



**CLUSTER DEVELOPMENT BASED AGRICULTURE TRANSFORMATION PLAN VISION-
2025**

Citrus Cluster Feasibility and Transformation Study



**Planning Commission of Pakistan, Ministry of
Planning, Development & Special Initiatives**

February 2020





FOREWORD

In many developed and developing countries, the cluster-based development approach has become the basis for the transformation of various sectors of the economy including the agriculture sector. This approach not only improves efficiency of development efforts by enhancing stakeholders' synergistic collaboration to resolve issues in the value chain in their local contexts, but also helps to gather resources from large number of small investors into the desirable size needed for the cluster development. I congratulate the Centre for Agriculture and Bioscience International (CABI) and its team to undertake this study on **Feasibility Analysis for Cluster Development Based Agriculture Transformation**. An important aspect of the study is the estimation of resources and infrastructure required to implement various interventions along the value chain for the development of clusters of large number of agriculture commodities. The methodology used in the study can also be applied as a guide in evaluating various investment options put forward to the Planning Commission of Pakistan for various sectors, especially where regional variation is important in the project design.

Muhammad Jehanzeb Khan,
Deputy Chairman
Planning Commission of Pakistan
Ministry of Planning Development and
Special Initiatives
Government of Pakistan.



FOREWORD

To improve enhance Pakistan's competitiveness in the agriculture sector in national and international markets, the need to evaluate the value chain of agricultural commodities in the regional contexts in which these are produced, marketed, processed and traded was long felt. The Planning Commission of Pakistan was pleased to sponsor this study on the **Feasibility Analysis for Cluster Development Based Agriculture Transformation** to fill this gap. The study aims to cover a large number of agriculture commodities spread in various clusters throughout the country.

I truly hope that the policies, strategies, and interventions suggested in this report will facilitate the federal and provincial governments to chalk out and implement plans for cluster-based transformation of the agriculture sector.

A handwritten signature in black ink, appearing to read 'Zafar Hasan', with a long horizontal stroke extending to the right.

Zafar Hasan,
Secretary,
Ministry of Planning Development and Special
Initiatives
Government of Pakistan



FOREWORD

This is part of the series of studies on 33 agriculture commodities undertaken for the purpose of preparing a cluster-based transformation plan based on the regional realities in the entire value chain including production, processing, value addition, and marketing. I congratulate the whole team of the project especially the Team Lead, Dr. Mubarik Ali to undertake and successfully complete this monumental study. We are thankful to all commodity specialists who have contributed to this assignment. The CABI Project officers Mr. Yasar Saleem Khan and Ms. Aqsa Yasin deserve appreciation. I truly believe that this study will serve as a basis to make and implement plans for cluster-based agriculture transformation. I hope you will enjoy reading the study and it can help you making your investment decisions along the value chain of various agriculture commodities.

Dr. Babar Ehsan Bajwa
Regional Director
CAB International



FOREWORD

This report is part of the series of studies on 33 agriculture commodities to prepare the agriculture transformation plan by incorporating regional realities at the cluster level. In the report, the clusters of various commodities are identified and characterized, and viable investment options along the value chain of each cluster are proposed. For this purpose, the study team has analyzed macro data, reviewed the literature, and made extensive consultation with stakeholders along the value chain. Foreign and local internationally reputed consultants, Dr. Derek Byerlee and Dr. Kijiro. Otsuka and national consultant Mr. Sohail Moghal were also engaged to understand the cluster-based development approach and conduct cluster-based feasibility analysis. An EXCEL-based Model was developed which was validated by our national consultants. Separate viabilities for individual technologies and products suggested in each commodity are also estimated. This humongous task would not have been possible to complete without the excellent cooperation and facilities provide by CABI, the hard work of commodity specialists and our research team especially Mr. Yasar Saleem Khan and Ms Aqsa Yaseen. The true reward of our hard work is the implementation of the proposed policies, strategies and interventions to develop agriculture commodity clusters in the country.

Dr. Mubarik Ali
Team Leader
Cluster Development Based Agriculture
Transformation Plan-Vision 2020 Project
Planning Commission of Pakistan and
CAB International



ACKNOWLEDGEMENT

It is not possible to mention the names of all those who collaborated with us in completing this report, but my foremost gratitude goes to numerous stakeholders along the value chain who generously shared the information about barley production, marketing, trade and value chain. Without their support, this report would not have reached to the level of present quality.

My sincere thanks go to **Planning Commission of Pakistan** for this initiative and especially financial assistance to complete the project activities. Here I am especially thankful to **Dr. Muhammad Azeem Khan** (Ex-Member, Food Security and Climate Change, Planning Commission of Pakistan), **Dr. Aamir Arshad** (Chief Agriculture, Planning Commission of Pakistan), **Mr. Muhammad Akram Khan** (Project Director; CDBAT project) and other CDBAT project team member **Mr. Muhammad Arif** (Research Associate) and **Dr. Habib Gul** (Research Associate) for successful coordination and support for the project.

I am also grateful to **Centre for Agriculture and Bioscience International** (CABI) and its Regional Director for Central and West Asia, Dr. Babar Ehsan Bajwa and CABI team especially Mr. Yasar Saleem Khan for selecting me as commodity specialist for this task and offering outstanding cooperation, support and advice during all the stages of this project. However, the research team takes the responsibility of any shortcoming left in the report.

Shamoon Sadiq
Senior Author

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DISCLAIMER

This report is prepared by using the data from various published and unpublished sources and that obtained during the consultations with stakeholders. The research team took utmost care to arrive at the figures to be used, but is not responsible for any variation of the data in this report than those reported in other sources. Moreover, the views expressed in this report are purely of the authors and do not reflect the official views of the Planning Commission of Pakistan, Ministry of Planning, Development and Special Initiatives or the Centre for Agriculture and Bioscience International (CABI).



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LIST OF ACRONYMS

AARI	Ayub Agriculture Research Institute
ACIAR	Australian Centre for International Agricultural Research
AMIS	Agriculture Management Information Service
ADP	Annual Development Plan
AESA	Ago-Eco System Analysis
AMRI	Agriculture Mechanization Research Institute
ASF	Agribusiness Support Fund
ASLP	Agriculture Sector Linkages Program
B2B	Business-to Business
BOI	Board of Investment
CABI	Centre for Agriculture and Bioscience International
CPEC	China-Pakistan Economic Corridor
CRI	Citrus Research Institute
DPP	Department of Plant Protection
EU	European Union
FAO	Food and Agriculture Organization
FEGs	Farmers Enterprise Groups
FFS	Farmers Field School
FSC&RD	Federal Seed Certification & Research Development
FTA	Free Trade Agreement
GAP	Good Agriculture Practices
HEC	Higher Education Commission
ICM	Integrated Crop Management
IPM	Integrated Pest Management
M.	Million
MRL	Maximum Residue Limit
NRSP	National Rural Support Programme
PARC	Pakistan Agriculture Research Center
PBIT	Punjab Board of Investment & Technology
PCSIR	Pakistan Council of Scientific and Industrial Research ()



PHDEC	Pakistan Horticulture Development & Export Company
PMO	Producer Marketing Organization
PMU	Project Management Unit
PTD	Participatory Technology Development
RSP	Rural Support Program
SIDB	Sindh Industrial Development Board
SMEDA	Small and Medium Enterprises Development Authority
SPS	Sanitary and Phyto-Sanitary
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TDAP	Trade Development Authority of Pakistan
TEVTA	Technical Education & Vocational Training Authority
UAF	University of Agriculture Faisalabad
UK	United Kingdom
WTO	World Trade Organization
ZTBL	Zarai Taraqati Bank Ltd
AMD	Agriculture Market Development
PEEP	Punjab Enabling Environment Project
PATTA	Pakistan Agriculture Technology Transfer Activity



EXECUTIVE SUMMARY

Globally citrus is cultivated on 6.4 million ha producing 106.7 million tonne of citrus with an average yield of 16.6 tonnes per ha. In Pakistan, it accounts for about 40% of total production of all fruits in the country by occupying around 193.7 thousand has and producing 2.4 million tonne of citrus with an average yield of 12.4 tonne per ha. As per the last latest available statistics, the trade value of global citrus related exports has reached US\$15 billion. Pakistan has earned US\$180 million from the citrus related exports (mainly fresh Kinnow), thus citrus is at the top fruit export commodity from Pakistan. At the global scale, around 60% of the world export earnings come from the fresh export of citrus, while remaining 40% from citrus juices, while these ratios for Pakistani export is 89% and 11% respectively.

The Kinnow (*Citrus reticulata* blanco) variety accounts for 85% of the total citrus production in the country. Around 90% of the world production of this variety comes from Pakistan. Pakistan's citrus production has been expanding at a rate of 1.58% per annum from 2001-16 as compared to the world average increase of 1.8% per annum. Therefore, Pakistan has lost its relative position from 11th to 12th among the citrus producing countries of the world. However, during this period, Pakistan has expanded its export quite rapidly at a rate of over 17% per annum compared to the growth in global export at 6.6%. This not only helped to improve the export-production ratio of the country but also its relative position among the world citrus exporting countries.

However, analysing more closely the overall performance of the country in citrus, the high growth in citrus exports seems to be not sustainable due to several reasons including: i) lower rate of growth in citrus production in the country than its population growth; ii) far lower per ha yield of citrus in Pakistan than in the major citrus producing and exporting countries of the world (despite some improvements in yield during 2000s); iii) low quality produce and export as depicted by 48% lower export price than the world average, which restricts Pakistan's export in low-end gradually shrinking markets; and iv) low percentage of citrus that is being processed. In fact, these weaknesses in Pakistan's citrus value chain have started impacting Pakistan citrus exports during 2012-16 as depicted in the dramatic slowdown in the growth of citrus export and turning the growth in export-production ratio to negative. All these actualities points towards the problems in Pakistan's citrus competitiveness especially in the international markets.

In view of the importance of citrus in terms of generating income and employment in rural economies and earning foreign exchange for the country, the Planning Commission of Pakistan initiated this study to analyse its whole value chain, identify constraints and potentials and recommend policies and viable interventions to overcome the competitiveness issues of citrus. To incorporate the regional variations, the analysis in this study is conducted on citrus cluster level.

Citrus is grown in all four provinces of the country, but 95% of total citrus production comes from Punjab province. Central Northern Punjab is identified as the major citrus growing district which consists of Sargodha districts and two of its surrounding districts, M.B Din and Khushab and Sargodha being its centre point. Khyber Pakhtunkhwa (KP) province is known



for its quality production, however, production in KP is currently very minimum thus does not qualify for the in-depth analysis in this study. However, with the appropriate government support we see it as a potential future cluster. In other provinces, citrus production is insignificant. Areas under different varieties indicate that about 85% of the citrus is covered by the Kinnow variety followed by Musambi (10 %), Feutral (4%) and Blood Red (1%). Thus, the main focus of this study is on Kinnow variety grown in Punjab cluster.

Kinnow sector has been the most vibrant among other fresh fruits sector in Pakistan. The key reason has been of having a relatively well-developed processing industry as compared to the processing of other fresh fruits in Pakistan. According to survey there are around 250 Kinnow processing enterprises in Sargodha district with an installed capacity to wash, grade, wax, and pack over 1.6 million tonne for primarily export markets. The success of this sector has been due to the pull strategy by opening of Russian market which led the establishment of this sizeable processing industry, the main driver for Kinnow cluster. Enhanced exports led to improvement of the whole supply chain i.e. production, infrastructure, quality improvement of Kinnow in domestic supply chain, networking, etc. Overtime, the citrus processing industry has developed an excessive installed capacity and this competition is bringing new innovation in the citrus industry such as product differentiation by using corrugated box for high-end market and applying innovative marketing strategies.

In consultation with stakeholders, this study has identified various constraints along the citrus value chain including its production, processing, marketing and export segments. At production level these include low density and low productive citrus orchards, primitive management practices such as flooded irrigation, unscientific pruning, etc. non-availability of healthy planting materials of diversified improved varieties and infestation of diseases. At the processing and value chain levels, these constraints include improper packaging and transportation, inadequate storage facility, limited processing and lack of certification and branding. At export level, poor quality of the produce (only less than 30% of the total production of citrus in Pakistan is of first grade) especially excessive seed numbers in the fruit and citrus canker, dependence on only one variety for very limited time, dependence on few markets, non-compliance of SPS protocols and lack of certifications. Dysfunctional citrus innovation system to address the emerging issues for quality demand and poorly functioning financing system to meet the needs of various stakeholders in the value chain are the major constraints at institutional level.

In order to address multilevel challenges from production to product and market development, performance targets are set, based on global average for yield, quality and export, and the interventions are designed to meet these targets over the period of five years. These interventions include restoration of orchards, strengthening of research, capacity building of stakeholders including producers, processors, and value chain agents, incentivizing the establishment of cold chain infrastructure and collection centres, certification of production practices, and promotion of export in high end market. A total of 490 small farm-level cold storages and 74 collection centres will be established in rural areas. These interventions are to be initiated by government and executed in collaboration with participation of private sector including the farmers, exporters, traders and processors. The total estimated investment of this cluster development/up-gradation plan is US\$79.7 million. Out of this, about 31% will be shouldered by the government in terms of



strengthening the research capacities, capacity building of stakeholders, setting up PMUs, subsidies on cold chain infrastructure, restoration of orchards and pack-houses, and providing interest free loans on the establishment of these infrastructures for the first year. It is expected that these incentives will encourage the private sector to bring the remaining 61% investment to establish the cold chain and value chain infrastructure.

These investments will improve various activities along the value chain which will require additional operational costs. During the 5th year of the project, these operational costs will be US\$48.7 million (discounted). It is assumed that revenues are to incur over a period of eight years when the last renovated plant will start generating benefit which will be worth of US\$199 million (undiscounted) during the last year of the project. Accounting for all the yearly value chain costs including the production, processing and marketing costs applied over five years as well as the investments applied in first four years, the estimated Net Present Value of the up-gradation plan is expected to be US\$474 million and the Internal Rate of Return (IRR) for the focal point of citrus cluster is 145%. The citrus up-gradation plan is also expected to create thousands of new jobs in rural area and additional foreign exchange of about US\$106 million.

These returns of the citrus up-gradation plan will be achieved only if the holistic cluster approach is adopted in meeting the requirements of the cluster. Strengthening of research, organizing of producers into FEGs to address quality issues and establish and manage value chain infrastructure in groups, capacity building of stakeholders along the value chain to produce and manage the quality requirements of citrus and linking stakeholders with international markets would be the key for the success of the program.



Summary Sheet

Information	Punjab Cluster
Area of cluster focal point (ha)	88,398
Production of the cluster focal point (tonnes)	1,115,787
Yield of the cluster focal point (tonnes/ha)	12.62
Annual yield growth without intervention (%)	1.2%
Area on which certified gardens will be established (ha)	3,536
Additional production from renovation of garden in 8 th year (000 tonnes)	188.5
Expected additional value from renovation of garden (000 US\$)	39,204
Increase in production due to improvement in management practices (000 tonnes)	119.4
Additional value of production due to improved management practices (000 US\$)	24838.7
Increased in production due to reduced post-harvest losses (000 tonnes)	277.0
Expected additional value of production due to reduction of losses (000 US\$)	57625.7
Enhanced volume of citrus to be exported due to improved int'l linkages (000 tonnes)	55.2
Added value from enhanced exports-production ratio (US\$)	24337.8
Expected additional value from exports with improvement in export-quality (000 US\$)	30714.7
Production with improved value chain in the domestic and international market (000 tonnes)	149.2
Additional production value - improvement in VC intervention (domestic and int'l)– (US\$)	77344.3
No of cold storage required	490
No of Collection center required	74
Investments (000 US\$)	
Investments on strengthening of research	1,851.9
Investment on training of farmers for Global Gap	155.556
Investment on capacity building value chain agents	13,333
Investments required on promotion of export	537.037
Investment on PMU	1,721.0
Government loans	4613.0
Investment on new garden	12,938.8
Certified citrus nursery establishment	457.4
Certification of production practices	1,437.4
Infrastructural Cost of cold storage	40499.6
Infrastructure cost on value addition-Collection Centres	13964.6
Total investment required over five year	79725.9
Total public sector investments, including loans and subsidies	24653.5
Total private sector investment	55072.4
Economic Analysis (000 US\$)	
Total increase in production due to all the yield increasing interventions (000tonnes)	628.3
Expected increase in export (000 US\$)	105753.2
Expected Gross Revenue due to all interventions in the 5 th year (000 US\$)	199049.7
Additional operational cost due to all intervention in the 5 th year (000 US\$)	48,707.3
Net cash flow from all Cluster Development Interventions (000 US\$)	145,970
NPV (000 US\$)	474,013
Internal Rate of Return	145.35%



1 INTRODUCTION

Amongst the wide array of horticultural crops grown in Pakistan, citrus hold a prominent position because of strong production base, domestic demand as 84% is consumed in the domestic market, export potential which would contribute to the country's socio-economic development. It occupies an important position among fruit in Pakistan as It accounts for about 40 percent of total production of all fruit in the country. Kinnow variety, mainly produced in Punjab, holds 95% of the total citrus production of the country. Citrus is mainly consumed as fresh although home produced citrus juice is very popular drink during the peak season of its supply. Nevertheless, only 2% of the total production is processed mainly in juice at the household and factory level.

1.1 Citrus Production and Trade in Pakistan

Citrus is grown on around 194 thousand ha and producing 2.4 million tonnes of citrus. It is grown in all four provinces of the country. Punjab is the center of production and supplies of citrus, mainly kinnow fruit of high quality and grade, contributing over 95% of citrus area and 97% of production. This is followed by Sindh having 4.9% share in production and 1.3% share in production (Table 1). Per ha yield of citrus is also highest in Punjab.

Table 1: Spread of citrus cultivation across province in Pakistan, 2014-15

Province/country	Area (000 ha)	Share (%)	Production (000 tonne)	Share (%)	Yield (tonnes/ha)
Punjab	183.4	94.7	2328.1	97.2	12.7
Sindh	4.9	2.5	30.1	1.3	6.1
KP	4.0	2.1	31.0	1.3	7.8
Balochistan	1.4	0.7	7.0	0.3	5.0
Pakistan	193.7	100.0	2396.2	100.0	12.4

Source: MNFS&R (2018)

Several varieties of citrus are grown in Pakistan (Table 2), Areas under different varieties indicate that about 85% of the citrus is covered by the Kinnow variety followed by Musambi (10%), Feutral (4%) and Blood Red (1%) (Asad Zahoor 2014). In 2015-16, not only Kinnow is the prominent variety in Pakistan, the country also accounts for over 90 percent of the world total production of kinnow – citrus reticulate variety (FAOSTAT: Production, Crops, <http://www.fao.org/faostat/en/#data/QC>).



Table 2: Varieties of Citrus Fruit in Pakistan

Variety	Main Features
Sweet Orange	Succri, Musambi, Washington Navel, Jaffa, Red Blood, Ruby Red & Valencia Late
Mandarins	Feutrell's Early & KINNOW
Grapefruit	Mash Seedless, Duncan, Foster & Shamber
Lemon	Eureka, Lisbon Lemon & Rough Lemon
Lime	Kagzi Lime & Sweet Lime

Source: PHDEC 2005, <http://www.phdec.org.pk/MktStrategies/Citrus.pdf> & <https://www.intechopen.com/books/agricultural-value-chain/citrus-value-chain-s-a-survey-of-pakistan-citrus-industry>

In Punjab more than 90% of kinnow is grown whereas oranges are mainly grown in KP. Besides mandarins (Feutrell's and Kinnow), other citrus such as Sweet orange (Musami and Red Blood) are very important among all the citrus varieties cultivated in Pakistan.

The majority of the farmers in Pakistan own and cultivate a small size of agricultural land of less than 2 has. However, in Punjab, average citrus farm size is 12.3 ha, which is considered relatively large compared to other crops (Chaudry, 2004). The size of citrus orchard ranges from less than 1 ha to as big as 65 has in different regions of the country. A few large citrus growers do exist; however, small and medium size growers are the majority.

The industry's main actors are orchard owners/growers, pre-harvest contractors, commission agents, exporters, wholesalers and retailers. Both production and marketing of citrus for domestic and export markets is handled by the private sector. The role of the public sector is limited to facilitation through its various research and development, market promotion and extension institutions. The citrus industry provides seasonal employment opportunities for the country's rural labor force, with jobs ranging from orchard management and picking to packaging and other postharvest operations.

1.1.1. Trends in Citrus Production

The country's citrus production has increased from 1898 thousand tonnes in 2001 to 2396 tonnes in 2015. This is about 26% increase in 14 years at a rate of 1.6% per annum. It is worth noting that this increase is lower than the population growth at 2.1% suggesting that per capita consumption of citrus might have declined over the time in the country. Moreover, lower increase in production than the population growth along with high export to be discussed in the next section has created pressure on citrus prices in the country.

Most of the increase has come through improvement in per ha yield while area expanded at a rate of only 0.3% per annum. These trends at the country level have seemed to be further strengthened when the data for the last five years are analyzed, i.e., the rate in area increase has further declined to negative while per ha increase in yield has further strengthened at 3.4% per annum. Similar trends are observed in Punjab over the period. However, in Sindh, the increase in citrus production is lower than the area expansion, suggesting that per ha yield is declining during this period. In KP and Balochistan, area, production, and yields all are on the declining trends (Table 3).



Although the trend in production of citrus has been positive but variation was quite high during the last ten years which is believed to be due to temperature variations in the growing areas. Such variation in temperature was recorded in 2007-2008 due to which the production dropped from 2.5 to 1.4 million tonne. Due to this, the per ha yield has also been fluctuation between 7.6 tonnes/ha during 2007-2008 and 12.8 tonnes/ha in 2005-06 (Table 3).

Table 3: Province wise area production of Citrus from 2001-2016

Year	Punjab		Sindh		KP		Baluchistan		Pakistan	
	Area	Prod	Area	Prod	Area	Prod	Area	Prod	Area	Prod
	(000 ha)	(000 tonnes)	(000 ha)	(000 tonnes)	(000 ha)	(000 tonnes)	(000 ha)	(000 tonnes)	(000 ha)	(000 tonnes)
2001-02	187.6	1813	3.9	30.9	4.8	40.2	2.4	13.6	198.7	1897.7
2002-03	183.2	1751	4.1	28.1	4.5	37.5	2.4	13.7	194.2	1830.3
2003-04	170.8	1623.5	4.1	27.7	4.3	38	2.4	13.1	181.6	1702.3
2004-05	166.6	1688.7	4.2	28.5	4.4	37.2	1.3	5.9	176.5	1760.3
2005-06	173.9	1872.3	4.2	28.6	4.4	36.8	1.3	6.0	183.8	1943.7
2006-07	182.1	2385.1	4.4	29.5	4.5	37.7	1.3	6.1	192.3	2458.4
2007-08	183.3	1400.7	4.5	31.5	4.1	34.4	1.3	5.8	193.2	1472.4
2008-09	189.2	2219.3	4.5	30.9	4.4	35.9	1.3	8.4	199.4	2294.5
2009-10	189.8	2059.5	4.5	30.5	4.2	33.8	1.4	8.4	199.9	2132.2
2010-11	188.2	2077.5	4.5	30.5	4.3	35.1	1.4	6.9	198.4	2150
2011-12	184.2	1912	4.9	30.9	4	32.3	1.4	7.0	194.5	1982.2
2012-13	183.6	2076.8	4.9	30.9	4.1	32.6	1.4	7.0	194	2147.3
2013-14	183.3	1930.1	5.1	31.4	4.2	33.3	1.4	7.0	194	2001.8
2014-15	183.2	2097.7	5.1	30.9	4	31.6	1.4	7.5	193.7	2167.7
2015-16	183.4	2328.1	4.9	30.1	4	31	1.4	7.0	193.7	2396.2
Annual growth (%)	0.3	1.7	1.8	0.6	-1.0	-1.6	-3.2	-3.4	0.3	1.58

Source: FAOSTAT, Production, Crops <http://www.fao.org/faostat/en/#data/QC>

1.1.2. Export of Kinnow from Pakistan

Kinnow also tops the list of foreign exchange earners among the horticulture exports from Pakistan, contributing over US\$180 million to the country's foreign exchange earnings (Table 4). Pakistan has been exporting both fresh citrus and its juices, the value of both has been constantly rising during 2001-16 at 17.3% per annum. Overall an increase of 831% has been observed in these exports. This high rate was achieved because of the low export value of only US\$19.3 million to start with in 2001. However, the growth in the export value of fresh and juices of citrus has significantly lowered to 3.4% per annum during the last five-year period of 2012-16, which is a serious concern for business community and policy makers.

The export of fresh citrus (mandarin) dominates contributing about 89% in the total citrus related export from Pakistan, while remaining 11% comes from mandarin juices. The average growth rates in the quantity and value of fresh citrus export during 2001-16 is 10.7% and 17.6% per annum, respectively. The growth in the quantities of citrus-juice export is slightly lower than the quantities of fresh citrus export, but opposite is true when the export rates for the values of citrus-juice and fresh-citrus are compared (Table 4).



Table 4: Trend in Pakistan's Export of Fresh Citrus and Citrus juice during 2001-16

Year	Citrus (mandarin) juices		Citrus (mandarin) Fresh		Total citrus related trade	Export-production ratio
	Quantity (000 tonnes)	Value (M. US\$)	Quantity (000 tonnes)	Value (M. US\$)	Value (M. US\$)	(Percent)
2001	3.01	2.41	107.7	16.9	19.3	5.67
2002	3.71	3.14	123.2	21.7	24.8	6.73
2003	2.07	1.78	95.1	22.1	23.9	5.59
2004	2.01	1.68	151.3	30.7	32.4	8.59
2005	7.75	6.36	79.0	21.7	28.1	4.06
2006	3.65	3.51	192.6	39.3	42.8	7.84
2007	7.34	9.16	123.3	32.9	42.1	8.37
2008	3.38	3.28	215.1	47.9	51.2	9.38
2009	6.85	6.46	178.0	44.3	50.8	8.35
2010	7.17	6.87	363.4	99.4	106.3	16.90
2011	9.63	9.99	331.8	124.0	134.0	16.74
2012	11.20	13.76	368.3	147.6	161.3	17.15
2013	15.08	14.68	365.3	155.4	170.1	18.25
2014	18.78	18.36	363.4	164.9	183.3	16.76
2015	25.34	20.09	407.7	171.9	192.0	17.01
2016	29.82	20.87	356.6	159.3	180.2	17.5
Growth rate (%)	16.15	15.59	10.7	17.6	17.3	9.9

Source: FAOSTAT Trade, Crops and Livestock Products: <http://www.fao.org/faostat/en/#data/TP>

With the high growth in citrus export, the production-export ratio has also observed the similar rate. The ratio has increased from 5.7% in 2001 to 17.5% in 20016 with an average yearly growth of 9.9% (Table 4). However, during the last five-year period of 2012-16, the growth in export-production ratio has turned into negative at 1.7% per annum. This is an alarming sign of losing competitiveness of Pakistan in international market. The possible reasons are deterioration in quality of fruit, lack of quality consideration and substandard exports, and competition from Turkey, Egypt and Morocco as they are supplying better quality and seedless mandarins at competitive price.

1.2 Global Context

1.2.1. Global vs Pakistan Comparison

Pakistan contributes 2.9% in the global citrus (mandarin and orange) area, while its contribution in production is only 2.0% because of its lower average yield than the world average. Pakistan attained 12.19 tonnes/ha in 2016, which is only 70% of the global average yield of 16.74 tonnes/ha. While Pakistan contributes 3% in the quantity of citrus export globally, its contribution in the export earnings is 1.75% because of the lower price that Pakistani export earns than the world average export price. Pakistani citrus exports fetch



only 58% of the world average export price suggesting the lower quality of Pakistani citrus as judged in international market (Table 5).

Farm gate price of citrus in Pakistan is US\$ 270 tonnes which is 31% lower than the international average farm gate price of US\$ 391 tonnes, providing Pakistan the competitive edge in the international market as well opportunities to attract investment in citrus production, producing exportable quality and developing value chain infrastructure (Table 5).

Pakistan exports higher proportion of its production than the world average. Pakistan's export-production ratio is 16% compared to the world average of 11% in terms of quantity while in terms of value of export these ratios are 27% and 22%, respectively. However, Pakistan's share in the total export juices is very small (Table 5).

Table 5: Comparison of World vs. Pakistani Citrus Sector (2016)

Parameter	World	Pakistan	Share (%)
Area (000 ha)	6428	187.2	2.91
Production (000) tonne	106727	2175.8	2.04
Value of production (M. US\$)	41778	588.3	1.41
Yield (tonne/ha)	16.60	11.6	70.01
Farm gate price (US\$/tonne)	391	270	69.07
Quantity of international trade (000 tonnes)	11891	356.6	3.00
Value of international trade of fresh citrus(M. US\$)	9094	159.29	1.75
Export quantity as % of production	11%	16%	-
Export value as % of production value	22%	27%	-
Average export prices of fresh citrus (US\$/tonne)	765	447	58.41
Quantity of citrus juices exported (000 tonnes)	5855.8	29.82	0.5
Value of citrus juices exported (M. US\$)	5940.7	20.87	0.3

Source: FAOSTAT: Production, Crops: <http://www.fao.org/faostat/en/#data/QC>

FAOSTAT: Trade, Crops and Livestock Products: <http://www.fao.org/faostat/en/#data/TP>

1.2.2. Global Citrus Production

The global production of citrus during 2016 was 107 million tonnes grown on the total cropped area of 6.4 million has. The citrus production globally has increased at a rate of 1.8% per annum, much higher than the average increase in the world population suggesting that per capita consumption of citrus is increasing overtime. The FAO balance sheet shows that per capita annual consumption of citrus at the global level has increased from 10.8 kg in 2001 to 12.4 kg in 2013, i.e., a 15% rise during the period. On the other hand, Pakistan's citrus consumption has declined from 10.8 kg to 8.8 kg in the corresponding year suggesting a 19% decline during the period (FAOSTAT: Food Balance Sheet: <http://www.fao.org/faostat/en/#data/CC>). This decline in Pakistan is due to slow production increase, and high export from Pakistan along with high population growth during the period.



Table 6: Trend in Global Citrus Production during 2001-17

Year	Area (million ha)	Production (M. tonnes)	Yield (tonnes/ha)
2001	5.326	81.220	15.25
2002	5.434	83.495	15.37
2003	5.486	82.001	14.95
2004	5.686	88.572	15.58
2005	5.749	87.305	15.19
2006	5.808	91.517	15.76
2007	6.083	85.870	14.12
2008	6.093	90.857	14.91
2009	6.175	90.946	14.73
2010	6.372	94.692	14.86
2011	6.326	99.879	15.79
2012	6.245	98.296	15.74
2013	6.497	102.135	15.72
2014	6.529	103.443	15.84
2015	6.536	105.861	16.20
2016	6.465	106.012	16.40
2017	6.428	106.727	16.605
Annual growth (%)	1.297	1.802	0.50

Source: FAOSTAT: Production, Crops: <http://www.fao.org/faostat/en/#data/QC>

Pakistan ranks at 12th in global production, which has declined from 11th position in 2001 due to slower growth in citrus production in Pakistan. The major citrus producing countries of the world are China, Brazil and India accounting for over one-half of the global citrus production. As noted earlier, Pakistan's per ha yield is lower than the world average. As a matter of fact, it is much lower than some of the competitive countries such as Turkey, Egypt and Morocco (Table 7). These high yields in these countries have been achieved through better farm management, adaption of GAP/SPS protocols, mechanization, high density plantation and development of appropriate infrastructure.



Table 7: Top Citrus Producing Countries of the World (2016)

Rank	Citrus Producing Countries	Production		Area		Yield
		000' Tonnes	% Share	000' Ha	% Share	Tonnes/Ha
1	China	32,378	24.5%	2,422	30.7%	13.37
2	Brazil	19,625	14.9%	761	9.6%	25.80
3	India	10,410	7.9%	902	11.4%	11.54
4	Mexico	7,939	6.0%	528	6.7%	15.03
5	USA	7,920	6.0%	298	3.8%	26.61
6	Spain	7,083	5.4%	294	3.7%	24.08
7	Egypt	4,310	3.3%	176	2.2%	24.46
8	Turkey	4,291	3.3%	135	1.7%	31.68
0	Argentina	3,281	2.5%	131	1.7%	25.04
10	Iran	2,984	2.3%	154	1.9%	19.41
11	Italy	2,528	1.9%	145	1.8%	17.39
12	Pakistan	2,344	1.8%	192	2.4%	12.19

Source: FAOSTAT: Production, Crops: <http://www.fao.org/faostat/en/#data/QC>

1.2.3. Global Citrus Trade

Globally, citrus related (i.e., fresh and juice) export has reached to US\$15 billion in 2016. About 60% of this export value consists of fresh citrus export, while remaining 40% comes from the export of citrus juices. The total export of citrus related export increased with an annual growth rate at 6.5% per annum. This growth consists of expansion in both the export of fresh citrus as well as in citrus juices, although growth in fresh citrus export is about 50% higher than its juices (Table 8). As noted earlier, an encouraging aspect of Pakistan's citrus value chain is that citrus related export from Pakistan experienced a far higher growth in citrus related export (17.3% per annum-Table 4) than the world average.

Globally, about 11.9 million tonnes of fresh citrus was exported during 2016 with an estimated value of US\$9.1 billion. This is up from 7.2 million tonnes of fresh citrus export worth of US\$3.2 billion in 2001 implying an average growth rates in these values at 3.8% and 7.2% per annum, respectively (Table 8).

In addition, about 5.86 million tonnes of fruit juices were exported during 2016 with an estimated value of US\$5.9 billion. These values have increased from 4.2 million tonnes worth of US\$2.7 billion in 2001 with an average annual growth rate of 2.5% and 5.7% during 2001-16 (Table 8).

About 11.2% of the citrus produced globally are traded internationally. The export production ratio has increased from 8.9% in 2001 with an average growth rate of 1.99% per annum (Table 8). This suggests that citrus is increasing becoming an international commodity with higher proportion of its production is consumed at somewhere else than the place of its production. Because of the faster expansion in export during the period, Pakistan's export-production ratio has increased at higher rate and now surpassed the world average ratio. This, however, as noted earlier, has adverse impact on the per capita consumption of citrus in the country.



Table 8: Trend in the Global Export of Fresh Citrus and Citrus Juices during 2001-16

Year	Citrus (orange and mandarin) juices		Citrus (orange and mandarin) Fresh		Total citrus related trade	Export-production ratio
	Quantity (000t)	Value (M. US\$)	Quantity (000t)	Value (M. US\$)	Value (M. US\$)	(Percent)
2001	4197.7	2704.2	7198.3	3167.3	5871.4	8.86
2002	3744.4	3053.2	7313.5	3620.9	6674.1	8.76
2003	4350.9	3504.6	7796.1	4425.2	7929.8	9.51
2004	4462.5	3379.3	7981.6	4924.6	8303.8	9.01
2005	4993.9	3767.5	8313.4	5093.0	8860.5	9.52
2006	4928.3	4534.2	8714.0	5100.5	9634.7	9.52
2007	5448.3	6182.6	8920.1	6061.9	12244.5	10.39
2008	5632.7	6167.9	9498.5	7150.9	13318.9	10.45
2009	5578.1	5283.5	10427.5	7630.2	12913.6	11.47
2010	5486.2	5628.5	11000.4	8315.3	13943.8	11.62
2011	5694.8	7032.7	11474.8	9024.3	16057.0	11.49
2012	5370.8	6594.8	11450.3	8998.8	15593.5	11.65
2013	5767.0	6711.3	11943.6	9506.4	16217.7	11.69
2014	5663.4	6356.0	11840.3	9167.1	15523.1	11.45
2015	5770.9	5932.1	11537.3	8810.8	14742.9	10.90
2016	5855.8	5940.7	11891.4	9093.9	15034.6	11.22
Growth rate (%)	2.5	5.7	3.8	7.2	6.6	1.99

FAOSTAT: Trade, Crops and Livestock Products: <http://www.fao.org/faostat/en/#data/TP>

The top citrus exporting countries to whom Pakistan has to compete in international market are Spain, Turkey, South Africa, and China accounting for about one-half of the export. South Africa is not the major citrus producing country of the world, but stands at 3rd rank among the top citrus exporting countries. On the other hand, India is at 3rd position in citrus producing countries of the world, but does not come among the top citrus exporting countries because of the large consumption of its own as well lower quality of citrus being produced in India. USA, China and Netherland are the countries fetching the highest price of their citrus export, while Pakistan fetches the lowest export price. In 2016 the Pakistan's export price was US\$ 441/tonne whereas the world average price in 2016 was US\$ 845/tonne (Table 9). This huge gap in export price indicates the poor value chain management of the produce as will be discussed in the coming sections. Pakistan has to learn a lot from its neighbouring country China on how to upgrade its value chain to the international requirements.

Table 9: Top Citrus Exporting Countries of the World (2016)

s.#	Exporters	Exports Quantity		Value		Price
		(000 tonnes)	Share %	(million US\$)	Share %	US\$/Tonne
1	Spain	3624.8	22.9%	3479.6	26.0%	959.9
2	Turkey	1706.7	10.8%	893.4	6.7%	523.5
3	South Africa	1701.4	10.7%	1166.0	8.7%	685.3
4	China	934.3	5.9%	1303.8	9.7%	1395.5
5	Egypt	824.0	5.2%	572.2	4.3%	694.4



s.#	Exporters	Exports Quantity		Value		Price
		(000 tonnes)	Share %	(million US\$)	Share %	US\$/Tonne
6	Mexico	750.6	4.7%	485.3	3.6%	646.6
7	USA	656.3	4.1%	1039.7	7.8%	1584.2
8	Netherlands	618.0	3.9%	795.8	5.9%	1287.7
9	Greece	613.4	3.9%	269.9	2.0%	440.0
10	Morocco	607.2	3.8%	361.9	2.7%	596.1
11	Argentina	394.4	2.5%	364.2	2.7%	923.6
12	Pakistan	388.5	2.5%	171.5	1.3%	441.4

Source: ITC (2016)

Among the citrus importing countries, Russia is the leading importer with 10% share in the global market followed by EU countries with 27.5% share. The major EU countries importing citrus are Germany, France, Netherlands and UK. Netherland is a redistributor country as most of the sea shipment citrus goes through Rotterdam the largest sea port of Europe, which are then transported to other EU countries.

Russia is the biggest importer of citrus fruit with total import of 1.5 million tonnes in 2016 (Table 10). Imports in Russia are mainly coming from countries like Turkey, Egypt, Morocco, China, South Africa and Pakistan. EU imports, which accounts for 27.5% of the global imports, is mainly supplied by Spain and other EU countries with little contribution from Turkey, Egypt and Morocco. The biggest importing countries in the Middle East are Saudi Arabia, Iraq and UAE which accounts for 11% of the global imported quantity with a value of US\$1.6 million. Although Pakistan is well established in the Middle East and Russian markets but in recent years the competitors such as Turkey, Egypt and Morocco have strengthened their market positions, which is mainly due to better quality and seedless fruit and have advantage of being located in the proximity of Russia and Middle East countries. China's recent growing presence in these markets is also a serious concern for Pakistan as she is supplying seedless mandarins and clementine. The future focus should be towards market diversification, entering the high-end markets with high growth rates. The potential countries in Europe are Germany, France and Netherlands. In the Far East there are new emerging markets such as China, Indonesia and Hong Kong (it's a redistributor country) with growing imports and high growth rates. Other potential countries which need to be tapped are Iraq which is the 7th biggest importing country and Pakistan has very little presence there, and Canada due to presence of South Asian population. Export potential to China is enormous due to very big consumer market, FTA status, and proximity to Pakistan and upcoming CPEC infrastructure

Table 10: Top Citrus Importing Countries (2016)

sr.#	Importing Countries	Quantity (000 Tonnes)	Share %
1	Russian Federation	1526.8	10.3%
2	Germany	1123.1	7.6%
3	France	1101.5	7.4%
4	Netherlands	1056.6	7.1%
5	United Kingdom	797.4	5.4%
6	Saudi Arabia	669.2	4.5%
7	Iraq	507.9	3.4%



sr.#	Importing Countries	Quantity (000 Tonnes)	Share %
8	Canada	493.4	3.3%
9	United Arab Emirates	458.3	3.1%
10	Poland	428.4	2.9%
11	Hong Kong, China	358.5	2.4%
12	Italy	356.6	2.4%
13	China	295.6	2.0%

Source: ITC

1.3 Need of the Study

Summarizing the macro level citrus sector analysis during 2001-16 in the domestic and international perspectives, it can be concluded that Pakistan, starting from very small base in 2001, has fared relatively well in the citrus export market by exporting its large quantities with a very high export growth rate. This has increased the citrus export-production ratio of the country at a level even higher than the world average ratio.

However, analyzing more closely the overall performance of the country in citrus, the high growth seems to be not sustainable due to several reasons. **First**, the increase in citrus production in the country is far lower than its population growth resulting to the decrease in per capita consumption and pressure on domestic prices in domestic market in the country. **Second**, although growth in citrus yield in Pakistan has been higher than the world average, it remains far lower than in the major citrus producing and exporting countries of the world thus keeping the country uncompetitive with respect to these countries. **Third**, the export price of Pakistani citrus is far lower than the world average indicating weaknesses in the citrus value chain which results lower quality of citrus being traded in international market. As the low-quality and low-price markets are shrinking over time, Pakistan cannot sustain on supplying to the low-end markets for ever; **Fourth**, Pakistan process far lower proportion (11%) of citrus into juices compared to the world average of 40% thus giving the country less opportunity to participate in the processed market. In fact, these weaknesses in Pakistani exports have started impacting Pakistan citrus imports during the last five years' period of 2012-16. The exports have slowed down during this period and export-production ratio has started declining indicating issue in the competitiveness of Pakistani citrus in international markets.

To overcome these competitiveness issues of citrus in domestic and international markets and in view of the importance of citrus in terms of generating income and employment in rural economies and earning foreign exchange for the country, the Planning Commission of Pakistan initiated this study to analyze its whole value chain, identify constraints and potentials and recommend policies and viable interventions. To incorporate the regional variations, the analysis in this study is conducted on citrus cluster level.



2 GOALS AND OBJECTIVES

The overall goal of this study is to contribute to *the Cluster Development Based Agriculture Transformation Plan -V2025*. Specific objectives of the study are:

1. To identify the major cluster of citrus production in Pakistan
2. To characterize and conduct SWOT analysis of citrus cluster
3. To identify technological, institutional, infrastructure and policy gaps in the cluster
4. Assess the potential of citrus production in the cluster
5. Suggest technological, institutional, infrastructure and policy interventions to achieve the cluster potentials
6. Conduct economic and social feasibility of the suggested interventions



3 METHODOLOGY

The project was initiated with a workshop organized by meetings organized by project sponsors CABI/Planning Commission in Islamabad. The main purpose was to have a proper understanding of the study to be conducted and expectations from the project sponsors. The meeting led to the development of the questionnaires and survey methodology.

The data and information related to the characteristics, gap, potential and required interventions to meet the gaps in citrus clusters were collected from three sources:

- a) *Macro-Data*. Macro data was collected and analysed from various sources, main source were ITC data, FAO AGSTAT, UN Comtrade, Pakistan Statistical Year Book 2016, Agriculture Statistic of Pakistan AMIS
- b) *Literature Review*. The literature related to the functioning, gaps, and interventions in citrus value chain is reviewed and synthesized to understand the constraint and potentials of the citrus sector in Pakistan. Besides, all the relevant material, concept papers, proposals, baseline survey reports, project/strategy documents were also reviewed (Detail list of the literature reviewed can be seen in annexure 1).
- c) *Stakeholders Consultations*. The primary data was collected with field visits, holding interviews and focus group discussions with the stakeholders in the citrus supply chain both in Punjab and Sindh. The stakeholders included (detail list in annexure 2):
 - Growers
 - Professional Farm Contractors
 - Provincial Government Agriculture Departments, Research Institutes (Sindh and Punjab)
 - Universities
 - Public Sector Trade Development Agencies
 - Government and Donor Development Programs
 - Input Suppliers
 - Wholesalers/Contractors
 - Processors
 - Regulator – DDP
 - Packaging Material Manufacturers
 - Transporters
 - Exporters

Following generic parameters and indicators are used in collecting the data:

- Global context of citrus sector;
- Production potential and review of citrus sector;
- Cost of production, harvesting, post-harvest processing of citrus from the growers and grower associations;
- Marketing, trading, and processing from traders, wholesalers, retailers, and processors;
- Issues and constraints relating to production, picking, drying, selling, marketing, trading, and processing from all stakeholders;



- Recommendations and benchmarks based on global parameters;

The author then used these data to first identify the citrus cluster in the country and then used his subjective judgment in prescribing the characteristics of each cluster, identifying the cluster strengths, weaknesses, opportunities, and threats (SWOT), investigating the functioning of existing value chain, and quantifying the cluster potentials. Based on the above analysis, interventions for improvement in each cluster were suggested. The cost and benefits of each intervention are also estimated to finally work out the Internal Rate of Return of the whole package. A Citrus Transformation Plan is also formulated which identifies sustainable cluster upgrading strategies for the development of the Citrus sector that can help create significant economic opportunities for producers, processors and all the stakeholders participating at different points of the value chain.



4. LITERATURE REVIEW

With the passage of time, citrus supply chain across Pakistan has faced diminishing returns. Multiple factors are responsible for this: inadequate technical support, non-availability of improved varieties, outdated irrigation system, infestation of diseases and abrupt climatic changes are stressors for the supply chain (Usman et al., 2018). Poor planning and quality ignorance are additional factors affecting supply. Poor quality assurances followed by adoption of traditional packaging practices appear to be detrimental for higher returns in international market (Khan et al., 2012). These conditions are costing loss of millions of dollars to national economy and livelihoods of the growers. (Usman, et. al. 2018)

Pre-harvest losses include different disorders and diseases such as nutritional imbalance, respiratory disorder, temperature disorder, and chilling injury etc. (Umar, 2017). A composite fruit sample (880) analysis showed about 47.5% blemishes were related to diseases (mainly scab like + melanose, and canker), 29.5% linked to insect pest (mainly mites and thrips) and 15% physiological/physical nature. Almost 56.5% fruit showed an unidentified complex syndrome along with potential wind scarring but their severity was low and fruit were exportable. Styler end deformity and skin cracking around fruit shoulder were also present. The significance of cosmetic quality of fruit can be visualized from the farm gate prices of different grades: A-grade: Rupee (Rs) 650-700 /40 kg; B: Rs 250-300/40 kg; C: Rs 80-120/40 kg.

Due to cosmetic quality issues (rind blemishes), the farm gate rejection varied from 20 to 50%, with some orchards completely rejected by exporters (Malik, 2014). Wind, mites and thrips were identified as major blemish causal agents in all Kinnow growing districts. Orchard hygiene is the other main issue, which is not followed by the orchard's owner. Pathogen of citrus blemish disease spread from diseased to healthy plant parts such as leaves and fruits under humid conditions/ rain splashes and flood irrigation water (2008 CABI). Lack of orchard hygiene, over irrigation, unclean harvest tools, and carry over plant debris and soil etc. could be the potential causes of widespread spread diseases (Malik 2014). Improved pruning techniques (removal of 8-10% of total bio-mass of tree) can significantly increase the percentage of "A" grade fruit and improve fruit diameter as well. In experimental study targeted to reduce the canker blemishes, twice foliar application of Bordeaux spray (one in last week of April and other in last week of May) proved to be excellent in controlling citrus canker and improving the skin quality. In confirmatory studies, all the tested treatments were applied as a technology package on a relatively larger scale and results confirmed that percentage of A (25.7%) and B grade (43.3%) fruit were significantly increased as compared to control (traditional practice) (6.3% A grade; 18.7% B grade fruit quality in major production districts (Shafique, 2013).

One of the best Kinnow orchard harvested recorded yield of 550 maunds/acre (55 tonnes ha⁻¹), which was almost at par with citrus yield of Florida (USA) and Australia. According to exporters, the average orchard yield for a well-managed orchard was around one truck/acre (250 maunds per acre or 25 tonnes per ha), while some of the best orchards yielded up to 2 trucks. It is to be noted that our national average yield of citrus is reported at 10 tonnes per ha, clearly indicating the large practical yield gap of 15 tonnes per ha. Provided the required



resources and technology are available and optimally used, Kinnow growers can compete globally in terms of productivity, with good prospects for increasing income (Malik 2014). One reason for low yield is due to small size of the orchards. A big proportion (43%) of the sampled citrus orchards was of size of up to only 5 acres. Small sized orchards are not economically viable. Moreover, it is also very difficult for them to adopt capital intensive technologies. Another reason is non-availability of certified rootstock in the nurseries. A round 40% of the citrus growers reported that they were not satisfied with the current type of varieties of citrus and they were looking for a new variety. The respondents from the nursery owners identified four issues related with quality of plants, which include problem of diseases, improper selection of soil, rootstock, scion, budding method, and budding height. (Siraj 2008).

As far as trimming and pruning are concerned, almost 40 percent of the citrus growers were not having the practice of pruning and trimming their trees. These statistics indicate that there is tremendous scope for boosting the yield and production of Kinnow in the country by creating awareness about pruning and trimming of the citrus trees (Siraj 2008)

Adulteration of the fertilizer has been a common problem reported by the citrus growers. As far as second attribute is concerned, prices of fertilizers have been rising more frequently in the recent past, making availability and accessibility very difficult. Another issue related with soil fertility management is the imbalanced use of fertilizers. Lack of proper knowledge about diseases and PPM results in indiscriminate use of pesticides, which lead to not only failure in achieving the purpose but also causes damage to quality of the fruits. Orchards owners incur considerable losses due to weeds, insects, pests, and diseases (Siraj, 2008).

A majority of the orchard's owners (66 percent) reported 91 to 100 plants/trees (equivalent to 225 to 247 trees/ha) of citrus planted in one acre. Density of citrus trees per ha in Pakistan is low. Closer plantation of citrus trees has proven to have higher yield per acre (Nawaz, Ahmed and Jiskani, 2008). Usman Nawaz al. (2019) revealed that all the pruning treatments were effective but the plants pruned from both sides performed better in terms of improved yield (greater number of fruits and higher total fruit yield per plant) and fruit quality (increased fruit size, higher juice weight, lower peel weight, lower juice TA, greater TSS:TA ratio, and higher total phenolic content (TPC) and total antioxidants) There are several other studies which endorse this view point. For example, Khurshid and Baxter (2006) opine that lower citrus tree density in Pakistan as compared to that in Australia is one of the factors responsible for poor yields in Pakistan. In Australia, 800 to 1000 citrus trees are planted on one ha. Hardy, Sanderson, Barkley, & Donovan (2007) have recommended high-density plantings of 1,000 trees/ha on *P. trifoliata*, and 800 trees/ha on citrange rootstocks.

Post-harvest losses are very high, which range from 22.5 percent to 37.5 percent. There are at least five different types of post-harvest losses in case of citrus, which include losses during picking, handling, packing, transportation and others. Others include biological losses (as perishable) during the waiting period i.e. lag involved between picking and the marketing. The contractors reported that during transportation loss of fruit ranged from 1% in case of packing in paities (wooden boxes) to 5% in case of open vehicle transportation or in case of packed in bags or gatoos (Siraj 2008). Inadequate cold storage facilities are one of the reasons of high post-harvest losses. During peak season, citrus fruits receive only 10



percent share in the total capacity of the storages (Ali, 2004, p. 225). It means only cold storage capacity of just 70,722 tonnes is available for the citrus fruits during the season.

But despite being world's largest exporter of kinnow mandarins, entry in developed country markets is scanty so far, possibly due to their excessive seed content and quality issue (Usman, et. al., 2018). Quality of citrus fruits is one of the important impediments in the export of citrus fruits from Pakistan. Proportion of first-grade fruit is less than 30 percent of the total production of citrus in Pakistan (Johnson, 2006, p. 2). It clearly indicates that if competitiveness of the Kinnow in the international market is to be improved, proportion of first-grade fruit would have to be increased (Ali 2004). For the last six years, kinnow could not be exported to Iran due to reluctance in issuance of import permit by Iranian government. "Import valuation of Pakistani kinnow is unrealistically assessed higher by \$3 per 10kg by the Russian government which makes it almost impossible to compete with Egypt, Morocco and Turkey. Demand of Pakistani kinnow in the international markets is on a sharp decline due to its poor appearance and too many seeds. Pakistan had "self-imposed" temporary embargo on export of kinnow to Europe and UK in 2014 and thus averted likely ban on import of kinnow by these countries (Staff Report 2017).

Only about 7 percent (11 citrus growers) of the respondents informed that they had approached the Extension Department for any technical guidance relating with the citrus orchard management. Less than half (46 percent) of those who approached the extension workers for any assistance indicated that the advice did not prove to be useful. Just over half of the respondents informed that they had never attended any training, seminar or workshop relating to any area of citrus or orchard management. Around one third of respondents had attended training event(s) organized by FFS (CABI).

One of the major constraints which can become a potential threat to the industry is the maximum cultivation and export of Kinnow. Citrus industry has been monopolized by single citrus cultivar. Citrus industry can fall apart if some problem happens with this cultivar (Aatif 2015).

Our discussions with stakeholders suggest that kinnow is normally packed in wooden crates. The wooden crates are available in 5, 8, 10 and 13 kg capacity. According to an estimate, around 400,000 trees would be uprooted annually to meet packaging requirement of citrus industry alone, and together with mango the requirement will almost be doubled. This is an alarming situation from environmental sustainability point of view. The wood is also seen as source of inoculum of different pathogens involved in decline. The situation requires an imminent solution. A possibility is to equate price of locally made cardboard box with wooden crates for a period of two to three years (currently price of locally made 10 kg cardboard box approximately is Rs90 against wooden Rs. 40/crate). One possible way is to give this subsidy to packaging manufacturer and make boxes available at cheaper price. Once cardboard is introduced in local market, industry will pick up looking at its greater benefits (reduced losses, increased market value).

Seedless citrus fruits are highly preferred over fruits with seeds. Average number of seeds in one Kinnow fruit is 12.2 as compared to 11.2 in case of Musambi, 9.5 in Feutral and 8.8 in Succari (Khan, 2010). Number of seeds in one fruit of Kinnow ranges from zero to 54. The seedless trait in Kinnow is possible owing to natural factors like ovule, pollen and pollen self-



incompatibility (Altaf and Khan, 2007, p. 2003). Research is in progress at National Institute of Agriculture and Biology (NIAB) since 1984-86 to develop seedless Kinnow (Ali, 2004, p. 191). The Orange Research Institute, Sargodha has reported that a 'less seeded' (i.e. 2-4 pips) variety of Kinnow has been developed there, however it is under the process of certification. It is source of concern that Citrus Research Centre, located at the University of California, Riverside is in the process of developing seedless Kinnow, which could challenge Pakistani Kinnow (Khan, 2010). Kinnow peak production season of citrus fruits in Pakistan is from December to February (Ali, 2004, p. 224). So presence of Pakistani Kinnow in the world market is for very small span of time. It is therefore, recommended that the researcher may develop such varieties which have extended duration of harvesting.



5. CLUSTER SPECIFICATION AND CHARACTERISATION

5.1. Specification of Cluster

As noted earlier, Punjab province contributes 95% of the total citrus area in the country. So, our cluster specification is confined to Punjab only.

1. **Central-North Punjab Cluster.** In Punjab, citrus cultivation remains concentrated in Sargodha districts and two of its surrounding districts, M.B Din and Khushab (Figure 1). This cluster known as Central-North Punjab Cluster is the main producing area of kinnow with a total are of 101 thousand has having a share of 57.3% in the provincial acreage and 60.4% in provincial production. Sargodha is the focal point of the cluster which alone contributes 50% of provincial area and 53% of the provincial production (Table 11).

Table 11: Major Citrus Growing Districts (2016-17)

PUNJAB	Area (Ha)	Share (%)	Production (tonne)	Share (%)	Yield (t/ha)
Central North Punjab Cluster					
Sargodha	88,398	49.9	1,115,787	52.7	12.62
M.B. Din	9,461	5.3	119,143	5.6	12.59
Khushab	3,602	2.0	44,213	2.1	12.27
Cluster Total	101,461	57.3	1,279,143	60.4	12.61
Potential Future Cluster-Southern Punjab					
T.T.Singh	12,679	7.2	218,161	10.3	17.21
Khanewal	7,176	4.0	97,201	4.6	13.55
Vehari	7,306	4.1	78,572	3.7	10.75
Sahiwal	5,899	3.3	69,068	3.3	11.71
Bahawalpur	6,763	3.8	57,123	2.7	8.45
Multan	5,811	3.3	54,046	2.6	9.30
Layyah	4,486	2.5	42,971	2.0	9.58
Okara	3,566	2.0	36,398	1.7	10.21
Potential Future Cluster-Total	53,686	30.3	653,540	30.9	12.17
<i>Provincial Total</i>	<i>177,215</i>	<i>100.0</i>	<i>2,116,466</i>	<i>100.0</i>	<i>11.94</i>

Source: AMIS

In this citrus following cluster related infrastructure are present:

- Around 250 Processing plants
- 4 Concentrate plants
- Cold Storages
- Packaging Industry
- Citrus Research Institute



- Exporters Association

Districts of Punjab Map – Sargodha Cluster



Figure 1: Map showing Sargodha cluster location in Punjab

2. **Future Potential Cluster (Southern Punjab Cluster).** The kinnow cultivation started in central Punjab from Sargodha but now it has spread over in many districts and the new thrust has been towards southern Punjab such as TT Singh, Khanewal, Vehari, Sahiwal, Bahawalpur and Multan. Some of the mango growers in south Punjab who have started growing kinnow mentioned that they have entered into kinnow production due to better returns, exportable product, longer shelf life and easy to handle fruit as compared to mangoes. Toba Tek Singh has become the most productive citrus district of the country with the average yield of 17.21 tonnes/ha followed by Khanewal (Table 11).
3. **Future Potential Cluster-Southern KP Cluster.** In province KP, six districts are known for this purpose: Mardan, Noshera, and Hazara districts are known for the sweet low-seed oranges. Although, currently the area under citrus is small to qualify a cluster, but with proper support it can be future potential for high-quality citrus production in the country.

5.2. Cluster Characteristics

The detail characterization of the Central North Punjab Cluster is described in (Annexure 3) and salient features of citrus are described here. The cluster is very suitable for growing Kinnow variety. The soil varies from silty loam/clay loam and the climate is semi tropical,



sometime having hot summers and cold winters. Due to extreme temperatures it effects the production. Other climatic constraints are fog during winter and monsoons during summers which negatively affect the production.

The sub-soil water is brackish and hence they rely on the canal water. There are two canals for irrigation, one is open throughout the year and the other one is for 6 months.

The farm size varies from small of few acres to over 50 ha. The average farm size is 12.3 ha. Over 90% of the farmers grow Kinnow committing on long term investment. Education level is much higher in this cluster so it is relatively easy to understand new cultivation methodologies and technologies. Previously 90% of the growers sold their products to pre-harvest contractors. In the last ten years 50% of the farmers are harvesting the garden by themselves and selling the produce directly to the local market or exporter/processor. The migratory labor is available during the harvesting season. Women are also involved in harvesting of citrus. Farmers do not get into pre-determined price and quality contract farming. Few farms are Global GAP certified which is costly intervention which deters farmers to adopt it.

Kinnow is famous for its tingy sweetness with TSS of 11-20%. The weight of the fruit ranges from 100 to 250 grams. The skin is smooth, soft, easy to peel and produce attractive fragrance. It has high number of seeds with average of 20 seeds per fruit.

Kinnow is a high yielding variety. The good kinnow tree is vigorous, top erect, dense leaves, symmetrical with few thorns, but have alternate bearing tendency. The normal planting distance is 20 x 20 feet with 90-100 plants per acre. It takes -5-6 years to bear fruiting which also depends upon culture practices.

Kinnow is commonly propagated on rough lemon (Jitti Khati) rootstocks of unknown parentage. Most farmers source their fruit plants and rootstock from local nurseries, while some source from the Citrus Research Institute. T-budding/T-grafting are propagation methods, which are done in two seasons during February-March and August-October.

Normally pruning is done to control the canopy size, removing dead, diseased, and water-shoot branches. Progressive farmers are doing more aggressive pruning (skirt pruning) for light penetration and prevent fruit damage from limb rubbing.

Normally farm yard manure with SSP, Ammonium Nitrate/Urea and sulphate of potash is applied in December/January and then in April and later in August/September. NPK is applied in February and then in mid-September. Majority apply pesticide three times a season i.e. in February, April and the September. Hardly weedicide is used, normally farmers plough their orchards.

Farmers are using below average and imbalance inputs, which has negative impact on the production. Many private retailers and authorized input providers in the region. Small farmers get inputs on credit provided by either dealers or commission agents. Lot of counterfeit inputs is being sold to farmers.



Pesticides are quite well monitored by the Punjab Government through Pest Warning and Quality control of pesticide, FSCRD and DPP.

Generally, farmers irrigate their orchards through flooding twice a month during summer and after 1-2 times in winters. Few farmers are now using drip irrigation. The critical time farmers irrigate their orchards are once immediately after harvest, then prior to flowering and then during fruit enlargement.

Most of the farmers are using clippers especially for processors/exporters. Once the fruit is harvested they are stacked in the field for initial grading and then loaded loose (30%) onto the open trucks for the domestic market. Wooden boxes (60%) are used for long distance markets. For processors plastic crates (10%) are used. Harvesting is done on marketing forces, when there is glut in the market they hold it much longer than required which results to alternate bearing issues.

The domestic value chain is dominated by wholesaler and contractor. The contractors buy out the orchard which is financed by wholesaler and obliged to sell it to him. The contractor is responsible to manage the farm till harvest. The price offered depends upon volume and size. The price fluctuates during the season depending upon the supplies as during glut (February) the prices decrease. The premium domestic wholesale markets are Sargodha, Lahore, Karachi, Islamabad and Peshawar. The “topping” malpractice still continues by placing better quality on top only.

There are around 250 processing units in the cluster, with top 30 having cold storage and some with blast chillers. They use sea transportation for exports. The boxes used are standard 10 kg corrugated box but recently they have started using 10 plastic crates for export purposes. DPP is responsible for quality control for exports and the inspection is undertaken at approved processing units.

The main export markets are Russia, Afghanistan, Middle East, Philippines and Indonesia. Due to shortage of grade “A” most exporters are sending mixed quality fruit and DPP is issuing certificate without proper inspection. This is causing a poor image internationally. Similarly, local market is also suffering from quality problems getting low prices for all supply chain stakeholders.

Many orchards are Global GAP certified but due to high cost it is discouraging its expansion. Lack of adoption of food safety and traceability is another constraint for exporters to enter high end market.

Many interventions have been undertaken by government and donor in the promotion of citrus sector in Punjab. Some major initiatives are: 1) “Model Farms Linked with Improved Supply Chain & Value Addition” project of Punjab government have been recently initiated providing incentives through cost sharing programs such as training, certifications, infrastructure and marketing linkages, 2) USAID programs such as AMD, PEEP, PATTA are working towards improving value chains in horticulture sector including citrus cluster. 3) TDAP is providing subsidy to the exhibitors in providing stalls at 50%. Also providing 50% subsidy on rental and salary cost to exporters for opening international offices.



5.3. SWOT Analysis

The SWOT analysis was carried out in Group discussions and interviews conducted with the stakeholders in the citrus value chain – from growers to middleman, processors, exporters, service providers, relevant government representatives, donors, etc. The results are structured around the value chain functions such as inputs supplies, production practices, cluster interactions, marketing/trade & exports and processing & Infrastructure.

Table 12: SWOT Analysis of Citrus Cluster

Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
Environment/Climate Change	Loamy to clay loamy soil texture, cold climate, and well drained land in Kinnow cluster which are very much suitable for Kinnow cultivation.	Prolonged winter and sudden rise in temperature affect flowering and fruit setting.		Increase flooding with more intense and frequent rainfalls
	Availability of canal irrigation throughout the year from Upper Jehlum, Lower Jehlum and Thal canals			Drought winter and shortage of canal water
Input Supplies	Reliable major fertilizer and pesticide supply system with many National / Multinational Companies providing these chemicals	Non-availability of appropriate quality fertilizer and micronutrients		Use of adulterated or expired pesticides.
		Declining organic matter in soils	Increasing poultry production and poultry manure is an opportunity to halt the declining organic matter	Injudicious use of chemicals
		Limited availability of certified, quality, and pure variety seed/seedlings	Seed Act 2015 which has obligated to Agricultural Departments to establish certified nurseries has created an opportunity to increase certified Kinnow nurseries	
Cluster interaction	Large number of farmers	Little interaction among farmers and researchers & extension departments	Possibility of learning from progressive farmers in the cluster	Infestation of Fruit Fly
	Processors cum Exporters are also buying Kinnow directly from farmers who have adopted better farm management hence supply	Producers have little information about the quality requirements in national and	Strong relation between Commission Agents/Wholesaler and Contractors	Pesticide residues



Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
	better quality	international market	(each have knowledge about quality demand at least in national market) can be transformed into quality-based supply contract	
				Exporting of poor quality kinnows has threatened its whole export
				The future threat could come from industry being dependent upon a single variety cultivar and export dependent upon few countries
Production Management practices		Little credit availability from formal institutes for any stakeholder of the cluster	Contract farming is on rise with defined quantities and quality parameter due to processors buying directly from farmers	
	Large number of farmers	Lack of certified nurseries and mother block, and traditional method of nursery plantation	Availability of training modules in several national (like NARC, provincial departments, private sector, etc.) and international organizations (AVRDC) to train farmers about latest methods of nursery raising, plant protection, intercropping, harvesting, preparing proper rootstock, efficient irrigation method, etc. have made the training of farmers and nurserymen a reality	
		Low plant population		
		Flooding irrigation		High pesticide



Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
		wastes water and deteriorate fruit quality		and low quality produce may cause heavy rejection in export and threaten the whole export market
	Experienced & educated farmer	Intercropping in kinnow orchards		
		Imbalance and sub-optimal use of fertilizer		
		Injudicious use of pesticide	Plant Protection Department of Governments of Punjab and PARC have some capacity (which need to be enhanced) to train farmers on sanitary and phyto-sanitary measures and good agricultural practices	Difficulty of training illiterate farmers about high tech methods and techniques
		Improper pruning - lack of knowledge		
		Improper harvesting practices		
		Wooden material used to prepare boxes for transportation	Availability of corrugated boxes in the market already being used in certain other fruits	
		No environment (temperature, humidity, etc.) control during transportation in the local market.		
		Improper stacking during transportation		
		High fuel cost especially diesel used in transportation		
Marketing	Good road infrastructure connecting Kinnow cluster with all big cities and the biggest port in the country			
	Availability of Reefers available for exports			
		Farmers disconnect with the market	Financial support by the commission agents and	



Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
			wholesalers to harvesting contractors can be converted into quality based delivery contracts	
		No grading (rather topping the good quality kinnow over poor quality) by the harvest contractor		
		Auctioning in the wholesale market with visual and spot grading	New Market Act in Punjab has created big opportunity to reform the old market practices in the province	
Trade/Export		Little capacity of farmers and traders and little quality infrastructure to produce, handle, and market the quality product	Emerging supermarkets can introduce contract with farmers which may improve retailing quality, and reduce post-harvest losses and trading margin	Supermarkets may exclude small farmers from the quality market
	Kinnow variety is recognized in the international market with its unique flavor.	Decreasing production of "A" grade is forcing exporters to export mixed quality fruit fetching low price.	If the quality is improved the export can increase multifold in value terms	
	Harvesting contracts or collectors pay the price to farmers based on the quality, quantity as well as the expected size of the fruit	Exports are dependent on few countries, there is oversupply bringing prices down	The collaboration of with TDAP, Provincial Governments Donors to overcome constraints in reaching high end export-market may open up big opportunities for Kinnow exports	Lack of stakeholders interest in capacity building to produce and quality may be unable to sustain existing export quantity.
		Little trade links with high end market	Model Farm project of Punjab Govt. offers funds to establish farm-level infrastructure like cold storage facilities, value addition and equipment for harvesting	Due to high seeded fruit it would be difficult to diversify markets such as EU market, but would be difficult to even sustain existing markets.



Parameters for SWOT Analysis	Strengths	Weakness	Opportunities	Threat
	Comparatively better developed value chain especially the processing industry	Lack of stakeholder's interest in capacity building to produce quality products may jeopardize the existing export level in the medium to long-run.		Competition from Turkey and Egypt as they have seedless mandarin and closer to Russian market
Processing	Because of higher shelf life Kinnow travels long distance without damage (Transportation to S. Petersburg, Russia takes around 40 days)	Due to high seeded fruit the price fetched from international market is very low.	Opening up new markets like Far East and China (CPEC)	High cost of certification for farmers to afford it
	Established market link in traditional markets, like Middle East		High demand for processed kinnow product within the country and abroad	Big processing firms from China through CPEC with big incentives from the Govt. of Pakistan may grab the whole fruit processing market
	The grading plants are well equipped with technology to fulfill international requirement. Besides top 30 units have proper management systems.	Poor image in the international market due to issuance of certificate by DPP without proper inspection, hence low quality kinnow are exported to Russia, even though it has certificate by DPP.	Government incentives for the import of agriculture machinery especially cold storage machinery	
	The concentrate is produced from "C" grade and non-salable fruit. In other words no fruit as such wasted in the supply chain except in value terms	Limited time span of Kinnow production (December till March) for processing.	Some value-added products can be produced from Kinnow such as concentrate for use in drinks, candies, jams etc. Besides kinnow peel can produce oil and animal feed.	



5.4. Kinnow Value Chain

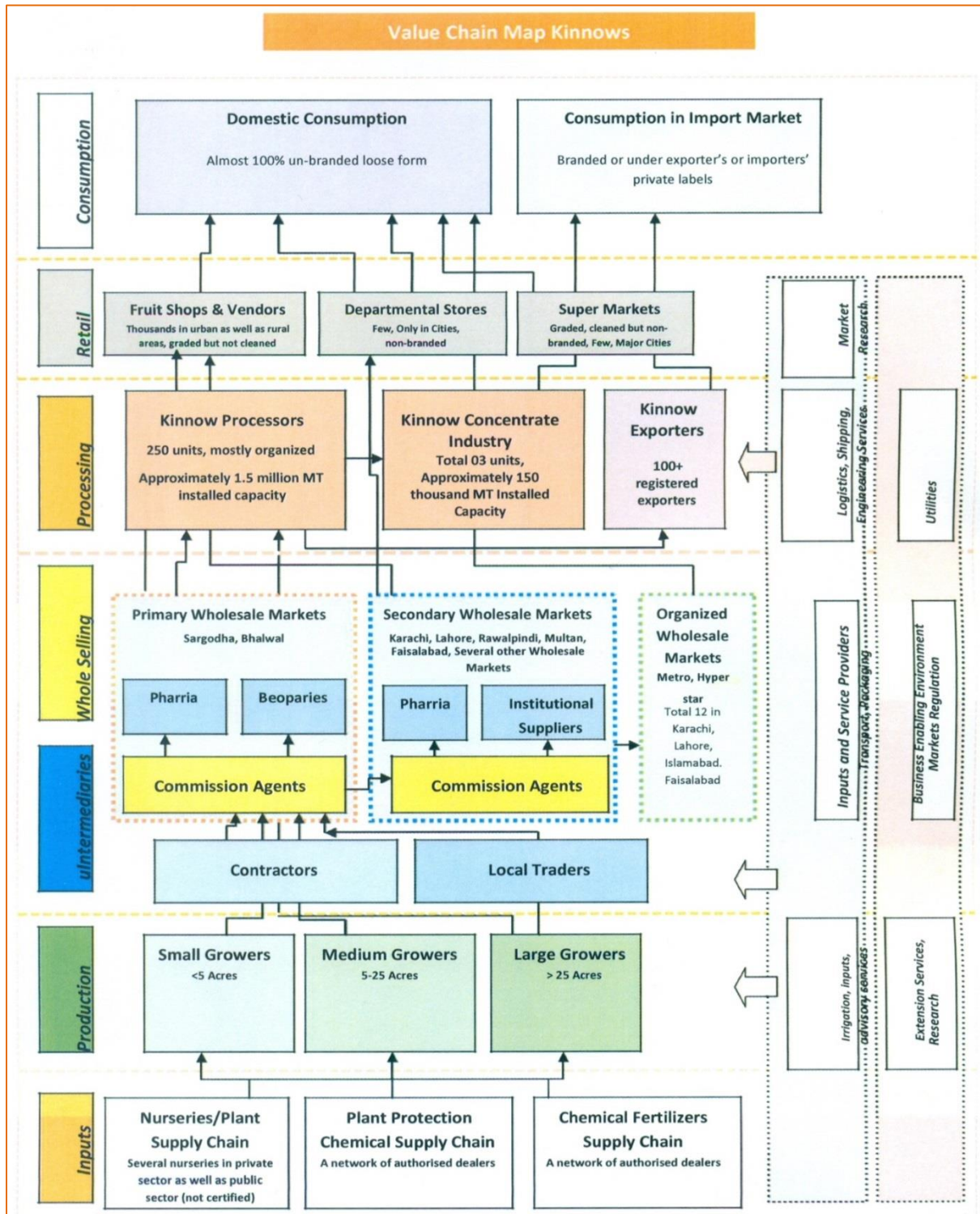


Figure 2: Diagram showing Map of Kinnow Value chain



5.4.1. Input Providers:

An elaborate presence of input providers exists in the kinnow producing areas. Every town has multiple dealers of fertilizers. In addition to authorized dealers of fertilizers and pesticides who sell as per the policies of their principals, there are many who buy in wholesale quantities and retail (small) quantities. These dealers also sell on credit to small growers who usually are short on finances. In addition to dealers' network, inputs are also provided by commission agents in the wholesale markets. The mode of payment usually is credit and commission agents usually charge marked up prices for the inputs they provide.

Due to proliferation of plant protection chemical brands/labels, growers find it difficult to differentiate between quality products and substandard ones. Availability of standard products is reported as an issue by growers.

Similarly, there are many stories of cheating growers by selling counterfeit products by fertilizer as well as pesticide dealers.

There are serious implications of substandard and counterfeit fertilizers and plant protection chemicals for kinnow growers as well. Many experts believe that incidence of disease has increased due to ineffectiveness of these chemicals. They also claim that some of the pathogens have mutated due to inappropriate application of broad-spectrum pesticides and therefore several insect pests have developed resistance against plant protection chemicals available in the market.

In order to ensure that adulteration does not take place at the retail level and that counterfeit products are not sold under established brands, many leading input marketing companies have established their own networks of franchise outlets. The franchise outlets are gaining popularity with growers who buy with cash and who have had unsatisfactory experience with the non-branded or conventional input dealers in the past.

On the other hand, the number of private dealers runs in the hundreds in the citrus producing areas alone, and a proliferation has been observed over the last few years. This is attributed to heavy profits available to the dealers by selling products of un-known brands or labels, or counterfeit products of popular brands.

While leading brands of fertilizers and other inputs are trying to create awareness among growers and also trying to increase availability of standard products through their franchise networks, the problems due to sale of substandard inputs is on the rise. Growers complain that they incur heavy losses due to substandard products. They also complain that at times government extension staff collude with sellers of substandard products and try to influence purchase decisions in favor of substandard products in exchange for gains offered by these companies.

An industry leader held Department of Agriculture responsible for the prevailing situation. He questioned the wisdom of the provincial government to approve hundreds of labels in the first place. He also expressed deep concern over the capacity of the government to ensure that the licensed producers were packing as per the standards and counterfeits were not selling in the market place.



5.4.2. Structure of the Production (Kinnow Orchards)

Kinnow orchards are the production house where fruit is produced. There are two major stakeholders involved at the farm level, the farmer/owner and the contractor. Typically, the owner of the farm manages all the farming activities at the farm but does not involve in the marketing of his fruit in the market. Since harvesting and marketing are capital intensive operations involving market risk, the farmer minimizes this risk and leases his farm to a marketing contractor at a wholesale price prior to the start of the harvesting season. However progressive farmers, having capital investment, tend to harvest and market the farm produce by themselves.

The contractor (pre-harvest contractor) is responsible for the harvesting, post-harvest operations, packaging, logistics and marketing of fruit in various fruit markets across the country. A typical marketing contract would have a lump sum fruit value to be paid in one to three installments to the owner. Usually one installment is paid in advance at the time of the contract while the rest are to be settled during the harvesting of the fruit. Estimated yield of the fruit, anticipated future price of the fruit and the estimated harvesting cost are the main drivers of the wholesale contract value. Depending on the risk averseness and the cash requirement of the owner, the marketing contracts are sometimes done years in advance with all the farming and harvesting operations to be carried out by the contractor as well. A higher upfront advance payment normally results in a lower overall lease value of farm.

The contractor either invests his own equity in the lease contract or borrows this amount from the broker of the fruit market. Some of the harvest contractors are the leasing agents of the fruit brokers who lease the farms on behalf of the brokers (*Aarhtis*) without investing their own equity. They supervise the entire harvesting and marketing activities managed through contract labor and earn a commission on the profitable sale of the farm. Since the capital is invested by the broker, a contractor is bound to sell his fruit to his brokerage house (trading shop in the *Mandi*) at his terms; including commission rate. The same is true for the farmer who sells his produce to the brokers from whom he has borrowed any loans to support his farming activities. Thus, at the farm level, the stakeholder who has investment capacity tends to benefit the most from the activity.

5.4.3. Structure of Marketing Channels

As about 50% of kinnow is grown in Sargodha district; the fruit markets of Sargodha and Bhalwal towns are major primary markets of kinnow. Farmers, contractors, commission agents, traders, exporters and retailers are the main players of the market. Farmers and contractors sell the produce to traders through commission agents. The traders of these primary markets target the following market segments:

- Assembly or village markets
- Primary wholesale Markets
- Secondary or terminal markets in other towns of Pakistan
- Local retailers
- Fresh fruit processors/ exporters
- Juice concentrate processors



5.4.4. Assembly or Village Markets:

These markets exist in villages and small towns, close to the farms. Usually these markets cater to the needs of local retailers who usually have roadside assembly and sale points during the harvesting season. These points also act as assembly points for aggregating small lots of fruit to take to either primary markets or the secondary wholesale markets.

5.4.5. Primary Wholesale markets:

As about 50% kinnow is grown in Sargodha district, fruit markets of Sargodha and Bhalwal towns are major primary markets of kinnow. Farmers, contractors, commission agents, traders, exporters and retailers are the main players of the market. Farmers and contractors sell the produce to traders through commission agents. The traders of these primary markets target the following market channels:

5.5. Main Players in the Wholesale Markets

There are three main players who manage the fruit marketing in wholesale fruit markets:

- The Brokers or Commission Agents (*Arhtis*) are responsible for the auction of the fruit.
- Resellers (*Phariya*) purchase fruit in bulk at auction through brokers and resell them to the local retailer.
- Distributors (*Ladaniya*) purchase fruit in bulk at auction through brokers and distribute it to secondary markets to be sold to resellers and retailers in secondary markets.

5.5.1. Commission Agent (Aarhi)

A broker or a commission agent holds a fruit and vegetable trading license issued by the local market committee and is supposed to facilitate the sale and purchase of the fruit. His clients are the sellers (grower/lease contractors), the buyers/resellers (*Phariya*) and the distributors (*Ladaniya*). Since a typical fruit auction entails bulk quantities in multiple lots, only the resellers and the distributors participate in the auction. The broker makes a commission as a percentage of the sale price of fruit charged from the seller and fixed fee per crate from the purchaser. While the maximum commission to be charged from the seller is generally fixed by the market committee in consultation with the brokers (normally 6%), the actual commission charged varies from broker to broker.

Brokers are the major capital investors themselves and therefore dictate the commission terms. More than 80% of the market is driven on credit starting from the broker to the fruit retailer. In addition, credit is extended to the resellers and the distributors. On the supply side of brokers, they often give loans to the fruit contractors and sometimes to the growers who are then bound to sell their produce through them. Growers and contractors who have borrowed from the brokers are charged with higher commissions depending on the amount of money borrowed. These commissions generally vary from 6-15% and are not publicly disclosed. On the selling side, while the broker makes a flat per crate commission from the



buyer, any credit sale is sold at higher rate, thereby making a higher margin for the broker. In the absence of a proper credit monitoring system, the brokers are also exposed to the credit risk and default.

Usually middlemen are not very popular in the chain. There is a strong perception in the minds of kinnow Value Chain actors that middle men exploit situations to their advantage. Most of the middlemen are expanding their role to become fresh fruit processors, eventually hoping to become exporters themselves.

5.5.2. Reseller (Pharia)

The local reseller called *Pharia*, purchases fruit in bulk from the broker (Commission Agent) in open auction lots and presents it for sale to retailers. He tries to get maximum credit from the broker to pass it on to his clients. His profits come from market appreciation and a premium on wholesale fruit prices. Fruit merchants (retailers) buy their daily requirement from resellers (*Pharia*) in small quantities. The retailer's margin comes from the type of transaction, cash discounts or credit premiums.

5.5.3. Distributor (Ladaniya) or Beopari

Ladaniya is the distributor of fruit operating between primary and secondary markets. He purchases fruit from the broker in open auction from the primary wholesale market in multiple lots and sends it to secondary markets as a combined load for sale through commission agents of the secondary markets at a higher price. He pays for the transportation costs and takes risks of price fluctuations in the secondary markets. In the secondary markets, the commission agent uses brokers by paying 5% commission for selling fruit to local resellers who sell to retailers.

5.5.4. Secondary or Terminal markets:

These markets are generally located in big urban locations. Lahore and Karachi, Islamabad and Peshawar are prominent terminal markets in the country. kinnow produced in Sargodha reaches through three distribution channels to the consumers. It reaches the domestic consumers through commission agents and middle men.

5.5.5. Marketing Channel # 1: Local Supplies

These markets are generally located in big urban locations. Lahore and Karachi, Islamabad and Peshawar are prominent terminal markets in the country. The wholesaler sells to in the domestic market either to traditional retailers which includes carts, road side vendors and small shops or to the modern retailers such as super markets and other modern shops who sell higher quality citrus to the middle and high income consumers.

5.5.6. Marketing Channel # 2: Exports

The 2nd channel supplies the exporter. The fruit is purchased by the processors. It undergoes processing i.e., washing, waxing, grading and packing and then it is stored in the



cold storage for some time before it is transported to Karachi for shipment to the export destination.

There are two supply chains operating for exports. One is comprised of growers, processors along with exporters, importers and consumers in the end market. In a few cases, either the growers have forward integrated into processing and exports, or the other way around, where exporters have integrated backward to have both processing and production of kinnows. By far this is the shortest of all chains and most efficient for its participants. Industry leaders are following this model for its obvious benefit of control over quality for reliability and traceability, etc.

The other supply chain operating for exports is comprised of growers, contractors, commission agents, processors, commercial exporters and importers/distributors. Usually, commercial exporters are newcomers in the chain and processors are the ones who operate as a service provider either by choice or due to availability of excess capacity.

5.5.7. Marketing Channel # 3: Concentrate Industry

The third market channel is supplies to the kinnow concentrate industry. The low and waste fruit is mostly purchased by the kinnow concentrate industry from the processors, which is processed into concentrate which is either exported or sold to the juice industry.

5.6. Analysis of Value Chain

5.6.1. Cluster Vibrancy

The soil and climatic conditions in the Sargodha areas have given kinnow a unique flavor which distinguishes it from other comparable mandarins grown in the world, which is well accepted among consumers in several markets. Biggest handicap is the seed factor which has impeded its market penetration to the high-end market such as EU. Even those exporters who are exporting to the EU countries the consignments are down-graded from “A” to “B” class.

The processing industry is relatively well developed as compared to the processing of other fresh fruits in Pakistan. According to survey there are around 250 Kinnow processing enterprises in Sargodha with an installed capacity to wash, grade, wax, and pack over 1.6 million tonnes per season primarily for export markets. The success of this cluster has been due to the pull strategy by opening of Russian market which led the establishment of this sizeable processing industry, the main driver for kinnow cluster. Enhanced exports led to improvement of the whole supply chain i.e. production, infrastructure, quality improvement of kinnows in domestic supply chain, networking, etc. With the improvement it has also led to certain constraints such as over installed capacity of processing industry, processors competing in the same market by supplying at very low prices.

Pakistan’s agro-climatic conditions provide a suitable environment for the production of Citrus, providing a strong comparative advantage as indicated by the sustained growth over the last four decades. In view of the availability of suitable agro-climatic conditions across several geographical areas in Punjab, particularly neighbouring districts to the present



production clusters, potential for further growth is recognized by experts and stakeholders. As the area under cultivation growth trends indicate, producing kinnows is profitable for the growers at the present level of productivity. The recent trends (last five years) in the area under cultivation however suggest that some growers could be finding other alternatives more attractive as compared to planting more kinnow orchards in the areas considered suitable for its production.

Several studies in the past have reported that a significant portion of produce (35% to 40%) was wasted due to various reasons (Ali, 2004, p. 251). During the assessment, it was learnt that significant improvement has taken place and in certain cases, the so-called wastages have reduced to almost zero percent. A leading processor whose operations are integrated across production (orchard), processing and exports reported that due to better orchard management practices, three pickings (harvesting practices) as opposed to one in the past, and sale of A & B grades are exported, grade B is marketed in the domestic market and C grade to kinnow concentrate plants, they were utilizing almost 100% of the orchard produce. It was maintained that the chain had become more efficient for domestic supplies as the “beoparies” or local traders were buying B grade directly from growers/contractors/processors and selling to retailers in consumption centers. Due to opening of Russian market, the industry had recovered higher economic value from small size fruit as well, which was not possible in the past. Also, establishment of cold storage has given option to hold the produce during glut times which has contributed to higher value realization.

Only about 16 percent of total citrus production of the country is exported. A study on price elasticity of kinnow, conducted by Haleem, Mushtaq, Abbas and Sheikh (2005) has reported price elasticity of citrus to be 1.48, which implies that increase in the export price of citrus is likely to give a considerable boost to the export. Currently, the export unit price of Pakistani kinnow is very low as compared to that of other citrus exporting countries; 52% of world average price for the mandarin category. This suggests that a substantial potential for export growth through improvement in quality exists.

Potential can be exploited through diversifying the markets of kinnow. Traditional markets for the Pakistani kinnow include Russia, Ukraine, Saudi Arabia, UAE, Philippines, Indonesia and Afghanistan. Pakistan exported 36,000 tonnes of kinnow to Indonesia worth \$19.8 million last year. “After the removal of quota curbs, it is expected that Pakistan’s kinnow exports will increase to 60,000 tonnes,” (All Pakistan Fruits & Vegetable Exporters, Importers & Merchants Association-PFVA). Several opportunities are available, and leading exporters are considering focusing their efforts for diversification into some African markets, besides neighbouring SAARC countries like Bangladesh and Sri Lanka. Exporters are also considering focusing on Hong Kong, Singapore, Malaysia and other markets in the Far East to have a broad base for their product. Feedback from the growers strongly suggests that the profitability has eroded on account of higher input costs and decline in quality. Many believe that the trend will continue if the farm practices are not improved to arrest incidence of disease and control blemishes, exports may not be able to diversify to achieve higher prices for the product.



5.6.2. Status of Kinnow Processing Industry:

According to a recent survey, there are around 250 processing units in Sargodha and Bhalwal areas. Most of the units have average production capacity of around 10-12 tonnes/hour employing 4-5 full time employees while during season they employ 70-100 temporary employees. Most of the processing plants have a single processing line with washing, sorting, waxing, drying, grading, packing and cold storage facilities About 45-50 processors are direct exporters while rest provide services to other processors, exporters and now to contractors for domestic market. Their export volumes are usually much higher than produce from their own fields and hence the processors and exporters procure fruit for export from other orchards either directly or/and through contractors. According to some leading exporters mentioned that there are about 45-50 leading processors who have well established processing units with locally manufactured machines, with blast chilling and cold storage facilities, while the situation of other units varies from plant to plant. They have also acquired HACCP Certification apart from ISO 9000 certifications. This is indicative of management systems well established and functioning. As a result of an intervention by ASF under the ADP funded program, several leading processors in collaboration with growers also achieved Global GAP certifications few years ago but was not sustainable due to mistrust between processor and contracted grower.

According to an estimate, the overall installed capacity of 250 odd processing units is sufficient to process the entire production as such. According to an estimate by an industry leader, the overall kinnow processing capacity in district Sargodha is more than the production available, implying that an over capacity exists at the moment. As Pakistan is exporting to only a few markets (Russia being the largest through sea shipments), many new exporters are compelled to sell in the same markets which have been served by their more established competitors. Since most of them end up competing on pricing in the absence of any unique selling point or product differentiation, there has been pressure on export prices. Due to price competition between exporters, the bargaining power has shifted to importers of Pakistani kinnows, receiving very low prices. It is worth observing that the average unit price for Pakistani Kinnow was 52% of the world average unit price for the mandarin category. However, such competition is also compelling for product differentiation as some of these has started using more attractive packaging, and innovative marketing strategies.

5.6.3. Juice Concentrate Processors:

Foreign companies like Citrus giant Cargill entered the processing industry in Pakistan in the nineties. Cargill sold its operations to its employees subsequently. The company, now called Citropak doubled its concentrate processing capacity in 2004, and is now producing other citrus based products. Another company, Fresh Juices Limited, is producing and exporting kinnow concentrate. Two more plants have recently come into production. It is estimated that four plants in total have over 50 tonnes per hour capacity (input weight) at the moment.

5.6.4. Value Addition:

Citropak have established technology for the production of animal feed and oil from kinnow peel waste. Such technologies are capital intensive but have high profit margins as the raw material is of very low cost and the finished products have high value. The government



through SMEDA should develop feasibility studies and in collaboration with PBIT and BOI should promote in the private sector for the establishment of such industries.



6. CHALLENGES FACED BY THE CLUSTER

Pakistan has faced multiple challenges during last few years in mainstreaming citrus sector. Under the given system, Pakistan is currently held-up in a low-quality low profit cycle. Irrespective of a well establish processing industry, citrus sector is faced with many challenges such as low yields, seeded fruit, non-compliance to international requirements such as Global GAP/SPS, lack of value chain infrastructure. The most important factor hampering the economics of the supply chain is related to the quality of citrus production. In view of the tough competition in international market, Pakistan has no option other than to improve the citrus quality or face continuous decline in export earnings.

6.1. Institutional Level Constraints

6.1.1. Lack of Capacity of Proper Management Practices

Knowledge about modern tree management practices such as pruning and canopy management are less than common. Even those who has opted for these practices are pursuing them crudely and using axes for pruning. Farmers lack resources in the use of technology in areas such as the development of high efficiency irrigation systems, pruning equipment, rotary tillers and the use of basic tools to harvest. Farmers lack understanding and knowledge of proper harvesting, high-density garden management, using proper fertilizer and pesticide in terms of type, quantity and timing. Moreover, little biological and agronomic options are made available to citrus farmers to control citrus pests. The system of divided responsibility for orchard management between growers and contractors contributes to the prevalence and persistence of disease in citrus orchards which is compounded by harvesting and post-harvest handling practices.

6.1.2. Dysfunctional Innovation System

Innovations are the key to keep the any cluster dynamic and competitive. After 2004 when processing was introduced in the citrus value chain, no significant innovation is introduced in the system. While the competing citrus producing countries have made a significant stride in meeting the emerging quality demand for citrus in international high-end markets, little such progress is made in Pakistan. The innovation system in the country has failed to develop low seed variety, a major quality factor, and diversify the germplasm base by introducing various varieties with different germplasm base and harvesting cycle. Overtime the processing industry has installed excess capacity which has created intense competition in terms of overcutting prices. This has led to low returns to the whole supply chain. The biggest possible future threat to citrus sector could come from the dependence upon a single variety cultivar.

Moreover, the research system could not introduce effective management system to control pest and alternate bearing, and develop economically viable and attractive packaging and



transportation system. The traditional extension system could not address the emerging productivity and quality issues in the citrus value chain such as citrus canker, alternate bearing, high pesticide residue, etc. Although the research system claims developing protocols for high density gardens and scientific pruning, these could not reach to farmers' field.

6.1.3. Weak Coordination amongst Stakeholders

There is little effective coordination amongst the stakeholders in the supply chain, even amongst the line departments such as extension and irrigation and also within the same sector such as farmers, extension, research, traders, exporters and processors. Although a few exporters are directly working with growers and farm contractors, it appears that the relationship between the two groups is largely restricted to the purchase and sale of fruits (in addition to the near absence of long-term interactions). Similarly, the associations are generally controlled by few top processors/exporters who take the advantage of all the projects and programs initiated by the government or donors. There is hardly any coordination or information dissemination to the whole supply chain stakeholders.

6.1.4. Limited Excess to Formal Credit

Credit plays an important role in the development of the economy. In agriculture credit is necessary to run the supply chain including enhancing productivity, farm mechanization, and adoption of new technologies, infrastructure development and processing. ZTBL is the leading bank providing credit to agriculture sector with about 30% of the total institutional disbursement. However, access to these loans by small farmers especially for value chain improvement has been reported to be difficult mainly due to cumbersome documentation, inadequate collateral, lack of information, risk factors of farmers and SMEs especially new start-ups. If the loans are available for value chain infrastructure, the huge operational costs to run this infrastructure is not covered in these loans.

A lack of credit facilities from formal sources for stakeholders in Pakistan's citrus value chains has given rise to the power of commission agents, and this has led to much inefficiency. Existing agricultural financing products (available through the formal banking sector) have multiple structural shortcomings like collateral and complicated paper work. Hence more than 90% of all growers and farm contractors depend on middleman. Notwithstanding its positive contribution, middleman credit is believed to be the root cause of most of the issues faced by the agricultural sector especially production issues and limiting placed on the farmer's ability to sell his produce to the best paying buyer.

6.2. Production Level Constraints

6.2.1. Poor Management Practices

As a result of poor understanding, knowledge and lack resources, poor management practices are adopted on citrus orchards such as: inefficient farm management and irrigation practices, inadequate pest and disease management strategies, use of imbalance fertilizer, lack of mechanization, and unscientific pruning. As per our survey of stakeholders, more



than 60% do pruning practices but not on scientific grounds. These practices are holding up the whole value chain at low productivity, low quality and low profitability scenario. These poor management practices in turn are due to small scale farms, pre-harvest contract system (advance sale to middle men) and low literacy and access to information.

6.2.2. Low Plant Density Garden

Another factor for low yield is the low-density citrus plantation. A majority of the orchard's owners (66%) reported to plant 91 to 100 plants/trees per acre (equivalent to 225 to 247 trees per ha). Khurshid and Baxter (2006) opine that lower citrus plant density in Pakistan as compared to that in Australia is one of the factors responsible for poor yields in the former case. In Australia, one ha may have 800 to 1000 citrus trees.

6.2.3. Lack of Certified and Quality Seedlings

Farmers experience difficulty in getting access to high quality planting material. Lack of reliable young pedigreed fruit trees from the uncertified nurseries leads to reduced unit yields, poor production efficiency in orchards and low quality of fruit produced.

6.2.4. Infestation of Insects and Diseases

However, years of neglect have compounded problems of the farmers and exporters. Various diseases are threatening the very existence of kinnow farms. Insect pests and diseases role is counted as significant in lowering the yield and production. Some of the major diseases which are commonly present in the farms and have threatened the future citrus farming in Pakistan are: Citrus Scab, Citrus Melanose, Citrus Canker, Root Rot and Withertip. While the pest problems include Aphids, Citrus Leaf Minor, Lemon Butterfly, Citrus Whitefly and Red Scales. Besides Scabs the most serious threat has been the Citrus Canker, which has also been declared as the quarantine disease. If steps are not taken on emergency basis the threat of pest and disease would become so prevalent that it would be difficult to reverse back leading to threatening the future of citrus industry.

6.3. Market Level Constraints

Sanitary and Phyto-sanitary (SPS) standards continues to hinder export markets access especially in EU market which have strict food safety requirements. Most importers require to obtain produce from orchards that are GlobalGAP certified, but limited capacity in the country to address food safety. There are only few dozen GlobalGAP certified farms in Pakistan. Compliance to GlobalGAP/SPS is a difficult and costly undertaking which requires investment in safety and management system, technical expertise and infrastructure development. There is lack of pre-inspection system due to lack of capacity with Department Plant Protection (DPP).



6.4. Value Chain and Processing Constraints

In recent times the quality of kinnow at the farm level has declined especially its cosmetic attributes. Due to rind blemishes, the farm gate rejection varied from 20 to 50%, while some orchards have completely been rejected by the exporters (Malik 2014). This has led to low returns to the whole supply chain. Other major challenges facing citrus value chain is high seeded fruit which has limited the entry to the high-end markets such as EU. The biggest possible future threat could come from exports dependence upon few countries such as Afghanistan and Russia (67% of total exports in 2016) and to some extent to Middle East. Any restrictive step taken in two countries can jeopardize the whole citrus sector in Pakistan.

Most of the processors are using plastic crates to minimize fruit damages but for domestic market it is still being transported by open trolleys pulled by tractor. Farmers face numerous challenges in maintaining product value from harvest to market. As previously indicated, the limited availability of cold chain facilities is repeatedly cited as a major constraint as the product has short shelf life and quickly lose its freshness. The transportation is being done in a traditional way by using tractors, open trucks & pick-ups, hardly anybody is using refrigerated transportation.

6.5. Challenges

6.5.1. Low Yield

As a result of poor management practices as narrated above, the average national yield in Pakistan at 12.62 tonnes/ha is far lower as compared to the international average yield of 16.74 tonnes/ha. This is even further lower when compared with the top citrus growing countries of the world such Brazil (25.80 tonnes/ha), USA (26.61 tonnes/ha) and Spain (24.08 tonnes/ha). Average national yield of some of the competing countries like China is 13.37 tonnes/ha, Turkey (31.68 tonnes/ha) and Egypt (24.46 tonnes/ha). With this low yield, it would be very difficult to continue competing in international market without receiving lower profit for various stakeholders.

6.5.2. High Post-Harvest Losses

Poor management practices, poor harvesting methods, inappropriate mode of transportation and lack of cold storages facilities, as discussed above, cause heavy post-harvest losses. Various studies and discussion with stakeholders highlighted that post-harvest losses in citrus range from 30-40% (ACIAR 2008, Johnson 2006). Controlling these losses is a challenge as it is a big wastage of resources which ultimately reflects in low profitability for various stakeholders in the value chain.





6.5.3. Poor Domestic Market Efficiency

As a result of poor marketing and post-harvest handling, market efficiency of citrus is very low. Loss of value is high due to poor quality caused by diseases especially causing rind blemishes. The major crop production goes through the traditional system. i.e. loose and unprocessed kinnows. This not only lower consumer value and the profitability of value chain actors, but also represent a substantial waste of resources used in the production and marketing processes. Improving market citrus efficiency can improve the citrus price that consumers are willing to pay, thus enhance the profitability of various stakeholders in the chain.

6.5.4. Poor Export Efficiency

According to one of the leading processor cum exporter mentioned that in kinnow sector it is not the marketing or processing issue but purely production issue. Despite being world's largest exporter of kinnow mandarins, entry in developed country markets is scanty so far, possibly due to their excessive seed content and quality and quarantine requirements. Demand of Pakistani kinnow in the international markets is on a sharp decline due to its poor appearance and too many seeds. Pakistani Kinnow is being replaced by other easy peelers e.g. seedless tangerines/oranges/mandarins/clementine from China, Turkey, Morocco, etc. Therefore, Pakistani Kinnow usually gets low preference over its competing products and even when mandarins are not available in certain time windows, the price offered to Pakistan product is very low. Quality of citrus fruits is one of the important impediments in the export of citrus fruits from Pakistan. Proportion of first-grade fruit is less than 30% of the total production of citrus in Pakistan (Johnson, 2006, p. 2). It clearly indicates that if competitiveness of the Kinnow in the international market is to be improved, proportion of first-grade fruit would have to be increased. The low-quality results one of the lowest export price earned by Pakistani kinnow in international market. Bringing export price at least at par to the international market price should be one of the targets of policy makers in the future.



7. POTENTIAL OF CITRUS CLUSTER

Citrus occupies an important position among fruit in Pakistan, accounting for about 40 percent of total production of all fruit in the country and kinnow holds 95% of the total citrus production. In 2016 Pakistan produced 2.27 million tonnes of kinnow. Pakistan accounts for over 90 percent of world total production of kinnow. Pakistan is the world's fifth-largest producer of mandarins. Kinnow also tops the list of foreign exchange earners among the horticulture exports from Pakistan, contributing close to 171 million dollars (US\$) to the country's foreign exchange earnings in year 2016 exporting 389 thousand metric tonnes, and holds the number one position among all fruits both in area and production.

Kinnow sector has been the most vibrant than the other fresh fruits sector in Pakistan. The key reason has been of having a relatively well-developed processing industry. In this section an attempt has been made to evaluate the potential of citrus cluster in terms of production, quality and market side of citrus value chain.

7.1. Production Potential

Per ha yield of citrus in Pakistan varies from farm to farm, with an average yield at around 10 tonnes/ha, while good farms have attained up to 25 tonnes/ha, indicating yield gap of 100% which could be harnessed with proper management practices. There are several possibilities to substantially enhance per ha yield. Important of those are:

1. As noted earlier, several studies have shown that an increase in density of plants in citrus gardens can significantly improve per ha yield (Khurshid and Baxter 2006; Hardy, Sanderson, Barkley, and Donovan 2007). Therefore, there is a great potential to enhance per ha citrus yield if a concentrated effort is made to renovate the old gardens with higher plant population. Luckily this may be possible without much disturbing the old gardens if old trees are properly pruned thus spare canopy can be used to insert new plants are inserted in between the old pruned plants.
2. Clean and healthy nursery plants of high varietal purity are a basic requirement for good quality citrus producing trees. Lately some progress has been made in this direction. For example, two kinnow GPUs have been established: one at Muhammad Nagar Farms Pakpattan (Kinnow) and the other at Sodhi Jay Wali khushab (Orange) under the supervision of Citrus Research Institute Sargodha where multiplication block is established. Protocols and SOPs where they produce root stock and seedlings for commercial nurseries have been developed and approved by FSC&RD although its adoption is very slow.
3. Scientific pruning of citrus trees has a great potential to enhance per ha yield, reduce the chance of alternate bearing, and even can improve the quality of fruit in terms of its size.
4. Many progressive farmers believe that balanced use of fertilizer to match the stock of nutrients in the soil along with micronutrients can significantly improve citrus yield. Luckily, the Punjab government has prepared a field-level soil profile for all



agriculture land in the province which can be used in deciding fertilizer and micronutrient levels.

5. The knowledge of Integrated Pest Management (IPM), especially to control citrus blemishes can reduce the production losses due to pests and improve its exportability. The Citrus Research Institute has prepared modules to control various pests on citrus which can be disseminated once through farmers' groups.
6. The furrow irrigation system can increase the yield by 18% in terms of number of fruit plant, fruit yield by 20% (or 123 kg per plant) and fruit size by 14% (or 71 mm) compared with the flood irrigation system. The furrow irrigation system proved also beneficial in terms of water savings (41%) as compared with flood irrigation, with the added benefit on yield and quality (A Reza 2011-ASLP). The Punjab government is providing subsidy to promote drip and sprinkler irrigation for many crops including citrus, which has the great potential to enhance citrus yield in the province.

Our consultation with stakeholders suggests that high density has the potential of increasing the per ha yield by 70%. If we are able to renovate only 20% of the total cluster area (not provincial area), this can generate US\$45 million after 4 years at the maturity of new plants.

We believe there is substantial potential to enhance per ha yield by adopting the improved management practices as listed above. However, because these practices are diffuse rather slowly, we assume a minimum of improving per ha yield of only 10%. This improvement in the citrus cluster can generate an additional production of 137 thousand tonnes worth of about US\$29 million. The added production will also create new jobs at the farm level by putting extra manpower in the pre- and post-harvest activities and deploying more staff for extension and support services.

7.2. Reduction in Post-Harvest Losses

There are some opportunities to reduce the post-harvest losses. Some of these are as follows:

1. Adopting proper citrus harvesting practices involving harvesting equipment and packing materials can substantially reduce harvesting losses, improve quality, and enhance the industry's profitability.
2. Traditionally over stuffed wooden boxes are used for packing of the produce for domestic market which is a cause of contamination. Proper paper bags or corrugated boxes or disposable light plastic crates can also reduce post-harvest losses. The loss can be reduced by 4% if fruits are packed in bags or gatoos compared to when they are packed in paities (wooden boxes) and transported in open vehicle (2008 CABI).
3. During peak season, only 10% of total citrus production receive storage facilities. Increasing this proportion by providing proper cold storage facilities at the farm-level can also reduce post-harvest losses significantly.

In recent times the post-harvest losses are already on the decline due to direct involvement of processors cum exporters and awareness through donor and government programs. These trends can be further strengthened by linking farmers with the national and international markets through group action. We are certain that the concerted efforts



on the above lines can bring down these losses from 30% to 15%. This can generate about US\$66.5 million in terms of saving the lost products due to poor post-harvest management operations. It is expected to create hundreds of new jobs in the cluster.

7.3. Demand Potential

The extra production obtained through renovation of gardens, improved management practices, and reduced post-harvest losses, as suggested above, can be absorbed mainly in the growing domestic market. With the improved quality it would cater for exports and the urban population especially through the supermarkets catering to the upper and middle class.

7.4. Increase Production to Export Ratio

Pakistan is the 12th largest exporter of citrus with about 2% market share globally. Pakistan's export production ratio in 2016 was 16.6% which was higher than the global average of 12%. But comparing with the competitor countries, Pakistan is much lower. For example, the export-production ratio of Turkey is 39.77%, Egypt 19.10% and Morocco 30%. Besides Pakistan is exporting to low priced countries where the quality and quarantine are less stringent and presence of expatriates and that is a main reason the exports are dependent on few countries and is being over supplied. The main exporting countries for Pakistani's citrus are UAE, Saudi Arabia, Afghanistan and Russia.

If Pakistan can diversify export market, the potential high-end markets are France and Netherlands who have annual growth rates of 1.4% and 3.6%, respectively during the last 15 years. In the Far East, there are China and Hong Kong are emerging markets with annual growth rates of 10.3% and 2% respectively during last 15 years. The existing import volumes in these countries are sizeable for Pakistani kinnows to show its presence. Export potential to China is enormous due to very big market, FTA status, its proximity to Pakistan and the CPEC project. On the other hand, Indonesia offers zero-rated market access to kinnow and oranges from Pakistan, offering a level-playing field to this product in the Indonesian market.

With the opportunities stated above, we assume that production-export ratio can be improved from 16.6% to 20%, which is expected to generate additional revenue of US\$24.92 million in Sargodha cluster.

7.5. Improvement in Quality

7.5.1. Quality Improvement for Domestic Market

There are certain emerging opportunities to improve the quality of citrus fruits. For example, in recent years the intense competition due to over capacity of processing industry has forced many processors and contractors to make innovations like packing kinnows in corrugated/plastic crates in the local market, which gave them better prices. Similarly, some cold storage in the private sectors are being built although progress is very slow compared to the need of the sector. However, the potential of such infrastructure which can improve



the quality of citrus is huge. For example, improving the quality by just 5% of the domestic produce to international export standards can generate US\$56 million of gross revenue in the whole value chain of the citrus cluster.

7.5.2. Quality Improvement for International Market

The export price of Pakistani citrus is at US\$ 441 per tonne, which is significantly low compared to the international average export price of US\$ 845. Adopting the SPS protocols, certification of produce, improving the value chain infrastructure such as storage, and with proper marketing strategies, this quality can be raised to at least par to the world average quality thus fetching at least world average export price. Fetching this higher export price has huge dividend as the existing and additional export can fetch additionally US\$36 million which will go to various stakeholders in Sargodha cluster.

7.5.3. Processing

Horticultural related industries only account for some 10 percent of the food, beverage and tobacco sectors and marginally over 2 percent of all industries in Pakistan. The type and size of enterprises engaged in horti-business can be broadly, though not exclusively, classified as either micro-scale or large-scale operations being undertaken by nationally recognized companies, whereas medium scale industry to larger extend are absent from the sector (Agribusiness Development Project-ADB). With the rise of juice demand including citrus drinks in the local market it attracted many large-scale branded industries to enter this market segment (like Shezan, Mitchell, and Engro Foods) which also led to the establishment of fruit concentrate industries such as Citropak in Sargodha who has recently added three more units in production. Nestle is now marketing kinnow juice in tetra packs. Moreover, from kinnow peel and seed many other by products could be made like pectin, citric acid, essential oils, flavonoids, antioxidants and limonoids. Due to the presence of large amount of cheap raw material from waste, the government should undertake further detail feasibility studies to access the viability of establishing such industries.



8. PLAN, STRATEGIES, POLICES AND NETWORKING

8.1. The Plan

The purpose of the whole exercise is to contribute towards the cluster-development based agriculture transformation for the agriculture sector in line with the Vision 2025. Looking at the constraints and potential of citrus value chain, following targets are fixed in consultation of stakeholders for a five-year project to improve the competitiveness of citrus in the domestic and international markets.

Table 13 Targets of Citrus Cluster Plan

1.	Increase yield from 12.62 tonnes/ha to 17.08 tonnes/ha in the Sargodha Cluster in the next five years
2.	Improve the quality of the produce in the domestic market by 5% of the produce to the export standard within next five years
3.	Improve the quality and export price from US\$ 441/tonne equal to the world average of US\$ 845/tonne in next five years
4.	Increasing the export to production ratio from the current 16.60% to 19.92% (20% increase) in five years
5.	Reduce post-harvest losses from approximated 35% to 15% in five years

8.2. Policies

In order to reinvigorate the citrus value chain, it requires support from the government through policy and regulation framework. Number of specific policy issues required to be addressed by the Government to improve the competitiveness of the citrus value chain in the country. These are:

- Promote and facilitate the establishment of Infrastructure in the private sector such as cool chain system through incentive mechanism such as grants, credit with low interest rate, tax incentives, and start of matching grants mechanism, etc.
- Establish special trading platforms in main citrus producing union councils with basic facilities like weighing, washing, grading, packaging, and storing, etc. for sale of quality citrus with local brands.
- Capacity building of stakeholders on address the GAP/SPS and WTO issues.
- Sargodha and surrounding citrus producing districts should be declared as Export Zone.
- The cost of electricity for industry will be reduced through the use of low “off-peak” rates.



- The Ministry of Commerce need to continue the incentives as provided in the Strategic Trade Policy Framework 2015-2018.
- It is important that FSC&RD should take immediate steps to delegate powers of establishing certified nurseries to the provinces.
- All nurseries should be registered with FSC&RD each having the mother blocks. The sale of true to type nurseries will be ensured.

8.3. Strategies

The primary cause undermining the development of the value chain is the lack of coordination between the stakeholders. Thus, in order to implement the project activities, a holistic and integrated framework needs to be adopted for designing and implementing agribusiness development programs.

The prime focus is on building the capacity of all the key value chain stakeholders with respect to GAPs and SPS protocols and international certifications, improving linkages between them to invest on supply chain infrastructure, and strengthening their domestic and international market linkages.

The value chain interventions are aimed at providing comprehensive and mutually supportive solutions to current challenges in developing value chains for the citrus cluster of Punjab provinces. The component will be implemented by PMUs in Punjab with the support of multiple partners including Agriculture Department shall play the leading role while collaborating with other government and private sector institutions.

The overall objective is to re-vitalize the citrus sector by improving production and productivity, quality, exportability, infrastructure and promotion of processing industry.

8.4. Institution Level Strategies

8.4.1. Strengthening of Research

Research should be demand driven which should benefit the stakeholders mainly the grower, trader and the processors. Some of key areas identified through survey and discussion with the stakeholder and experts where the research needs to be initiated on priority basis are:

Development of Seedless Kinnow. There is a demand for seedless mandarin, particularly in the West, but unluckily the Pakistan does not produce such variety. It is suggested that, to increase the exports Pakistani farmers should start seedless kinnow production so that exporters could be able to penetrate European Union markets and introduce new variety, which would fetch good rates in the existing markets. As a matter of fact, that Pakistan will fast be losing its existing market as seedless mandarin and clementine from competitive countries such Turkey, Egypt and Morocco are strengthening their market shares.



The number of seeds in one fruit of Kinnow ranges from 0 to 54. The seedless trait in Kinnow is possible owing to natural factors like ovule, pollen and pollen self-incompatibility (Altaf & Khan, 2007, p. 2003). Research is in progress at National Institute of Agriculture and Biology (NIAB) since 1984-85 to develop seedless Kinnow (Ali, 2004, p. 191). The Orange Research Institute, Sargodha has reported that a 'less seeded' (i.e. 2-4 pips) variety of Kinnow has been developed there, however it is under the process of certification. Even Ayub Agriculture Research Institute has claimed to have introduced seedless Kinnow called AARI 2016 and have been adapted by some farmers. Much time has been spent on developing seedless kinnow by the research institutes in Pakistan, and time is essence as most of the competing countries are already entered the markets with seedless mandarins, clementine and tangerines. Citrus Research Centre, located at the University of California, Riverside have developing seedless Kinnow (KinnowLS) which in the past being restricted to be propagated in California only, but now is ready to be propagated outside USA. On priority basis the government needs to negotiate and acquire the seedless KinnowLS variety for further propagation in Pakistan.

Off-Season Kinnow. Peak production season of Kinnow fruits in Pakistan is from December to February (Ali, 2004, p. 224). So presence of Pakistani Kinnow in the world market is for very small span of time. Many mandarin producing countries worldwide have developed early and late varieties giving them long harvesting season such as Spain where main harvesting takes place between October and May (8 months), whereas Turkish season starts in October and ends in February (5 months). Exporters are of the opinion that availability of different maturing varieties is important for the competitiveness of the value chain. Brief harvesting season also has implications for the processing plants as they remain idle for rest of the year. Their low capacity utilization effects their competitive position. It is therefore, recommended that the researcher may develop such varieties which have extended duration of harvesting.

High Density Orchard. Although Citrus Research Institute have established high density plantation and few farmers have taken the initiatives in establishing new orchards, but there is a need to promote it extensively through incentives and awareness and training programs. More research on canopy management should assess the impact of pruning on flowering, light distribution within the canopy and the leaf area required during the development of the tree.

Proper Management Practices Research is required to develop proper orchard management practices especially proper pruning and canopy management, proper dosage and timing of fertilizer and pesticide and use of IPM techniques & water management especially under high-density gardens.

Packaging Materials. Impact of various packaging material on cost, post-harvest losses, and marketability of citrus in different markets along various distance to travel. Once the "right" types of packaging material for a destined distant market are identified, then it should be incorporated in the grades and standards regulation.



8.4.2. Social Mobilization & Networking

One of the strategic interventions in citrus cluster development is to organize Farmers Enterprise Groups (FEGs) 20-25 farmers who would be involved in the implementation of GAP/SPS compliant farms. Experiments and field trials shall be organized with focus on GAPs application in field. Field days shall be organized by FFS in a crop season to share experience and results of the application of GAPs at FFS site. The field days shall be completely managed by the farmers. The rest of the farming community shall also be invited to share learning, experience and overall benefits of application of GAPs in the field on regular basis. Also these FEGs would be able to create economies of scale and can collectively deal with input suppliers, technology suppliers, financial support, contractors, exporters and processors to get better deals.

Some NGOs, particularly, Rural Support Programs (RSPs) have initiated rural development activities with community participation. RSPs organize small community groups, mobilize group resources to build financial capital and provide training to develop skills of its members. RSPs provide micro finance services to members of community organizations without collateral. RSPs can organize a relatively small group of several persons interested in enterprise development. Due to their experience and extensive network the project needs to collaborate with RSPs social mobilization of these FEGs and support them in their collective efforts.

8.4.3. Establishment of Project Management Unit (PMU)

To implement the entire project activities there is a need to establish an institutional structure Project Management Units (PMUs), the main office to be based in Lahore with sub office in Sargodha cluster.

8.4.4. PMU Functional Organization

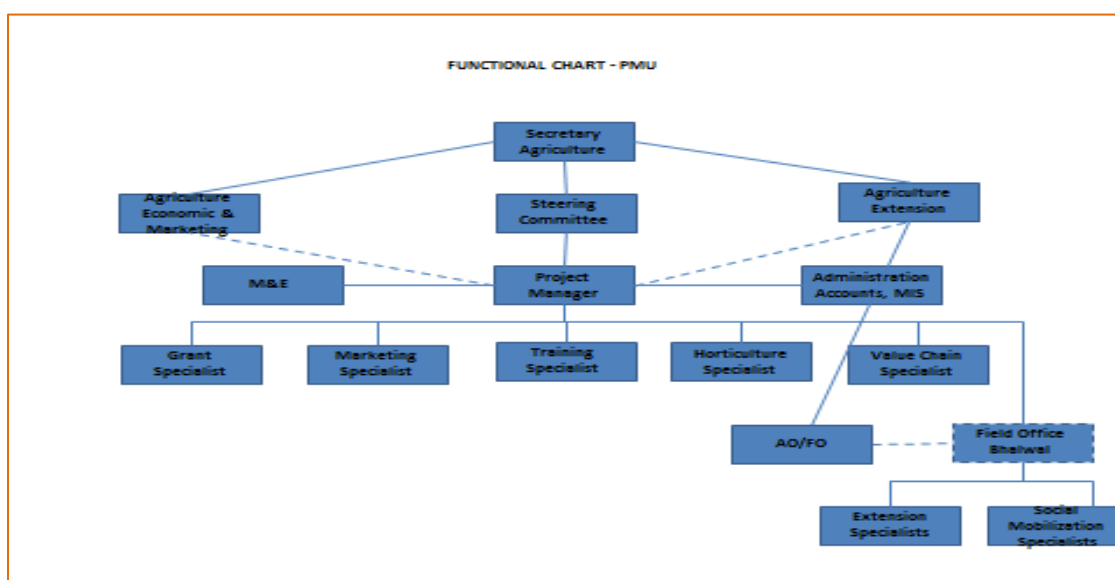


Figure 3: PMU Functional Chart



The project office shall be set up in Lahore as a central project office to implement the project for Punjab (the reason for Lahore is that PMU would ultimately implement the cluster development programs in various other products such as mango, potato, basmati rice, etc.). The PMU would be working directly under the Steering Committees which would be headed by the Agriculture Secretary. The Steering Committee shall include representations from all level of the value chain and this forum would provide a platform to integrate stakeholders for better networking. The Project Managers and all other members of core technical team, supporting team including accounting, administration, monitoring and MIS will be deployed in the office the respective offices. Field offices in Bhalwal would be established which would cover the activities in their respective citrus cluster. Depending on the nature of their assignment, short-term experts engaged from time to time will be deployed at any of these two offices. PMU Project Manager would work closely with Directorate of Agriculture Extension (Horticulture) and Directorate of Agriculture (Economics & Marketing) on ongoing basis. An organogram of the proposed organization structure is shown in the above chart. The PMU would work in close coordination with:

Directorate of Extension (Horticulture): Activities include designing GAP modules, farmer trainings calendar and plan, and implementation of GAP trainings deploying Farmer Field School (FFS) model. PMUs to utilize services of experienced team of Directorate of Extension (Horticulture) to support as facilitators in FFS. Capacity building of these facilitators will also be key activity under the FFS activity. The Directorate will also be involved in structuring of the inception report, work planning and implementation of other activities.

Directorate of Agriculture (Economics & Marketing): Close functional coordination will be maintained with the Directorate of Agriculture (Economics & Marketing) in structuring of the inception report, work planning and implementation of PMUs activities including capacity building, certification, supply chain infrastructure improvement and international and domestic marketing linkages.

Public Sector Agencies: We will interact with public-sector agencies such TDAP, PHDEC, SMEDA, PBIT SIDB, Commercial Embassies/Consulates, etc. to develop activity-specific synergies; e.g. participation in international trade shows; promotional campaigns; technical support in feasibility studies and business plans for supply chain improvement initiatives; agribusiness certification and capacity building initiatives; establishment of domestic market buyer-seller linkages etc.

Universities and Research Institutes: PMUs shall make arrangements with a number of universities and research institutes for organization of class-room and on-field trainings, particularly during FFS implementation. These universities and institutes shall also be engaged to host trainings on SPS compliance, food safety, certification audit etc. The universities and institutes include: University of Agriculture Faisalabad, ARID Agriculture University Rawalpindi, University of Agriculture Sargodha, Bahauddin Zakariya University Multan, Ayub Agriculture Research Institute Faisalabad, and Pakistan Council of Scientific and Industrial Research (PCSIR), Sindh Horticulture Research Institute, Agriculture Research Institute (Tando Jam) and Tando Jam University.



Service Providers: A pool of service providers including: certified trainers, auditors, management consulting firms, machinery and equipment vendors, cold storage specialists, legal experts, international marketing specialists, chartered accountant firms, agriculture experts, technical consultants etc. PMUs shall link beneficiaries looking for consulting services, to these service providers during the course of project implementation. Capacity of these service providers will also be built through different training programs.

8.4.5. Improving Financial Access

There is a dire need for intensification and innovative way of credit disbursement through banking system for agriculture sector. Such schemes are particularly needed by small growers, to link them with value chains. Special consideration should be given to farmers who are registered for GAP/SPS compliance and encourage group financing system as it reduces the risk of defaults

8.4.6. Capacity Building of Stakeholders

The prime strategy will be building the capacity of all the key value chain stakeholders (farmers, processors, transporters, exporters, certifying bodies, service providers etc.) with respect to GAPs and SPS protocols, international certifications, investment in supply chain infrastructure, value addition, development and strengthening of domestic and international market linkages. The Project Management Unit (PMU) agricultural universities, SMEDA, RSP, TEVTA, and foreign consultants shall organize need-based training programs in the next five years for the processors, value addition and exporters, etc. aimed at improving their overall capacity to comply with international compliance requirements. Some of the themes of these trainings for various stakeholders are given in Annexure 4:

8.4.7. Improvement in Service Delivery

- A product-specific handbook of Good Agricultural Practices (GAPs) and SPS protocols for citrus value chain by team of experts represented from PMU, Directorate of Agriculture Extension (Horticulture), R&D institute, and academia.
- Some examples of topics, which shall be thoroughly covered in the modules, include the management of: soil and plant nutrition, insect pest and diseases, pruning and canopy, food safety and phytosanitary, harvest & post-harvest fruit handling, high density plantation and environment. Modules shall be selected and finalized by PMUs in consultation with Directorate of Agriculture Extension (Horticulture) DPP and NARC. Detailed training methodology to be provided in each training module. In order to track effectiveness of the training delivery, a mechanism for evaluation of each training shall also be provided in each module.
- These training courses will be implemented by the private sector awarded on competitive basis with the finance provided by the provincial departments. The Extension Department and PMUs will monitor the implementation of these modules by the private sector.
- FFS sites will be established and operated at the each FEGs level on the sites provided by the group. On average a group of 20-25 member farmers from FEGs shall attend each FFS meeting.



- In coordination of PMU extension experts, AD/AO/FO of Extension Department shall be assigned to each FFS. The farmers shall also be provided with the copies of GAP modules in Urdu language. PMU extension experts and AD/AO/FO shall conduct field sessions based on standard modules.
- At least two field days shall be organized by FFS in a crop season to share experience and results of the application of GAPs at FFS site. The field days shall be completely managed by the farmers. The rest of the farming community shall also be invited to share learning, experience and overall benefits of application of GAPs in the field.
- Farmers shall continue the practice of GAPs application in their fields and orchards. Facilitators (Licensed Farm Assurers) shall undertake follow-up visits to provide ongoing guidance and to track overall progress by the graduate farmers. Strong interaction among farmers through FEGs will also be encouraged.

8.5. Production Level Strategies

8.5.1. Establishment of High-Density Gardens

High-density plantation gives high yield it can get earlier return on investment; better spray coverage at less cost, easy harvesting and return to fulfill production sooner after tree damage or removal, use of mechanization and less water utilization when the water is getting scarce. The future development should be towards high-density plantation in this crop which is dependent on the use of dwarfing cultivars and/or rootstocks and better canopy management strategies. Some progressive farmers have already adapted high density plantation but more efforts need to be made to put maximum acreage under high density plantation. The productivity of kinnow is not likely to be increased by the use of high-density plantings without extensive efforts in plant breeding and canopy management. So the research institutes in collaboration with PMU and the extension department need to promote high density intervention.

In order to attain higher yield and improved quality produce, high density plantation program will be initiated in citrus cluster under the supervision of respective research and extension. Although Citrus Research Institute in Sargodha has taken the initiatives towards high density plantation, but there is a need to promote it extensively by the government through awareness and training programs.

In high density plantation 500 plants per ha will be planted. As discussed earlier, the high-density plantation has significantly higher yield than the old low-density gardens. It is proposed that 20% of the existing citrus area will be replaced with the high-density garden. To minimize the impact of garden renovation, it is suggested that new high-yielding dwarf variety plants will be inserted in the old garden by pruning the old plants, and old plants will be gradually removed when the new plants will be almost ready to bear fruit. For this purpose, scientific pruning methods for the existing gardens will be introduced to create a space for the new plants. As renovations of gardens will require lots of additional cost, new citrus plants will be subsidized at 20% rate provided if they are purchased from the certified nurseries. It is conservatively estimated that new high-density gardens will improve the per ha yield by 75%.



8.5.2. Establishment of Registered Nurseries

Previously FSC&RD was exclusively mandated to establish certified nurseries but due to lack of financial and human resource capacity it is unable to implement such extensive programs. So, to overcome these shortcomings under the Seed Act 2015 it has obligated the Agricultural Departments to establish certified nurseries and has created an opportunity to increase certified nurseries. But unfortunately, it has still not practically transferred such powers to the provinces. It is important the government should take immediate steps to ensure to delegate powers of establishing certified nurseries to the provinces.

Local nursery producers would be encouraged to register with local FSC&RD offices by PMU, AD/AO/FO and R&D institute to participate into the scheme to produce certified quality young fruit trees. This would be on a voluntary basis, but would bring with it certain fringe benefits, namely:

- Registration with FSC&RD shall provide the nursery producer with a guarantee of quality and help to raise the business and reliability of the nursery
- They shall get access to propagation materials from the multiplication blocks (on a payment basis) and also access to any new varieties introduced. Non-Registered nurseries will not have access to this material
- These nurseries will become a part of the certification scheme for young fruit trees
- Owners and staff of the registered nurseries will have access to training in improved nursery management and production practices
- participation in the registration and certification scheme will raise the business profile of the nursery and encourage repeat business through certified quality and increased reliability
- Ultimately the nurserymen will attain higher prices for the production, compared to uncertified planting materials.
- The GPU's and multiplication blocks shall remain under the Agricultural Research System but should be monitored for health, cleanliness and freedom from pest, disease and virus infestation by the FSCRD to keep its varietal integrity and check if the SOPs are being followed.
- Price is a big factor that most farmers which drives them either to develop their own nursery or buy them from uncertified nurseries. So, it is important that government to provide incentive in form of cost sharing for growers buying plants from these registered nurseries.

The target is to develop 1,500,000 certified plants within the next five years through government financial support.

8.5.3. Orchard Level Intervention

Some of the key kinnow stakeholders mentioned that the issue is not marketing but quality production which is curtailing the growth of kinnow sector especially the exports. Extension has the key role to play in the development of quality and improvement of yield by applying best agriculture practices through training programs. In order to make an effective change in production practices kinnow specific extension program would be launched which would entail extension staff (specialized/experienced in citrus production background) to



specifically catering the emerging needs of the kinnow sector. It has been found during the interviews with the exporters and association that they are willing to support the kinnow specific extension program by contributing matching funds, if extension is jointly implemented with farmers, industry and the department. The University and research organizations will also be made a part of the program for their technical inputs.

Modern kinnow pre-harvesting and harvesting practices can substantially improve industry profitability by reducing citrus losses and improving the quality of the fruit. Some key areas to improve farm practices are:

- Timely, balanced, and judicious use of fertilizer, pesticide/insecticides, micronutrients in line with the soil nutrient stock after soil testing.
- Though Pest Warning and Quality Control department, federal and provincial seed corporation and plant protection departments are making good efforts in monitoring the adulterated fertilizers and pesticides in the market but still many unbranded adulterated inputs suppliers are still active in the market, which needs to be effectively controlled.
- Pruning is a crucial horticulture practice to ensure the health of the tree and is one of the ways of improving the quality of the fruit and increasing yield. So extensive training has to be imparted to the growers on best pruning practices using latest machinery and tools.
- Strong message from the provincial government to rationalize the use of water on the farms and discourage flood irrigation. Other options such as furrow irrigation system should be promoted for the growers who cannot afford drip irrigation system. The furrow irrigation system needs to be further tested and adopted on a wider scale in commercial orchards in citrus growing regions of Punjab
- Encourage the use of proper tools to harvest such as harvesting knife, bagging cutter, secateurs, etc.
- Under the new grades and standards, the use of wooden boxes will be phased out as it a source of contamination and cutting trees promotes environment degradation. The other options are either corrugated boxes or disposable light plastic crates, which has been introduced in kinnow sector and is nearly the same price as of the wooden boxes.

There is an urgent need in Pakistan for the application of better technologies to boost the citrus industry's performance such as modern harvesting equipment, pruners, electronic spraying machines, rotary tillers, hydraulic lifters, etc. USAID under one of their programs have introduced such technologies which included sensor-based spray machines and tractor mounted imported pruners. Imported technologies are expensive and, in any case, local users may find them difficult to operate, so there is a need to develop low cost, easy to operate machinery. Institutions such as the PARC, Agricultural Mechanization Research Institute (AMRI) at Multan and agricultural universities can play an important role by launching projects to develop low-cost local machinery and equipment.



Figure 4: Modern Mechanized Method of Pruning of Orchards

This requires capacity building of the stakeholders involved in pre and harvest activities mainly the farming community through extensive training programs. PMU with Agriculture Department Extension would play a key role in its implementation. Presently the focus of the extension services is towards major crops hence not much attention or expertise has been developed on horticulture/citrus sector. Specialized horticulture extension services are required to improve orchard level practices. These must be equipped with adequate knowledge of modern orchard practices, such as pruning, spraying, picking, harvesting and handling of kinnows. To this end, both short- and long-term training courses on modern orchard and postharvest management need to be provided for PMU extension staff and Agriculture Department Extension staff.

8.6. Marketing Level Intervention

8.6.1. Improvement of Domestic Market Value Chain

A major governance related weakness of citrus value chains in Pakistan is a lack of well-defined grades and standards. Such grades and standards are essential for the competitiveness in markets with heterogeneous product needs. The current lack of well-defined grades and standards makes price comparisons for citrus of different qualities/grades difficult for both consumers and value chain actors. Consequently, the value chain actors incur losses because of low quality citrus in their supplies and consumers fail to get value for their money. There is therefore a need to develop grades and standards for citrus. The PMUs in coordination with the Agriculture Economics and Marketing wings of provincial agriculture department and relevant research institutions can develop these grades. Strict enforcement of such grades and standards would help consumers to obtain the values they desire and increase the profitability of value chain actors. Proper grading to conform to these standards, packaging, transportation, etc. will be encouraged.

For exports all consignments are transported through reefers from the processing units. But for domestic markets the transportation is another key constraint for citrus losses, which is due to being transported on open trucks, wooden boxes loosely stacked and overloaded



even kinnows are transported in bulk without any packing. It is important to introduce reefer trucks so that quality produce is transported to destination. But being expensive hence the farmers and contractors do not use this mode of transportation. There is a need to undertake a separate study to assess the cost benefits of the extra cost involved of reefer transportation against the extra value obtained for the quality product to different major wholesale markets.

8.6.2. Strengthening Domestic Market Linkages

Pakistan's share of exports out of the total production is small around 16% and the remaining is sold in the domestic market. It is assumed that after quality improvement and achieving international certifications share of exports in the international markets will improve but still large quantities of export quality shall be available for domestic markets of 200 million. In order to sell such export quality citrus in the domestic markets, the farmers shall be linked directly with the domestic retail markets and processors who are now selling quality processed kinnows to the high-end markets in the urban areas. With the establishment of international chain stores and upcoming large local stores the demand for safe hygiene and quality products is increasing. Sourcing fresh commodities of high grades at sustainable basis is a big issue for these chain store, they purchase in bulk from the wholesale markets (mandis) and sort grade and pack as per their standards and then bring to stores for sale. This exercise not only increases the cost of the commodity but also effects quality. Chain stores direct link with GAP farmers (especially small farmers under FEGs) would not only be able to source quality produce but on better prices as it by-passes the middlemen costs.

Local expositions are important events to link all stakeholders (farmers, exporters, input suppliers, retailers, technology suppliers, etc.) under one roof. It would be important for respective provincial governments to hold such trade fairs and support the certified farmers to showcase their products. DPP can also promote these GAP/SPS and certified farms by enlisting them on their formal notification list which should be sent to the exporters.

8.6.3. Linking Stakeholders with International Markets

The aim is to introduce and significantly increase the export of fresh products in the high-end international markets which has high import volumes and growth by providing support to key stakeholders including selected farmers, processors and exporters to participate in international exhibitions, trade shows, trade fairs and other international trade oriented events. The initiative shall facilitate participation in events that provide a suitable environment for networking with business contacts leading to the establishment of buyer-seller relationships, gaining a better understanding of market demands and conditions, and understanding the steps required to enhance market-readiness and competitiveness.

The government will support the certification for GAP wherever there is a demand for such certification (See Annexure 5 for the implementation of certification of standards). National brand name needs to be introduced, confirming that the product originates from the GAP farms and cluster-based value addition industry. The brand name shall be used by project beneficiaries who source products from the clusters. Even small farmers in groups can also



participate. Government would provide all support in creating the collective National brand name and its promotion. The promotion jointly undertaken by PMU and TDAP shall promote Pakistan's image as a reliable partner in exporting kinnows in the high-end market. TDAP needs to take the lead with special plan and budget to be allocated to promote the brand. The products to be promoted through the national brand name conforming to the international standards developed by TDAP and the PMU.

In the high-end markets normally they are large multinational stores who have very strict quarantine, requirement, cumbersome documentation, long term commitments, consistent deliveries of quality products. This requires entrepreneurship to manage such clients with huge financial commitment. Hence it is important to identify the right exporters for linkages with high end international chain stores.

Leading private sector companies or market leaders (**wholesalers and processors**) remain the key drivers of the demand of horticulture products for the growing clusters. SMEs engaged in processing, value-addition and other commercial operations shall also be included, supported and linked to the chain. For wholesalers either they can rise to be an exporter or would create awareness amongst them the value of quality products.

Many major international exhibitions on horticulture are held during kinnow off season time when exporters do not have excess to their products for display. Those exhibitions have to be identified which are held during kinnow production time. This does not mean to suggest that the biggest exhibitions should not to be attended. Also, in store displays at high end stores should also be part of marketing promotion so that the consumer is made aware of Pakistani kinnow for its quality and unique taste.

Besides Pakistan's image as a low-quality supplier in the international market there also a distrust as exporters are sending mixed quality kinnows by topping with "A" grade and rest are "B" grade in corrugated boxes. It is important that grades and standards are established and DPP should be mandated to inspect the fruit maturity, defects and proper grading before it is exported.

To complement general event participation, support and sponsor more targeted and intensive Business-to-Business (B2B) networking events. Such targeted B2B networking events shall involve pre-arranged matchmaking between qualified buyers and producers of kinnow. Specifically, while implementing this component, the aim is to introduce and increase the export of target products in the high-end international markets which has high import volumes and growth; some of the potential countries for fresh kinnows exports identified are Germany, France, Netherlands, China, Indonesia and Hong Kong. Although the market growth of Indonesia is in decline but the existing import volumes are attractive for Pakistani kinnows to show its presence. The attraction is that Indonesia offers zero-rated market access to kinnow and oranges from Pakistan, offering a level-playing field to this product in the Indonesian market. However, Pakistani exporters face tough competition in Indonesia as regional states also export fruits to Indonesia on low duties because of the agreements among the Association of Southeast Asian Nations (ASEAN) trading block. The increased access to global markets shall encourage domestic firms to invest in upgraded facilities, improved productivity, product development and compliance to international standards.



Some of the options available for participation in leading trade shows/exhibitions include AGRAME Dubai, Euro Tier, Fruit Logistica Germany, Fruit Logistica Hong Kong, Gulf Food Dubai, World Food Moscow, etc. Those events will be selected, which are scheduled within the season of product, so that samples of target products can also be displayed at the events for sample tasting. In this regard, collaboration with Trade Development Authority of Pakistan (TDAP), Pakistan Horticulture & Development Company (PHDEC) and Commercial Councilors with respect to identification and participation in the relevant marketing activities shall be sought. It is proposed while visiting at expos on the side line pre-arrangements shall be made with chain stores to display Pakistani citrus in a store with taste sampling so that consumer can get awareness of Pakistani kinnows qualities.

International marketing consultants from EU and China and a local marketing company can also be hired to support in this endeavor. PMU and Agriculture Economic and Marketing departments in coordination with these companies would carry out some of the following activities:

An implementation plan shall be the part of strategy and shall include the following details:

- a. Key identified potential high-end international markets (some countries already mentioned above)
- b. Specific compliance & packaging requirements
- c. Mapping of key potential international trade shows and exhibitions for participation by the program participants
- d. Marketing and promotion program – establishing market presence through branding
- e. Identification of any potential host country partners, facilitators, etc.
- f. Criteria of selection of beneficiaries for participation in events
- g. Tentative costs of participation in 10 international exhibitions (50 participants) and promotional campaigns in next five years shall be organized.

In addition to providing grants to beneficiaries for participation in the events, PMU shall provide a complete package of support and assistance to them to ensure that they gain maximum benefit from the participation.

8.6.4. Development of Information Web-Portal

A dedicated web-portal containing GAP handbooks and training modules shall be prepared to reach the audience at a larger scale. The portal will contain information regarding international citrus market situation, merging new quality requirements in different markets, new technologies being used in different segment of the value chain, etc. The portal will also contain various training modules. The portal shall provide an option to visitors to subscribe to training messages/tips. Participants of all trainings will be automatically registered for the SMS tips. A system shall be devised to structure periodic tips in Urdu from the GAP handbooks and training modules, which shall be circulated to beneficiaries and other subscribers on a periodic basis.



8.6.5. E-Commerce-Portal & SMS-based Training Message Scheme

An integrated innovative tool including e-commerce portal and SMS-based training message schemes in the training delivery mechanism will be introduced by PMUs at the provincial levels. A dedicated web-portal containing information on mango supply, prices, changing quality standards, and emerging technologies in production, value addition, and processing in major mango producing markets, upcoming mango related national and international events, GAP handbooks and training modules shall be prepared to reach the audience at a larger scale. The portal shall provide an option to visitors to subscribe to training messages/tips circulated to registered subscribers on periodic basis. Participants of all trainings will be automatically registered for the SMS tips. A system shall be devised to structure periodic tips in Urdu from the GAP handbooks and training modules, which shall be circulated to beneficiaries and other subscribers on a periodic basis.

8.7. Value Chain Improvement

The citrus value chain will be improved to enhance citrus quality and its export price at least equal to the world average by adopting best practices, such as globally accepted phytosanitary standards and certification regimes. A special trading platforms shall be established in rural citrus growing towns with basic facilities of weighing, washing, grading, packaging, sorting, etc. will be available. These centers will be owned and operated by the FEGs. The farmers will bring produce directly from the field and shall be offered for sale directly in safe and hygienic conditions. Any farmers can use the services of the platform on payment. The idea is to bring the market closer to the farmers' field and provide them quality services at their doorstep. These trading platforms would also serve and provide GAP/SPS and quality produce to small exporters exporting to the ethnic markets of UK, Gulf and Far East. It would also cater to the local high-end chain stores. Regulation is required by the provincial governments to create special trading platforms in the wholesale markets and develop grades and standards for farmers to sell their produce under this new market channel. A total of 83 collection centers will be provided be strengthened with basic marketing and value addition facilities.

8.8. Cold Chain Infrastructure Development

One of the key pillars of modern value chain is the presence of appropriate infrastructure such as processing and cool chain system which has become critical for reducing post-harvest losses, promote exports earning valuable foreign exchange, price stabilization in domestic market empowering growers to control as per demand supply situation and avoid quality deterioration due to short shelf life. As mentioned earlier that there is limited level of cool chain infrastructure present in the kinnow value chain. To upgrade the value chain, it is important for the government to promote establishment of cold storage projects.

In the fruit and horticulture industry, inadequate cold chain infrastructure means that products have a short shelf life and quickly lose their freshness and quality beyond addressing the cold chain inadequacies. Besides during when there is glut in the market the



farmers/contractors have little option to hold the product hence get very low prices. The increased availability of storage would enable farmers to time the release of their produce to periods of higher prices, better transport availability or other more favorable conditions.

To keep the cold chain intact from production to market there is need for establishing cold storages at citrus production areas and at wholesale markets in small towns. The cold storages would be established under grant mechanism by the government through FEGs. These cold storages will be owned and operated by the FEGs. Any farmer can get services of the storage on paid basis. The profit of the storage will be distributed according to the proportion of investment each farmer's contributed in establishing the cold storage. A total of 490 small farm-level cold storages with a capacity of 315 tonnes (in the citrus season of 90 days) would be required to pass all the exports and 5% of the domestic produce destined for high-end markets.

8.9. Coordination of Institutions to Implement Strategies

Following institutions and parties will be engaged to implement different strategies to achieve various targets of the Plan.

Table 14: Summary of Target related Interventions Sargodha Cluster

TARGET	KEY INTERVENTIONS	KEY IMPLEMENTING PARTNERS
Increase Yield by 32.62% in the next 5 years	<p>Supply of true-to-label plants to the farmers through the establishment of certified nurseries at subsidized rates.</p> <p>Capacity building on orchard management especially proper pruning and canopy management, proper dosage and timing of fertilizer and pesticide and use of IPM techniques & water management.</p> <p>Implementation of GAP/SPS through FFS methodology. Web-Portal & SMS-based Training Message Scheme</p> <p>Promote High Density plantation and use of drip irrigation</p> <p>Use of better technologies on the farms (mechanization) especially for pruning, plowing and pesticide spraying</p> <p>Excess to financing to farmers</p>	<p>PMU, Citrus Research Institute (CRI), FSC&RD, NARC</p> <p>PMU, Agriculture Extension Punjab, Academia, Certifying Agency</p> <p>PMU, CRI, Extension Department</p> <p>Directorate of Agricultural Mechanization PARC, AMRI</p> <p>State Bank of Pakistan</p>
A. Improve quality 20% produce in domestic market based upon international standards in the next 5 years	<p>Value Chain Improvement which includes:</p> <p>Capacity building farmers and contractors for pre and post-harvest management which includes fertility management, plant protection management, proper harvesting, packaging and transportation. Use of proper equipment for</p>	<p>PMU, Agriculture Extension Punjab, Academia, Certifying Agency</p>



<p>B. Reduce Post-Harvest Losses from 35% to 15% in the next 5 years</p>	<p>harvesting. Implementation of GAP/SPS through FFS model</p> <p>Provide incentive to adapt Certification regimes</p> <p>Establishment of cool chain system to increase the shelf life and quality of citrus. Government to provide incentive mechanism</p> <p>Regulations such as implementation of grading and standards and establishment of special platforms for sale of standardized citrus</p> <p>Direct linkages of farmers with the market which includes exporters, processors and retailers to bypass traditional value chain. Local expositions are effective way of networking</p>	<p>PMU, Agriculture Extension, FEG/PMO, Certifying Agency</p> <p>PMU, Agriculture Dept. Punjab, SMEDA, Grant Expert (private sector company)</p> <p>PMU, Provincial Government, Agriculture Departments of Punjab</p> <p>PMUs, Agriculture Dept. (Economic & Marketing)</p>
<p>Increase export to production ratio 20% (from 16.60% to 19.92%) and improve quality export price in the next 5 years</p>	<p>Market diversification to high end potential markets with high growth rates</p> <p>National Brand would be established for exports for those citrus sourced from GAP/SPS farms</p> <p>Capacity Building besides production aspects training would be imparted on WTO, Tariffs & Trades Customs Laws, Food Safety Standards and Phyto-sanitary requirement</p> <p>Linkages with domestic and international markets through expos/B2B</p> <p>Existing processing units to acquire international certifications, including quality assurance and food-safety compliance certifications such as: IFS, ISO 22000, FSSC 22000, BRC etc.</p>	<p>PMU, TDAP, Agriculture Dept. (Economic & Marketing) Punjab, Commercial Councilors</p> <p>PMU, TDAP, International Expert</p> <p>PMU, Academia, relevant government departments</p> <p>PMU, Agriculture Dept. Punjab, TDAP</p> <p>PMU, Agriculture Department Punjab, Certifying Agency</p>
<p>Establish Cool Chain infrastructure in the next 5 years</p>	<p>Incentive to be provided by government</p>	<p>Federal government and Punjab government</p>



9. BENEFITS AND COST OF CLUSTERING

This section discusses the costs associated with cluster development strategies presented in the previous section. This also identifies resources and requisite inputs for achieving all the targets given in Section 2. An economic and social impact analysis has also been conducted that evaluates the benefits of the citrus cluster development interventions in the target region of Punjab.

9.1. Investments, Costs and Returns

An investment of US\$ 370.72 is needed to support the cluster development efforts in the Punjab. The main investment is in the establishment of cold storages units. This investment would be shared between government and the private sector through incentive mechanism (PMU/government is to develop the cost sharing grant mechanism). Other cost such as establishment of PMU, training, marketing, research, etc. would mostly be borne by the government. 70% of the government share in the investment should be provided by the federal government, by establishing a Cluster Development Fund (CDF) under Planning Commission Pakistan. The remaining 30% should come from the provincial budgets.

9.2. Summary of Investment Costs

Investment costs are summarized in the following Table.

Table 15: Summary of Investment Costs

Summary of Investment Cost	Value
Cluster	Punjab
Total Investment (US\$)	79,725,866
Total land under citrus production in the focal point (ha)	88,398
Estimated investment per ha (US\$)	727

9.3. Economic Returns

Cluster development investments are expected to help generate revenues from the year 2 of interventions. All the five cluster interventions are expected to result in additional gross revenues of US\$ 36.7 million in second year and US\$ 199.0 million in fifth year. The value chain development operational costs related to orchard renovations are applicable from year 1, while all other operational costs including those related to improved management practices in production, processing, marketing and selling are applicable from year 2 through year 5, the total of which ranges from US\$ 3.8 million in first year and \$ 55.1 million in fifth



year. The total initial cluster investment is US\$ 64.22 million in the focal point of citrus cluster, i.e. in Sargodha district over the period of five years.

Offsetting these value chain costs from revenues, net economic benefit in first of interventions will be negative US\$ 17.0 million. This amount is exactly equal to the value chain development operational costs and investments in year 1, as no revenues or benefits are expected in first year of cluster development interventions. The net economic benefits in subsequent years are expected to range from negative US\$ 7.4 million in second year to US\$ 139.6 million in fifth year. The research and capacity building related investments shall be made in first five years with a distribution of 40%, 30%, 15%, 10% and 5% from year 1 through to year 5 respectively, while investment on cold chain are distributed according to the number of cold storages required to pass the targeted output in the cold storage. Similarly, investment on renovation garden will be distributed according to the number of has to be renovated every year.

9.4. Conclusions

In conclusion, the overall economic, social and environmental impact of the cluster development program shall be positive, sustainable and long lasting. Accounting for all the fixed costs and variable costs including the production, processing and marketing cost, the estimated Internal Rate of Return (IRR) for Sargodha cluster is 85%; based on investment costs in the cluster and the present value of resulting revenues over the period of eight years. This estimated IRR signify the fact that cluster development interventions are likely to positively impact not only the existing output of citrus cluster, but also likely to add additional value increasing the overall potential of the citrus value chain across the country

Table 16 Economic Returns and Investments in Punjab Cluster

	A	B	C	D	E	F	G	H	I	J
7	Intervention-2		-	5,301	12,005	18,315	24,839	25,264	25,636	26,136
8	Expected Additional Revenue from Increased Yield		-	-	-	-	-	-	-	-
9	Intervention-3		-	12,098	25,210	40,477	57,626	60,128	62,639	65,340
10	Expected Additional Revenue from Reduction in Post Harvest Losses		-	-	-	-	-	-	-	-
11	Intervention-4		-	4,471	9,760	16,383	24,338	25,395	26,480	27,596
12	Expected Additional Revenue with Improvement in Export-Production Ratio		-	-	-	-	-	-	-	-
13	Intervention-5		-	14,241	31,133	52,076	77,344	80,237	83,206	86,253
14	Improvement in value chain		-	-	-	-	-	-	-	-
15	a) Bring national export price to international export price		-	-	-	-	-	-	-	-
16	b) Bring 5% of Production to International Export Price		-	-	-	-	-	-	-	-
17	Total Expected Additional Gross Benefits [TEAGB]		-	36,711	78,108	134,578	199,050	213,761	228,317	244,529
18	Expected Costs		-	-	-	-	-	-	-	-
19	Renovation of Gardens: Cost of Orchard Establishment		1,811	1,811	1,811	1,811	1,811	-	-	-
20	Renovation of Gardens: Cost of Orchard during Gestation Period		2,018	4,037	6,055	6,055	6,055	4,037	2,018	-
21	Cost of Increase in Productivity (yield)		-	1,338	2,843	4,338	5,863	5,363	6,086	6,130
22	Cost for Reducing PHL		-	2,676	5,575	8,352	12,744	13,298	13,866	14,451
23	Operational Cost of Cold Storages		-	3,272	7,131	11,867	17,560	18,169	18,734	19,434
24	Cost of Pack-houses		-	867	1,830	3,145	4,654	4,815	4,981	5,151
25	Total Costs [TC]		3,830	14,060	25,306	36,168	48,707	46,302	45,745	45,225
26	Cluster Investments		-	-	-	-	-	-	-	-
27	<i>Government</i>		-	-	-	-	-	-	-	-
28	Investments on Research & Development		741	556	278	185	93	-	-	-
29	Training of farmers for Global Gap		62	47	23	16	8	-	-	-
30	Training of value chain agents		5	4	2	1	1	-	-	-
31	Investments required on promotion of export (USD)		215	161	81	54	27	-	-	-
32	Investment on PMU		688	516	258	172	86	-	-	-
33	Government loans		1,154	1,325	1,603	1,914	153	-	-	-
34	<i>Subsidized private sector investment</i>		-	-	-	-	-	-	-	-
35	Investment on new plants for garden renovation		2,588	2,588	2,588	2,588	2,588	-	-	-
36	<i>Private Sector with government subsidized financial support</i>		-	-	-	-	-	-	-	-
37	Certified citrus nursery establishments		183	137	69	46	23	-	-	-
38	Certification of production practices (USD)		575	431	216	144	72	-	-	-
39	Infrastructural Cost of cold storage		7,273	8,536	10,573	12,728	1,322	-	-	-
40	Total investments (USD) [TI]		13,485	14,361	15,636	17,848	4,372	-	-	-
41	Net Benefits [TEAGB]-[TC]-[TI]		-	17,314	8,290	37,106	80,562	145,370	167,453	183,172
42	Estimated Internal Rate of Return (IRR)		-	16.7%						



10. ANNEXURES

Annexure 1 List of Data and Literature Reviewed

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Annexure 2 List of Stakeholders Consulted

Sr. No	NAME	INSTITUTION	LOCATION
1	Tahir Hussain	FSC&RD	Lahore
2	Syed Fayaz Ali	SFA - Value Addition	Kabirwala
3	Shaukat Hussain	Grower	Bhalwal
4	Allah Ditta	Grower	Sargodha
5	Safdar Hussain	Grower	Sargodha
6	Ijaz Mustafa	Grower	TT Singh
7	Ansar Iqbal Haral	Grower/Processor	Sargodha
8	Ch. Amjad Nisar/Majid	Grower/Processor	Bhalwal
9	Shahid Sultan	Packaging/Grower/processors	Bhalwal
10	Zafar Ahmed	Contractor	Bhalwal
11	Imran M Siddique	Horticulture Research Station	Sahiwal
12	M Nawaz Khan Maken	Citrus Research Institute	Sargodha
13	Kamran Haider	Citropak	Sargodha
14	Shezad Abbas	Dir. Extension Punjab	Lahore
15	Sajid Ahmed	Dy Director (Tech) Agriculture Dept	Lahore
16	Naseer Ahmed	Dy Dir Agri Extension Punjab	Lahore
17	Abid Mahmood	DG (Research) Agri Dept Punjab	Lahore
18	Allah Ditta	TDAP	Lahore
19	Mohd Asif	SMEDA	Lahore
20	Mohd Najeeb Ullah	Director AARI	Faisalabad
21	Dr. Atta ur Rehman	AARI	Faisalabad
22	Dr. Mohsin Malik	AARI	Faisalabad
23	Moiz Aziz	AARI	Faisalabad
24	Ghulam Ishaq	PEEP/USAID	Lahore
25	Tariq Qamar	BVC	Lahore
26	Dr Waqar Ahmed	PATTA	Lahore
27	Shafqat	Model Farms Project Punjab	Lahore
28	Zahoor Alam	Horticulture Consultant	Islamabad
29	Syed Abad Hussaini	Agriculture Economist Consultant	Islamabad
30	Mujahid Ali	Commission Agent	Lahore



Annexure 3: Salient Features of Citrus Cluster

Characteristics and Comparison of the Clusters

Salient Features	Punjab Know Cluster
Product	KINNOW, fresh
Cluster Districts	Sargodha, M.B. Din, and Bhalwal
Area of the cluster (000 ha)	101.46
Production of the cluster (000 tonne)	1,279.14
Yield (tonne/ha) of the cluster	12.61
Area of the cluster focal point: (000 Ha)	88.4
Production of the focal point: (000 Tonnes)	1,115.8
Average yield of the focal point: (tonnes/ha)	12.62
Percentage of the crop area that lies in the cluster (Citrus area of the cluster/Citrus area in the country)	52.39%
Percentage of the total cropped area in the cluster (citrus area in the cluster/total cropped area in the cluster)	12.46%
Geographical and Environmental Factor	Varies from silty loam to clay loam in texture, low in organic matter and alkaline in reaction
	Flat plain with some areas with slight slope
	Latitude 32.1 N, Longitude 72.30 E
	Semi Tropical climate with very hot and dry summers and cold winters.
	Two types of canals system for irrigation one is almost throughout the year although it is becoming increasingly scarce, and the other supplied for six months.
	Brackish ground water
	Average annual rainfall is 410 mm
	Average temperature in summer is 34.1 C and 11.8 C in winters. In summers the temperature rises up to 45 °C and in winters it drops to 2° C
	Due to climate change factor it has witnessed temperature fluctuations, effect the production. Other factors effecting production is fog occurring during winters.



Salient Features	Punjab Know Cluster
Kinnow growers	Small landholdings with average size of 12.3 Ha. 96% grow citrus on their own land thus make long term investment
	A large number of farmers (90%) in this region are educated (5 years of schooling). 80% growers are very experienced and involved in citrus sector for many years. So most of them are able to understand and follow new methods of cultivation.
	Previously 90% of the growers marketed their product to pre-harvest contractors. Last 10 years it has come down to 50%, selling directly to local market and processors/exporter
	Citrus Processors Association, Representatives of PFVA
	Availability of seasonal (migratory) labour for kinnow production practices, especially harvesting
Product Feature	Tingy sweet taste when fully ripened (TSS 11-20% , acidity)
	Sizes range from 38 (largest) to 120 (smallest) pieces per 10 kg box. The average weight ranges from 100 gms to 250 grams.
	Kinnow has soft skin, smooth and easy to peel and attractive fragrance.
	Tree Shape: Ellaiipsoid, Spheroid, Obloid. A good tree is vigorous, top erect, dense leaves, symmetrical with few thorns, but have alternate bearing tendency
	Leaves habit: Simple, Bifoliate, Trifoliate. Leaf Division: Evergreen, Deciduous, Semi-persistent. Leaf Apex: Acute
	Kinnow tree goes through 3 droppings. 1st at flowering immediately after blooming. 2nd after few weeks involving fruit of pea size. Third drop occurs in late August.
	Kinnow is a seeded variety with seeds ranges from 0-54, average seeds 24 per fruit. Poly embryonic
	Fruit Shape: Spheroid, Ellipsoid, Pyriform, Obloid, Ovoide. Fruit Skin Color: Green, Green Yellow, Yellow and Orange
Nursery and Planting	Kinnow is commonly propagated on rough lemon (Jitti Khati) rootstocks of unknown parentage
	Most growers source fruit plants and rootstock from local nurseries , while some source from other growers and Citrus Research Institute (CRI)
	T Budding/ T Grafting are propagation methods. Budding is done in two seasons, Feb-March and Aug-Oct.



Salient Features	Punjab Kinnow Cluster
	<p>Plant to plant distance 20 x 20 feet</p> <p>Average number of plants in one acre = 90-100, Ha = 247 trees. Low density as compared to international level</p> <p>Few progressive farmers have adopted high density farming. Under this new technique, kinnow stalks are planted 10ftx15ft trees 270 trees per acre)</p>
Inputs/Management Practices	<p>NPK = February N:330 gms, P:500 gms, K:500gms, April N: 330 gms, Mid-September N:330 gms per plant</p> <p>Normally farm yard manure (FYM) at the rate of 40-80 kg, 3-4 kg SSP, 4 kg of Ammonium Nitrate/Urea, 1 kg of sulphate of potash per tree is used in December/January, April and August/September is applied.</p> <p>Majority sprays 3 times a season. 1st Spray - Mid Feb: Bordeaux Mixture- Lime, CuSO₄, 01-DPL. 2nd Spray - April: Chlorfenapyre, Difenaconazole, 01-DPL. 3rd Spray - Mid Sept: Bordeaux Mixture, Insecticide & Fungicide; Difenaconazole, Azoxystrobin, Acetameprid, 01-DPL</p> <p>Farmers are using below average and imbalance inputs, which therefore impacts the output. Except few big growers of kinnow</p> <p>Input supply system especially pesticides is monitored quite well by the Government through Pest Warning and Quality control of Pesticides, Federal and Provincial seed certification department and Plant protection departments in this region for better and regular supply of inputs to kinnow growers.</p> <p>Many input providers - authorized dealers and independent retailers in Kinnow production cluster. Small farmers get inputs through credit from dealers and commission agents. Due to proliferation of such suppliers it is difficult for farmers to differentiate from standard to substandard (counterfeit) inputs.</p> <p>Generally farmers irrigate the field through flooding twice a month during summer season and 1-2 months during winter season. Few progressive farmers have started using drip irrigation.</p> <p>The critical time the farmers are irrigating their orchards is immediately after harvesting and applying fertilizer (April/May). Slight regulated water prior to flower initiation. Then during fruit enlargement stage, 3 weeks before harvesting</p>



Salient Features	Punjab Know Cluster
	Intercropping is still common. Wheat and Barseem (fodder for animals) are commonly sown in the orchards while some also grow vegetables.
Pruning/Harvesting	Hardly any weedicide is used. Farmer usually plough their orchards.
	Harvesting is done on marketing forces i.e when there is glut in market they delay harvesting. Sometimes they hold it much longer than required which leads to alternate bearing.
	Most of the fruit is harvested by using clippers. But many are still picking it manually too. It is stacked in the field for initial grading. For local market it is loaded loose in open trucks. They are also packed in wooden boxes for long distance mandis. For processing they are transported in plastic crates.
Packaging/Transportation	Pruning is normally done to control size and remove dead, disease and water-shoot branches. Progressive farmers are doing more aggressive pruning by removing branches to allow air penetration and access under trees (skirt pruning) for light penetrate and prevent fruit damage from limb rubbing.
Wholesaler/Retailer	30% of fruit is transported in open trucks without packing. 70% in packed form (50% wooden crates, 10% plastic crates and rest 10% in bags) Wooden are 5, 8 ,10 & 13 Kgs boxes whereas others are 10 kg capacity corrugated boxes.
	Contractors or wholesalers buy the product from farmers as they have connection with the commission agents in the market. The price offered to the farmers are based on citrus variety, flowering intensity, orchard health, distance from metal road and availability and cost of transport
	The auction in the wholesale market is generally based on the quality and brand name
	Final grading is done by the retailers.
	Usually contractors are financed by commission agents or wholesalers. Thus the contractor is obliged to sell the produce through the leading commission agents.
	The 'topping' malpractice, where better-quality fruits are placed at the top of each package, is still continued.
	The prices are high at the commencement of the season, declining gradually as the supplies increase and declines again at the end of the season
	Producers normally lease out the kinnow orchard, mostly between April and July, to the pre-harvest contractor-who take care, watch and ward of the crop till maturity.



Salient Features	Punjab Know Cluster
<p>New Technologies/Infrastructure</p>	<p>Presence of premium domestic markets i.e. Karachi, Lahore, Islamabad, Peshawar and Sargodha</p>
	<p>Has around 250 washing, grading packaging plants in this cluster</p>
	<p>Over top 30 processors have cold storage facilities with few of them have blast chillers</p>
	<p>Private sector has established four kinnow concentrate plants where all the "C" grade fruits are processed.</p>
	<p>There is one major corrugated box manufacturer and five plastic crate manufacturers which is a major source of packaging requirement.</p>
	<p>Kinnows are exported by sea. Most of the kinnows exported are packed in 10 kg corrugated boxes. Recently exporters are also using 10 kg plastic crates. The size range from 38 pc/10kg box to 120 pc/10 kg box.</p>
	<p>Quality-control personnel are sampling kinnows 4-5 boxes from each load to assess fruit maturity and defects prior exports besides Russia. For export to Russia all inspection is undertaken at the approved processing units before loading it into the refrigerated container (0-4 C).</p>
	<p>Due to high number of seeds (0-54) it's a deterrent to export to high end markets especially to Europe.</p>
	<p>Major chunk of kinnows export goes to Russia, Afghanistan, Dubai, Saudi Arabia, Philippines and Indonesia; but compared to the international exporters the price per kg is very low.</p>
	<p>Due to shortage of A" grade kinnow production most exporters are exporting mixed quality fruit (A & B quality)</p>
<p>Poor image in the international market due to issuance of certificate by DPP without proper inspection, hence low quality kinnow are exported to Russia.</p>	
<p>Small size (80-120 pc/10 kg) is sold to Russia, Medium size (56-72 pc/10 kg) sold to Middle Eastern countries and Medium/Large size (38-62 pc/10 kg) is exported to Far East</p>	
<p>Supply Chain</p>	<p>The kinnow consigned to domestic and export markets suffer from fruit quality problems. Loss of confidence by marketers, and reduced profits for everyone</p>



Salient Features	Punjab Know Cluster
	<p>Kinnow is having various inbuilt constraints and bottlenecks throughout the Supply Chain. There is uneven Price Spread throughout the chain.</p> <p>Inadequate cargo infrastructure and cumbersome procedures at ports creates issues for the exporters.</p>
Certification	<p>There are many orchards in this cluster which are Global GAP certified. This certification is costly and not affordable by most of the farmers. Besides its not sustainable as the requirement is for high end markets, Kinnow is not in that market end.</p> <p>Food safety standards and traceability (HACCP, EuropGAP, Global Gap, IFS etc.) of Pakistani Kinnows is another obstacle to enter into high end markets. Companies are following regulations and standards such as FSSC 22000, SQF, IFS or BRC in the manufacturing food industry.</p>
Gender Involvement	<p>On kinnow harvesting the whole family is involved including women and children for picking, grading and packing at farms.</p>
Subsidies/Incentives/Facilities	<p>TDAP gives substantial subsidy to the exhibitors in providing stall at 50% or more subsidized rates and also sponsors a large number of delegations to be sent abroad.</p> <p>Punjab Govt. has recently launched "Model Farms Linked with Improved Supply Chain & Value Addition" project providing incentives through cost sharing for programs such as training, international certification, development of supply chain infrastructure and marketing linkages.</p> <p>Citrus Research Institute at Sargodha has been working for the last many years providing research, extension and nursery plants.</p> <p>USAID projects and programs such as ASF, FIRMS, AMD, PATTA, PEEP, has been working towards development of supply chain and increasing incomes and generating additional employment in the major kinnow-growing areas.</p> <p>Govt. of Pakistan is providing an incentive to Horticulture export enterprises by way of picking up to 8% interest on loans obtained for cool chain and cold storage. This facility is available to all users, whether the unit is export oriented or not.</p>



Salient Features	Punjab Know Cluster
	TDAP agreed to help exporters in opening export offices abroad by giving 50% of the rental and 50% of the salary.
Socioeconomic Networks	NRSP - The process is social mobilization - bringing people together on new terms for a common purpose. The conceptual tools are 'social guidance' (recruiting local men and women who will take on a leadership role), advocacy, capacity building and awareness raising. The programmatic tools are training, support to institutions, micro-credit, infrastructure development, natural resource management and 'productive linkages'.



Annexure 4 Training Modules for Various Stakeholders

1. Farmers

- Pruning and Canopy Management,
- Replacement of old with new high-density gardens
- Good Agricultural Practices (GAP) practices
- Sustainable and Eco-friendly Production
- ICM/IPM techniques for sustainable pest management
- Balance & Timely use of Fertilizer including Micronutrients and Plant Growth Regulators
- Soil Management
- Harvesting techniques
- Post-harvest management at the farm like stacking, packaging, grading, de-sapping, etc.

2. Processors, Value Addition and Exporters

- WTO
- Tariff and Trade
- Custom Laws
- Food safety standards
- Phyto-sanitary requirements
- Grading and HWT process
- Packing and packaging
- Labelling and branding
- Product presentation techniques
- Food safety standards

3. Nursery Men/Women

The nursery owners and operators of the fruit nurseries will be given training to produce certified true-to-type healthy nursery plants. The training modules have already been developed by NARC and its implementation would be imparted by R&D Institutes. First master trainers will be trained who will train the nursery staff practically on the nursery. This training is likely to include the following topics:

- efficient nursery propagation techniques and management
- improved plant husbandry
- record keeping of nursery activities, especially budding and grafting maps
- plant protection and plant hygiene
- financial monitoring – income and expenditure recording
- marketing and linkage with clients
- packing and labelling of trees



- registration of nursery with FSCRD and meeting its requirements
- design and printing of fruit nursery catalogue in order to develop a broader client base and advertise the benefits of certified fruit trees.

MU in collaboration with FSC&RD and NARC shall provide training to the R&D staff officers and the labor working in the multiplication block for managing the health, growth and quarantine. They shall also be trained on nursery management. The R&D Institutes should provide the root stock and budding materials to only those commercial nurseries which are registered with FSC&RD.

- Use of ICM/IPM techniques/Disease and Pest Management,
- Balance & Timely use of Fertilizer including Micronutrients and Plant Growth Regulators,
- High Density Plantation, Mechanization

Training of Trainers

- In order to further build the capacity of PMU extension experts and AD/AO/FO as facilitators, they shall impart training at Agriculture Universities, where staff would be trained (TOT) by certifying agencies or by **Global GAP Farm Assurer Program** training through Global GAP official trainer, which will also include Global GAP exam to qualify as **Licensed Farm Assurer**. Farm Assurers are independent GLOBAL GAP trained and approved consultants who provide expertise to help producers implement Good Agricultural Practices.



Annexure 5. Promotion of Certification

During the past few decades the reduction of tariff and other trade barriers has resulted in a phenomenal increase in the international trade of agriculture and food products. However, the internationalization and privatization of standards that has accompanied this globalization trend has resulted in grades and standards taking on greater meaning in terms of consumer and retailer demands for quality, safety, authenticity and sustainability. This phenomenon represents new barriers to entry and continued market access in the form of compliance requirements and costs for producers, processors and traders. Unless Pakistan's agribusiness products conform to the increasingly higher standards, the agribusiness sector will not be able to enter, let alone compete, in world markets under a WTO regime. There is, thus, an immediate need to enhance the ability of growers and agribusiness enterprises to respond to sanitary and phyto-sanitary (SPS) and food-quality standards to meet the increasingly stringent international market requirements especially the high end markets. Improved product quality and compliance with safety standards will facilitate the integration of growers and enterprises with supply chains that go beyond the local markets.

Certification especially Global GAP is an expensive undertaking from year to year if it is not rewarded with better price. The past experience shows that many did not renew their annual certifications processes as they had to sell it in the local market with no price advantage. In order to reduce the certification cost, farmers group (FEGs) shall be formed to undertake certification jointly, such programs have been undertaken before in kinnow sector. Another module is the create Producer Marketing Organization (PMO) where the processors take the lead to implement certification of the group of farmers they are sourcing produce under contractual arrangement.

It is recommended that for next five years the government should pick up the cost of the certification charged by certifying company, all other expenses incurred on the farm improvement would be borne by the farmer.

PMU would hire the services of a Certifying Agency to support growers and enterprises to acquire international certifications, including quality assurance and food-safety compliance certifications such as: Global GAP, IFS, ISO 22000, FSSC 22000, BRC etc. This program shall be implemented in collaboration with domestic and international certifying

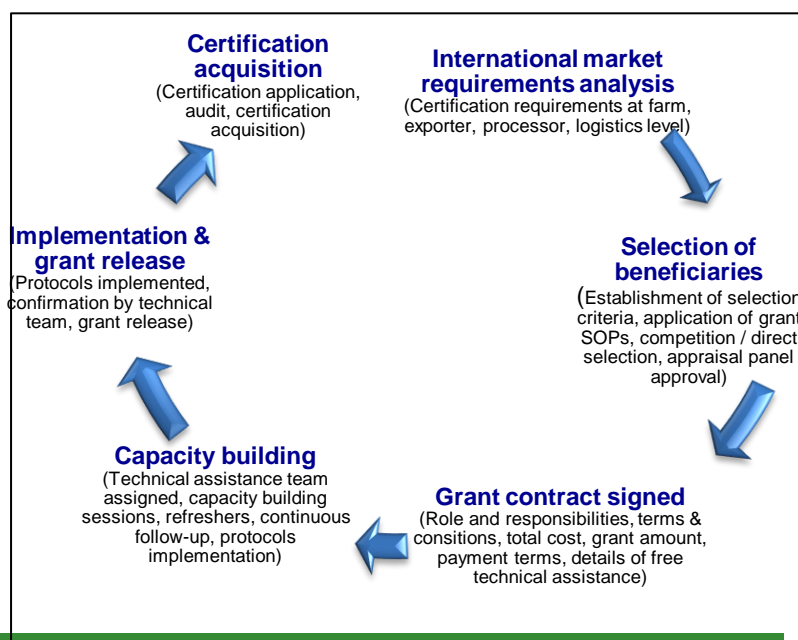


Figure 5: An international certification support model



bodies and shall play a pivotal role in increasing competitiveness of the target agriculture value chains and enable the participants to integrate into the global market.

An international certification support model (Figure 2), which has been successfully deployed for over a decade in all the international certification support programs implemented by it in Pakistan. The model combines the following elements in a single framework: establishment of international markets requirements regarding certifications, target participants of certification program, selection mechanism, mechanism for technical assistance and grants support to acquire certification. The above-noted elements of the model shall be implemented as follows:

Based on the value chain development strategy, a concept note should be prepared for international market requirements for certifications at: (1) farm level, (2) processors and value addition level. The concept document shall also very specifically identify and describe target participants (farmers, processors, etc.) of the international certifications support program at each of the two levels noted above. Tentative criteria for the selection of participants should also be provided in the concept document. The document should also contain a plan for implementation of international certifications support program. The concept note together with the implementation plan shall be approved by PMU for further implementation.



Annexure 6. Flow of Costs and Returns at Value Chain Level

Flow of Costs and Returns at Value Chain Actors Level – Domestic Supply (Rs.)

Costs/Returns		Grower	Transporter	Commission Agent	Wholesaler	Retailer
Cost per Kg	Raw Material	0			10	22
	Production	4.65				
	Harvest	2				
	Packing	3.95				
	Transport	0.58	0.25			
	Others	0.45			0.85	2
Total Cost/KG		11.63	0.25	0.85	12.00	27.80
Cost Flow		22.13%	0.48%	1.62%	22.85%	52.93%
Revenues /KG		15.5	0.5	1.7	22	48
Gross Margins		3.87	0.25	0.85	10.00	20.20
Return Flow (%)		11.02%	0.71%	2.42%	28.43%	57.43%

Table 17: Flow of Costs and Returns at Value Chain Actors Level – Exporter (Rs)

		Grower	Transporter	Exporter Sea Shipment
Cost per Kg	Raw Material			22.80
	Production	4.40		
	Harvest	2.0		3.0
	Packing			10.0
	Processing			6.0
	Transport		0.25	17.70
	Others	0.45		
Total Cost/KG		6.85	0.25	59.5
Cost Flow		10.3%	0.4%	89.3%
Revenues /KG		19.5	0.5	73.0
Gross Margins		13.0	0.25	13.5
Return Flow		48.6%	0.9%	50.5%

There are many actors in the citrus value chain each having different cost and returns. In order to get a better understanding of the scenario, distribution margins for each market intermediary have been estimated. The distribution margin or price spread is the difference between the price paid and received by each specific market intermediary. The market intermediaries involved in the traditional chain include grower, contractor, transporter,



commission agent, wholesaler and the retailer. Another chain is the processor/exporter sourcing citrus directly from the growers and processes and exports citrus by sea.

There is a general perception that intermediaries involved in the marketing of agricultural produce take away a major share of the total profit. As shown in the tables above, the retailer received a maximum share of 57.43 percent in the distribution margin while the wholesaler, commission agent and transporter received 28.43 percent, 2.42 percent and 0.71 percent share in the distribution margin respectively. Whereas the growers share is 11.02 percent which provides returns per kg without any value addition. It may explain here that farmers gets better price in unit terms but returns per acre is low, probably due to low yield. The retailer's share in the distribution margin is calculated on the assumption that the total produce purchased by him is sold at a given price. However, in reality the retailer is the last owner of the produce and has to bear all kinds of losses, since produce left unsold fetches a much lower price the next day.

In addition, structure of supply chain in case of exports through sea shipments. The table above explains the typical export supply chain Distribution Margin (DM) increases at each actor level and the ultimate price reached at optimum value passing through different channels of citrus value chain.