved management, water management, use of latest technologies, etc. The public and private sectors need to establish infrastructure including cold chains to support these value chains. However, a better understanding of the role of women in the value chain of fruits and vegetables in KP is needed to support these interventions.

11. Agriculture Extension and Advisory Services for Horticulture in KP

The role of agricultural extension and advisory services cannot be underplayed in the transformation of subsistence farming to agriculture as an industry. The important role of agriculture extension services in tackling poverty in developing countries has been acknowledged in many studies. Agricultural extension not only provides the critical link between agricultural research and farmers, but also advances the cause of rural development by improving the livelihoods of rural communities. Its role in KP started with the USAID funded Village Agricultural and Industrial Development (V-AID) Program in 1952, and more recently the agriculture department offers Farm Service Centers as an approach for improving its advisory services. Farm Service Centers are primarily established to bridge the gap between farmers and quality agricultural inputs and services across Khyber Pakhtunkhwa. By facilitating access to better inputs, knowledge, and tools, the centers are designed to empower farmers to shift from subsistence farming to a commercially oriented one, earn a better living, and improve food security and nutrition.

On the research front, at least two major research institutes are serving the horticulture sector of the province. Agricultural Research Institute Tarnab, Peshawar and Agricultural Research Institute Mingora, Swat, provide fruit plants to farmers of KP for the promotion of orchards. However, fruit plants are mostly imported from Punjab and sold in the plant nurseries found in the vicinity of these institutes. Farmers typically visit the offices of the research staff located in these offices for technical insights and advisory services. The research staff also visit model and relatively big orchards when a problem is reported to them. The published evidence in support of advisory services of agricultural extension and research departments for harvesting, marketing and processing is very limited. The Agricultural Research Institute, Tarnab Peshawar has the services of a food processing unit, known as the Food Technology Section. Established in 1934, the section started production of a few value-added products (juices, jams, marmalades etc) and typically sell these to the local community.

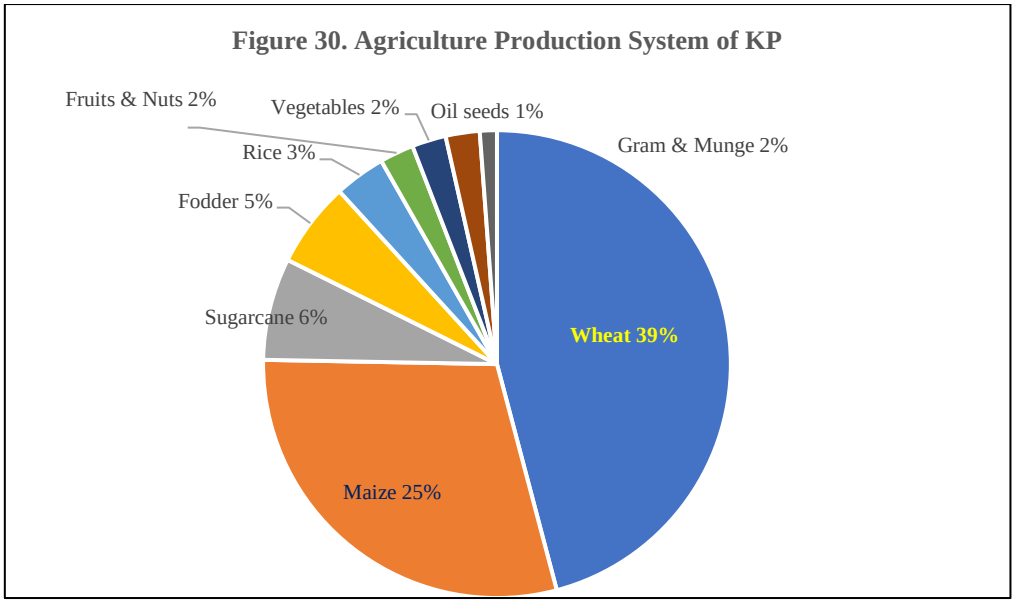
A dedicated and very well-known project for fruits and vegetable promotion, funded by the Swiss government known as Malakand Fruit and Vegetable Development Project (Project for Horticultural Promotion) was launched in the Malakand division in 1988.

The Technology Transmission Unit in the then Agricultural Research Station, North, Mingora used to transfer the latest agricultural technologies to fruit and vegetable growers. Ali and Rehman (2003) report that the unit published 36 agricultural extension messages, 24 advisory leaflets, 7 issues of horticultural newsletter quarterly, Baghban, 5 grading charts, 3 video films, 7 slide series and one poster. The project also established Pilot Application Centers for the propagation of the extension and training materials. The project directly worked with farmers to create awareness for overcoming the problems of marketing and storage of fruits and vegetables. The study reports that 53% of the respondents have used the published materials of the project in off-season vegetables, round gourd, onion, tomato, cucumber, mushroom, and peas production in the division. The project was instrumental in increasing nursery business by introducing new varieties of cherry, strawberry, and onion (Swat-I). The project established cold storages at their various business centers. The project played a key role in promoting various aspects of fruits and vegetables in the area and substantially increased farmers' skill and knowledge in orchards management.

12. Conclusions and Policy Recommendations

This study is carried out to identify the three major fruits and vegetables produce of settled and merged districts of KP using analysis at the regional and provincial levels. The selection of top-three fruits and vegetables was based on area, production and market value of the fruits and vegetables. It is concluded that peaches and apples are the leading two fruits, using the three criteria both in the settled and merged districts of KP. The third leading fruit in settled districts is plums and almonds in the merged districts. Similarly, tomatoes, arum and okra are the leading fruits and vegetables in the settled and merged districts

Agro-Climatic conditions of Khyber Pakhtunkhwa including the newly merged districts provide substantial opportunities for high value crops especially horticulture. Nevertheless, the horticulture value chain in KP faces serious challenges as highlighted in Section 6.3 above and the competitive environment for horticulture business as highlighted in Section 7. Shortage of quality and high yielding seed, lack of varieties in line with local and global demand, weak skills, seasonal water shortages, limited financial resources, poor marketing facilities, and climate risk are key constraints to unleashing the potential of horticulture in KP. Yields of horticulture crops in KP are low in comparison with average of three best countries (see Figure 23) as well as national average—yields exceed that of KP's by 78 percent, 52 percent and 45 percent for cabbage, cauliflower, and citrus, respectively. Closing yield gaps vis-à-vis national and global averages of various crops is expected to significantly increase the share of horticulture in the total cropped area in KP including NMDs (currently less than 5 percent of total cropped area, see **Figure 30**). Post-harvest losses in KP are significant and with the adoption of modern practices and appropriate technology, a huge savings is possible (Table 24).



Source: Crop Statistics of KP 2019

Table 24. Estimates of Post-Harvest Losses (Rs in Million)

Commodity	Gross Value of Production	Value of Post-Harvest Losses	Net Possible Savings
Soft Fruits & Vegetables (Peach, Apricot, Guava, Plum, Tomato)	3,584	975	526
Citrus and Apple	3,432	487	144
Dates and Walnuts	1,655	385	204
Potato	1,069	160	53
Maize, Tobacco, and Sugarcane	46,822	5,219	1,116
Sheep and Goat	47,198	11,946	3,459

Source, Khyber Pakhtunkhwa Agriculture Policy, 2015-2025

Policy Recommendations

Availability of food at affordable price is the primary goal of the agricultural marketing system in Pakistan. This goal has motivated research to focus on the study of attaining efficiency of agricultural inputs. More recently, studies of market inefficiencies and value chains have taken the lead role. In developing countries, the state also plays a role in the marketing of food but it plays a lesser role in the marketing of fruits and vegetables in Pakistan. The KP Agricultural and Livestock Produce Markets Act, 2007 regulates the markets in KP.

There is a bigger demand for the quality and safety of fruits and vegetables. There is a need to build institutions and mechanisms to increase farmers' and women participation in fruits and vegetable value chains. Several other factors are influencing the transformation of the existing value chains as well. These factors are mostly motivated by the growth in income, both at domestic (local) and international fronts. Population increase, urbanization, income growth, and integration of the global and local food markets including retailing, distribution, and wholesale services firms (FAO 2010; Reardon & Timmer, 2007) helped in the up-gradation of the existing value chains. Hence, value chains of fruits and vegetables may show greater diversity, as fruits and vegetables producing farm may either establish their food chain or

interact at international and domestic levels with other participants (or actors) for higher income.

The Agricultural Policy Document of the Government of KP acknowledges that the commercial production of fruits and vegetables in Swat has substantially expanded during the past two decades. Markets and urban population in Peshawar, Islamabad/Rawalpindi and Lahore have become a great source of income for the fruits and vegetable producers of the area. The Agricultural Policy envisages two-pronged strategies for food security and improved livelihoods. The strategies required an increase in farm productivity and increased farmers participation in the post-harvest value chain.

In the post-WTO era, the state has reduced its role in setting farm products' prices and input subsidies and focus on the market-led growth through increased participation of different actors primarily farmers/producers in marketing have increased. However, due to transaction costs and lack of relevant knowledge, farmers are unable to participate at the high-end of the value chain, resulting in their low incomes. Poole and de Frece (2010) suggest that often it is small-scale institutional innovations in the local market organization that serves best to stimulate smallholder participation in input and output markets. Poole (2013) identifies the following key areas of value chain research for study in the developing country context:

i. Governance – the relationships among the value chain actors.
ii. Upgrading – the resultant value addition due to interventions and value chain actors' capacity.
iii. Equity – the distribution of returns among the actors in a value chain.
iv. External environment – the socioeconomics, culture, and technology, legal framework, and standards.

Accordingly, the following policy recommendations are made for consideration of the policy makers:

1. **Policy Framework Update**: It is opportune time to review the Khyber Pakhtunkhwa Agriculture Policy 2015-2025 in terms of achievements, domestic and global demand and variety trend in horticulture, emerging challenges and opportunities such as locus, climate change, etc., international best approaches and explore the measures needed to integrate with the global value chain. The Department may need update the Agriculture Policy for next ten years, say 2022-2032. The Policy Update must reflect on the key policy measures and activities to benefit from the potential opportunities arising through cooperation for agriculture sector development envisaged in Long Term Plan for China-Pakistan Economic Corridor (**see Box 2**).

2. **Horticulture Policy**: Given the potential of Khyber Pakhtunkhwa including NMDs, the Government may consider designing Horticulture Policy that may focus not only the supply chain but also the value chain and their linkages with domestic markets and global value chain. The Policy may also focus on some non-traditional fruits and vegetables such as avocado, olive, blueberry, etc.

The Horticulture Policy must address the structural, regulatory, and institutional impediments including access to credit, product quality, varieties, value addition,

Box 2. CPEC-Areas of Cooperation in Agriculture Development

The key areas of cooperation in Agriculture Development include biological breeding, production, processing, storage and transportation, infrastructure construction, disease prevention and control, water resources utilization, conservation and production, land development and remediation, ICT-enabled agriculture and marketing of agricultural products to promote the systematic, large-scale, standardized and intensified construction of the agricultural industry. It includes:

- → Promoting the transition from traditional agriculture to modern agriculture in the regions along the CPEC to effectively boost the development of local agricultural economy and help local people get rid of poverty.
- → Strengthen the upgrading of agricultural infrastructure in the regions along the CPEC.
- → Promoting the construction of water-saving modern agricultural zones, and increase the development and remediation of medium- and low-yielding land to achieve efficient use of resources.
- → Strengthening drip irrigation technology for water efficiency.
- → Strengthening cooperation in the fields such as crop farming, livestock breeding, forestry and food growing, and aquatic and fishery in the regions along the CPEC, with the emphasize on technical exchange and cooperation in the fields of development of comprehensive agricultural production capacity, construction of farmland water conservancy facility and agricultural products circulation facility.
- → **Collaborate in forestry, horticulture, fisheries and livestock medicines and vaccines.**
- → **Strengthen production of horticulture products.**
- → Improve post-harvest handling, storage and transportation of agricultural products, and innovate in marketing and sales models.
- → Improve water resources operation and management, strengthen development of pastoral areas and desert, and promote application of remote sensing technology.
- → Strengthen production of agriculture inputs particularly pesticides, fertilizer, machinery and support services including agriculture education and research.

Source: Long Term Plan for China-Pakistan Economic Corridor 2017-2030

branding, packaging, for boosting horticultural production, market share in the domestic markets, and exports. It may also require: (i) producers to establish reputation as reliable suppliers of quality products for both domestic and export markets; (ii) establishing a mechanism within the Agriculture Department or reliable Third Party accreditation for Horticulture Quality Certification Scheme conforming to international standards on the basis of fee-for-service basis. This functions can also be assigned to the proposed Agribusiness Authority; (iii) develop a comprehensive grading system for quality assurance mechanism; (iv) establishing a digitalized wing within the proposed authority to observe domestic and international market operations and communicate channels to convey its findings to producers regarding product demand, preferred characteristics in terms of size, quality, visual attributes including packaging; and (v) introducing new varieties, post-harvest handling and business development activities and investment facilities.

3. **Water-Energy-Food-Forest-Biodiversity Nexus:** Water, land, energy, forests, and biodiversity (WEFFB) are strongly interconnected and are critical to rural livelihoods as well as food and nutrition security. Nevertheless, the WEFFB ecosystem is increasingly under stress and vulnerable to climate change and other factors. The challenges are more noticeable in South Asia's breadbasket basins because of glacier melting, changing hydrological and ecological regimes, climate change, transboundary water conflicts, unsustainable (ground)water abstraction, deforestation, biodiversity loss, rapid urbanization shrinking cultivable land and reliance on fossil fuel putting 8 percent of world's food production at risk.

   It is important that all relevant institutions in the public sector, key stakeholders in the private sector, farmers, academia, non-governmental organizations in the sectors to make the next Agriculture and Horticulture Policy Framework more inclusive and well synergized for: (i) enhancing water productivity and efficiency in the agriculture sector; (ii) increasing water, energy, food and nutrition, and environmental sustainability; (iii) developing more sustainable and equitable food system in KP; and (iv) developing horticulture sector and value chains, through knowledge products, practical learning tools and guidelines, science policy dialogues, effective agriculture innovation system and advisory services and leading the policy implementation.

4. **Institutional Framework**: Horticulture including floriculture sector has proved to be a key to diversify land use. Over time, the sector has established its credibility for improving productivity of land, generating more employment, and providing nutritional security to the people. To unleash the full potential of horticulture in KP, following institutional structures, within the provincial Department of Agriculture and Livestock, are proposed:

   (i) **Establish Agribusiness Innovation Authority:** Food and agribusiness now is a US$ 5 trillion[28] industry which represents 10 percent of global consumer spending. Developing countries are now investing along the agribusiness value chain from farmers to firms for inclusive agribusiness development. Connecting producers and entrepreneurs to domestic, regional, and global markets raises not only the income but also deliver food from surplus to deficit regions and provide diversified sources of growth. The Government may consider establishing the Agribusiness Innovation Authority that may:

      a. build an export channel that does not drive local prices up but is inclusive and raises farm income of the authority.

      b. foster and accelerate the growth of agro-processing sector, post-harvest value addition, and strengthening the horticulture and agriculture value

[28] https://www.worldbank.org/en/topic/agriculture/brief/help-farmers-reach-markets

chain to commercialize horticultural and agricultural production and to take advantage of opportunities arising from CPEC and global value chains;

c. provide enabling environment for investment from storage facilities, processing and trade facilitation and infrastructure to the border to cut transaction costs for farmers, improve competitiveness of farmers and firms, improve agriculture products variety as well as processing and align it with international demand and reduce post-harvest losses;

d. encourage the promotion of Small and Medium Enterprises (SMEs) and support agribusiness entrepreneurs by linking them to markets and to domestic and foreign agribusinesses for revenue growth and jobs creation with a special focus on NMDs;

e. provide fee-based advisory services including technical knowledge, networking, SME incubation, innovation, access to facilities and finance to farmers and firms, improving commercial viability of farmers, particularly smallholders, by facilitating them to reach consumers beyond local markets, develop their skills, business development services and access to quality inputs; and

f. help farmers and firms to meet horticulture quality, food safety standards and compliance with export markets standards and improving the grading and packaging products. For this, the Agribusiness Authority can work in collaboration with the Khyber Pakhtunkhwa Food Safety and Halal Food Authority.

(ii) **Establish Directorate of Horticulture or KP Institute of Horticulture Research and Development (KPIHRD)** for focused research and its adaptation in horticulture sector, encouraging farmers to increase the acreage under horticulture crops, enhancing water as well as farm productivity, variety diversification, and value addition.

(iii) **Climate Smart Agriculture Directorate:** Pakistan ranks 5th in terms of vulnerability to climate change. The Government may consider establishing a Directorate of Climate Smart Agriculture (CSA) either in the University of Agriculture, Peshawar or the Department of Agriculture for research and development of improved policies to promote CSA.

(iv) **Establishing Agriculture Marketing Information System Wing:** Establishing a digitalized Agriculture Marketing Information System Wing in the Department of Agriculture will facilitate in providing timely information regarding product demand, market information and pricing to the producers and value chain stakeholders.

5. **Establishing Agribusiness Innovation Fund**: To operationalize Agribusiness Authority, the Government of KP may consider establishing Agribusiness Innovation Fund to encourage and support entrepreneurs, in particular, women and youth. **IFPRI is developing a separate paper for promoting agribusiness in KP and designing the Agribusiness Innovation Fund.**

6. **Potential of CPEC:** The literature suggests strong relationship between infrastructure development, particularly connecting the farms to markets, and agricultural output. CPEC can play an important role in accelerated development of agriculture and horticulture sector and their output in Pakistan including KP and increase the supply. Secondly, rising income and living standards, increasing urbanization, changing diet habits, and food safety concerns have fueled China's agricultural imports since 2001. It is now the world's largest agricultural importer, surpassing both the European Union and the United States with imports totaling to US$ 133.1 billion in 2019.[29] Increasing demand for healthy foods is driving fruit and tree nuts sales higher. China's fresh fruit import increased to US$ 10.3 billion in 2020.[30] The top nine fruits in order of import value were fresh durians, cherries, bananas, mangosteens, fresh grapes, dragon fruit, longans, kiwifruit and oranges (fresh and dried). KP can take advantage of these opportunities.

7. **Establishing Knowledge Base for Inclusive Horticulture Growth:** The objective of establishing knowledge base for inclusive horticulture growth is to design integrated solutions and address the constraints and opportunities for competitiveness and inclusive value chains as elaborated above. This may also highlight the measures taken to filling key knowledge gaps regarding standards, certification, market information, international trade opportunities, potential areas for investment, integrated water management, legal and regulatory environment for domestic and international markets for horticulture produce from KP.

8. **Agricultural Inputs:**

   i. **Seed:** Quality seed is a basic input for horticulture sector and has a leading role in enhancing agricultural productivity. Revitalization of research and development and in line with the requirements of the domestic and global markets is key to availability of quality seed. It requires: (a) changes in the Seed (Business Regulation) Rules 2016 and Seed (Regulation) Rules, 1987 to provide necessary safeguards and rapid multiplication of unique seeds; (b) establishing enforcement mechanism as envisaged under Plant Breeders' Rights Act, 2016; (c) strict enforcement of Intellectual Property Rights Act, 2012 and requirements of the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) which

[29] Foreign Agriculture Service, United States Department of Agriculture, September 2020 https://www.fas.usda.gov/sites/default/files/2020-09/china-iatr-2020-final.pdf

[30] International Tropical Fruits Network, https://www.itfnet.org/v1/2021/02/china-2020-fruit-imports-surpass-usd10-billion-for-first-time/

the Government of Pakistan has ratified; (d) establishing a System of Consumer Traceability for Seed Authenticity to track and trace seed produced by seed companies, certified by Federal Seed Certification and Regulation Department (FSC&RD) and sold by seed dealers by introducing unique algorithmic labels which farmers can verify through SMS; and (e) developing a Seed Information Management System to digitalize seed data to ensure seed quality.

ii. **Farm Mechanization:** Farm mechanization is an important element to accelerate growth in agriculture sector. The Government of KP may encourage farm mechanization where possible by taking advantage of federal concession on imported farm machinery and agricultural equipment at reduced tariff (Custom Duty 0-2 percent and GST 7 percent).

iii. **Integrated Pest Management:** The farmers/producers of horticulture need to be trained in integrated pest management in line with key global standards for exports. There is a significant statistical evidence that farmers' level of knowledge scores on chemical, biological and cultural control methods of pest with extension contact was higher than others.[31] These results reflect the significance of extension-farmers' contact in providing farmers with knowledge in integrated pest management and international best practices for productivity enhancement.

iv. **Access to Credit:** As discussed in Section 9, access to formal financing is yet another area that needs substantial improvement, particularly for smallholder farmers. A 2017 study of micro-credit programs in district Mardan revealed that only 9.5 percent of all formal credit flows went to small farmers.[32] This study and another study (2012)[33] also suggested that credit dispersed for seeds, irrigation, and tractors is correlated to increased yields and revenues for farmers. Access to formal financing is even more difficult in the NMDs as more farmers rely on informal debt for farming. A survey in 2019 that almost half of the households (49 percent) contracted a debt in the preceding six months to pay medical expenses and to purchase food.[34] Similarly, the KP Agriculture Policy (2015-2025) as well as Tribal Districts Action Plan highlight the need to restructure the existing institutions of agricultural extension services. A recent study of farmer's knowledge of modern

[31] Ullah, A. and A. Khan. 2019. Effect of Extension-farmers Contact on Farmers' Knowledge of Different Pest Management Practices in the Rain-fed Districts of Khyber Pakhtunkhwa, Pakistan, Sarhad Journal of Agriculture, 35(2): 602-609. DOI | http://dx.doi.org/10.17582/journal.sja/2019/35.2.602.609

[32] Jan, I. & Khan., Sajid & Khan., Noor & Ashfaq. M., 2017. Effects of Microcredit Programme of Khushali Bank Limited on Agricultural Productivity in District Mardan, Pakistan. Sarhad Journal of Agriculture, Vol.33(4). Pages: 688-693. Available at: https://www.researchgate.net/publication/321378739

[33] Babar Shahbaz, Qasim Ali Shah, Abid Q. Suleri, Steve Commins and Akbar Ali Malik (2012), Working Paper 5: Livelihoods, Basic Services and Social Protection in North Western Pakistan, Secure Livelihoods Research Consortium. London, 2012. Available at: https://luskin.ucla.edu/sites/default/files/download-pdfs/livelihoods%20and%20basic%20services%20in%20NWP.pdf

[34] Khyber Pakhtunkhwa Agriculture Policy, 2015-2025

best practices in raid-fed areas of KP indicates that most farmers received extension support less than once a year and had little knowledge of prioritized practices.[35]

Strengthening farmers' access to credit, especially smallholders, through public and private sector credit institutions to invest in horticulture will be a key to promote and expand horticulture in KP.

9. **Upgrading Technology: Agriculture sector including horticulture of KP needs technological upgrading to replace traditional practices.** The use of appropriate machinery and precision tillage practices can improve soil fertilize and reduce chemical usage. It is important to develop local farm machinery or modify imported equipment to make them compatible to local conditions, farmers resources and payment capacity. Adoption rate of crucial agricultural technologies including genetic material, inputs and farming approaches, particularly in the merged districts, is low.

10. **Promoting Modern Techniques for Horticulture:** The KPIHRD may also be entrusted to promote hydroponic farming technology that provides a high degree of crop supply of the highest quality and generate employment higher than other sectors of agriculture.[36] The off-take agreement with reputable retailers ensures certainty of market for the produce. Similarly, the Institute can encourage vertical farming which provides a constructive solution for the small farm size and water stress, particularly in the mountainous areas of the province. The experimental trials on vertical tomato farming technique and its replication by 80% small farmers of Talash area in Lower Dir in Khyber Pakhtunkhwa and Arang area in Bajaur agency, in NMDs, has shown promising results and provided a way forward for adoption in other areas where farmers are facing the problems of land and water scarcity.[37] The benefits of vertical farming include: promotes urban and peri-urban farming, healthy Local Economies, environmental friendly, local food security, market stability, safe, nutritious and affordable food, social capital, energy efficiency, and efficient use of land. These techniques are conducive to grow rocket salad, spinach, asparagus, mussculam, broccoli, cabbage, culiflower, clipground, vidablogger, iceberg, 5 verities of lettuce, watercress, mustard leaf, asparagus, kale and leaf.

11. **Productivity Enhancement**: The Horticulture Policy may focus on productivity improvement and innovation to enable the sector becoming more competitive and resilient. It will require an in-depth analysis of availability of quality inputs, particularly

[35] Ullah, A. & A. Khan, 2019. Effect of Extension-Farmers Contact on Farmers' Knowledge of Different Pest Management Practices in the Rain-fed Districts of Khyber Pakhtunkhwa, Pakistan. Sarhad Journal of Agriculture, Vol.35(2). Pages: 602-609. Available at: http://dx.doi.org/10.17582/journal.sja/2019/35.2.602.609

[36] It is estimated that one hydroponic farm creating at least 40 jobs. Zinhle Mncube (2018). *Hydroponic Farming What Problem Are We Solving For?*, Knowledge Pele Industries.

[37] Daily Business Recorder, *New techniques double growth of tomato crop in Dir, Bajaur*, May 24, 2016 https://fp.brecorder.com/2016/05/2016052448569/

for diversification, yield and production and cost structure of horticulture industry of KP to identify structural and other issues that affect the competitiveness of producers in domestic and overseas markets including producers' knowledge, skills, and market awareness.

12. **Post-Harvest Losses and Value Addition:** Post-harvest handling, storage, processing and marketing infrastructure is limited. Value addition through processing is not very strong as less than 10 percent of the total production of fruits and vegetables is processed in KP[38], thus loosing higher returns. While considerable improvements have been made in the grading, processing, storage, packaging, labelling and transport of fruits and vegetables around the country, these areas still require public and private investment in KP including NMDs. There is now an increasing demand of organic production of selected high-value fruits and vegetables, but a large community of farmers are unaware about the potential increase in revenues associated with organic farming. The Horticulture Policy may focus on these areas.

13. **Effective Extension:** Nonetheless, promoting modern techniques and productivity enhancement in horticulture requires an effective extension manpower which has strong knowledge, awareness, and well trained in global best practices. This has to be combined with a strong digital based monitoring and evaluation system to monitor the performance of extension workers. This can also be well integrated with the Farm Services Centers. There is a need to develop nurseries with quality and certified nursery plants of varying maturity in KP including NMDs to sustain supply and reduce seasonal price fluctuations. Scaling up efforts and funding are imperative to ensure vocational and on-farm training and skill development of farm labor, field technicians, field assistants, and service providers in the public and private sectors, particularly in remote areas and NMDs, in modern methods such as agrochemicals, and improved crop varieties. Also, train male supervisors and managers with respect to management skills, sexual harassment, and discrimination. For this, Department of Agriculture Extension and Vocational Training Institutes can be mobilized to conduct these trainings. The resulting enhanced work environment increases productivity. On job-training and awareness for post-harvest management across the value chain, grading and sorting at the packaging houses is essential to minimize losses and maintaining product quality.

14. **Establishing Cold Storage Infrastructure:** There is a need to establish pre-cooling centers, proper cold-storage with blast cooling system, and management and operation of storage facilities must be a priority to strengthen the horticulture value chain. This can be initiated through public-private partnership.

15. **Smallholder Horticulture Growers:** Opportunities for smallholder growers are often limited in the domestic or regional markets in the developing countries. These

[38] KIAPIP Project Appraisal Document, The World Bank, 2019

smallholders can be trained in producing products for the niche domestic or regional markets and meeting minimum standards and quality. Easing credit access to smallholders who are already in the value chains, either directly through buyers or wholesalers can minimize financial constraints to upgrading their production and supply system and facilitate them in accessing market information. They can be integrated with Farm Service Centers.

16. **Contract Farming and Crop Insurance:** Since the farm size is generally small in KP with the exception of some areas, contract farming by linking the farmers with the value chain for quality inputs, product variety, credit, creating revolving funds, extension services, increasing production, and meeting other standards may be considered to promote horticulture in the province. Encouraging contractual (future markets) production and vertical coordination can ensure a fair share of the producers in price spread along the supply chain. Additionally, initiating crop insurance may be a good step forward in terms of mitigating risks that small farmers are averse to take. Diversification of horticultural products may also require resource-providing contracts with guaranteed purchasers to share the risk between smallholders and exporters or seller in the domestic markets.

17. **Market Reforms:** It is strongly proposed to further reform the agriculture produce markets and strengthen the Farm Service Centers to bring innovation to agricultural marketing system and making them more efficient, competitive, and transparent as well as ensuring equitable margins for the producers and address the welfare aspect of the consumers. **IFPRI is developing a separate papers reviewing Agriculture Produce Marketing System and assessing the Farm Service Centers in KP, which are in final stages.**

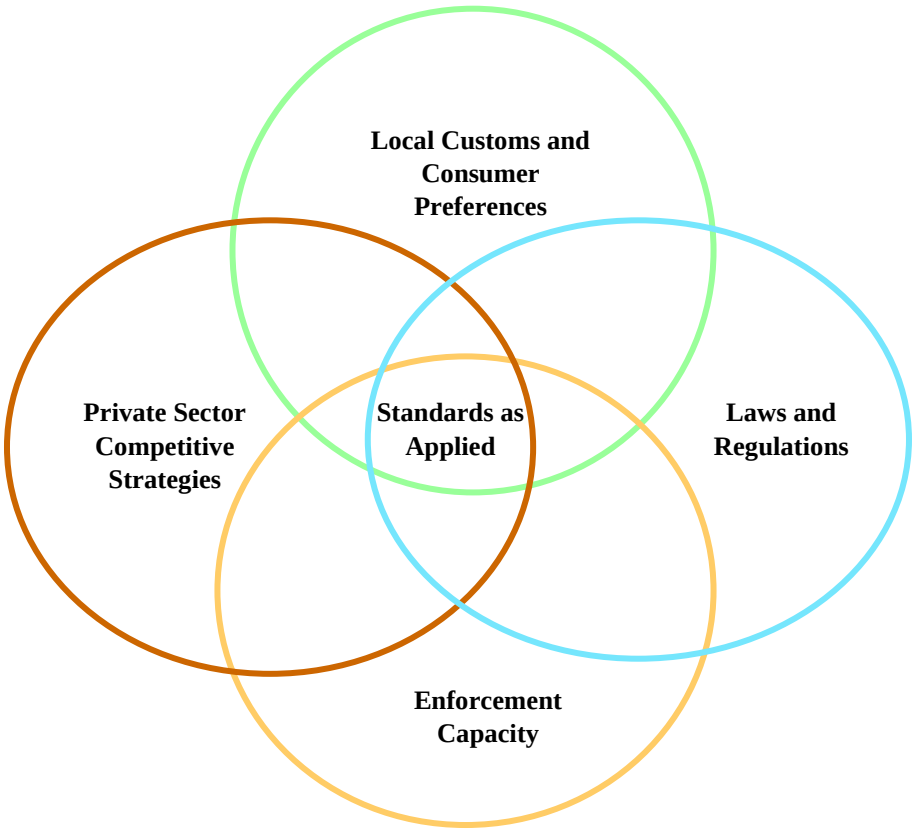
18. **Processing and Transportation:** As underlined above, the Government of KP needs to incentivize the stakeholders to strengthen various elements of horticulture value chain including processing fruits and vegetables including dried, frozen, preserved, juices and pulps which increase shelf life of the raw product, collaboration with international import companies for developing quality branding, arrange for blast chilled the processed products and cold storage units for transportation, and effective marketing and distribution system. This function can also be assigned to the proposed Agribusiness Innovation Authority and incentivization can be done through Agribusiness Innovation Fund.

19. **Food Safety Governance:** Consumer awareness and concern for food safety is growing not only within Pakistan but more so in the international markets, particularly in Europe and Gulf countries. They are now more concerned about chemical residues on fresh fruits and vegetables, biosafety, and phytosanitary conditions and are demanding for strict enforcement of food safety laws and regulations. Additionally, supermarket chains are now exerting significant influence over the entire value chain

and command the production, harvest, transportation, processing and storage of fruits and vegetables apart from ensuring quality and standards compliance.

The Government of KP has enacted Khyber Pakhtunkhwa Food Safety and Halal Food Authority Act, 2014 as well as Regulations in 2017, there is a need to necessary measures to enforce national and international standards for horticulture as highlighted in Table 1 above. In addition, the province of KP may also consider legislating on the lines of Punjab Agriculture, Food, and Drug Authority to address the issue of chemical residues on fresh produce. Directive 90/642/EEC stipulates that each EU Member State must implement a program to monitor pesticide residues in fresh produce and other foodstuffs.[39] It may be noted that these standards reflect an interface between requisite laws, associated institutions, their structures and effectiveness, business strategies of producers and entrepreneurs, and consumer preferences as illustrated in **Figure 31.** In most countries like Pakistan and market segments, the primary focus of consumers is price while in many market segments, primary preference is quality, safety and other attributes of fresh produce while price is a sector consideration. Many of these standards are demand driven, therefore the regulatory landscape is fluid and is prone to short-term changes.[40]

Figure 31. Diverse Standards in the Single Market



[39] Steven Jaffee. 2003. From Challenge to Opportunity Transforming Kenya's Fresh Vegetable Trade in the Context of Emerging Food Safety and Other Standards in Europe, The World Bank.

[40] Ibid.

The Department of Agriculture may take necessary measures to train farmers and value chain workers to meet national and international standards and establishment of appropriate institutional sanitary and phytosanitary framework at provincial level. Similarly, the Government of KP may incentivize healthy competition by providing enabling environment and address those barriers that impede competitiveness and value addition activities.

20. **Categorization of Exporters of Fresh Horticulture Produce:** The horticulture industry around the globe is transforming rapidly and so are the trading operations as producers-exporters or exporters are moving towards vertical and horizontal integration in response to demand for quality, standards, and compliance to various protocols. The Government of KP may need to categorize these producers-exporters or exporters within the province or the country for trade linkages to unleash the potential of KP horticulture produce. This tentative categorization is at **Table 25**.

Table 25. Categorization of Horticulture Producers-Exporters

Types	Main Characteristics	Major Facilities Needed	Required Main Skills	Investment
Brief Case Traders/ CAs	Small scale buying; periodic and opportunistic sales in the market	Pick up truck Small office	Rudimentary trading skills	Small as facilities are used for multiple purposes
SME Regular Exporter	Regular sales to regular clientele; most sales are of loose packed produce	Small packing shed, small storing capacity, 3-4 pick up trucks, basic equipment	Some trading and management skills, regular interaction with farmers; may have some graders	Medium investment in business
Large Exporter	Regular sales to regular clientele frequently; sell a mix of loose and pre-packed produce; most sales to wholesalers based distribution and to small supermarkets	Packaging facilities, cold storage facilities Reasonable transportation facilities	Supply chain management skills, quality control arrangements, field staff and agronomists	Medium to high
Premium suppliers	Regular supplier to supermarkets and other high-end distributors; more sales are of pre-packed produce with improved packaging and quality product	Need development and operation of farms with investment in horticultural inputs and water management; ensure supply and traceability; ensuring quality control; upgrading packing facilities; blast cooling system; good hygiene and sanitation system; pre-cooling centers near major production areas	Supply chain, food hygiene, HACCP management skills, multiple layers of quality assurance personnel, Advance production planning skills including professional farm management skills, need to be accredit suppliers, and reputable branding	High depending annual volume turnover
Value Addition processors	Same as premium suppliers with a 'high care line of processed and prepared ready foods	As for the premium suppliers. Additionally, facilities for separating high and low-risk areas, distinct high care rooms with necessary temperature control and air venting systems, metal detectors, heat sealing equipment	As in the case of premium suppliers and additionally food technologists and food science personnel	High but varies by unit size and need for new structure and equipment and their regular maintenance

Adapted from Steven Jaffee

21. **Gender Participation:** The horticulture export industry offers the developing countries, like Pakistan, an important new source of employment. Cultivation of fruits and vegetables is substantially more labor-intensive than growing cereals (Joshi et al. 2004; World Bank 2009) and provides more post-harvest opportunities to add value. Packing and processing services, such as washing, chopping, and mixing, as well as bagging, branding, and applying bar codes are now often carried out at the source rather than at the end market destination. A large number of women have entered the industry to work in both production and post-harvest jobs, termed as the "feminization of agriculture" (Deere 2005; Lastarria-Cornhiel 2006; Zuo 2004). The increased demand for female labor have important consequences for gender equality and poverty alleviation in rural areas.[41]

    Providing dedicated support to female farmers to build their capacity to participate in all activities along the value chain, water usage, and increasing their role in decision making process, delivering customized training is vital. Additionally, it is important to mitigate barriers for women and address knowledge and data gap on the role of women in KP's agriculture, horticulture sector, and livestock rearing which are relevant to local context and culture. The public sector can mitigate constraints facing the women by influencing the local institutional setting. Policy recommendations to minimize gender-based constraints in the horticulture industry and secure women's access to benefits of economic upgrading may include the following: (a) increase awareness of women as valuable economic agents; (b) ensure equality in wages and labor conditions; (c) introducing work conditions through legislation that feasibly can be accomplished without undermining the competitiveness of the horticulture industry; (d) create opportunities for women through encouraging process and product upgrading, product diversification, cultivation of high value crops, kitchen gardens and introduction of new technologies, such as greenhouses; (e) improve women skills required by horticulture industry through academic certification courses either through formal education, training, or experience; (f) engage and educate smallholders as integrated family unit instead of interacting only with male heads of household because of engaging women as integral to production can empower them within the family; (g) improve financial literacy to facilitate women's access to credit; (h) encourage female smallholders to participate in niche markets such as organic produce, farmers' markets; and (i) support female associations by building their capacity in networking and leadership.

22. **Integration with Global Value Chains and Promoting SMEs:** Welch and Luostrainen (1988) have identified four pathways to facilitate firms to participate in Global Value Chains:[42] (i) *Supplier linkages with international firms*: firms can domestically produce and supply goods or services to international firms, such as,

[41] Man-Kwun Chan and Dr. Stephanie Barrientos. 2010. Improving Opportunities for Women in Smallholder-based Supply Chains, Bill & Melinda Gates Foundation.

[42] Christine Zhenwei Qiang, Yan Liu, and Victor Steenbergen. 2021. An Investment Perspective on Global Value Chains, The World Bank

multinational corporations or domestic exporters, which will in turn export those products to the international market; (ii) *Strategic alliances with MNCs* (coproduction): firms can coproduce goods or services together with MNCs, which will then use those inputs in their global production networks; (iii) *Direct exporting*: firms can domestically produce goods or services and sell them directly on the international market; and (iv) *Outward foreign direct investment (OFDI):* firms can use OFDI to move part of their production facilities abroad or to establish an overseas sales affiliate, thereby internationalizing their production and most likely their sales. The pre-requisites for internationalization of horticulture produce include:

(a) an international partner or domestic exporter to source local inputs for export oriented production and willing to establish a new affiliate with local partner and share part of its technological knowledge; and

(b) a domestic firm with ability to produce and supply goods and services that meet the standards required by the partner through international certification and reliable supply at competitive prices; proven experience in production for the domestic market, knowledge of local institutions and regulatory mechanisms and willingness to engage with a foreign partner to upgrade and expand its business; or

(c) a domestic firm which has the minimum production capabilities, quality and productivity, to compete internationally and sufficient global markets knowledge, market experience, financial solvency and are willing to establish its foreign subsidiary and to tailor its products to international demand.

The horticulture industry in most developing countries is organized through strong linkages between firms which are either producer-exporters or only exporters buying produce from independent growers. While producer-exporters usually consolidate vertically through (i) backward integration of exporters to production and increased dominance of large farms; (ii) contracted supply from out-growers whereby the farmer may receive inputs, credit, technical assistance, and guaranteed sales from the exporters; [43] and (iii) noncontracted supply from the dependent growers.[44] On the demand side, large supermarket chains are the leading actors in key fruit and vegetable markets, with controlling market shares, such as, Metro, Makro, Modern Trade, Carrefour, Green Valley, Al-Fateh, Hyperstar, etc.

[43] Cornelia Staritz and José Guilherme Reis (eds.). 2013. Global Value Chains, Economic Upgrading, and Gender Case Studies of the Horticulture, Tourism, and Call Center Industries, The World Bank.

[44] Steve Jeffee and Oliver Masakure. 2005. "Strategic Use of Private Standards to Enhance International Competitiveness: Vegetable Exports from Kenya and Elsewhere", https://www.researchgate.net/publication/223499942_Strategic_Use_of_Private_Standards_to_Enhance_International_Competitiveness_Vegetable_Exports_from_Kenya_and_Elsewhere

23. **Development of Frozen Fruits and Vegetables Market**: There is an increasing demand for frozen fruits and vegetables, both in the domestic and global markets and their trade is on the rise. This provides an opportunity to horticulture farmers in KP to sell their surplus produce in large quantities. The technology used for freezing is known as Individual Quick Freezing (IQF) and investment in IQF facilities has potential benefits. The products that can be considered for quick freezing may include: potatoes, bitter gourd, carrot, okra, mango, citrus pupl, apricot, etc. The ready to cook (RTE) food segments has stimulated the rise in frozen food companies in Pakistan which are catering to the needs of tier-1 cities.

24. **Capacity Building:** Building capacity of farmers, government institutions and private sector in areas that are important for the value chain development of horticulture and high value crops, such as modern crop management practices, Climate Smart Agriculture, Integrated Pest Management, management of pressurized irrigation systems, post-harvest crop handling, quality control, packaging, branding, marketing, and farm accounting, etc. must be key elements of horticulture policy regime. Capacity building of government institutions, farmers, and private sector entrepreneurs may focus on operational risk-management including business plan, fiduciary aspects, governance and accountability and strengthening water management.

The province of Khyber Pakhtunkhwa including NMDs has huge potential in horticulture sector, and it is key to take necessary measures to implement policy recommendations proposed at page 61 onwards. Equally important is to align the policy matrix included in the KP Agriculture Policy 2015-2025 (**summarized at Table 26**) with the above recommendations to address farm level constraints to productivity increase and post-harvest losses, the interventions proposed to mitigate the challenges, and institutional arrangements and set of skills are required towards this end**.** There is a need for greater realization in the government to improve and strengthen the value chain of fruits and vegetables.

Table 26 Policy Matrix

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
Formulation of Horticulture Policy	KP needs to unleash its potential and to take advantage of opportunities arising out of CPEC	• Develop horticulture policy framework	**ST**	KPAD DG Research Research Institutes Academia	• Consultation with the academia, researchers, private sector, professionals and department experts and other stakeholders • Horticulture Policy Framework must address the structural, regulatory, and institutional impediments including access to credit, product quality, varieties, value addition, branding, packaging, for boosting horticultural production, market share in the domestic markets, and exports. • Policy measures for clusters development • Measures to strengthen the		Providing an umbrella policy framework for promoting horticulture and high value agriculture (HVA) in the province

[45] This column provides only acronyms of the Directorates/Wings of the KP Agriculture Department (KPAD), ST:12 months, MT:1-2 years, LT:2-4 years

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
					horticulture value chain • The policy process may also review areas of agriculture development under CPEC-II and horticulture demand of international markets to be part of this policy		
Institutional Framework for promoting horticulture in KP	Diversification towards horticulture including vegetables, fruit, pulses & condiments and create enabling environment and establish institutions to promote horticulture and strengthen its value chain in KP	• Establish Agribusiness Innovation Authority in KP • Establish Directorate of Horticulture or Institute of Horticulture Research and Development (KPIHRD) • Establish Agriculture Marketing Information System Wing in the Department of Agriculture • Higher allocation for High Value Agriculture and improve	**MT/LT**	**KPAD** **DG Research** **DG Extension**	•A detailed review of horticulture production hubs/areas and assess horticulture production and its varieties •Assessing the domestic and international markets demand where KP horticulture has comparative advantage •Identify gaps and measures needed to promote horticulture •Review and identify potential of high value agriculture in KP	• Improve professional skills of core staff to commission research in HVA & Horticulture • Retrain Extension Field Staff for better training in HVA and horticulture to better equip the farmers for moving towards HVA and post-harvest techniques and other areas	• Shift from staple crops to HVA in line with changing trend in food consumption and market demand • Expand area under horticulture and production, strengthening horticulture value chain • Advantage of emerging opportunities • Higher growth of Agriculture sector

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
		knowledge of farmers about horticulture and crop diversification			• Explore the potential demand for horticulture following operationalization of CPEC • Prepare a comprehensive plan including measures and funding needed to implement the plan. The plan may also include the possibility of branding and marketing collaboration between the two private sectors (China and Pakistan) • Drafting and approval of required law for establishing Agribusiness Innovation Authority • Approval to establish Directorate of Horticulture or Institute • Funding for the Authority, Fund, and Directorate/Institute		• Higher income for farmers

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
					and the plan through provincial ADP •Divert part of savings from subsidies towards High Value Agriculture and promote agribusiness •Communicate with farmers about economic and financial benefits of HVA, HVA techniques and better post-harvest management techniques		
Investment	To provide incentives for private sector investment in agriculture, investment in agribusiness, value addition and agriculture technology	• Establish Agribusiness Innovation Fund along with its governance structure	**ST-MT**	**KPAD** **KPFD** **KPP&D**	• Drafting and approval of required law for establishing Agribusiness Innovation Fund • Establish the Fund and allocation of resources • Notifying governance structure for the Fund • Develop matching grant operational manual including	• Capacity to develop business model for managing the fund and evaluation of proposals	• Increased value addition of agri-horticulture products and use of innovative technology • Increased private sector investment in Agriculture

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
		• Design incentive structure to attract private sector investment in all agriculture inputs	**MT-LT**	**KPAD** **KPFD** **KPP&D**	proposals' evaluation criteria • Attract investors in agribusiness through public calls for proposals • Evaluate proposals and extend grants to successful applicants • Preference to rural women and youth • Prepare incentive structure to attract private sector investment in all agriculture inputs in consultation with the federal government/FBR and private sector such as HEIS technology, Climate resilient seed varieties, quality seeds, extension services hubs, research, etc.		• Increased employment opportunities
Mainstreaming Climate Change in Agriculture and Irrigation and adaptation to	Pakistan, though one of the lowest emitter of GHG, but climate change is affecting water availability and therefore needs adaptation strategies	Establish a Directorate for Climate Smart Agriculture	**MT-LT**	**KPAD** **KPID** **DG Research** **DG Extension** **KPARB**	• Preparation and Approval of PC-I in coordination with PID & Private sector • Allocation of Funds	• Institutional Capacity building of Agriculture department on Climate Smart	• Adaptation of climate smart techniques in agriculture and irrigation

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
climate smart agriculture	in agriculture and irrigation				• Hire professional and technically sound faculty for training and management • Train farmers in adapting climate smart agricultural techniques and practices including water use and other inputs such as fertilizers, pesticides • Introduce climate resilient varieties in collaboration with other research institutions	Agriculture Techniques	• Use climate resilient seed/plant varieties for agriculture •
		Collaborate with Livestock Department and EPA to reduce GHG emissions from Livestock and Agriculture	**MT-LT**	**KPAD KPEPA**	•Ensure safe capture, transport, and storage and appropriate application of manure •Focus on production of high-quality feed from agriculture for livestock •Introduce new breeds of livestock • Review Livestock Policy for incorporating	•	•

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
					climate sensitive actions		
Seed Sector Reform	Access to quality certified seed and timely availability is critical for improved yield and production of horticulture Lack of certified nursery plants of varying maturity level and lack of certified *quality horticulture* seed and local hybrids	• Establishment of certified and clean nurseries with development of quality plants with varying maturity to manage market supply and reduce seasonal gluts and price risks, development of local hybrids and certified supply for horticulture • Seek foreign investment in seed sector in consultation with the Federal Government	**ST-MT**	**(KPAD)** **DG Research (Horticulture) Private Sector** **FSCs** ***Intellectual Property Organization***	• Assessment of the existing capacity of private and public sector for multiplication and producing certified seed • Review the capacity of Breeders for multiplication and production of quality seed • Assess requirements and availability of quality certified seed for horticulture • Identify the gaps • Draft the required regulations to regulate production of quality seed and protection of breeders' rights in consultation with the federal and provincial governments stakeholders and the private sector	Streamline Agriculture research system for horticulture Hire enforcement staff as well as staff for testing labs Training of enforcement teams and testing teams Train prosecution teams and trial courts	• Enabling environment for private sector investment in seed sector • Availability of quality seed at competitive price • Higher yield and productivity • Check against malpractices, monopoly, and private sector participation in seed multiplication and production • Protection of Breeder's rights

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
					• Enforce the regulations • Establish required infrastructure for enforcement of regulations • Strengthen Intellectual Property Rights regime in consultation with the Federal Government to encourage foreign investment in horticulture seed sector • Establish Labs at Divisional level and Provincial HQ • Public awareness campaign • Allocate needed funds		
Agricultural Extension	Agricultural Extension, a key linkage with farmers, needs to be equipped with current knowledge, specialization, use of ICT, and effective partnerships with private sector and civil society to	• Reorganize and strengthen extension system to disseminate innovative and updated information to the farmers	**ST-MT**	**KPAD DG Ext. DG Research Ag. Marketing Information Wing**	• Identify existing gaps and ICT capability in extension system and develop 3 years plan for improvement • Establish a platform for collaboration and coordination	• Upgrade at least one training school as Centre of Excellence in Extension • Redesign & modernize curricula in Agriculture	• Outcome based improved extension service delivery • Transition towards public-private partnerships

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
	promote high value and climate resilient Gagriculture	• Introduce ICT for effective information dissemination and monitoring • Build Partnerships with private sector for use of modern technologies and inputs	**ST-MT** **ST-MT**		with Commodity Boards, Universities and Research to sharpen extension • Establish M&E System in KPAD/Extension Wing • Introduce AgriSMART App to be a full M&E system with: o Monitoring layer o Location validation o Aggregate compliance o Farmer feedback • Build interfaces with AgriSMART APP, WhatsApp and other ICT platforms • Add check off reviews for messages in APP, WhatsApp and other ICT products of Extension • Design operational MOU for building partnerships with private sector and	Training Schools/ Institutes to meet the current and future demands of the sector • Organize refresher training courses for extension staff • Equip the staff in use of ICT • Incentives to improve academic qualification • Impart knowledge in area specific value chains in KP • Training in Sanitary & Phytosanitary (SPS) requirements and nutrition sensitive agriculture • Vocational and on-farm training of farm	• Adoption of modern agriculture practices for higher yield and water productivity • Shift to HVA and CSA • Improved value chains of select commodities

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
		• Digitalize soil survey data as was done in Punjab under Extension 2.0 • Develop and implement Human Resource improvement Plan	**MT-LT** **ST-MT**		establish platform for coordination and regular feedback/monitoring • Convert one of the existing research institute or prepare/approve new scheme • Allocate funds • Soil Testing surveys results be shared with extension staff and farmers for better planning • Establish helpline • Review existing system of recruitment, qualification, compensation package, and training and restructure the cadre, incentives package and training in coordination with Finance Department • Increase female extension staff & rural youth • Improve mobility	labour and service providers for skill development and promotion of Businessmen Panel (BMP) • Training in Integrated Pest Management, Integrated Crop Management and multi-disciplinary team development	
	Research is central to the creation of a	• Establish KP Agriculture	**MT**	**KPAD DG Research**	• Carry out review and diagnostics of	• Rationalize manpower of	• Promotion of demand driven

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
Agricultural Research	dynamic agriculture. KP's public spending on agricultural research is low and its research has been of variable quality.	Research Board to steer the agriculture research including horticulture system in an integrated manner • Move from supply driven to demand driven research • Develop standards in line with for various commodities, both domestic and international, and a grading system to improve quality of horticulture products	**MT** **MT**	**Academia Research Institutes**	existing Agriculture Research System in KP • Engage all stakeholders for wider consultations • Draft a law to establish KPARB and mandate it for better prioritization of demand driven research and coordination and to professionalize its management as well as the Board • Focus on competitive grants for prioritized research • Ensure effective coordination between PARB and Research Institutes to build value chains of different commodities and build public awareness	research institutions and professionalize it according to research themes and strands • Incentivize research scientists and associated manpower • Increase funding for research and appropriate adjustment in procurement rules in consultation with FD	and quality applied research for increasing productivity and dealing with other challenges • Professionally managed KPARB and agriculture research in the province • Home grown solutions to domestic challenges facing agriculture in KP
Small farm holdings and small farm holders	Small landholdings– low financial capacity, Limited/inadequate	• Strengthening FSCs (machinery/input pool, strengthening	**MT**	**KPAD DG Extension**	• Developing network of FSCs based farmer associations of small farmers and	• Livelihood based Social organization, training in	• Supporting Small farm holders, increased

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
	credit and crop insurance facilities- resulting non-adoption of mechanized production practices and innovations	financial capacity through savings, developing entrepreneurial skills) and ensuring inclusiveness of small farmers in the Farmer Organizations, and introduction of weather/ water supply index-based insurance schemes with the promotion of innovations • Promote Vertical farming and hydroponics for horticulture, specially for vegetables		**KP Rural Support Program PPAF Other financial institutions**	development of insurance schemes through community involvement • Engage Private sector	weather indexing for insurance schemes	productivity and enhanced farmers' income
Contract Farming	No or low farm level market coordination and pre-harvest contractor based marketing in fruits	• Encouraging contractual (future markets) production and enhancing vertical coordination to increase producers' share in price spread along the supply chain • Vertical coordination	**ST-MT**	**KPAD** FSCs-Market Committee (local Govt)- Food industry Pakistan Horticulture Development and Export Board	• Enabling legal framework for contract farming as well as coop farming in KP • Develop standard format for contract farming •	• Collective and contractual marketing training	• Economies of scale in input cost, production and better price for the farmers output

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
		through linking farmers associations at FSCs level with food chains/exporters					
Rationalizing agriculture inputs cost	Increasing cost of inputs and quality concerns	• Promotion of alternative nutrient option (biological control, bio-fertilizer etc.,), balance nutrient management (cropping pattern, time and method of application of inputs etc) and farm input market management • Up-scaling research outputs through commercial production of low-cost input technologies and dissemination	**ST-MT**	**KPAD** **DG Research** Public-Private Partnership and Business Companies in a research organization	•	• Biological products development and use	• Reduced cost of production
Post-harvest losses	Harvesting plan not integrated with maturity levels, shelf-life, target market, Conventional Harvesting methods and tools,	• Development of maturity indices for species/ varieties with reference to market type • Standardized harvesting methods and use	**MT-LT**	**KPAD** DG Research DG Extension- Farm machinery Institute Community Vocational Institute Agriculture	• Dissemination of commodity specific and user friendly maturity indices to farmers, service providers and market agents	• Training and capacity building of service providers and chain stakeholders on post-harvest management	• Reduced post-harvest losses • Marketing quality product • Better price for farmers output

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
	Unskilled labor for harvest and post-harvest handling (quality unconscious behaviour) and no focus on post-harvest management by actors in supply chains, Poor grading and sorting, Lack of postharvest treatment Unscientific Packing procedures and improper packing material, General transportation systems, same for all commodities, limited, refrigerated transport facilities, Improper handling at market and poor market infrastructure, Limited processing and value addition, Lack of proper storage infrastructure,	of proper harvesting tools/ clippers etc. • Awareness creation and establishment of pack houses for sorting and grading • Development of standards packing material, capacity building • Designing cleaning and washing equipment, popularizing post-harvest treatments • Standardizing packing procedures, awareness creation and production and promotion of cardboard cartons. • Commodity specific transport through multipurpose containers with refrigerated facilities • Enhanced market facilities and		University (business and post-harvest management programs) Private Sector Community (FSCs) Market committee	• Promotion of size and quality based grading and sorting system at packhouse level • Identification and dissemination of post-harvest treatment methods and procedures • Packing & grading houses in production hubs, commercialization offsite specific technology • Encourage private sector investment through policy support to improve the transport system • Investment of market fee and development of markets in private sector • Promotion of primary processing and value addition with product diversification at household and small	• Training of labour and supply of harvesting tools • On the job training of labour and awareness campaigns for post-harvest management and training of service providers and entrepreneurs across the value chain • Farm machinery designing and adjustment to local condition (collaboration and training) • Skill development modules and implementation • Design and development of packing material, standardize methods of	

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
	poor knowledge of operation and management of storage facilities	improved market infrastructure • Develop suitable technology, Awareness and training for stakeholders especially small processors and product development through primary processing • Establishment of model cold storage and skill development for preparation and management of cold storages			scale processing for fruits and vegetables • Encourage private sector investment, training for storage operators	packing and grading • Post-harvest management • Product-specific packaging material designs • Transportation science • Product handling knowledge • Processing and product development • Efficient storage facilities and product storage •	
Modernizing Agricultural Output Markets	Modern and well-functioning Agricultural output markets are essential for aggregating output, fostering price recovery, and ensure quality is critical	• Develop and design Food Outlook System for timely information about each commodity demand and expected pricing	**ST-MT**	**KPPAD** Crop Reporting Services Agriculture Marketing Information Wing	• Develop credible data base for all crops, commodity arrival and pricing • Design Food Outlook that provides forecasts of production, estimated surplus or	• Strengthen the capacity of CRS and Marketing and Information Wing • Improve the quality of data	• Evidence based demand for various commodities and informed decision by farmers for cropping

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
		• Review, amend, approval and implementation of amended Agricultural Marketing law	**MT**		shortages, prices of key commodities • Implement Bi-annual Food Outlook and disseminating it through ICT based extension and CAPP using Information Wing • Design systems that permit accurate daily price and quantity reports and better grading and standards evaluations • Complete stakeholders consultations on the proposed draft law • Enactment of the law through Provincial Cabinet and Assembly to regulate public and private agriculture produce markets • Create required infrastructure for enforcement of the law	collection and build data base • Build capacity of Agriculture Marketing Wing to regulate these markets and establish regulatory set-up • Develop programs to connect markets using ICT based products. • Hire professional manpower with experience in banking and agri-business markets • Alternately, enter into banking arrangements with some bank • Training of the manpower to fulfil the	• Smoothening market functioning • Enable private sector managed output markets • Establishing farmers' markets • Develop quality standards for commodities & encourage value chain development • Build holding capacity of farmers to get the right price for their output

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
					• Assess future roles of traditional assemblers and wholesalers (arthis and Pharias) or Commission Agents • • Decide the location of concerned authority within PAD and hire its management	requirements of the system • It requires well trained and experienced staff as they will be dealing with public money relating to perishable crops	
		Establish a Warehouse Receipt System for key crops in the province	**MT**	**KPAD**	• Formulate and enact legal framework and notify the same for introducing warehouse receipts system formally		Promote Electronic Warehouse Receipts System
Water Management	In view of changing scenarios, focus on increasing water productivity and mainstreaming climate change in irrigation practices as well as better flood management is critical	• Estimation of water demand and preparation of contingency plans • Conservation of surface and underground water	**ST-MT** **ST-MT**	**KPAD KPID OFWM** **KPAD KPID OFWM**	• Assess crop-wise water demand, annual water availability, estimate shortages or surplus and prepare contingency plan to deal with the situation • Data may be collected on regular basis • Approval of Provincial integrated water	• Build Capacity of Water Management and Training Institute to evaluate usefulness and cost-efficiency of new irrigation and water harvesting technologies for local use and production	• Enhanced water conservation and security • Efficient use of water resources • Enhanced water productivity • Preserving groundwater aquifer

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
					policy by the provincial Cabinet and its notification • Improve the Delivery Performance Ratio of canals and watercourses • Finalize and approve Underground Water Management law • Rationalize Water pricing Policy to meet M&R Expenditure • Demarcation of the Critical groundwater areas of the KP • Publish the groundwater zoning map • Establish an electronic geo-referenced database for tube wells • Register all existing tube wells in KP including their geographical coordinates	• Retrain extension wing field staff in use of water efficient techniques for training the farmers • Awareness Campaign • Extension field staff as well as CRS staff to be equipped to determine this. • Also to be trained for its enforcement	• Attracting private investment in local production of water efficient technologies at affordable rate • Private sector investment in providing post-installation services

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
		• Promote the use of water efficient technologies in irrigation	**MT-LT**	**KPAD KPID OFWM**	• No fresh permission for installing tubewells in rain-fed or irrigated areas • Detach water rights from land holding • Implement KIAPIP to for using water efficient technologies for agriculture • Enabling environment for private sector investment in local production of irrigation water efficient technologies • Enabling environment for private sector investment to provide post-installation services		
		• Take Steps for rain harvesting and water storages	**ST-MT**	**KPAD OFWM**	• Train OFWM staff in rain-harvesting and water storages techniques • Dissemination of knowledge through		

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
		• Dis-incentivizing water thirst crops and promote water thrifty crops • Better coordination for flood control works and disaster preparedness	**MT-LT**	**KPID KPAD OFWM DG EXtension**	OFWM staff and extension staff • Review the water demand of water thirsty crops in the province • Workout the exact demand of such crops to meet the domestic requirements • Restore the crop zoning system. • Shift from policy interventions that directly or indirectly promote cultivation of water intensive crops • Ensure timely dissemination of weather updates and information, develop and deploy early warning mechanism for the farmers		

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
Change Management	To implement this agriculture and horticulture policies and build the required capacity, leadership, effective communication and change management are essential elements	• Implement the Plan for change management, rationalizing span of control, delegation of powers, and build capacity where necessary	**ST-MT**	**KPAD KPFD**	• Review the existing structure of KPAD • Change the structure to rationalize span of control, empowerment for prompt decision-making, and create necessary structure for emerging issues • Delegation of Power at each level • Create mechanisms for inter-departmental, intra-department policy and coordination mechanisms for effective planning • Strengthen Planning, Finance and Internal Audit wings of the department • Create and institutionalize Agriculture Delivery Unit directly under the Secretary • Rationalize Human Resource management and	• Prepare a comprehensive plan to build the capacity of the department and train them in modern techniques of management as well as change management and leadership	• An efficient and productive government department equipped to deal with emerging challenges and implement the Agriculture Policy.

Policy Area	Brief Description	Proposed Actions	ST/MT/ LT	Action Centre[45]	Proposed Process	Capacity Building	Outcomes/ Verification
					incentive structures for each cadre functioning in the department • Provide requisite technology for ICT based communication & decisions		
Effective Communication and Monitoring and Evaluation for management decision-making	The success of Agriculture and Horticulture Policies depends upon evidence based Planning geared towards bridging the gaps identified which needs results based monitoring and evaluation system as well as an effective communication strategy	• Design intra and inter department as well as mass communication policy and strategy • Develop & implement ICT based management and performance monitoring and evaluation in the department • Create Planning, Monitoring and Evaluation Wing or Cell	**ST-MT**	**KPAD** **DG Extension** **PM&E Wing**	• Prepare a Diagnostic and Design Report for developing communication Policy and Strategy as well as establishing M&E System • Prepare PC-I to include required manpower and need technological equipment and allocation of resources • Operationalize the systems and starts collecting requisite data and information • Expansion of Planning, Monitoring and Evaluation Cell	• KPAD to hire required manpower • Arrange for department-wise, specially the field staff, training in ICT and use of system • Strengthen PM&E in terms of manpower and capacity building	• Evidence based decision making and planning and implementation • Prompt and effective management decision-making through Dashboard • Performance based HR System

REFERENCES

Abass, A., G. Ndunguru, P. Mamiro, B. Alenkhe, N. Mlingi, and M. Bekunda, (2014) Post-harvest food losses in a maize-based farming system of semi-arid savannah area of Tanzania. *Journal of Stored Products Research* 57:49–57.

Ahmad, N. (2004) Household behavior in Pakistan, evaluation of rural-urban consumption patterns, 1998-99. M Phil Thesis submitted to Bahaudin Zakariya University, Multan.

Ahmed, U.I., L. Ying, K. Mushtaq, and M. K. Bashir, (2015) An econometric estimation of post-harvest losses of kinnow in Pakistan. *International Journal of Economics, Commerce and Management*, 3(5), 773-783.

Ali, B., M .Zamin, and M. Rehman, (2003) Assessing the role of project for horticultural; promotion extension and training materials in the solution of horticultural problems in the target area: A case study of Malakand Division. *Asian Journal of Plant Science*, 2(7), 578-581

Ali, U. Ch. and M. Arocha, (2014) HVOSV- Value chain competitiveness assessments for: Bitter Gourd, Capsicum, Cucumber, Tomatoes, and Squash. Sub Agreement TAP-ISA-013-002. The Agribusiness Project (TAP) USAID.

Awan, M.S., A. Hussain, T. Abbas, and R. Karim, (2012) Assessment of production practices of small-scale farm holders of tomato in Bagrote Valley, CKNP region of Gilgit-Baltistan, Pakistan. *Acta Agriculturae Slovenica,* 99(2), 191–199.

Aziz, B. (1997) Analysis of Consumer Demand Systems using Time Series Data of Pakistan. M Phil Thesis submitted to Quaid-i-Azam University, Islamabad.

Badar, H. (2014) Value Chain Performance Improvement for Sustainable Mango Industry Development in Pakistan. A thesis submitted for the degree of Doctor of Philosophy School of Agriculture and Food Sciences at The University of Queensland, UK.

Bajwa, B. (2012) Horticulture (peaches, dates, potatoes, chilies) value chain assessment final report for the agribusiness project. Under Sub Agreement UAP-ISC-012-001-CNFA. The Agribusiness Project (TAP) USAID. CNFA, Inc. 1828 L Street, NW, Suite 710 Washington, DC 20036.

Barrett, C. and Mutambatsere, E. (2008) "*Agricultural Markets in Developing Countries*" in Lawrence, E. Blume and Steven N. Durlauf, editors, *The New Palgrave Dictionary of Economics, 2nd Edition* (London: Palgrave Macmillan, 2008), file:///C:/Users/A.W.Rana/Downloads/SSRN-id1142518.pdf

Burki, A. A. (1997) Estimating consumer preferences for food, using time series data of Pakistan. *The Pakistan Development Review*. 36:2 (Summer) pp. 131—153

Burney, N. A., and A. H. Khan (1991) Household consumption patterns in Pakistan: an urban-rural comparison using Micro Data. *Pakistan Development Review*, 30, 145-171.

Bussink, W,C. F. (1970) A Complete set of consumption coefficient for West Pakistan. *Pakistan Development Review*, 10(2), 193-231.

Chan, Man-Kwun and Barrientos, Dr. Stephanie. 2010. "Improving Opportunities for Women in Smallholder-based Supply Chains." Seattle: Bill and Melinda Gates Foundation. https://docs.gatesfoundation.org/documents/gender-value-chain-guide.pdf

Chang, R., L. Kaltani and N. Loayza (2009), "Openness Can be Good for Growth: The Role of Policy Complementarities", *Journal of Development Economics*, Vol. 90(1), 33-49. file:///C:/Users/A.W.Rana/Downloads/Openness_Can_be_Good_for_Growth_The_Role_of_Policy.pdf

Chohan, T.Z., and S. Ahmad (2008) Post-harvest technologies and marketing channel in tomato production in Danna Katchely. *Azad Jammu Kashmir Pakistan Journal of Life and Social Sciences*, 6(2), 80-85.

De Janvry, A., and E. Sadoulet (2009) The impact of rising food prices on household welfare in India. working paper. Retrieved from https://gspp.berkeley.edu/assets/uploads/research/pdf/IndianFoodPricesMar09.pdf

Eccel, E., R. Rea, A. Caffarra, and A. Crisci (2009) Risk of spring frost to apple production under future climate scenarios: the role of phenological acclimation. *International Journal of Biometeorol*, 53(3), 273–286

FAO. (2004) Fertilizer use by crop in Pakistan. Land and Plant Nutrition Management Service. Land and Water Development Division Food and Agriculture Organization of the United Nations. Viale delle Terme di Caracalla 00100 Rome, Italy.

FAO. (2010) Occasional Paper 13.

Fujisawa, M., and K. Kobayashi (2011) Climate change adaptation practices of apple growers in Nagano, Japan. *Mitig Adapt Strateg Glob Chang*, 16(8), 865–877

Gereffi, G. and O. Memedovic (2003), T*he Global Apparel Value Chain: What Prospects for Upgrading by Developing Countries?*, United Nations Industrial Development Organisation, Geneva. https://www.unido.org/sites/default/files/2009-12/Global_apparel_value_chain_0.pdf

Gereffi, G. and Lee, Joonkoo, (2009); Henson, Spencer and Jhon Humphrey 2009; Jaffee and Masakure 2005, "Understanding the Complexities of Private Standards in Global Agri-Food Chains as They Impact Developing Countries" file:///C:/Users/A.W.Rana/Downloads/Henson_Humphrey_private_standards_JDS_2010.pdf

Gereffi, Gray and Lee, Joonkoo. (2014 and 2016) Economic and Social Upgrading in Global Value Chains and Industrial Clusters: Why Governance Matters Published online: 23 September 2014 Springer Science+Business Media Dordrecht 2014, (2016) 133:25–38 DOI 10.1007/s10551-014-2373-7Article in Journal of Business Ethics · January 2016 DOI: 10.1007/s10551-014-2373-7
file:///C:/Users/A.W.Rana/Downloads/2016-01-24_GereffiLee_JBE_EconomicsocialupgradinginGVCsclusters-governancematters.pdf

Ghafoor, U., S. Muhammad, K.M. Chodhri, M. A. Randhawa, and I. Ashraf (2010) Harvesting and marketing problems faced by citrus (kinnow) growers of Tehsil Toba Tek Singh. *Journal of Agriculture Research*, 48(2), 253-257.

Government of Khyber Pakhtunkhwa, Crop Statistics 2019

Government of Pakistan. (2018) Agricultural Statistics of Pakistan 2017-18. Economic Wing. Ministry of National Food Security and Research.

Government of Pakistan. 2020. Economic survey of Pakistan 2019-20. Economic Advisor's Wing, Ministry of Finance, Islamabad, Pakistan.

Government of Punjab. (2018) Feasibility Study: Fruit and Vegetable Canning Unit, Agriculture Department, Government of Punjab.

Haq, U. Z., H. Nazli, K. Meilke, M. Ishaq, A. Khattak, A. H. Hashmi and F. U. Rehman. (2011) Food demand patterns in Pakistani Punjab. *Sarhad Journal of Agriculture*. 27(2): 305-311.

Haq, Z. (2012) Food Value Chain Analysis: A Review of Selected Studies for Pakistan and Guidelines for Further Research. Working Paper No. 010.

Haq, Z. and J. Cranfield (2011) Household food demand in Pakistan: Does demand specification matter? *African Journal of Business Management*. 5(17) http://www.academicjournals.org/AJBM

Haq, Z., H. Nazli, and Meilke, K. (2008) Implications of High Food Prices for Poverty in Pakistan. *Agricultural Economics*. 39, 477–484

Haq. Z., M. Ishaq, A. Farooq, K.N. Saddozai, S. and Yaqoob. (2009) Effect of farmers' characteristics on onion yield. *Sarhad J. Agric*. 25 (3), 523-527.

Hassan, S., A. Hussain, M. A. Khan and I. Mahmood, (2012) Rural-urban retail prices and marketing margins of fresh fruits and vegetables in Pakistan. *Pakistan Journal of Agricultural Research*. 25 (3), 206-217.

Hassan, S., A. Hussain, M. A. Khan and Mahmood, I. (2012) Rural-urban retail prices and marketing margins of fresh fruits and vegetables in Pakistan. *Pakistan J. Agric. Res*. 25 (3), 206-217.

Hussain, S., E. Hussain and U. Partap (2017) Strategies for Apricot Value Chain Development in Chitral, Pakistan. ICIMOD Working Paper 2017/21.

Husaini, Syed Amanullah and Rehman, Jawad. 2020. Understanding the Bottlenecks and Opportunities in Value-Added Exports of Fruits and Vegetables, Pakistan Business Council, Karachi

Ilyas, M.B., M. U. Ghazanfar, M. A. Khan, C. A.Khan, and M. A. R. Bhatti, (2007) Post-harvest losses in apple and banana during transport and storage.*Pakistan Journal of Agricultural Sciences.* 44(3), 534-539.

Iram, S., and H. M. I. Ahmad (2013) Major post-harvest diseases of mango and their management. *International Journal of Agronomy and Plant Production,* 4 (12), 3470-3484.

Jahangir, K., R.K. Aditya, H.L. Kar, A. U. Jan and A. S. Syed (2018) Willingness to pay for pesticide free fruits: evidence from Pakistan, *Journal of International Food and Agribusiness Marketing*, 30(4), 392-408, DOI: 10.1080/08974438.2018.1449697

Jaffee, Steven. 2003. From Challenge to Opportunity Transforming Kenya's Fresh Vegetable Trade in the Context of Emerging Food Safety and Other Standards in Europe, The World Bank.

Jan, I. & Khan., Sajid & Khan., Noor & Ashfaq. M., 2017. Effects of Microcredit Programme of Khushali Bank Limited on Agricultural Productivity in District Mardan, Pakistan. Sarhad Journal of Agriculture, Vol.33(4). Pages: 688-693. Available at: https://www.researchgate.net/publication/321378739

Jariko, G.A., M.A. Junejo, M.S. Rahpoto, and M. Z. Shah, (2011) Socioeconomic factors affecting adoption of sunflower varieties in Sindh. *Pakistan Journal of. Commerce and Social Sciences.* 5 (1), 192-201.https://www.researchgate.net/publication/267302952

Jaffee, Steve and Masakure, Oliver. 2005. "Strategic Use of Private Standards to Enhance International Competitiveness: Vegetable Exports from Kenya and Elsewhere", https://www.researchgate.net/publication/223499942_Strategic_Use_of_Private_Standards_to_Enhance_International_Competitiveness_Vegetable_Exports_from_Kenya_and_Elsewhere

Khair, M. S. (2020) Needs and challenges of apple value chain in Balochistan. The Project for Agri-Food and Agro-Industry Development Assistance (PFAID) www.pfaid.org

Khan, F.U., N. Khan, and F. Anjum, (2016) Farmers perception about yield losses of kinnow (Citrus reticulate) during its harvesting and post harvesting operations: A case study of tehsil Sargodha, Pakistan. *Journal of Rural Development and Agriculture*, 1(1): 12-19.

Khan, M, I. (1970) Demand for food in Pakistan in 1975. *Pakistan Development Review*, 10(3): 310-333.

Khan, M. (2017) Post-production losses of peach at firm level in Pakistan. *Pakistan Business Review*, Special Issue, 199-207.

Khan, M. (2017) Post-production value chain and supply chain analysis of peach in Pakistan. Unpublished dissertation of Ph.D., Department of Economics, University of Peshawar, Peshawar.

Khan, M. A., M. Nazir, A. Hussain, M. Irfan, and U. Farooq, (n. d.) An assessment of the welfare impacts of credit use on the rural communities of Pakistan.

Khan, M., and J. H. Bae (2017) The Environmental Perspectives of Apple Fruit Supply Chain Management in Chitral, Northern Pakistan. *International Journal of Supply Chain Management*, 6(4), 01-16.

Khan, M., M. Rahim, M. Naeem, K. M. Shah, Y. Bakhtiar and M. Tahir, (2008) Postharvest economic losses in peach production in district Swat. *Sarhad Journal of Agriculture*. Vol.24, No.4.

Khan. A. and M. Khan (2014) Costs of production and marketing of peach in swat Khyber Pakhtunkhwa. *Sarhad Journal of Agriculture*. 30(2), 277-282

Khushk, M. A., Memon, M. A. and I. M. Lashari, (2006) Marketing system of selected fruits in Pakistan. *Bangladesh Journal of Agriculture Research*. 31(1) : 39-68

Kohls, R.L. and J.N. Uhl, (1985) In Marketing of Agricultural Products. Macmillan Publishing Company, United States of America.

Li, X.M., Q.F. Bai, and L. Zhu (2011) The influence of climate change on suitability of Shaanxi apple growth. *Journal of Applied Meteorological Sciences*, 22(2), 241–248

Malik, S. (1992) A Study of Rural Poverty in Pakistan with Special Reference to Agricultural Price Policy. Ph. D. Thesis submitted to University of Sussex, UK.

Malik, S. and A. Babar (2006) Surmising Consumer Demand System and Structural Changes using Time Series Data for Pakistan. *Pakistan Economics and Social Review*, 44(1), 117-136.

Memon. M.H., K. Khan, M.Y. Abbass, G. Khan, and M. A. Kamal (n.d.) Impediments to Technology Adoption: A Case Study of Peach Production in District Swat, Pakistan. *Journal of Managerial Sciences*, IX (2), 226-242.

Mudassar, K., B. Aziz and A. Anwar (2012) Estimating Consumer Demand of Major Food Items in Pakistan: A Micro Data Analysis. *Pakistan J. Life Soc*. Sci., 10(1), 53-58.

Nazli, H., H. Haider, and A. Tariq, (2012) Supply and Demand for Cereals in Pakistan, 2010-2030. IFPRI Discussion Paper.
http://www.ifpri.org/book-8211/ourwork/program/pakistan-strategy-support-program

Osman, A., N. Saari, R. Saleh, J. Bakar, N. D. Zainal, and M. Yacob (2009) Post-harvest handling practices on selected local fruits and vegetables at different levels of the distribution chain. *Journal of Agribusiness Marketing*, 2, 39-53.

Poole, N.D. (2013) Value chain perspectives and literature: a review. Food Chain 3(3): 199–211.

Poole, N.D. and A. de Frece (2010) A review of existing organisational forms of smallholder farmers' associations and their contractual relationships with other market participants in the East and Southern African ACP Region. EU-AAACP Paper Series. No. 11. Rome, Food and Agriculture Organization of the United Nations. Retrieved 28 March 2017, from http://www.fao.org/fileadmin/templates/est/AAACP/eastafrica/FAO_AAACP_Paper_Series_No_11_1_.pdf.

Pu, J.Y., X.Y. Yao, X.H. Yao, Y.P. Xu, , and W.T. Wang (2008) Impacts of climate warming on phonological period and growth of apple tree in Loess Plateau of Gansu province. *China Journal of Agrometeorology*, 29(2), 181–186

Qasim, M., W. Farooq and W. Akhtar. (2018) Preliminary report on the survey of tomato growers in Sindh, Punjab and Baluchistan. Policy and Institutional Reforms to Improve Horticultural Markets in Pakistan, (ADP/2014/043), Report 04/18

Qu, Z.J., R.F. Liu, Z. X. Guo, J. H. Wang, L. Liu, and Q. Chai (2013) Study of risk assessment and prediction of apple blooming freezing injury in Shaanxi Province. *Journal of Natural Disaster*, 22(1), 219–225

Qiang, Christine Zhenwei Qiang, Liu, Yan, and Steenbergen, Victor. 2021. An Investment Perspective on Global Value Chains, The World Bank

Reardon, T., and P. Timmer, P. (2007) Transformation of agricultural output in developing countries since 1950: How haw thinking changed? In R.E. Evenson, P. Pengali and T.P Schultz (Eds.), Handbook of agricultural economics: Agricultural development: Volume 3, Farmers, Farm Production and Farm Markets. Elsevier B.V, Oxford, 2808-2855.

Rehman, A. (1963) Expenditure elasticities in Rural West Pakistan. *Pakistan Development Review*, 3(2), 232-249.

Rehman, M.U., N. Khan, and I. Jan (2007) Post-harvest losses in tomato crop: a case of Peshawar valley. *Sarhad Journal of Agriculture*, 23(4), 1279-1284.

Sabir, M. H., B. M. Khan and Z. Hussain. (2010) Marketing margin of Mandarin: A case study of Sargodha region, Pakistan. *Pakistan Journal of Social Sciences. Vol. 30, No. 2, pp. 275-291*

Saeed, A.F.H., and S. N. Khan (2010) Post-harvest losses of tomato in markets of district Lahore. *Mycopath*,8(2), 97-99.

Safdar, S. and A. Chughtai, 2013. Sales and labor multiplier study for peach value chain. Commissioned by Chemonics International under the USAID Firms Project.

Samee, D., F. Nosheen, H. Khan, I. Khowaja, K. Jamali, P. Paracha, S. Akhtar, Z. Batool and Z. Khanum, Z. (2015) Women in Agriculture in Pakistan. FAO Islamabad.

Sanogo, I. (2010) Market analysis tool-how to conduct a food commodity value chain analysis? World Food Program and VAM Food Security Analysis.

Shah, A. (2018) Tomato Marketing Channel Survey: A Preliminary report. Policy and Institutional Reforms to Improve Horticultural Markets in Pakistan, *ACIAR Project* 2014/043.

Shah, N. A., A. Farooq, A. Hassan, A. K. Samad, M. A. Niazi and U. Farooq. (2014) Status of Fruit Farming in Central Valley of Khyber Pakhtunkhwa. *Asian Journal of Agriculture and Rural Development, Asian Economic and Social Society (AESS)*, 4(10), 1-10, DOI: 10.22004/ag.econ.198430

Shaheen, S., S. Anwar, and Z. Hussain (2011) Technical efficiency of off-season cauliflower production in Punjab. *Journal of Agricultural Research*, 49(3)

Shahbaz, Babar, Shah, Qasim Ali, Suleri, Abid Q., Commins, Steve, and Malik, Akbar Ali Malik. 2012. Working Paper 5: Livelihoods, Basic Services and Social Protection in North Western Pakistan, Secure Livelihoods Research Consortium. London, 2012. Available at: https://luskin.ucla.edu/sites/default/files/download-pdfs/livelihoods%20and%20basic%20services%20in%20NWP.pdf

Shahzad, M., A. Ali, A. H. Qureshi, N. Jehan, I. Ullah, and M. Khan (2013) Assessment of post-harvest losses of plum in Swat, Pakistan. *Pakistan Journal of Agricultural Research*, 26(3), 185-194.

Shahzad, M., A. Tahir, N. Jehan, and A. Shah (2018) Packaging decisions in horticulture sector of Khyber Pakhtunkhwa: A Province of Pakistan. *Pakistan Journal of Applied Economics*, Special Issue, 481-491.

Shahzad, M., A. Tahir, N. Jehan, and M. Luqman (2015) Impact of different packaging technologies on postharvest Losses of stone fruits in Swat, Pakistan. *Pakistan Journal of Agricultural Research*, 28(1), 53-63.

Sharif, M. 2011. Structure, Conduct and Performance of the Marketing Systems Margins and Seasonal Price variations of selected fruits and vegetables in Balochistan, NWFP, Northern Areas and Azad Jammu and Kashmir, Pakistan Agriculture Research Council, Islamabad.

Sharif, M., N. Akmal, and S. Taj (2009) Financial viability for investing in citrus cultivation in Punjab. *Pakistan Journal of Agricultural Research* 47(1), 79-89.

Sharif, M., U. Farooq, and W. Malik (2005) Citrus Marketing in Punjab: Constraints and Potential for Improvement. *The Pakistan Development Review*, 44(4), 673–694.

Siddique, M.I. and E. Garnevska (2018) Citrus value chain(s): a survey of Pakistan citrus industry. http://dx.doi.org/10.5772/intechopen.70161

SMEDA. (2014) Pre-feasibility study: Fresh fruit processing unit (mango, citrus and apple) PREF-NO. 43. Small and Medium Enterprises Development Authority, Ministry of Industries and Production, Government of Pakistan. www.smeda.org.pk

Staritz, Cornelia and Reis, José Guilherme. (2013), Global Value Chains, Economic Upgrading, and Gender Case Studies of the Horticulture, Tourism, and Call Center Industries January 2013https://documents1.worldbank.org/curated/en/912761468337873624/pdf/832330WP0GVC0G0Box0382076B00PUBLIC0.pdf

Tahir, A., H. Shah, M., Sharif, W. Akhtar, and N. Akmal (2012) An overview of tomato economy of Pakistan: Comparative analysis. *Pakistan Journal of Agricultural Research*. 25 (4), 288-294.

Tariq, M., M. K. Hussain, Z. K. Malik, and N. Jehan (2018) An estimation of technical efficiency of strawberry production in District Charsadda Khyber Pakhtunkhwa. *Sarhad Journal of Agriculture*, 34(1): 93-101. DOI | http://dx.doi.org/10.17582/journal.sja/2018/34.1.93.101

Ullah, A. & A. Khan, 2019. Effect of Extension-Farmers Contact on Farmers' Knowledge of Different Pest Management Practices in the Rain-fed Districts of Khyber Pakhtunkhwa, Pakistan. Sarhad Journal of Agriculture, Vol.35(2). Pages: 602-609. Available at: http://dx.doi.org/10.17582/journal.sja/2019/35.2.602.609

Wahid, U., S. Ali, and N. A. Hadi (2017) On the estimation of technical efficiency of tomato growers in Malakand, Pakistan. *Sarhad Journal of Agriculture*, 33(3), 357-365. DOI | http://dx.doi.org/10.17582/journal.sja/2017/33.3.357.365

Waqar, M., R. Gu, and F. Nie (2018) Mapping ICT use along the citrus (kinnow) value chain in Sargodha District, Pakistan. *Sustainability* 10, 4743; doi:10.3390/su10124743

World Bank, Khyber Pakhtunkhwa Irrigated-Agriculture Productivity Improvement Project (KIAPIP) Project Appraisal Document, 2019

Yousaf, K. (2017) Pakistan peach value chain. Australasian Agribusiness Perspectives. 20(3) ISSN: 1442-6951.

Yu, Winston, Yang, Yi-Chen, Savitsky, Andre, Alford, Donald, Brown, Casey, Wescoat, James, Debowicz, Dario, and Robinson, Sherman. 2013. The Indus Basin of Pakistan – The Impacts of Climate Risks on Water and Agriculture. Washington, DC, World Bank.

Zeb, J., and Z. Khan (2008) Peach marketing in NWFP. *Sarhad Journal of Agriculture*, 24(1), 161.

Zeb, J., Z. Khan, G. Nabi, and K. Nawaz (2007) Marketing margins for onion in Swat. *Sarhad Journal of Agriculture*. 23 (3),793-801.

Annex-I Agro-climatic zones of Pakistan

Zone	Locality	Climate	Rainfall (mm)	Soil	Crops
I	Indus Delta	Arid Tropical Marine	75 mm in summer and 5 mm in winter	Clay and silty	Rice, sugar cane, banana, and pulses
II	Lower Indus Plain	Arid and subtropical	45-55 mm in summer 18 mm in winter	Silty and sandy loam, calcareous loamy and clay	Cotton, wheat, and sugar cane on the left bank of the Indus and rice, wheat, and gram on the right bank
IIIa	Sandy Desert	Desert		Sandy and loamy fine sand	The land is used for grazing
IIIb	Sandy Desert			Sandy and loamy fine sand	The land is used for grazing
Iva	Northern Irrigated Plain	semi-arid to arid	300 to 500 mm in the east and 200 to 300 mm in the southwest	sandy, loam-clay and loam	Wheat, rice, sugar cane, oilseed, and millets in the North and wheat, cotton, sugar cane, maize, citrus, and mangoes in the center and South
IVb	Northern Irrigated Plain	semi-arid	20 to 30 mm	silty clays and clay loams	Sugar cane, maize, tobacco, wheat, berseem, sugar beet, and orchards
V	Rainfed	The Salt Range and the Potwar Plateau	200 mm in summer and 35 to 50 mm in winter		wheat, millet, oilseed, and pulses
VI	Wet Mountains		235 mm in summer and 116 mm in winter	Silt loams to silty clays	Rainfed agriculture and forest
VII	Northern Dry Mountains		25 to 75 mm in winter and 10 to 20 mm in summer	deep and clay	The area is used for grazing
VIII	Western Dry Mountains	Barren hills with steep slopes	95 mm in summer and 63 to 95 mm in winter	deep and loamy	The land is used for grazing and wheat and fruit crops are grown on loamy soils
IX	Dry Western Plateau	Mountainous areas	Monthly rainfall is 37 mm in summer		The land is used mainly for grazing, melons, fruit crops, vegetables, and wheat
X	Sulaiman Piedmont	plains of the Sulaiman Range	Less than 15 mm	arid and hot	Wheat, millet, and gram

Source: ARP-II Diagnostic Survey, 1994

Annexure II. Characteristics of the AEZs in Khyber Pakhtunkhwa Province

Characteristic	AEZ-A		AEZ-B		AEZ-C	AEZ-D		AEZ-E
	A-1	A-2	B-1	B-2		D-1	D-2	
Climate	Arid, very cold	Arid, cold	Cold, Sub-humid	Cold, Humid	Warm, Sub-humid	Hot, semi-arid	Hot, arid	Warm, semi-arid
Rainfall mm/y	350-500	500-700	750-1000	1000+	450-700	400-600	<300	<350
Rabi rain mm	300-400	300-450	400-500	500+	250-300	200-300	100-150	100-150
Kharif rain mm	<150	200-300	300-500	500+	200-220	200-300	150-200	150-200
Mean Temp. °C	16-18	18-20	16-18	18-20	30+	22+	22+	22+
Summer Temp. °C	20-25	25-30	25-30	25-30	10	30+	30+	30+
Winter Temp. °C	0-5	10	5	10	10	10	12	10
Altitude	1200+	600+	1000+	600+	600+	300-900	150-300	400-950
Soil Type	Loamy, shallow, rock outcrop lithic				Loam	AsAEZ-A	Loam	As AEZ-A
Cultivated area 000 ha	18	363	105	140	400	172	543	--
% irrigated land	91	54	24	29	64	7	38	--
Farm size	1.0	1.0	1.7	1.4	1.7	1.8	6.0	--
Main Kharif crops	Rice	Maize	Rice	Maize	S/cane	G/nut	S/cane	--
Second Kharif Crops	Maize	Rice	Maize	Rice	Maize	Sorg. /Mil.	Rice	--
Third Kharif Crops	--	Vegetables	--	Cash crop	Cash crop	--	Pulses	--
Rabi Crops	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat	Wheat
Second Rabi Crop	O/seed	Vegetables	O/seed	vegetables	S/cane	Gram	S/cane	--
Third Rabi Crop	--	O/seed	--	O/seed	Cash crop	--	Pulses	--
Population/Km^2	15	150	180	380	550	100	100	--

Source: ARP-II Diagnostic Survey, 1994

Annexure III. Area and Production of Major Vegetables in Khyber Pakhtunkhwa

Vegetables/ Fruits	Area (Hectare)			Production (Tons)			Yield (Kg per Hectare)		
	Settled Districts	Merged Districts	Total	Settled Districts	Merged Districts	Total	Settled Districts	Merged Districts	Total
Major Rabi Vegetables									
Tomato	3381	327	3708	41742	2189	43931	12346	6694	11848
Turnip	2027	1325	3352	36866	13539	50405	18187	10218.11	15037.29
Peas	1781	71	1852	12166	335	12501	6831	4718.31	6750.00
Spinach	1196	498	1694	15855	3251	19106	13257	6528.11	11278.63
Cauli Flower	1113	336	1449	14640	2070	16710	13154	6160.71	11532.09
Radish	858	200	1058	11596	1339	12935	13515	6695.00	12225.90
Cabbage	502	16	518	4134	104	4238	8235	6500.00	8181.47
Carrot	454	107	561	7056	745	7801	15542	6963	13906
Major Kharif Vegetables									
Tomato	7670	2213	9883	70944	15089	86033	9250	6818	8705
Okra	1677	406	2083	14948	1861	16809	8914	4583.74	8069.61
Arum	1338	7	1345	17924	10	17934	13396	1428.57	13333.83
Bitter Gourd	1206	21	1227	11980	93	12073	9934	4428.57	9839.45
Squash Gourd	960	124	1084	12126	596	12722	12631	4806.45	11736.16
Brinjal	765	102	867	8564	560	9124	11195	5490.20	10523.64
Pumpkin	661	129	790	6217	775	6992	9405	6007.75	8850.63
Bottle Gourd	498	32	530	4373	227	4600	8781	7094	8679

Source: Go Khyber Pakhtunkhwa, 2016

Annexure IV. Area and Production of Major Fruits in Khyber Pakhtunkhwa

Vegetables/ Fruits	Area (Hectare)			Production (Tons)			Yield (Kg per Hectare)		
	Settled Districts	Merged Districts	Total	Settled Districts	Merged Districts	Total	Settled Districts	Merged Districts	Total
Peaches	7253	731	7984	48605	3400	52005	6701	4651	6514
Apple	5315	2426	7741	40026	49307	89333	7531	20324.40	11540.24
Musk Melon	3269	59	3328	36497	910	37407	11165	15423.73	11240.08
Persimmon	3063	93	3156	25874	1005	26879	8447	10806.45	8516.79
Plums	2541	399	2940	23415	2012	25427	9215	5042.61	8648.64
Apricot	2120	563	2683	7857	2924	10781	3706	5193.61	4018.26
Dates	1542	77	1619	11626	693	12319	7540	9000.00	7609.02
Walnut	1385	218	1603	11393	2358	13751	8226	10816.51	8578.29
Pears	1472	117	1589	14808	1279	16087	10060	10931.62	10123.98
Guava	1551	22	1573	26536	249	26785	17109	11318.18	17027.97
Watermelon	712	64	776	10297	1027	11324	14462	16046.88	14592.78
Banana	369	0	369	10485	0	10485	28415	#DIV/0!	28414.63
Mango	340	7	347	3028	70	3098	8906	10000.00	8927.95
Pomegranate	68	106	174	546	1188	1734	8029	11207.55	9965.52
Almond	60	107	167	188	810	998	3133	7570.09	5976.05
Grapes	30	60	90	116	469	585	3867	7816.67	6500.00
Figs	37	17	54	189	171	360	5108	10059	6667

Source: Go Khyber Pakhtunkhwa, 2016

Annexure V. Area (hectares) under Rabi Vegetables in Khyber Pakhtunkhwa

	District	Turnip	Carrot	Spinach	Tomato	Cauli Flower	Cabbage	Peas	Radish	Others	Total
Settled Districts	Charsadda	1	0	7	92	50	0	0	0	1084	1234
	Nowshera	0	0	6	131	71	0	0	0	589	797
	Mardan	64	20	70	303	84	0	55	47	652	1295
	Swabi	223	74	73	52	100	6	172	55	51	806
	Kohat	3	0	10	4	2	0	12	1	99	131
	Mansehra	93	44	99	0	92	62	0	73	230	693
	Battagram	0	0	0	0	0	0	0	0	4	4
	Abbottabad	11	0	5	8	13	7	4	12	0	60
	Haripur	35	13	18	20	4	3	5	28	0	126
	Kohistan	17	0	20	0	0	0	0	0	18	55
	Malakand	126	30	67	782	56	0	27	31	79	1198
	Swat	440	0	320	700	160	90	1120	190	200	3220
	Buner	320	0	30	40	18	0	5	13	0	426
	Shangla	12	0	8	35	0	0	10	10	3	78
	Dir Lower	121	21	6	27	21	0	36	20	13	265
	Dir Upper	71	6	88	5	22	0	16	9	12	229
	Chitral	226	104	156	235	123	229	205	180	30	1488
	D.I. Khan	77	37	51	451	58	46	40	76	17	853
	Tank	22	12	2	390	20	3	6	14	0	469
	Bannu	33	20	14	28	43	0	13	26	13	190
	LakkiMarwat	12	3	13	11	25	3	4	53	3	127
Merged Districts	Mohmand	123	0	13	43	0	0	0	91	0	270
	Khyber	32	23	17	30	17	0	53	7	0	179
	Kurram	623	8	0	0	0	0	8	3	0	642
	Oriakzai	7	0	0	10	0	0	0	0	0	17
	Bajour	440	0	365	54	257	16	3	40	0	1175
	N. Waziristan	57	23	27	85	47	0	0	21	0	260
	S. Waziristan	11	7	33	36	7	0	0	23	0	117
	PeshawarFR	8	3	7	17	5	0	7	5	0	52
	KohatFR	6	0	0	3	0	0	0	0	0	9
	BannuFR	7	10	3	5	0	0	0	3	0	28
	D.I. Khan FR	11	33	33	44	3	0	0	7	0	131

Source: Go Khyber Pakhtunkhwa, 2016

Annexure VI. Area (hectares) under Kharif Vegetables in Khyber Pakhtunkhwa

	District	Okra	SquashGourd	Brinjal	Pumpkin	Bitter Gourd	Bottle Gourd	Tomato	Arum	Others
Settled Districts	Peshawar	150	191	165	178	350	173	18	450	189
	Charsadda	19	0	21	0	0	45	756	95	1342
	Nowshera	0	0	0	25	204	0	0	98	991
	Mardan	205	154	62	0	299	0	14	481	238
	Swabi	54	29	30	0	22	18	89	43	0
	Kohat	106	0	20	0	4	42	3	0	350
	Hangu	59	0	1	2	0	0	1	0	57
	Mansehra	70	71	63	54	43	40	345	9	195
	Battagram	12	0	0	10	6	0	14	0	24
	Haripur	33	15	35	39	17	75	137	52	307
	Kohistan	13	0	0	0	0	14	33	0	24
	Malakand	78	25	35	21	20	0	280	20	13
	Swat	180	45	60	110	35	20	4360	20	1590
	Bunir	120	158	55	40	58	0	61	0	140
	Shangla	35	10	5	21	5	0	155	5	19
	Dir Lower	126	3	1	2	0	0	378	0	2
	Dir Upper	67	3	1	1	0	0	188	0	4
	Chitral	66	71	43	29	32	24	132	0	0
	D.I. Khan	85	95	85	56	67	35	210	45	25
	Tank	47	52	55	32	10	12	375	0	0
	Bannu	136	30	25	35	33	0	103	10	4
	LakkiMarwat	9	1	0	0	1	0	5	0	82
Merged Districts	Mohmand	19	7	12	0	2	0	820	0	0
	Khyber	30	12	9	11	3	8	40	0	7
	Kurran	115	0	0	0	0	0	770	0	0
	Oriakzai	8	5	0	60	0	10	17	0	14
	Bajaur	90	35	27	6	8	8	160	2	0
	N. Waziristan	97	45	38	42	0	0	120	5	95
	S. Waziristan	31	10	10	0	8	6	260	0	22
	BannuFR	9	7	6	6	0	0	5	0	3
	D.I. KhanFR	5	3	0	0	0	0	17	0	3

Source: Go Khyber Pakhtunkhwa, 2016

Annexure VII. Area (hectares) under Fruits in Khyber Pakhtunkhwa

	District	Peaches	Watermelon	Musk Melon	Apricot	Banana	Apple	Dates	Guava	Mango	Pears	Plums	Walnut	Almond	Persimmon
Settled Districts	Peshawar	80	50	35	1200	0	0	0	10	0	300	382	0	0	67
	Charsadda	63	52	63	85	0	28	4	45	0	134	225	0	0	197
	Nowshera	74	128	260	108	7	35	3	64	24	132	252	0	0	110
	Mardan	296	194	576	14	2	0	0	41	50	221	96	0	0	50
	Swabi	31	109	101	115	0	5	1	54	8	109	244	0	0	44
	Kohat	0	0	0	2	0	0	0	566	0	0	3	0	0	0
	Mansehra	52	0	0	34	0	677	0	0	0	53	166	84	0	33
	Battagram	13	0	0	10	0	58	0	0	0	7	22	26	0	0
	Abbottabad	20	0	0	12	0	571	0	0	0	3	45	15	0	16
	Haripur	107	61	36	30	20	2	0	109	4	20	97	0	0	0
	Kohistan	0	0	0	0	0	0	0	0	0	0	19	77	0	0
	Malakand	105	34	120	66	1	0	0	143	10	12	50	0	0	150
	Swat	5735	0	0	270	0	3580	0	0	0	300	630	415	5	1860
	Bunir	300	3	0	25	10	15	0	0	0	41	75	0	0	150
	Shangla	55	0	0	20	0	40	0	0	0	30	20	115	0	90
	Dir Lower	93	0	0	4	0	4	0	0	0	22	40	60	2	32
	Dir Upper	205	0	0	72	0	10	0	0	0	21	152	498	43	262
	Chitral	24	0	2	47	0	237	0	0	0	67	0	95	10	2
	D.I. Khan	0	55	264	0	25	41	950	84	232	0	0	0	0	0
	Tank	0	0	150	0	4	5	44	27	10	0	0	0	0	0
	Bannu	0	0	0	0	300	2	480	402	2	0	15	0	0	0
	LakkiMarwat	0	26	1662	0	0	0	60	0	0	0	0	0	0	0
Merged Districts	Mohmand	12	0	0	65	0	13	47	5	0	0	35	0	0	27
	Khyber	8	0	0	18	0	7	0	0	0	10	4	18	7	7
	Kurram	95	0	0	52	0	45	0	0	0	5	0	32	0	9
	Oriakzai	25	0	0	27	0	35	0	0	0	10	0	57	0	0
	Bajaur	40	0	0	55	0	46	0	0	0	17	130	48	0	50
	S. Waziristan	547	48	49	340	0	2280	0	0	0	75	230	63	100	0

Source: Go Khyber Pakhtunkhwa, 2016

Annexure VIII. Food Demand in Pakistan and Khyber Pakhtunkhwa

Items	Pakistan			Khyber Pakhtunkhwa		
	Per Capita Consumption (Kg)		Total Demand (000 Tons)	Per Capita Consumption (Kg)		Total Demand (000 Tons)
	Monthly	Annual		Monthly	Annual	
Wheat and Wheat Flour	7.00	84.00	17824.80	7.80	93.60	3325.61
Rice and Rice Flour	1.06	12.72	2699.18	0.85	10.20	362.41
Biscuit	0.03	0.40	83.98	0.02	0.22	7.70
Mash	0.05	0.60	127.32	0.06	0.72	25.58
Moong	0.07	0.84	178.25	0.05	0.60	21.32
Masoor	0.06	0.72	152.78	0.03	0.36	12.79
Other Pulses	0.04	0.48	101.86	0.15	1.80	63.95
Milk (fresh & boiled)	6.85	82.20	17442.84	3.73	44.76	1590.32
Milk packed	0.22	2.64	560.21	0.40	4.80	170.54
Yogurt (loose/packed)	0.45	5.40	1145.88	0.53	6.36	225.97
Vegetable Ghee	0.69	8.28	1757.02	0.84	10.08	358.14
Cooking Oil	0.32	3.84	814.85	0.17	2.04	72.48
Mutton	0.06	0.72	152.78	0.02	0.24	8.53
Beef	0.19	2.28	483.82	0.30	3.60	127.91
Fish	0.06	0.72	152.78	0.01	0.12	4.26
Chicken Meat	0.36	4.32	916.70	0.31	3.72	132.17
Eggs	3.04	36.48	7741.06	2.72	32.64	1159.70
Banana	4.58	54.96	11662.51	3.26	39.12	1389.93
Citrus Fruit (mossaumi etc)	1.78	21.36	4532.59	1.99	23.88	848.46
Apple	0.26	3.12	662.06	0.26	3.12	110.85
Other Fruit	0.58	6.96	1476.91	0.53	6.36	225.97
Dry Fruits	0.02	0.28	59.79	0.05	0.58	20.76
Potato	1.27	15.24	3233.93	1.14	13.68	486.05
Tomato	0.51	6.12	1298.66	0.82	9.84	349.62
Onion	0.95	11.40	2419.08	0.77	9.24	328.30
Other Vegetables	2.22	26.64	5653.01	2.01	24.12	856.98
Chillies	0.06	0.73	154.16	0.03	0.30	10.82
Sugar (desi & milled)	1.28	15.36	3259.39	1.41	16.92	601.17
Gur and Shakkar	0.07	0.84	178.25	0.25	3.00	106.59
Tea (black and green)	0.09	1.04	221.41	0.10	1.20	42.46
Population (million)			212.20			35.53