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Kinnow Value Chain

Knowledge gaps and ICT prevalence in the chain

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KNOWLEDGE FOR LIFE

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List of Abbreviations

AARI	Ayub Agriculture Research Institute
ACIAR	Australian Centre for International Agricultural Research
AMD	Agricultural Marketing Department
ASF	Agribusiness Support Fund
AUP	Average Unit Price
CASs	Central Asian States
CBSA	Citrus Board of South Australia
CRI	Citrus Research Institute
DDO	Deputy District Officer
DO	District Officer
DPP	Department of Plant Protection
EDF	Export Development Fund
EDO	Executive District Officer
FA	Field Assistant
FAO	Food and Agriculture Organization (of the United Nations)
FAQs	Frequently Asked Questions
FFS	Farmer Field School
FGD	Focused Group Discussion
FYM	Farm Yard Manure
HACCP	Hazard Analysis and Critical Control Points
HDI	Human Development Index
ICT	Information Communication Technology
IPM	Integrated Pest Management
IT	Information Technology
MDG	Millennium Development Goal
mg	Milligram
MGBI	METRO Group Buying International
NGO	Non-Government Organizations
NIAB	National Institute of Agriculture and Biology
NOC	No Objection Certificates
NWFP	North West Frontier Province
PHDEB	Pakistan Horticulture Development & Export Board
PPMs	Plant Protection Measures
PPO	Plant Protection Ordinance
Qty	Quantity
R&D	Research and Development
ROC	Returns to Capital
RP	Research Portal
SCARP	Salinity Control and Reclamation Programme
SD	Standard Deviation
TDAP	Trade Development Authority of Pakistan
TOFs	Training of Facilitators
UNCTAD	United Nations Conference on Trade and Development
USA	United Sates of America
WTO	World Trade Organization
ZTBL	Zarai Taraqiati Bank Limited

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Executive Summary

Fruits and vegetables are very important for human beings on several accounts. They are rich sources of nutrients, minerals, vitamins, and enzymes. Moreover, they have high medicinal values. Citrus occupies an important position among fruits in Pakistan. It accounts for about 40 percent of total production of all fruits in the country. It is grown on around 185,400 hectares. In 2007-08, Pakistan produced 1.67 million tones. Among various species and cultivars, Kinnow has distinctive position for Pakistan. Pakistan accounts for about 95 percent of the world total production of Kinnow.

There exists substantial potential for improvement in the citrus value chain of Pakistan. One way of exploiting the afore-mentioned opportunities successfully is the use of Information Communication Technology (ICT), as information is the key for success. Moreover, ICT offers greater opportunities for small holding farmers to improve their livelihoods and improve the overall agriculture of the country. India and West Africa have successfully experimented with using IT in linking the farmers with the markets (World Bank, 2007, p. 121).

Pakistan can use improvement in the citrus value chain as an instrument to achieve Millennium Development Goal of alleviating poverty (MDG1), as fruits and vegetables can be used to alleviate poverty.

Keeping in view the importance of ICT in the alleviation of poverty in Pakistan, CABI launched a study on the use of ICT in the citrus production, and marketing as a tool for poverty alleviation. Objectives of the study were to study the current practices of production and marketing of citrus fruit (Kinnow), to identify skill and information gaps at various transfer points of the citrus and to explore the venues, how can ICT be used to bring improvement in the value of citrus products.

The study employed a qualitative approach as it was exploratory in nature. Various stakeholders of the citrus value chain were interviewed by using semi-structured questionnaires. In total 168 farmers / citrus growers, 16 contractors / middlemen, 24 exporters / processors of Kinnow, 4 nursery owners, and 66 extension workers were interviewed.

Yield of citrus in Pakistan is quite low as compared to that in Brazil, USA, and China. Average national yield of citrus in Pakistan is around 90,760 hectogram per hectare, while according to FAO Statistics of 2007 per hectare yield of citrus is 151,652 hectogram in China, 129,950 hectogram in Turkey and 285,714 in USA. Moreover, results of the present survey indicate that there exists large variation in the yield of Kinnow in the country. Highest yield range from 110 to 475 maunds per acre, with mean of 350 maund.

One reason for low yield is due to small size of the orchards. A big proportion (43 percent) of the sampled citrus orchards was of size of upto only 5 acres. Small sized orchards are not economically viable. Moreover, it is also very difficult for them to adopt capital intensive technologies. In several other countries, citrus orchards are of much larger sizes, therefore, they can produce and export large quantities of citrus. One option could be to popularize the system of cooperative farming so that orchards become viable business units.

Another reason is non availability of certified rootstock in the nurseries. A round 40 percent of the citrus growers reported that they were not satisfied with the current type of varieties of citrus and they were looking for any 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. Continuous improvement in the genetics of Kinnow is needed not only to sustain but also to improve its competitiveness in the world market. 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. Another problem with the genetics of Kinnow is that seedless citrus fruits are 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, ud). So research institutions need to bring genetic improvements in the Kinnow.

Third reason is poor management of soil. This is the area which has been neglected and not properly addressed. Survey results reveal that almost one third of the respondents (32 percent) reported to not have any knowledge about the issues relating to soil health. Generally, chemical fertilizers are used to manage fertility of soil. But fertilizer market is ridden with several problems. Almost half of the respondents indicated that it was difficult or very difficult to obtain fertilizer at critical times. Availability has two attributes i.e. quality and price. 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. Deficit application of nitrogen and phosphorus negatively impacts the size of fruit and that of potash impacts the colour and the taste of the fruit. Balanced use of fertilizer reduces number of immature fruits falling down. But farmers lack proper training in when, how, how much, and which fertilizer should be used. As a result, the citrus trees most often face malnutrition. Problem is further compounded due to deficiency of nutrients and organic matter. Inadequate application of the phosphorous and potassium related fertilizers is another issue. That is primarily due to lack of knowledge and the high price of the fertilizers.

Appropriate plant protection measures (PPMs) not only ensure higher yield but also lead to improvement in the quality of fruits. A majority of the respondents (citrus growers) informed that they were having poor knowledge about the diseases of citrus orchards. 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. In the presence of weeds, the citrus plants/trees have to compete for nutrients, micronutrients, water and air. Eventually, the citrus plants/trees suffer. Average amount of loss in value of fruits accrued due to these issues, based upon perception of the respondents, comes to 34.07 percent. Researchers and Extension Workers have their roles to play in dealing with this issue.

Canal water availability is quite inadequate. Only one third of the respondents reported that they had adequate supply of water. To manage the inadequacy of canal water, it is supplemented with groundwater, which is being overexploited, eventually, groundwater table is falling. Citrus growers need to be educated in how to efficiently and effectively use water in the orchards.

Intercropping in the citrus orchards is considered injurious to the health of citrus orchard trees and fruits. Wheat and barseem were the most commonly sown crops in the orchards. Intercropping is generally done by the farmers without assessing the water requirements of the crops to be sown in the citrus orchards, which leads to inefficient use of water resources (Johnson, 2006, p. 37). Moreover, differential requirement of water also create negative impact on the health of both the crop and the orchards. Small landholders can not afford to keep on investing for 8-9 years with the hope of future returns only. Therefore, they have an economic compulsion to go for intercropping. One option could be to avoid those crops which directly compete with citrus plants.

Trimming and the pruning are crucial horticultural practices to ensure health of the citrus trees. Moreover removal of weeds is also important for the same purpose, as weeds compete with the citrus trees in nutrients. However, survey results indicate that almost 90 percent of the citrus growers do not pay attention towards cleanliness in the farms. 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.

Farmers have serious financial constraints. Therefore they are unable to use capital intensive technologies or make timely purchase the inputs. Situation has gotten worse with the high rate of increase in the price of fertilizer. Around 85 percent of the orchards growers informed that they had no access to any credit line. Zarai Taraqiati Bank Limited (ZTBL) is a major financial institution which offers credit for the farm businesses. During 2007, ZTBL dished out loans of worth Rs. 6.206 million only to 164 orchard growers (ZTBL, 2008b). It is not clear that out of Rs. 6.206 million, how much

proportion was given to the citrus orchards growers. Even this amount is quite small and is just a fraction (0.01 percent) of total loan disbursed (Rs. 56 Billion) in 2007.

Returns to the citrus growers are not upto their satisfaction. None of the respondents (contractors) showed satisfaction with prices of Kinnow, they earned last year. What are the reasons of low prices? There are only few exporters of Kinnow, eventually, only a small quantity of the fruit is exported. It results in the glut of Kinnow in the local market which pushes the prices downwards. Secondly, sometimes big players of the market pool together and push prices downward. It is the phenomenon of market distortion. Above all, quality is the major factors responsible for low returns.

Quality of citrus fruits is also 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). However, around half of the respondents (54 percent) reported that they were raising the citrus orchards with the intention that their produce will be exported. What are the reasons of poor quality? The respondents indicated following reasons for the deterioration in the quality of citrus fruits: pests and diseases, improper way of picking and handling, lack of adequate transportation facilities, poor condition of inter-city road network, lack of air-conditioned transportation facilities, vagaries of weather and lack of absorption capacity of the market during peak season.

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 they 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 one percent in case packing in *paities* (wooden boxes) to 5 percent in case of open vehicle transportation or in case of packed in bags or *gatoos*. Researchers need to bring improvement in its skin.

There is substantial scope for improvement in the picking, packing and transportation practices in a bid to minimize the post-harvest losses. Almost 75 percent of the respondents (contractors) reported that last year they transported 30 percent of their produce in open vehicles without any packing while remaining 70 percent was transported in packed form (50 percent produce was packed in wooden boxes, 10 percent in plastic boxes, and remaining 10 percent in bags etc.

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.

As far as export of Kinnow is concerned, only 4 percent of total citrus production of the country is exported (Ali, 2004, p. 251). One reason for the low export is due to the fact that Pakistan has very small and under-developed citrus processing industry. There are around 200 citrus factories in Sargodha District. Exporters/processors operating in Sargodha and Bhalwal and Toba Tek singh were interviewed and their facilities visited. Most of the exporters have 3-4 employees working around the year and about 100-200 employees working during the season, which begins in November and lasts in April. Most of the exporters are growers as well as processors. The processing factories which do not have their own cold storage facility sell their product to other processors who export themselves or sell to the wholesales from Baluchistan and NWFP. These wholesalers export Kinnow to Iran, Afghanistan and the CIS states by road. The processed Kinnow is also sold to buyers from Karachi who supply it to the local market and also export it.

The survey of Kinnow exporters has identified 11 major problems, they are facing (**Table 94: Major problems in the export of citrus**). “High freight charges” emerged as a top most problem. Freight charges have been rising over time, eroding the competitiveness of exporters from Pakistan. Moreover, deterioration in law and order situation lead to rise in the insurance charges, which further negatively impacted the competitiveness. Lack of quality packing material is another constraint in the value addition.

How to bring improvement in the citrus value chain? It can not be materialized without improving the whole farming system? Farming system has five types of institutions i.e. farms, extension department, research and development centres, educational institutions and other supporting institutions like banks, and export promotion agencies. These all five institutions need to have strong integration with each other. However, in reality, there are institutional gaps, eventually, initiatives taken by the government for improvement in the farming system have not been able to yield any big breakthrough. Currently, there are week linkages of farmers with all other institutions. The citrus growers are poorly organized. Only 38 percent of the respondents from the citrus growers reported to have membership of any related organization.

There are poor linkages among the institutions. How to develop integration among all these institution? ICT can be used as an effective instrument in developing and strengthening integration among various institutions related with farming systems. ICT offers several opportunities for the citrus production and marketing management. India and West Africa have made major advancements towards linking the farmers with markets through IT.

Extension Department is responsible for providing the technical assistance to the farmers. Only three officers were reported to have specialization in horticulture. In citrus growing belt, this number is quite small. Moreover, it is also important to note that the region had only one specialist of Plant Pathology, one of Entomology and one of Marketing. Post harvest losses in case citrus are in excess of 30 percent. So the region needs to have adequate expertise in agricultural marketing as well. There are several areas, wherein the Extension Workers believed, they needed training. MS Office emerged as the top most training area, with mean value of 4.20 on a scale of 5. It was followed by the use of internet, marketing management and pest management.

Traditionally the approach for agriculture help lines has been to provide information to the farmers (one stake holder) on farm production related issues, primarily on disease/pest, soil issues or on other issues related to production. ICT can be used as an instrument in bringing improvement in the citrus value chain in general and the citrus production in particular. Extension Department, PHDEB and other related departments may be involved in creating this knowledge portal cum help line. The knowledge portal and the associated helpline will work as a single point of information for citrus production, marketing, processing, all related Government rules, regulations and policies etc. The portal will also include best practices in Citrus commodity chain, in the form of short video clips or pictorial manuals. The farmers and other stakeholders would be able to submit their queries and problems through telephone and the Internet / email and receive answers in the same mode. This single source would be used to answer the stakeholders' queries directly and also to send text and voice based sms to the stakeholders for sending information alerts. The frequent queries from the stakeholders will be organized in to FAQ's available on the portal. In this way a knowledge base that can be used directly at the grassroots level by the farmers, extension workers will be built. It is suggested that the portal also host moderated online discussion forums, targeted at groups like extension workers, processing/export industry etc. These forums will provide a discussion space and an excellent source of capturing local knowledge and also of voluntary diffusion of knowledge by the members to the members. The academic institutions / universities and research institutions will continuously review the queries of farmers and online forums and will align their research agenda with contemporary issues and problems. The research output and publications of universities and the research institutions should also be made part of the portal.

1. Introduction

Fruits and vegetables are very important for human beings on several accounts. They are rich sources of nutrients, minerals, vitamins, and enzymes. Moreover, they have high medicinal values. They provide protection against cancer of stomach, esophagus, lung, oral cavity and pharynx, endometrium, pancreas, and colon (Sisson, 2002). Besides, increase in their consumption can lead to reduction in child mortality (Millennium Development Goal 4) and improving maternal health (Millennium Development Goal 5) (Hanschke, 2006).

However, there exists huge gap between their demand and supply. Recommended per capita intake of fruits and vegetables is 400 grams per day (equivalent to 146 kg per year), while only a small minority of world population meets this dietary requirement. In 2002, global annual per capita supply of fruits and vegetables was only 173 kg i.e. 112 kg vegetables and 61 kg fruits (Weinberger & Lumpkin, 2005, p. 3). The situation in Pakistan is even worse. During 2003-05, per capita production of fruits and vegetables was mere 68 kg as compared to 118 kg in India (World Bank, 2007, pp. 326-327).

Currently, fruit market in the world is experiencing several new trends. They include continuous improvement in quality of citrus products, development of well-integrated marketing chains (superstores etc.), improvements in the cool chains, greater integration of farms with the markets, and prolonged existence of the fresh citrus fruits in the markets. Moreover, demand for the fruits and vegetables is on rise in both developed and the developing countries, so is the case of citrus fruits. Statistics reveal that per capita food consumption in developing countries is shifting to fruits and vegetables (World Bank, 2007, p. 60). This trend is further evident from the fact that exports of fruits and vegetables from developing countries have increased from just US$ 20 billion in 1980 to around US$70 billion in 2004 (World Bank, 2007, p. 61).

These trends offer several opportunities for Pakistan. Pakistan can exploit these opportunities and can make advancement towards Millennium Development Goal of alleviating poverty (MDG1), as fruits and vegetables can be used to alleviate poverty. In countries like Tanzania, most of the farmers who could liberate themselves from the clutches of poverty had diversified their sources of earnings like growing of fruits and vegetables etc. (World Bank, 2007, p. 73). Development of fruits and vegetable sector can not only help in denting poverty but will also lead to increase in consumption of fruits and vegetables by poor. Studies indicate that consumption of fruit and vegetable increases as household income rises (Sisson, 2002).

Annual production of fruits and vegetables in Pakistan is estimated at around 12 million tones (PHDEB [Pakistan Horticulture Development & Export Board], 2005, p. 9). According to FAO statistics, share of Pakistan in total world production of fruits and vegetables was just 0.71 percent in 2004. It is a source of concern that it is exhibiting a declining trend as during 1989-91, share of Pakistan was 0.87 percent (FAO, 2008). On the other hand, during last two decades several other countries managed to give a big boost to production of fruits and vegetables and increase their share in total world production. For example, China managed to increase its share in total world production of fruits and vegetables from 18.48 percent during 1989-91 to 36.62 percent during 2004. During the last half of the previous century, acreage and production of citrus alone in China increased by around 20 times (Xinlu, 2001).

Citrus occupies an important position among fruits in Pakistan. It accounts for about 40 percent of total production of all fruits in the country. It is grown on around 185,400 hectares. In 2007-08, Pakistan produced 1.67 million tones. Among various species and cultivars, Kinnow has distinctive position for Pakistan. Pakistan accounts for about 95 percent of the world total production of Kinnow – citrus Reticulata variety (Mahmood & Sheikh, 2006).

Question is how to develop the citrus sector in Pakistan so as to achieve afore-mentioned MDGs. One way of exploiting the afore-mentioned opportunities successfully is the use of Information

Communication Technology (ICT), as information is the key for success. Moreover, ICT offers greater opportunities for small holding farmers to improve their livelihoods and improve the overall agriculture of the country. India and West Africa have successfully experimented the use of IT in linking the farmers with the markets (World Bank, 2007, p. 121).

Keeping in view the importance of ICT in the alleviation of poverty in Pakistan, CABI launched a study on the use of ICT in the citrus production, and marketing as a tool for poverty alleviation. Objectives of the study include:

- To study the current practices of production and marketing of citrus fruit (Kinnow)
- To identify skill and information gaps at various transfer points of the citrus
- To explore the venues, how can ICT be used to bring improvement in the value of citrus products

2. Research Methodology

The study employed a qualitative approach as it was exploratory in nature. In line with the objectives of the study, following key stakeholders of the citrus sector were interviewed:

- Farmers / citrus growers
- Exporters of Kinnow
- Contractors and middlemen
- Nursery owners
- Extension Workers
- Input suppliers like pesticide and fertilizer companies

Semi-structured questionnaires were developed for the interview of each of the above stakeholders. The questionnaires were designed in line with the objectives of the study, as enunciated in the previous section, and were pre-tested before administering on full-scale basis.

A team of 6 members was selected from the professionals of CABI South Asia, who were entrusted the task of data collection from the above stakeholders. The staff of Fruit and Vegetable Development Project Punjab and In-Service Training Institute also assisted in the data collection from farmers. Data were collected by teams during the month of October and November 2008. Data were processed and analyzed in SPSS.

Profile of the respondents is discussed below:

2.1 Profile of farmers / citrus Growers

In total 168 growers were interviewed by using a semi-structured questionnaire. Sample was randomly drawn from five tehsils of Sargodha District: about 24 percent from Tehsil Sargodha, 23 percent from Tehsil Bhalwal, 20 percent from Tehsil Silanwali, 18 percent from Tehsil Shahpur and remaining 15 percent from Tehsil Sahiwal.

Only 13 percent citrus growers were of age less than 25. Almost 80 percent of the growers were upto age 55. Range of the growers ranged between 19 and 75 years, with mean of 44.5 years. See Table 1: Age of the respondents (citrus growers) and Figure 1: Age-wise distribution of citrus growers.

Table 1: Age of the respondents (citrus growers)

Age of the respondents		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Upto 25	13	7.7	7.7	7.7
	26 – 35	38	22.6	22.6	30.4
	36 – 45	40	23.8	23.8	54.2
	46 – 55	42	25.0	25.0	79.2
	Above 55	35	20.8	20.8	100.0
	Total	168	100.0	100.0	

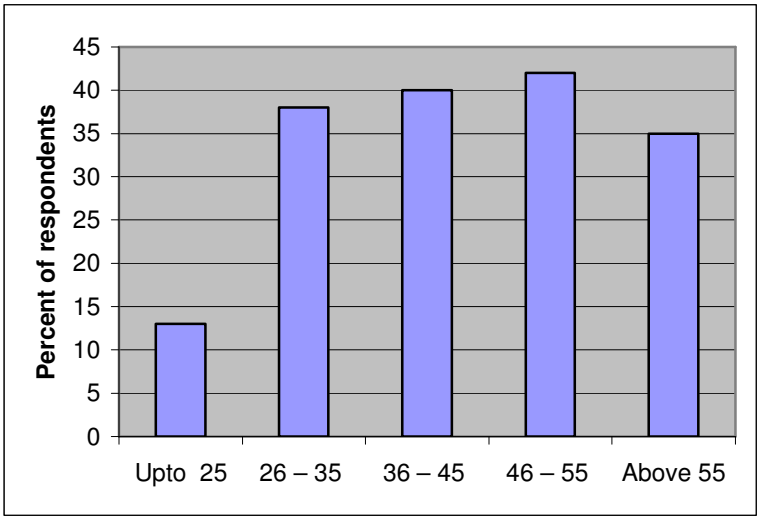


Figure 1: Age-wise distribution of citrus growers

Almost 94 percent of the respondents (all citrus growers) were reported to be literate. This ratio is well above the national average. According to Pakistan Economic Survey 2007-08, literacy rate in Pakistan is around 55 percent (Government of Pakistan, 2008, p. 168). Average number of schooling year was found to be 9.45 years with standard deviation of 3.55.

A significant proportion (36 percent) of the respondents was matriculate (10 years education). However, ratio of the respondents with education above matric was small. Only 16 percent of the citrus growers were graduates. As there is positive correlation between level of education and the adoption of new technology, therefore, it indicates that citrus growers have higher likelihood of adopting new technologies. Moreover, age profile of the respondents seems to be further supportive on this account as more than 50 percent of the respondents are below 45. See Table 2: Education of the citrus growers.

Table 2: Education of the citrus growers

Education Level		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Un Educated	11	6.5	6.5	6.5
	Primary	16	9.5	9.5	16.1
	Middle	29	17.3	17.3	33.3
	Matric	60	35.7	35.7	69.0
	FA/FSc	25	14.9	14.9	83.9
	BA/BSc & more	27	16.1	16.1	100.0
	Total	168	100.0	100.0	

A majority of participants (96 percent) reported to have their own land where they were growing citrus. It is strength of the citrus production system in Pakistan, as ownership entitlement allows the citrus growers to make long term investments in the orchards. Remaining four percent reported that they were either growing citrus either on land leased on long term basis or on land for which they had power of attorney. See Table 3: Owned Land: of the citrus growers.

Table 3: Owned Land: of the citrus growers

Owned Land		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	161	95.8	95.8	95.8
	No	7	4.2	4.2	100.0
	Total	168	100.0	100.0	

Farming experience is another important parameter for developing profile of the respondents. Average experience of farming was found to be 21 years, with standard deviation of 12.45, and experience of citrus production was found to be around 15 years with standard deviation of 10.176. More than 70 percent of the respondents were reported to have farming experience of less than 26 years while in case of citrus production, it was found to be 85 percent. Results indicate that a big majority of the citrus growers (65 percent) started the citrus farming business during last 15 years. See Table 4: Experience of farming.

Table 4: Experience of farming

Experience		Farming		Citrus Production	
		Frequency	Percent	Frequency	Percent
Valid	Upto 5	15	8.9	31	18.5
	6 – 15	54	32.1	78	46.4
	16 – 25	52	31.0	34	20.2
	26 – 35	24	14.3	19	11.3
	Above 35	23	13.7	6	3.6
	Total	168	100.0	168	100.0

More than half of the citrus growers (55 percent) did not have any other profession other than the citrus production and/or farming. However, around 25 percent citrus were in government service, and 13 percent were running a business as their second profession. See Table 5: Other occupation of the growers.

Table 5: Other occupation of the growers

Other Occupation		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No other	92	54.8	54.8	54.8
	Business	22	13.1	13.1	67.9
	Govt Job	42	25.0	25.0	92.9
	Labor	4	2.4	2.4	95.2
	Private Job	8	4.8	4.8	100.0
	Total	168	100.0	100.0	

2.2 Profile of the Contractors

Following sub-sections give a brief profile of the respondents from the contractors:

- **Level of Education**

A majority of the respondents (94 percent) from the category of contractors was literate. Around 13 percent of them were having at least a bachelor degree. On the other hand, there were only 6 percent respondents who were not literate. High literacy level among the contractors offers an opportunity to diffuse improved practices during pre-harvesting and post harvesting stages of citrus. See Table 6: Education level of contractors.

Table 6: Education level of contractors

S.No.	Category	Frequency	%share
1	Un-educated	1	6
2	Can just read and write	3	19
3	Middle	5	31
4	Matric	3	19
5	Intermediate	2	13
6	Graduate and above	2	13
	Total	16	100

- **Age and experience**

All respondents were above 40, and almost 50 percent of them were in their late 40s. All of the respondents had experience more than 15 years with 25 years as average length of experience.

- **Number of employees in the company**

Fifty percent of the respondents reported that their firms had no permanent employee except for the owner and a few members of their family and a guard (usually a total of 3-4 people), while each of the remaining 50 percent firms had only one permanent employee. However, number of temporary (contingent) staff per firm ranged from 30 to 40 with 44 as average number of temporary employees. When they contract out any orchard they hire labour to look after the orchards and to do other operations. Number of employees initially remains very small, however, it increases with the development of fruits on the trees, as more people are required to protect the fruits from theft etc. Number of employees further increase, but with greater proportion, when the harvesting season begins, as greater number of people are required to pick, stock, grade, pack, transport and market the fruits. This is the stage when maximum labour is engaged in the citrus sector.

2.3 Processors and Exporters

In total 24 business concerns from the Kinnow processing and export business were interviewed to identify the issues related with processing and export of Kinnow from Pakistan. A majority of the respondents (83 percent) had proprietorship type of companies, and only one fourth of the firms were registered as private limited companies [**Table 7: Type of business concerns (processors and exporters**]

Table 7: Type of business concerns (processors and exporters)

Type of business	Frequency	Percent	Cumulative Percent
Proprietorship	20	83.3	83.3
Private Limited	3	12.5	95.8
Partnership	1	4.2	100.0
Total	24	100.0	

Number of employees in the processing / export firms ranged from 2 to 400 with average number of 36. However, a majority of the respondent companies (54 percent) had employees ranging from 6 to 20 and only one fourth of the companies had employees more than 100 (Table 8: Number of employees).

Table 8: Number of employees

Number of employees	Frequency	Percent	Cumulative Percent
Upto 5	6	25.0	25.0
6 – 20	13	54.2	79.2
21 – 100	2	8.3	87.5
101 – 200	2	8.3	95.8
Above 200	1	4.2	100.0
Total	24	100.0	

2.4 Profile of the Extension Workers

Profile of the respondents from the Extension Workers is given in Section 11.1: Profile of Respondents from Extension Department.

3. Importance of Citrus Fruits

Citrus fruits are important source of nutrients, vitamins etc. These are also quick source of fibre, vitamins, minerals and many other necessary compounds required by human body (Rodrigo and Zacarias, 2006, p. 293). Among citrus family, oranges contain greater proportion (190 mg) of Vitamin A than Grapefruits (80 mg) and Lemon (20 mg). (See Table 1)

Table 9: Composition of citrus fruits

Nutrients	Unit	Orange	Grapefruit	Lemon	Lime
Energy	Calorie	50	44	44	53
Vitamin C	mg	49	40	45	27
Vitamin A	mg	190	80	20	
Calcium	mg	33	17	14	14
Phosphorus	mg	23	18	10	10
Water	g	87.2	88.8	89.3	86.0
Protein	g	0.9	0.5	0.9	0.8
Fat	g	0.2	0.2	0.6	0.1
Iron	mg	0.4	0.3	0.1	0.1
Cupper	mg	0.3	0.03	0.1	
Vitamin B-1	mg	0.08	0.04	0.04	0.04
Vitamin B-4	mg	0.03	0.02	-	-
Citric Acid	%	1.42	1.28	7.07	-
Fiber	g	0.3	0.3	0.9	
Carbohydrates	g	11.20	10.10	8.70	12.30
Nicotinic Acid	mg	0.20	0.20	0.10	0.10

Source: Citrus Fruits, Agricultural Information Centre, Agriculture Bureau, Government of Pakistan, 1995, p. 62.

Vitamin-A is an important requirement of the human body. Deficiency of Vitamin-A impairs the immune system of 40 percent of the children in developing countries and causes preventable blindness, anemia, respiratory diseases, diarrhea, measles, and malaria (Hanschke, 2006).

Citrus is also an important source of employment and livelihood in Pakistan. Employment generated from Kinnow production alone and marketing during 2001-02 was about 23.48 million labour-days (Sharif, Farooq, and Malik, 2005, p. 673). Economy of Sargodha District mainly depends upon Kinnow. Its Human Development Index (HDI) is 0.535 and ranks 22nd among all districts of the country. So any improvement in the Kinnow economy is expected to bring improvement in the livelihood of the people of Sargodha.

Kinnow is also a growing source of foreign exchange earnings for the country. Among the category of fruits, Kinnow is the largest source of export earnings for Pakistan. During 2007-08, Pakistan's export of Kinnow accounted for about 36 percent (US$ around 53 million) of the total fruit exports. However in addition to this is the officially accounted figure by TDAP, Kinnow is also reported to be exported illegally. The illegal export is via road to a) Afghanistan b) CIS states via Afghanistan c) Iran and d) India. Statistics reveal that export of Kinnow has substantial potential for growth. During the latest year i.e. 2007-08, export earning from Kinnow increased by about 62 percent over previous year (TDAP, 2008).

4. Profile of Citrus Industry in Pakistan

4.1 History of Citrus in Pakistan

Citrus fruits originated in South East Asia and reached Mediterranean region before Christ. In China, orange was present, around 4000 years ago. Christopher Columbus took the lemon seed to North America in 1493 (Ali, 2004, pp. 23-24).

Ju Lu" (Record of Citrus), authored by Han Yanzhi in Southern Song Dynasty in 1178 which records 27 species/varieties of citrus. The National Citrus Germplasm Nursery in China conserved 1190 major varieties/species of citrus in the 1980s taken from China and the world as well (Xinlu, 2001).

Kinnow was evolved (by H.B. Frost) as a result of the cross breeding of King and the Leaf varieties of citrus at Citrus Research Institute, University of California, USA in 1915 (Ali, 2004, pp. 23-24; Kinnow, 2008). Both the parent varieties i.e. King and the Leaf have Indo-Chinese origin (PHDEB, 2005, p. 9).

In 1936, several varieties of citrus were experimented in Indian continent. Kinnow reached this continent during 1940s and first two plants were planted in Punjab Agricultural Research Institute (now known as University of Agriculture Faisalabad) (Ali, 2004, p. 153). The cultivars of Kinnow and the feutrell were imported to Pakistan in 1940, Kinnow from California and Feutrell from Australia (Johnson, 2006, p. 2).

Taxonomy of the Kinnow is as follows:

- Kingdom: Plantae
- Order: Sapindales
- Family: Rutaceae
- Genus: Citrus
- Species: C. reticulata

Soil and climatic conditions of Pakistan have added a distinctive flavor and taste in the Kinnow (PHDEB, 2005, p. 9). Therefore, Kinnow has become a trademark of Pakistan. Currently, about 95 percent of the world's total production of Kinnow is produced in Pakistan (Mahmood & Sheikh, 2006).

4.2 Areas where citrus is grown?

Citrus is grown in 140 countries. Latin America and the Caribbean are the largest citrus producing region (32.6 percent of the total) (Government of South Australia, 2005, p. 11). Citrus fruits include orange, mandarin, tangerine, grapefruits, pumelos, tangelos, citron kumquat, lime and lemon (Ali, 2004, p. 22).

Citrus is grown in all four provinces of the country. In province Punjab, it is grown in several districts which include Sargodha, Sahiwal, Toba Tek Singh, Lahore, Sialkot, Jhang, Mianwali, Multan, and Gujranwala. In province NWFP, six districts are known for this purpose: Mardan, Peshawar, Swat, Swabi, Noshera, and Hazzara. Province Sindh has three districts (Sukkur, Khairpur, and

Nawabshah) where citrus is grown and in province Balochistan, Mekran, Sibi and Kech are the three districts where citrus is grown (Pakissan.com, 2008)

Best quality Kinnow is mainly grown in Sargodha. Total area of the district Sargodha is 5856 square km (Hayat, 2007, p. 9)

4.3 Citrus Production

Brazil and United States are the leading producers of citrus (Spreena, 2001). In Brazil, Sao Paulo state is the major producing centre and the Florida of USA. See Table 10: Major producing countries of citrus.

Table 10: Major producing countries of citrus

Category	Major producing countries
Oranges	Brazil, United States, Mexico, India, Spain, China, Iran, Italy, Egypt, Indonesia.
Small citrus (e.g.: mandarins)	Nigeria, China, Syria, Guinea, Japan, Saudi Arabia, India, Sierra Leone, Angola, Tunisia.
Lemons and limes	Mexico, India, Iran, Spain, Argentina, Brazil, United States, China, Italy, Turkey.
Grapefruit	United States, China, South Africa, Mexico, Israel, Cuba, Argentina, India, Turkey, Tunisia.

Source: UNCTAD (2008), FAO (2004), Spreena, T. H. (2001); Gunner, Langberg, and Wodecki, (2005).

Total world production of citrus increased by almost four times between 1961-2004, reaching 105 million tones during 2000-2004 (UNCTAD, 2008).

Kinnow is commercially grown in USA (Arizona and California), Pakistan (Punjab) and India (Punjab) (Sandhu, & Minhas, 2006, p. 312). However, Pakistan accounts for almost 95 percent of the world total Kinnow production (ACIAR, 2008).

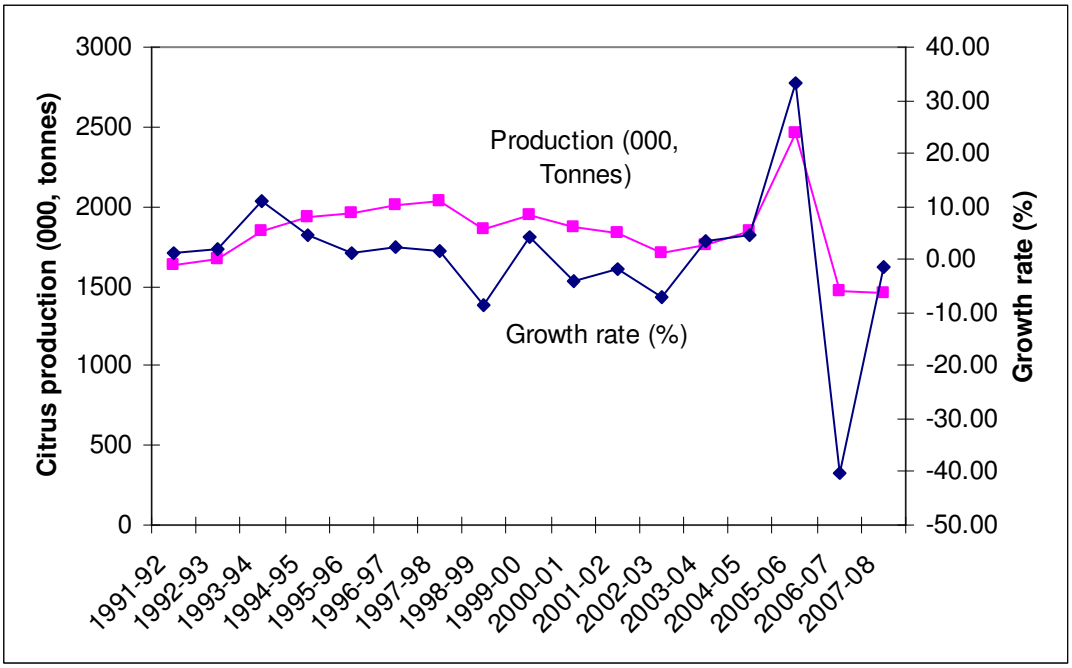
Statistics indicate that growth in citrus production in Pakistan has been quite uneven in the recent year. See Figure 2: Production of citrus in Pakistan. Low growth of citrus production during 1990s was due to lack of incentives for farmers to increase production (Sharif, 2004, p. 2). The year 2005-06 proved to be the best year, as the country had record production of citrus i.e. 2.55 million tones, that lead to rise in the per capita availability of citrus fruits to around 15.96 kg per year. In terms of per capita availability, second best year was the 1994-95, when per capita availability rose to 15.90 kg. However, after 2005-06, the situation has not been conducive for the citrus production in the country, and the production fell down to 1.450 million tones, which is the lowest in the last two decades. Hence, per capita availability of citrus fruits in the country has dwindled to only 9.01 kg. See Table 11: Production of citrus fruits. It implies that the production surplus has drastically reduced.

Table 11: Production of citrus fruits

Year	Production (000, Tonnes)	% change
1990-91	1609	-
1991-92	1630	1.31
1992-93	1665	2.15
1993-94	1849	11.05
1994-95	1933	4.54
1995-96	1960	1.40
1996-97	2003	2.19
1997-98	2037	1.70
1998-99	1861	-8.64
1999-00	1943	4.41
2000-01	1865	-4.01
2001-02	1830	-1.88
2002-03	1702	-6.99
2003-04	1760	3.41
2004-05	1843	4.72
2005-06	2458	33.37
2006-07	1473	-40.07
2007-08	1450	-1.56

Source: Pakistan Economic Survey 2007-8

Figure 2: Production of citrus in Pakistan



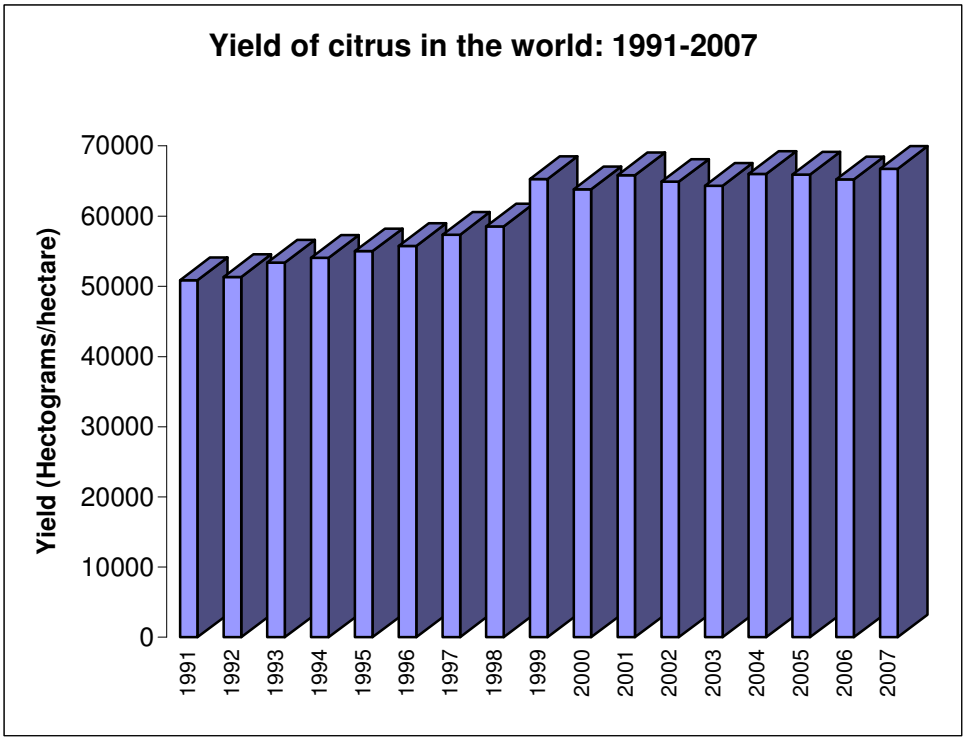
Source: Pakistan Economic Survey 2007-08

Citrus production has experienced strong growth in the world since mid 1980s, however, the pace of growth has slowed recently down primarily to declining prices of citrus and processed citrus products (Spreena, 2001).

Total consumption of oranges in the world increased at a compound rate of 3.5 percent during a period from1986-88 to 1996-98 (Spreena, 2001).

4.4 Yield of Citrus

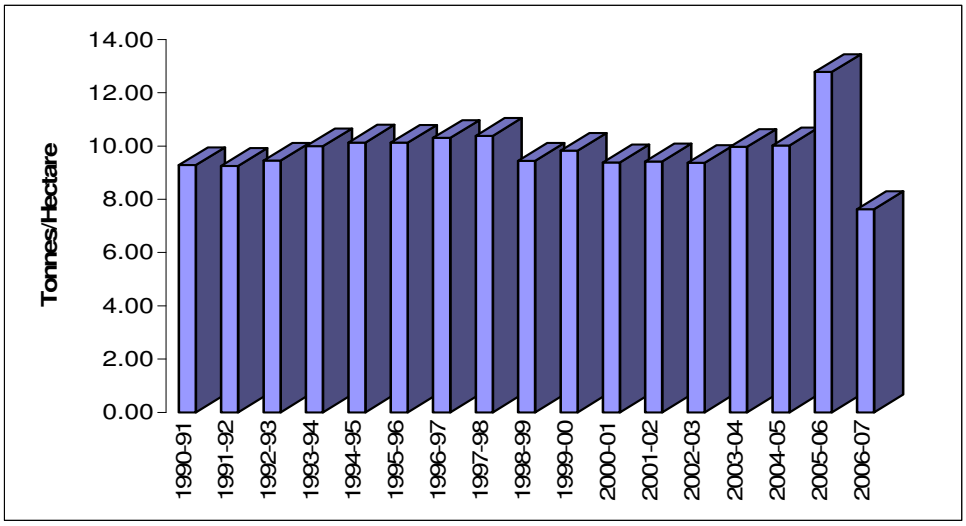
Yield of citrus in Pakistan is quite low as compared to that in Brazil, USA, and China. Average national yield of citrus in Pakistan is around 90,760 hectogram per hectare, while according to FAO Statistics of 2007 per hectare yield of citrus is 151,652 hectogram in China, 129,950 hectogram in Turkey and 285,714 in USA. Figure 3: Yield of citrus in the world: 1991-2007



Source: FAO (2008).

Average yield of citrus has significantly improved in the world (Figure 3: Yield of citrus in the world: 1991-2007) during last decades while in Pakistan no significant improvement has been observed (Figure 4: Citrus yield in Pakistan). Pakistan needs considerable improvement in the genetic material of the citrus.

Figure 4: Citrus yield in Pakistan



4.5 Kinnow Value Chain

Kinnow value chain is very long and complex. There are three streams of Kinnow value chain:

- Wholesaler-retailer-consumer
- Processing, export, superstores, and foreign consumers,
- Citrus juice factories, wholesalers, retailers and consumers

Kinnow is generally transported in plastic buckets, each weighing 20 kg to 40 kg, to the processing factories. In the processing factories operations like washing, drying, waxing, re-drying, grading, packing and labelling are carried out. Packing is generally done in wooden cartons or corrugated fiber board boxes, weighing 6 to13 kg. At every transfer point there is substantial potential for improvement.

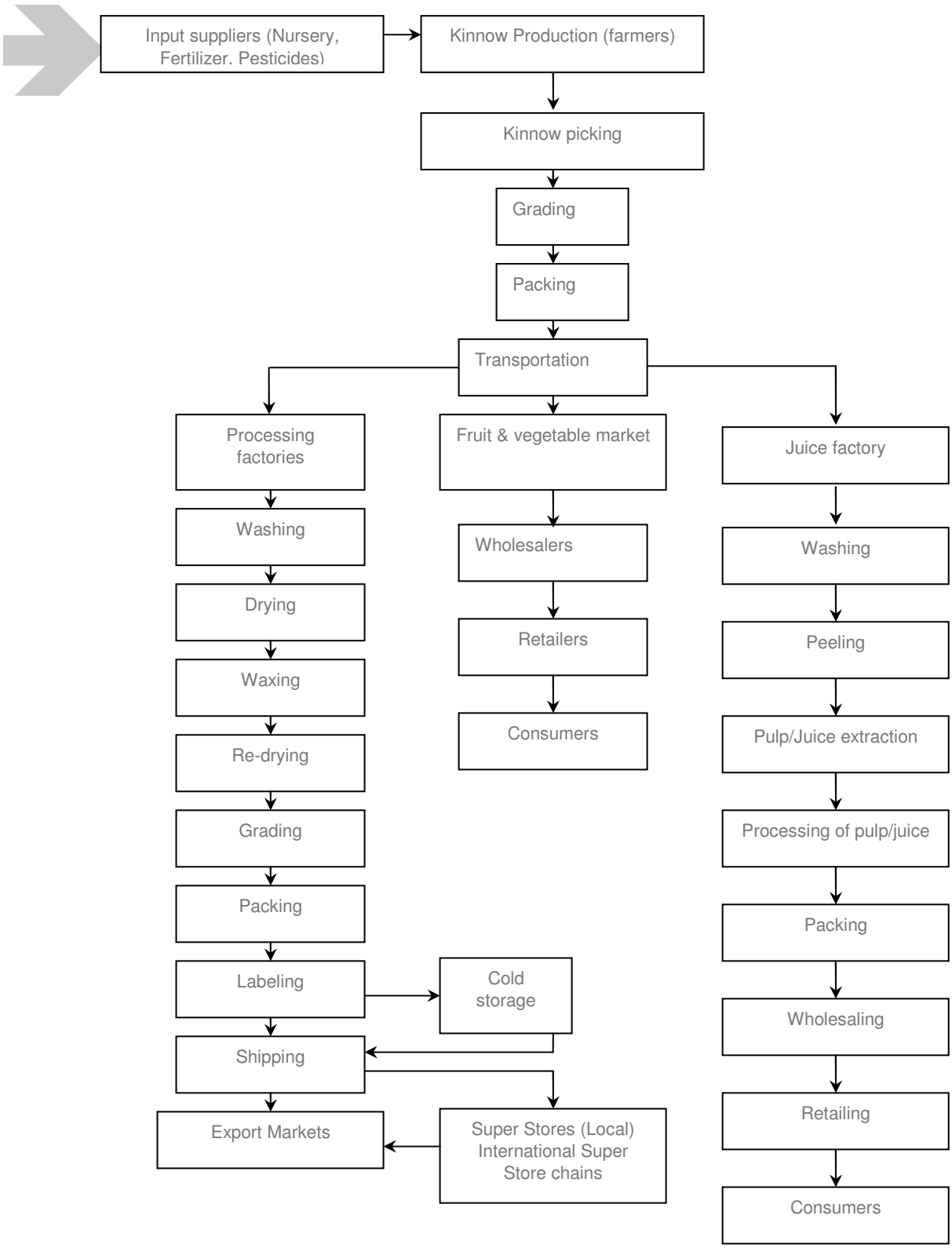


Figure 5: Kinnow value chain

5. Citrus Production System

5.1 Climatic requirements and actual temperature

Semi-tropical climate along the southern and northern most latitude limits is best for the production of citrus on commercial basis (Mahmood & Akhtar, 1996). Air temperature below -2C and above 37C inhibits the growth of the citrus plants and fruits (Ali, 2004, p. 79). As far as water requirement is concerned, on an average a mature citrus tree needs 900 to 1200 mm water per annum (Ali, 2004, p. 79).

5.2 Time of plantation:

A big majority (90 percent) of the respondents reported that last year, plantation was done between August and October. The optimal period for planting is the September. See Table 12: What time of the year do you plant new citrus plants? Delay or early planting is likely to impede the growth of plants, therefore, the Extension Department would have to launch a campaign to create awareness on what is the optimal timing for planting the citrus plants, among the citrus growers.

Table 12: What time of the year do you plant new citrus plants?

Plantation time	Frequency	Percent	Cumulative Percent
Jan	1	.6	.6
Feb	6	3.6	4.2
March	4	2.4	6.5
April	1	.6	7.1
July	1	.6	7.7
Aug	34	20.2	28.0
Sep	80	47.6	75.6
Oct	40	23.8	99.4
Dec	1	.6	100.0
Total	168	100.0	

5.3 Size of farms and economies of scale

In Pakistan, most of the orchards are of very small size. A big proportion (43 percent) of the sampled citrus orchards was of size upto only 5 acres (Table 13: Citrus orchard size). Small sized orchards are not economically viable. Moreover, it is also very difficult for them to adopt capital intensive technologies. In several other countries, citrus orchards are of much larger sizes, therefore, they can produce and export large quantities of citrus. For example, in South Africa, citrus farms generally range in size from 0.5 ha to 500 ha, with some even larger than 6 000 ha (Urquhart, 1999, p. 3). One

option could be to popularize the system of cooperative farming so that orchards become viable business units.

Table 13: Citrus orchard size

Orchard Size	Frequency	Percent	Cumulative Percent
Upto 5 acres	72	42.9	42.9
6 – 12 acres	63	37.5	80.4
13 – 25 acres	19	11.3	91.7
26 – 50 acres	9	5.4	97.0
Above 50 acres	5	3.0	100.0
Total	168	100.0	

Are you planning to increase area under citrus orchards? A majority (around 84 percent) of the respondents indicated that they did not intend to increase the size of their orchards (Table 14: Are you planning to increase area under citrus orchards?). It implies that majority was having some constraints for expansion in the size of orchards.

Table 14: Are you planning to increase area under citrus orchards?

	Frequency	Percent	Cumulative Percent
Decrease	7	4.2	4.2
Increase	20	11.9	16.1
Same	141	83.9	100.0
Total	168	100.0	

5.4 Orchard layout

A majority of the orchards owners (66 percent) reported 91 to 100 plants/trees (equivalent to 225 to 247 trees / hectare) of citrus planted in one acre (Table 15: Average number of plants/trees per acre). Sharif (2004) also reported almost same figure i.e. 241 trees per hectare. These findings are also in concurrence with the results of Nawaz, Ahmed and Jiskani (2008) who have reported that in majority of cases in Pakistan, number of citrus trees in one acre land range from 90-99.

Density of citrus trees per hectare in Pakistan is low. Closer plantation of citrus trees has proven to have higher yield per acre (Nawaz, Ahmed and Jiskani, 2008). 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 (p. 4). In Australia one hectare land may have 800 to 1000 citrus trees. 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 (p. 2).

The above discussion leads to the conclusion that horticultural experts should evolve a most optimal layout plan for the citrus orchards so as to have maximum number of trees per acre. Higher number of productive trees per acre will also lead to improvement in the economic viability of the small orchards in the country. As most of the orchards are of small size, a small improvement in the

density will not only boost production of Kinnow in the country but will also improve livelihood of the small landholders.

Table 15: Average number of plants/trees per acre

No. of plants	Frequency	Percent	Cumulative Percent
Upto 80	10	6.0	6.0
81 – 90	43	25.6	31.5
91 – 100	111	66.1	97.6
101 – 110	1	.6	98.2
Above 110	3	1.8	100.0
Total	168	100.0	

5.5 Genetics of the Kinnow

Genetic capability of a variety determines its potential of yield. There are several issues related with genetics of citrus in general and the Kinnow in particular, which are discussed below:

- **Citrus Varieties Grown in Pakistan**

Several verities of citrus are grown in Pakistan, which can be grouped into five major categories. First category is Sweet Orange which has varieties like Succri, Mausami, Washington Navel, Jaffa, Red Blood, Ruby Red and Valencia Late. In the category of Mandarines, there are two varieties: Feutrells Early and Kinnow. Third category is Grape Fruit, varieties like Mash Seedless, Duncan, Foster and Shamber are most commonly prevalent. Lemon is fourth category, which has varieties which include Eureka, Lisbon Lemon and rough Lemon. And fifth category is Lime which has two main varieties: Kaghzi Lime and Sweet Lime (Pakissan.com, 2008).

As discussed earlier, the juicy Kinnow is a unique hybrid of two varieties of California Oranges. It has a soft skin which is easy to peel and has an attractive fragrance.

Kinnow and feutrell are the two dominant cultivars of citrus in Pakistan which account for about 80 percent of total production (Johnson, 2006, p. 7).

- **Source of citrus plants and rootstock**

What are sources of citrus plants and rootstocks for the citrus growers? Survey results reveal that local nursery is the most important source; followed by other citrus growers, own nursery and the Citrus Research Institute (CRI). See Table 16: Source of citrus plants and rootstock.

Table 16: Source of citrus plants and rootstock

Source of plants	Frequency	Percent	Rank
Local nursery	113	67.3	1
Other citrus growers	55	32.7	2
Own nursery	13	7.7	3
Research Institute	13	7.7	4

- **Satisfaction with current genetic material**

A majority (60 percent) of the citrus growers reported that they were satisfied with the current type of varieties of citrus and they were not looking for any new variety. The remaining 40 percent who expressed their intensions to look for new varieties indicated following motives (Table 17: Are you looking for new varieties of citrus?):

- The current varieties were highly susceptible to diseases
- They required more inputs and care

Table 17: Are you looking for new varieties of citrus?

New Varieties of Citrus	Frequency	Percent	Cumulative Percent
Yes	67	39.9	39.9
No	101	60.1	100.0
Total	168	100.0	

- **Tissue culture and Germplasm**

Continuous improvement in the genetics of Kinnow is needed not only to sustain but also to improve its competitiveness in the world market. The genetic improvement of Kinnow fruit is needed to give a big boost to its exports (Altaf, Iqbal, & Khan, 2004, p. 98). In this context, tissue culture and genetic engineering can offer promising results. Some initial level work on tissue culture for Kinnow has been reported by some scientists, for example, by Altaf (2006). However, there is need for more research on this area.

Scheme for certification in fruit plants has been initiated. NWFP has established germplasm units of temperate, tropical and sub-topical fruits. Similar schemes are being envisaged for fruits like citrus and mango in Punjab and Sindh provinces (Government, of Pakistan, 2008, p. 26).

5.6 Nurseries

Nurseries have a pivotal role in the development of the Kinnow crop, as it is the main source of the nursery plants / rootstock. Nursery owners were interviewed to explore issues pertaining to the nurseries, as described in the following sub-sections:

- **What varieties of citrus do you have?**

The nurseries in the country have small diversity of the varieties and cultivars of citrus fruits. Summary of the varieties and cultivars of citrus which were reportedly in possession of the respondents from nurseries is given in Table 18: Varieties / cultivars of citrus available with nurseries in Sargodha.

Table 18: Varieties / cultivars of citrus available with nurseries in Sargodha

Variety / Cultivar	Nursery-1	Nursery-2	Nursery-3	Nursery-4
Blood red.	√	√	√	
Feutral	√	√	√	
Kala blood			√	
Grape Fruit	√	√		
Honey	√			
Kinnow	√	√	√	√
Lemon (Citrus limon)		√	√	
Mussambi.	√	√		
Orange (Citrus sinenis)			√	
Salustiana.	√			
Shamber,	√			
Star rudy.	√			
Sweet lime.		√		
Tarocco	√			
Valentia late.	√			

- **Issues related with quality of plants**

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. They reported that citrus canker was the most damaging disease.

They indicated that the most common insects and pests of the citrus fruits include leaf miner, aphids, white fly, lemon butter fly and citrus psylla.

- **How do you protect your nursery from diseases and pests?**

Most of the nursery owners reported that they were using application of pesticides, fungicides and insecticides to control the insects, pests, fungi, and diseases. It appeared that no standard mechanism was being followed to control the diseases, insects, fungi and pests, owing to lack of knowledge. Only one of the respondents reported that in his nursery seed was being treated before sowing. One of the four respondents also indicated that he was also using blue lime for this purpose.

- **Suggestions to improve the quality of the Kinnow plants at the nursery**

The respondents from nursery owners suggested the following practices for the improvement in quality of Kinnow plants at the nurseries:

- Proper land preparation
- Shifting of seedling at proper time
- Best selection of scion. Jitti Khati should be used for rootstock.
- Suitable bud height
- Government should register the nurseries.

- **Training courses participated by the nursery owners**

Only two of the four nursery owners reported to have attended any training relating to citrus management. One had participated in a training relating to use of fertilizer in citrus, and other one had attended a training course relating to plant protection measures.

- **What are your sources of knowledge about Kinnow?**

Sources of knowledge (relating to citrus) for the nursery owners in Pakistan include Books, journals, research papers, internet, university, Agriculture Department, CRI, Agriculture Magazine, departmental literature, and experts of extension.

- **Problems of the nurseries**

The respondents from the nursery owners identified several problems, which they were facing:

- Shortage of staff
- Lack of trained staff for using scion, grafting etc.
- Inadequacy of funds,
- Shortage of green houses,
- Non-availability of imported varieties
- Shortage of equipments
- Deficiency of water
- Danger of diseases
- Non-availability of suitable points for sale

5.7 Fertility Management

There are several issues related with fertility management of soil in Pakistan. This is the area which has been neglected and not properly addressed. One third of productivity gains to be accrued from the technological progress in Pakistan wipe out due to soil and water degradation (Ali and Byerlee, [2002] cited in World Bank, [2007, p. 53]).

Sargodha is most popular for the citrus production. However, its soil has also some issues. Almost 8 percent of the total area of the District Sargodha is badly affected from salinity and another 6 percent area moderately affected (Hayat, 2007, p. 19). The following sections discuss the situation of soil health in the Kinnow growing region:

- **Knowledge about issues of soil health**

Survey results reveal that almost one third of the respondents (32 percent) were reportedly not having any knowledge about the issues relating to soil health. See Table 19: Do you know about soil health issues? Results suggest that more awareness need to be created regarding micronutrients deficiency management, and pH value management.

Table 19: Do you know about soil health issues?

Code	Knowledge area	Frequency	Percent	Cumulative Percent
	No knowledge	54	32.1	32.1
A	Water logging	7	4.2	36.3
B	Soil Salinity	30	17.9	54.2
C	pH	4	2.4	56.5
D	Micronutrient deficiency	7	4.2	60.7
E	A & B	24	14.3	75.0
F	All	13	7.7	82.7
G	A & C	9	5.4	88.1
H	A & B	1	.6	88.7
I	A, B & C	15	8.9	97.6
J	B & D	2	1.2	98.8
K	B & C	2	1.2	100.0
	Total	168	100.0	

- **Application of organic fertilizer**

About 73 percent of the respondents informed that they are used to apply some quantity of organic fertilizer (primarily the farm yard manure [FYM]) in the orchards (Table 20: Do you use organic fertilizer in your orchard?). This is indeed a good sign that in majority of the cases, application of organic fertilizers is in practice.

Table 20: Do you use organic fertilizer in your orchard?

Use Organic Fertilizer	Frequency	Percent	Cumulative Percent
Yes	122	72.6	72.6
No	46	27.4	100.0
Total	168	100.0	

Only a small proportion of the respondents i.e. 27 percent reported that they were unable to apply FYM in their orchards. What are the reasons for their inability to do so? A majority of such respondents (83 percent) stated that non-availability of FYM was the primary reason. See Table 21: Reasons for not knowing how to use organic fertilizer. However, a very small proportion of them indicated that it was difficult to prepare organic fertilizer, therefore, they did not apply.

Table 21: Reasons for not knowing how to use organic fertilizer

Reason	Frequency	Percent	Cumulative Percent
Non-availability	38	22.6	82.6
Difficult to prepare	7	4.2	97.8
Both	1	.6	100.0
Total	46	27.4	

How much organic fertilizer you annually use? Average quantity of organic fertilizer applied in one acre orchard was found to be 2546 kg per year. Almost 23 percent of the respondents reported application of less than 101 kg organic fertilizer per acre and only 24 percent indicated that they had

used more than 1000 kg per acre orchard during last one year. See Table 22: Annual application of organic fertilizer per acre

Table 22: Annual application of organic fertilizer per acre

Quantity of organic fertilizer	Frequency	Percent	Cumulative Percent
Upto100 kg	38	22.6	31.1
101 – 1000	39	23.2	63.1
1001 – 5000	19	11.3	78.7
5001 – 10000	22	13.1	96.7
Above 10000	4	2.4	100.0
Total	122	72.6	

Survey results indicate that a majority of the respondents (55 percent) did not know how to prepare organic fertilizer. See Table 23: Do you know how to make organic fertilizer? Therefore there is a need for capacity building of the citrus orchard growers in the field of organic fertilizer preparation and application. Extension providers need to evolve a strategy to meet the training need in this area. This is important particularly as organic fruit are becoming highly popular/preferred in the world.

Table 23: Do you know how to make organic fertilizer?

Know how to make Organic Fertilizer	Frequency	Percent	Cumulative Percent
Yes	75	44.6	44.6
No	93	55.4	100.0
Total	168	100.0	

- **Application of chemical fertilizers**

Almost half of the respondents indicated that it was difficult or very difficult to obtain fertilizer (Table 24: Availability of inputs: Fertilizer) Availability has two attributes i.e. quality and price. 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 the availability and accessibility very difficult.

Table 24: Availability of inputs: Fertilizer

Availability	Frequency	Percent	Cumulative Percent
V. Easily available	1	.6	.6
Easily available	22	13.1	13.7
Just okay	62	36.9	50.6
Difficult	44	26.2	76.8
Very difficult	39	23.2	100.0
Total	168	100.0	

Balanced use of fertilizer is very crucial for maintaining the fertility of the soil. Lot of technicalities are involved in deciding how much, when, and how to apply various types of fertilizers. So the question

is what are sources of information relating to fertilizer use, that the citrus growers consult? Responses of the respondents on the importance of the sources of fertilizers were sought on a scale of 5 ranging from 0 (in case of least used) to 4 (most commonly used). Results reveal that pesticides companies emerged as most important source of information, with average value of 2.02, followed by the contractors. See Table 25: Sources of information relating to fertilizer use.

Table 25: Sources of information relating to fertilizer use

Source	N	Minimum	Maximum	Mean	Std. Deviation
Self decision	168	0	4	1.57	1.458
Agriculture department	168	0	4	1.47	1.266
Pesticide companies	168	0	4	2.02	1.824
Seed companies	168	0	4	1.81	1.900
Farmers field schools	168	0	4	1.24	1.441
Global Gap	168	0	4	1.65	1.805
Other farmers	168	0	4	1.55	1.570
News Papers	168	0	4	1.78	1.568
Radio	168	0	4	1.70	1.546
TV	168	0	4	1.71	1.537
Contractors	168	0	4	1.99	1.864
University of Agriculture	168	0	4	1.90	1.858
Others	168	0	4	1.24	1.833

5.8 Plant Protection Measures

Appropriate plant protection measures (PPMs) not only ensure higher yield but also lead to improvement in the quality of fruits. Hence, competitiveness in the international market is improved. PPMs are also needed because, certain importing countries have certain quality requirements. For example, countries like USA and Japan have strict phytosanitary requirements.

Pakistan needs to learn from those countries, where best practices of plant protection are being followed. Adoption of Integrated Pest Management (IPM) by the citrus growers in South Africa was driven by three factors: 1) requirements of the importers, especially with respect to pesticide residue regulations; 2) increasing resistance of pests and diseases to pesticides; and 3) environmental responsibility on the part of citrus growers (Urquhart, P. 1999, p. 5). Following sub-sections discuss the issues related with plant protection in Pakistan in the citrus production:

- **Knowledge of diseases**

How would you rate your knowledge about disease of citrus crop? A majority of the respondents (citrus growers) informed that they were having poor knowledge about the diseases of citrus orchards. Only 10 percent respondents reported to have very good knowledge on this aspect. See Table 26: How would you rate your knowledge of citrus crop diseases? 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.

Table 26: How would you rate your knowledge of citrus crop diseases?

Level of knowledge	Frequency	Percent	Cumulative Percent
Very good	17	10.1	10.1
Good	28	16.7	26.8
Satisfactory	42	25.0	51.8
Poor	41	24.4	76.2
Very poor	40	48.2	100.0
Total	168	100.0	

Around 52 percent of the citrus growers knew that their orchards were infected with some diseases, or pests. Remaining 48 percent reported that currently, their orchards were not affected with any disease (Table 27: Is your orchard currently infected with any disease/pest?). On the other hand, interview with the experts of horticulture and field surveys revealed that most of the citrus orchards in the country in one way or the other way were infected with some diseases. It implies that the citrus growers need to upgrade their knowledge relating to orchards management.

Table 27: Is your orchard currently infected with any disease/pest?

Infestation	Frequency	Percent	Cumulative Percent
Yes	88	52.4	52.4
No	80	47.6	100.0
Total	168	100.0	

- **Losses due to diseases**

Orchards incur considerable losses due to weeds, insects, pests, and diseases. In the presence of weeds, the citrus plants/trees have to compete for nutrients, micronutrients, water and air. Eventually, the citrus plants/trees suffer. Average amount of loss in value of fruits accrued due to these issues, based upon perception of the respondents, comes to 34.07 percent. Breakdown analysis suggests that 35 percent of the respondents reported losses ranging from 16 to 30 percent. Around 6 percent of the respondents indicated that last year they incurred loss in excess of 60 percent. See Table 28: Loss due to weeds, insects, pests, and disease

Table 28: Loss due to weeds, insects, pests, and disease

Magnitude of loss	Frequency	Percent	Cumulative Percent
Upto 15	29	17.3	17.3
16 – 30	59	35.1	52.4
31 – 45	36	21.4	73.8
46 – 60	34	20.2	94.0
Above 60	10	6.0	100.0
Total	168	100.0	

- **Pest Management Practices**

What are the pest management methods in practice in your orchard? Around three fourth (72 percent) of the respondents reported that they were using only chemical methods to control the pests/insects, i.e. by using the pesticides, insecticides and or fungicides. Only one percent respondents reported that they were using biological methods to control the pests (Table 29: What are the pest management methods in your orchard?).

Table 29: What are the pest management methods in your orchard?

S.No.	Method	Frequency	Percent	Cumulative Percent
A	Cultural	15	8.9	8.9
B	Chemical	121	72.0	81.0
C	Biological	1	.6	81.5
D	Physical	2	1.2	82.7
E	A & B	23	13.7	96.4
F	A, B & D	5	3.0	99.4
G	A, C & D	1	.6	100.0
	Total	168	100.0	

This offers an opportunity to the PHDEB, which can facilitate such citrus growers who are not using pesticides, to improve quality and quantity of their products, and establish their linkages with exporters so as to market pesticides free citrus fruits in USA or European countries.

Number of sprays applied on citrus orchard during a season reported by the respondents ranged from 0 to 8, with mean value of 2.49 and SD of 1.528. Around 10 percent of the respondents indicated that they applied 5 or more than 5 sprays. Just around 90 percent respondents reported to have applied maximum of 4 sprays during previous season. See Table 31: Do you know about the beneficial insects of the citrus crop?

Table 30: Number of sprays

Number of sprays	Frequency	Percent	Cumulative Percent
NA	19	11.3	11.3
1	15	8.9	20.2
2	61	36.3	56.5
3	37	22.0	78.6
4	19	11.3	89.9
5	12	7.1	97.0
6	2	1.2	98.2
7	2	1.2	99.4
8	1	.6	100.0
Total	168	100.0	

All insects are not enemies of the citrus trees. Some are beneficial too. A large majority of the respondents (72 percent) did not have the knowledge of any beneficial insect. However, 28 percent respondents reported to have some knowledge of beneficial insects (Table 31: Do you know about the beneficial insects of the citrus crop?). Owing to lacking of knowledge about the beneficial insects, there is high likelihood that farmers use pesticides indiscriminately leading to the killing of beneficial insects as well.

Table 31: Do you know about the beneficial insects of the citrus crop?

Knowledge of Beneficial Insects	Frequency	Percent	Cumulative Percent
Yes	47	28.0	28.0
No	121	72.0	100.0
Total	168	100.0	

- **Sources of knowledge relating to PPM**

What are sources of information regarding use of pesticides? Pesticide companies emerged as top ranked source of information regarding use of pesticides with mean value of 1.77 as per table on the next page on a scale 5 [ranging from 0 (not consult at all) to 4 (most commonly consulted)], followed by contractors (1.70). Extension Wing of the Department of Agriculture did not figure out among leading five sources of information, rather it ranked lowest among all sources with mean value of mere 1.219. See Table 32: Sources of information relating to use of pesticides.

Table 32: Sources of information relating to use of pesticides

Sources of Info	N	Minimum	Maximum	Mean	Std. Deviation
Self decision	168	0	4	1.45	1.543
Extension department	168	0	4	1.26	1.219
Pesticide companies	168	0	4	1.77	1.882
Farmers field schools	168	0	4	1.19	1.460
Global Gap	168	0	4	1.63	1.803
Other farmers	168	0	4	1.49	1.631
News Papers	168	0	4	1.49	1.645
Radio	168	0	4	1.51	1.555
TV	168	0	4	1.51	1.540
Contractors	168	0	4	1.70	1.859
University	168	0	4	1.61	1.821
Others	168	0	4	.87	1.644

- **Relationship between age of the citrus growers and the use of pesticides**

Survey results reveal a negative relationship between age and the adoption of pesticides. In total, 19 citrus growers (11 percent of total respondents) were not using pesticides application to control the pests and diseases. Out of these 11 percent citrus growers, more than two third (68 percent of 19 citrus growers) were of age above 35. Pearson Correlation coefficient was found to be -0.126, significant at 10.4 percent, which clearly indicates that negative but weak relationship exists between age and the number of pesticide sprays on citrus orchards. See Table 33: Correlations between age

and the adoption of pesticides. These results partially support the findings reported by Yasin, Aslam, Parvez, and Naz (2003, p. 45).

Table 33: Correlations between age and the adoption of pesticides

		Age	Adoption of pesticides
Age	Pearson Correlation	1	-.126
	Sig. (2-tailed)		.104
	N	168	168
Adoption of pesticides	Pearson Correlation	-.126	1
	Sig. (2-tailed)	.104	
	N	168	168

Further analysis reveals some more interesting findings, which are different from the findings of above referred study. For example, the citrus growers with age upto 25 years had used 2.38 pesticides application on their orchards, which is less than any other group other than the group with age exceeding 55 (Table 34: Relationship between number of sprays and age of the citrus growers). One plausible explanation for this phenomenon is that the citrus growers in higher age brackets are likely to be laggards, while the ones of age less than 25 are likely to be more of innovators.

Table 34: Relationship between number of sprays and age of the citrus growers

Age	No. of sprays (Mean)	N	Std. Deviation
Upto 25	2.38	13	2.103
26 – 35	2.79	38	1.562
36 – 45	2.58	40	1.318
46 – 55	2.45	42	1.596
Above 55	2.14	35	1.396
Total	2.49	168	1.528

5.9 Irrigation Management Practices

Canal water availability is quite inadequate. Only one third of the respondents reported that they were having adequate supply of water (Table 35: Availability of water). Moreover, in most parts of the citrus growing belt, the underground water is brackish and hence unfit for the irrigation purpose. However, Hayat (2007) opines that Sargodha which is located along the Indus Basin does not have the problem of shortage of the water. He argues that it is mismanagement of water rather than actual shortage of what which results into this 'feeling' of water inadequacy. There are two types of canals in the district i.e. those which flow round the year and those which flow only for half of the year Hayat (2007, p. 17). Obviously, this could be another reason for this feeling of inadequacy of water by a significant number of respondents (almost 66 percent).

Table 35: Availability of water

Availability of Water	Frequency	Percent	Cumulative Percent
Adequate	56	33.3	33.3
Inadequate	59	35.1	68.5
Highly inadequate	53	31.5	100.0
Total	168	100.0	

To manage inadequacy of canal water, it is supplemented with groundwater, which is being overexploited, eventually, groundwater table is falling (Hayat, 2007, p. 19). More than one fourth of the respondents reported that they were using tubewells to supplement the canal water so as to meet the irrigation requirements of their orchards (Table 36: Do you know the techniques to fertility management in Kinnow?).

Table 36: Do you know the techniques to fertility management in Kinnow?

	Frequency	Percent	Cumulative Percent
Canal water	120	71.4	71.4
Tube well	4	2.4	73.8
Both	44	26.2	100.0
Total	168	100.0	

The solution lies in the adoption of more efficient and effective irrigation technologies in the orchards. Aujla, Abbas, Mahmood, and Saadullah (2007) suggests that orchard growers should be facilitated to switch from traditional surface irrigation practice to a high efficiency irrigation system like drip irrigation system. The urgency of early adoption of such technologies is increasing in the face of growing challenges of water shortage in the country.

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5.10 Intercropping Practices

Intercropping in the citrus orchards is considered injurious to the health of citrus orchard trees and fruits. However, farmers / citrus growers have not yet abandoned this practice. Survey results indicate that only around 13 percent of the respondents did not intercrop in the orchards (Table 37: Intercropping). Wheat and barseem were the most commonly sown crops in the orchards. In some cases other crops were also reported by the respondents which include vegetables, rice etc. Even though rice is also intercropped this season with Kinnow, its incidence was rather low.

Table 37: Intercropping

	Frequency	Percent	Cumulative Percent
No crop	22	13.1	13.1
A. Wheat	44	26.2	39.3
B. Barseem	20	11.9	51.2
C. Others	7	4.2	55.4
A & B	66	39.3	94.6
A & C	9	5.4	100.0
Total	168	100.0	

One of the finding of the survey of the extension workers (officials and officers) was that intercropping is one of the reasons for low productivity of the citrus orchards in Pakistan. The survey results also lead to the suggestion that intercropping should be discouraged.

Intercropping is generally done by the farmers without assessing the water requirements of the crops to be sown in the citrus orchards, which leads to inefficient use of water resources (Johnson, 2006, p. 37). Moreover, differential requirement of water also create negative impact on the health of both the crop and the orchards.

Then why intercropping is not being abandoned by the citrus growers? Sharif (2004) argues that more risk averse farmers go for intercropping to minimize the risks. This is not the only reason. Most of the farms are small in size, therefore, the farmers have the temptation to use the land for multiple purposes. Livestock raising and wheat production are considered essential farm activities, which have both economic and social reasons. Probing revealed that it is generally considered as a social taboo for a farmer to buy milk or wheat and is against the social prestige. In view of this, small farmers necessarily grow wheat and barseem (fodder for the animals). Another reason is the long time that the citrus trees take to mature. Citrus tree in Pakistan takes 8-9 years to bear high quality commercially viable fruit , while in Australia it does so at year 6 (Khurshid, and Baxter, 2006, p. 13). Small landholders can not afford to keep on investing for 8-9 years with the hope of future returns only. Therefore, they have an economic compulsion to go for intercropping. It is a matter of fact that they can not afford to leave the orchard land fellow for 5 years, therefore, alternate options would have to be considered. One option could be to avoid those crops which directly compete with citrus plants.

5.11 Trimming and Pruning of Orchard

Trimming and the pruning are crucial horticultural practices to ensure health of the citrus trees. According to Dick (1995), pruning is done to:

a. *allow light penetration into the canopy which helps in disease & insect control*
b. *prevent crowding of main scaffold branches and to remove branches which cross;*
c. *remove or shorten water shoots to prevent them from becoming too dominant;*
d. *allow air circulation and access under trees (skirt pruning);*
e. *increase fruit size and quality*
f. *prevent fruit damage due to limb rubbing.*

Through an experiment, Ahmad, Chatha, Nasir, Aziz, Virk, and Khan (2006) concluded that pruning practices leads to significant increase in yield (upto 841 fruits per plant), weight (248.5 g) and juice (46.39 percent) of Kinnow fruits, improvement in their quality and development of the orange red colour

Moreover removal of weeds is also important for the same purpose, as weeds compete with the citrus trees in nutrients. However, survey results indicate that almost 90 percent of the citrus growers do not pay attention towards cleanliness in the farms. See Table 38: Do you clean the orchard?
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Table 38: Do you clean the orchard?

	Frequency	Percent	Cumulative Percent
Yes	151	89.9	89.9
No	17	10.1	100.0
Total	168	100.0	

As far as trimming and pruning is concerned, almost 60 percent of the citrus growers informed that they were in the practice of pruning and trimming their trees (Table 39: Do you do trimming and pruning of orchard?). 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.

Table 39: Do you do trimming and pruning of orchard?

	Frequency	Percent	Cumulative Percent
Yes	99	58.9	58.9
No	69	41.1	100.0
Total	168	100.0	

6. Quality Management

6.1 Citrus Growers

Citrus growers have a major role in the management of quality of Kinnow. How do they perceive about quality of Kinnow is certainly of great significance from the view point of developing a strategy for improvement. Following sub-sections discuss about their perspectives on the quality of Kinnow:

- **Satisfaction with quality of Kinnow**

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) analyzed a sample of 400 crates and found that 90 percent crates contained mixed quality fruits. The study further revealed that 60 percent of the sampled crates had 15 percent oranges not meeting the quality requirements (p. 202).

Are citrus growers aware of the quality considerations? So a question was asked from citrus growers: Are you satisfied with the quality of Kinnow that you produce? Survey results reveal that around 38 percent of the citrus growers showed dissatisfaction with the quality of their produce. See Table 40: Are you satisfied with the quality of Kinnow that you produce?

Table 40: Are you satisfied with the quality of Kinnow that you produce?

	Frequency	Percent	Cumulative Percent
Yes	105	62.5	62.5
No	63	37.5	100.0
Total	168	100.0	

- **Quality Management and Environmental Considerations**

More than half of the respondents (54 percent) reported that they were raising the citrus orchards with the intention that their produce will be exported. However, remaining 46 percent did not agree with above intentions. See Table 41: Do you produce for the export market?

Table 41: Do you produce for the export market?

	Frequency	Percent	Cumulative Percent
Yes	90	53.6	53.6
No	78	46.4	100.0
Total	168	100.0	

More of the citrus growers (76 percent) reported that they were not following any quality procedures or practices to ensure quality of their produce. See Table 42: Do you follow the quality procedures at your farm?

Table 42: Do you follow the quality procedures at your farm?

	Frequency	Percent	Cumulative Percent
Yes	40	23.8	23.8
No	128	76.2	100.0
Total	168	100.0	

6.2 Views of Contractors on Quality

Citrus orchards are generally transferred to contractors at any time before the maturity of the fruits. Sharif, Farooq, and Malik (2005, p. 677) have reported that harvesting rights of 95 percent of the orchards were sold at the stage of flowering. Therefore, contractors have an important role to play in the management of quality. How do they perform various practices, which can impact the quality of fruits? What are their views relating to quality of fruits? How can quality of citrus be improved? Responses of the contractors on these questions are discussed below:

What are the reasons of poor quality? The respondents indicated following reasons for the deterioration in the quality of citrus fruits:

a. Pests and diseases
b. Improper way of picking and handling: Trained labour is not available.
c. Lack of adequate transportation facilities
d. Poor condition of inter-city road network
e. Lack of air-conditioned transportation facilities
f. Vagaries of weather
g. Lack of absorption capacity of the market during peak season

How can quality be improved? Following are the ways:

a. Timely application of water, fertilizer, and pesticides,
b. Timely trimming and pruning of the citrus trees
c. Availability of easily accessible cheap credit
d. Capacity building of the farmers in disease and management
e. Subsidy on diesel
f. Making air-conditioned cargo vehicles available in the country. It is recommended that duty on the import of such vehicles should be waived.
g. Farm to market road network should be improved
h. Imparting training to the labour responsible for picking, packing, uploading and downloading.

7. Sale of Harvesting Rights of Orchards

7.1 Incidence of Sale of harvesting Rights

Majority of the citrus growers (83 percent) do not harvest themselves (Table 43: Do you harvest the orchard yourself?). Rather they sell harvesting rights to the contractors, who then pick fruits, grade them, pack them, transport them and sell them in markets, or sell to the Kinnow processing factories or sell to the exporters. In some cases, exporters buy-in the harvesting rights directly from the citrus growers.

Table 43: Do you harvest the orchard yourself?

	Frequency	Percent	Cumulative Percent
Yes	28	16.7	16.7
No	140	83.3	100.0
Total	168	100.0	

During the current year, till September, almost 80 percent of the orchards' harvesting rights had been sold, however, fate of the remaining 20 percent was yet to be decided by the citrus growers. See Table 44: Have you sold output of your orchard for the current year?

Table 44: Have you sold output of your orchard for the current year?

	Frequency	Percent	Cumulative Percent
Yes	134	79.8	79.8
No	34	20.2	100.0
Total	168	100.0	

7.2 Time of Contracting

During the current year, conclusion of the deals for contracting out the orchards began in January. However, real momentum was generated in the month of April, when just over 10 percent of the deals (till September) was successfully negotiated. Most of the deals (24 months) were struck in the month of July. After July the process got slow down. During first 9 months of the current year, almost 80 percent of the orchards owners had sold out the harvesting rights to the contractors. See Table 45: When did you sell output of your orchard this year.

Table 45: When did you sell output of your orchard this year?

Month	Frequency	Percent	Cumulative Percent
January	2	1.5	1.5
February	3	2.2	3.7
March	2	1.5	5.2
April	14	10.4	15.7
May	23	17.2	32.8
June	25	18.7	51.5
July	32	23.9	75.4
August	22	16.4	91.8
September	11	8.2	100.0
Total	134	100.0	

7.3 Contract Conditions

Contract conditions matter much with how citrus crop is going to be properly looked after, how it would be harvested, and how would it benefit to the farmers, as discussed below:

- **Views of the Citrus Growers**

Under what conditions contracting between citrus growers and the contractors is done. Almost 99 percent of the respondents who had concluded their deals informed that they had sold the harvesting rights only for one year. In case of remaining about one percent of the respondents, the deal was for two years.

There are several factors which are considered while contract is being negotiated between contractor and the farmer, which include age and health of the orchard, flowering intensity, citrus variety, distance from metal road, quality of road, availability of transport facilities and transportation cost (Sharif, Farooq, and Malik, 2005, p. 677). The present study has found that these factors on the basis of their weight are ranked as follows: citrus variety, flowering intensity, health of the orchard, distance from metal road, quality of road, citrus variety, availability of transport facilities and transportation cost

The above discussed factors are not the only factors which influence the negotiation process, as these factors are of prime interest for the contractors only. Considerations for the farmers are different. The factors which are of prime interest for the farmers include creditability and financial health of the contractor. In case, the contractor runs into losses, there is always very high probability that he will refuse to make remaining payment to the orchard owners.

- **Views of the Contractors**

All sampled middlemen reported to have only rented-in orchards. All of them informed that under the contract agreement, they were supposed to pay 25 percent of the total payment as advance and remaining 75 percent in three installments. Other terms and conditions were also same. In all cases, the period of contract was one season only and none of the orchard was reported to be on lease on long term basis. Under the contract, the middlemen perform the following roles:

- Advise on application of water, pesticides, and fertilizer
- Making fertilizer and pesticides available. But in such cases, the middlemen make deductions from the total payments to be made to the farmers.

The respondents (middlemen) complained that the farmers were most of the times unwilling to apply fertilizer and pesticides on timely basis. They rated level of their cooperation at 3.00 on a scale of

5.00 where 1 = never, 2 = few times, 3 = sometimes, 4 = usually, and 5 = all times. The respondents informed that sometimes they had to force to farmers to apply fertilizer and pesticides at critical stages. Around 50 percent of the farmers reported that farmer who can not manage their gardens well, they lease them out, however, when the middlemen work hard and health of garden improves, the farmers try to cancel the contract and succeed in taking their orchards back. The contract is based on past relationship and trust. It is usually verbal, however, some important clauses of agreement are written in a notebook. But agreement is never transformed into a proper legal document.

7.4 Reasons for selling harvesting rights

Sharif, Farooq, and Malik (2005, p. 680) identified seven reasons for selling the rights of harvesting the citrus orchards, which included 'no marketing knowledge' (43 percent of respondents), 'exploitation of commission agents' (20 percent), 'growing of other crops' (15 percent), 'risk in marketing process' (10 percent), 'marketing requires investment' (10 percent), 'time constraint' (14 percent), 'need of cash' (10 percent) and 'transportation problem' (7 percent).

However, survey results of this study indicate that the top most problem is lack of finances (38.7 percent), followed by time constraints (26.8 percent), exploitation by the commission agents (19 percent), risk of loss (6.5 percent), lack of marketing knowledge (6 percent) and lack of transportation facilities (3 percent). Reason of 'lack of finances' is quite understandable, as 55 percent of the citrus growers did not have any other business or profession while 25 percent were in government service, which was their second profession (Table 46: Top most reasons for selling harvesting rights?). Both categories of the people generally remain in deficit of finances. Second top ranked reason was the time constraint. Again the same explanation holds true. Marketing of citrus fruits not only needs substantial resources but also requires considerable time. Activities like picking, grading, packing, marketing research, and transportation have very high time and resource implications.

Farmers generally have an attitude of risk aversion. Even most of the wealthy farmers also try to transfer the risk by selling the harvesting rights. Usually such farmers sell the rights in August or later in the year.

Table 46: Top most reasons for selling harvesting rights?

Reason	Frequency	Percent	Cumulative Percent
Lack of finances	65	38.7	38.7
Time constraints	45	26.8	65.5
Exploitation by commission agents	32	19.0	84.5
Risk of loss	11	6.5	91.1
Lack of market knowledge	10	6.0	97.0
Lack of transportation facilities	5	3.0	100.0
Total	168	100.0	

7.5 Price of the selling harvesting rights

More than half of the respondents expressed lack of satisfaction with the returns from citrus orchards. Only six percent termed the returns as good (Table 47: Returns from citrus orchards: do you think it is a good price?). Dissatisfaction of the citrus growers with the price they get, is due to

the fact that contractors are more informed about the market therefore, they manage to dominate the negotiation process.

Table 47: Returns from citrus orchards: do you think it is a good price?

	Frequency	Percent	Cumulative Percent
Very Poor	25	14.9	14.9
Poor	68	40.5	55.4
Satisfactory	65	38.7	94.0
Good	10	6.0	100.0
Total	168	100.0	

Only 71 respondents (53 percent) responded the question to at what price, did you sell the harvesting rights to the contractors this year?

Price of selling harvesting rights of one acre ranged from Rs. 12,000 to Rs. 150,000, with average of Rs. 56246 per acre (SD = 36218.077). In majority cases (around 51 percent), the price ranged from Rs. 26,000 to Rs. 50,000 per acre. Only 4.2 percent respondents reported that the prices at which they concluded the contract this year was above Rs. 100,000 per acre. See Table 48: Selling Prices.

Table 48: Selling Prices

Selling price (Rs.)	Frequency	Percent	Cumulative Percent
Upto 25,000	9	12.7	12.7
26,000 – 50,000	36	50.7	63.4
51,000 – 75,000	13	18.3	81.7
76,000 – 100,000	10	14.1	95.8
Above 100,000	3	4.2	100.0
Total	71	100.0	

8. Fruit Harvesting

8.1 Picking season

Harvest season of citrus fruits begin in September (with start of the picking of Feutral Early) and ends in March with Kinnow as the last citrus fruit. In some cases, the Kinnow harvest continues till April, but in such cases, fruit is available only at the top of trees. (PHDEB, 2005, p. 10). Pakistan has shorter period of the availability of citrus fruits as compared to its competitors (Figure 6: Kinnow picking season in Pakistan). For example, in case of Australia the harvest season spreads over a period staring from August and ending in February. (PHDEB, 2005, p. 10).

Figure 6: Kinnow picking season in Pakistan

	Months											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Picking season												

Picking season of Kinnow starts in the month of November. Interviews of the contractors revealed that in majority of the cases (73 percent), last year, picking started during 3rd week of November. Only 7 percent of the respondents (contractors) reported that last year, they started picking of citrus fruits during 1st week of December. Market remains glutted with fruit from Mid December to end Mid February (Table 49: Start of the picking season).

Table 49: Start of the picking season

S.No.	Start of picking	Frequency (%)
1	3rd week of November	73
2	4th week of November	20
3	1st week of December	07

Picking season ends in the month of March. Almost 90 percent respondents reported that last year they ended picking activity during last week of March, however, remaining 10 percent continued till 15th April (Table 50: End of the picking season).

Table 50: End of the picking season

S.No.	End of picking	Frequency (%)
1	Last week of March	53
2	1st week of April	33
3	2nd week of April	13

Pakistan needs to develop such varieties which can ensure availability of citrus fruits over an extended period of time. There are two options for Pakistan i.e. either by developing late harvesting varieties or by developing early harvesting varieties. Most of the countries except Australia have late harvesting varieties so it would be beneficial for Pakistan to develop early citrus harvesting varieties.

It will not only help in expanding its market but will also help in getting higher unit price in the International market.

8.2 Harvesting Practices

In most of the cases, picking is done by the contractors. Only one fourth of respondents reported that trained labour is used for picking Kinnow in their orchards (Table 51: Is trained labour used for picking Kinnow in your orchards?)

Table 51: Is trained labour used for picking Kinnow in your orchards?

	Frequency	Percent	Cumulative Percent
Yes	43	25.6	25.6
No	125	74.4	100.0
Total	168	100.0	

Around 70 percent of the labour employed at the farm for harvesting is migratory. Generally, they are not concerned with external scarring of the fruit when picking it. Labour is paid on the basis of number of baskets of the fruits picked, therefore, consideration for the labour is quantity and not quality. On an average, one labourer usually earns around PKR 200/day.

Several picking techniques can be used to harvest citrus fruits. Each technique has its own merits and demerits. A large majority (73 percent) of the respondents indicated that clippers were mainly used last year in their orchards to pick citrus fruits. Around 17 percent reported that in their orchards, picking was done manually (directly by hands without using aids such as clippers) last year. See Table 52: What are picking techniques followed at your farm?

Table 52: What are picking techniques followed at your farm?

	Frequency	Percent	Cumulative Percent
A. Clipper	123	73.2	73.2
B. By hand	29	17.3	90.5
C. A & B	11	6.5	97.0
D. With stick	0	0	97.0
All above	5	3.0	100.0
Total	168	100.0	

Baskets and plastic boxes are mainly used to handle the citrus fruits during the process of picking (Table 53: What are the handling methods followed at your farm?).

Table 53: What are the handling methods followed at your farm?

	Frequency	Percent	Cumulative Percent
A. Into a basket	50	29.8	29.8
B. Open top plastic box	40	23.8	53.6
C. Any other	56	33.3	86.9
A & B	22	13.1	100.0
Total	168	100.0	

8.3 Grading and Packing material

All of the respondents reported that they grade the products before selling. Almost 75 percent of the respondents (contractors) reported that last year they transported 30 percent of their produce in open vehicles without any packing while remaining 70 percent was transported in packed form (50 percent produce was packed in wooden boxes, 10 percent in plastic boxes, and remaining 10 percent in bags etc. See Table 54: Packing material.

Table 54: Packing material

S.No.	Packing material	Frequency (percent)
1	Wooden material	50
2	Cotton / jute bags	10
3	Plastic packing	10
4	No packing	30

8.4 Why does the price remain low?

None of the respondents (contractors) showed satisfaction with prices of Kinnow, they earned last year. They were completely dissatisfied with the markets. They identified following reasons for low prices:

- There are only few exporters of Kinnow, eventually, only a small quantity of the fruit is exported. It results in the glut of Kinnow in the local market which pushes the prices downwards
- Middlemen lack know-how of export business.
- Sometimes big players of the market pool together and push prices downward. It is the phenomenon of market distortion.
- If quantity to be sold is large in quantity, price goes down by as much as 50 percent
- Low quality
- Irregular supply

8.5 How can the price of Kinnow be improved?

Respondents from the middlemen suggested that arhties and middlemen should be given training in export business management so that export of citrus from Pakistan may receive a big boost. It will eventually, lead to reduction in supply of Kinnow in the local market, which will push the prices high. Secondly, the quality of fruits should be improved, which will also lead to higher returns.

8.6 Magnitude of Post-harvest losses

Post-harvest losses are source of major concern. There are several studies which present different estimates on the post-harvest losses. Mahmood and Sheikh (2006) have reported that around 20-40 percent of the Kinnow production is wasted during post production processes. Issue of high post harvest losses is the phenomenon common in many countries. For example, in India, magnitude of post harvest losses in case of fruits and vegetables is estimated at 40 percent (World Bank, 2007, p. 126). Where do losses occur?

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 they perishable) during the waiting period i.e. lag involved between picking and the marketing. See Table 55: Magnitude of post-harvest losses.

Table 55: Magnitude of post-harvest losses

S.No.	Category of loss	Magnitude of loss (percent)
1	Picking	5
2	Handling	2.5
3	Packing at farm	5
4	Transportation	5-20
5	Others	5

The contractors reported that during transportation loss of fruit ranged from one percent in case packing in *paities* (wooden boxes) to 5 percent in case of open vehicle transportation or in case of packed in bags or *gatoos*.

Reasons for post-harvest losses include:

- Poor condition of containers
- Inadequate and poor storage facilities
- Poor quality of wax

9. Marketing

The decade of 1990s marked the emergence of modern marketing system, which included societal dimension (Ali, 2004, p. 6). Two clearly differentiated markets exist for the citrus fruits: 1) market for the fresh citrus fruits; and 2) market for the processed citrus fruit, predominantly the orange juice (UNCTAD, 2008).

There are several issues associated with marketing of fruits and vegetables in general and the Kinnow in particular. About 30-35 percent of the citrus fruit production in Pakistan is unsuitable for marketing due to a variety of factors which include lack of crop management, poor fruit quality and storage facilities (Khurshid, and Baxter, 2006, p. 3). The following sub-sections discuss the marketing system of Kinnow in Pakistan:

9.1 Local Markets

There are three types of markets for the citrus fruits in the country (Sharif, 2004, pp. 9-10), which are discussed below:

- **Assembly Market**: These markets exist in small towns, close to the farms.
- **Wholesale markets:** These markets are mostly equipped with better storage, transportation and handling facilities and generally located in tehsil and district headquarters. Sargodha is a big wholesale market for Kinnow.
- **Terminal markets**: These markets are generally located in big urban locations. Lahore and Karachi, Islamabad and Peshawar are prominent terminal markets in the country.

9.2 Marketing Infrastructure

Total capacity of cold storages in the country is quite small vis-à-vis requirements of the country. There are 470 cold storage houses in the country with total capacity of 707,220 tonnes (Table 56: Storage houses and their capacity). 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.

Table 56: Storage houses and their capacity

City/Province/State	Number of storage houses	Capacity (tones)
Punjab	412	628,110
Sindh	22	27,560
NWFP	18	37,200
Islamabad	15	12,700
Balochistan	2	1,100
AJK	1	550
Total	470	707,220

Source: Ali (2004, p. 224).

Government of Pakistan launched a scheme called “Cool Chain and Cold Storage for horticulture Products” in 2007[1], which reads as follows:

> “Mark-up cost of loans obtained by business concerns for establishment of cool chain infra-structure will be picked-up by the Trade Development Authority of Pakistan through the Export Development Fund (EDF) up to a maximum of 6%”

[1] Trade Development Authority of Pakistan, Government of Pakistan, No 4(37)/PPI/2004 Dated Karachi , the January 05, 2007

However, the desired results have not been achieved.

9.3 Role of Contractors

Only 25 percent of the respondents (out of total 16 contractors interviewed) reported that their firms were selling products to the exporters, another 25 percent indicated that they were selling to citrus processing factories, while remaining informed that they were selling to wholesalers, retailers and other parties in the market.

9.4 Role of middlemen

Middlemen play an important role in the citrus markets. In countries like China it has been found that profit of middlemen sometimes is several times greater than that of citrus growers (Chunjie, 2001).

A focused group discussion (FGD) was arranged at Sargodha, in which around 20 farmers participated. They highlighted that middlemen manage to exploit the farmers because they are financially weak. The middlemen stop making payments in case there is a probability of loss or any fear of decline in profit. The middleman put all losses on the credit of farmers. The farmers also indicated that middlemen (arhties) in the fruit markets do not properly do their job and therefore the growers have to incur losses.

On the other hand in another group discussion, the middlemen reported that in the years when the yields turn out to be far more than initial estimates, it is the farmers who breach the contract. The farmers find new buyers for their outputs at higher rates late in the season. They usually return the money they have already received from the middleman, but only after a prolonged waiting period and only the sum that they had received from the middleman, i.e. the damage to the middleman's income due to the breach of contract late in the season is not covered.

Most of the middlemen are expanding their role to become fresh fruit processors eventually hoping to become exporters themselves. This group of people, though not very popular in the chain, was found to be the most enterprising in the whole chain.

10. Learning and Development

10.1 Citrus Growers

Continuous learning is a key for continuous improvement. How citrus growers learn is discussed and analyzed as under:

- **Sources of learning**

Learning and development system needs to be efficient and effective to ensure continuous improvement in the citrus production and marketing management system. Survey findings of the citrus growers reveal that on an over all basis, nurseries emerged as top ranked source of learning relating to orchards management, followed by GlobalGap, the University of Agriculture Faisalabad, pesticide companies, and so on. Agriculture department did not emerge among the top most important sources of information. See Table 57: Sources for information on citrus production & management

Table 57: Sources for information on citrus production & management

Source of Information	N	Minimum	Maximum	Mean	Std. Deviation
Self decision	168	0	4	1.42	1.404
Agriculture department	168	0	4	1.33	1.146
Pesticide companies	168	0	4	1.86	1.796
Nurseries	168	0	4	1.77	1.880
Farmers field schools	168	0	4	1.30	1.535
Global Gap	168	0	4	1.76	1.856
Other farmers	168	0	4	1.36	1.594
News Papers	168	0	4	1.56	1.648
Radio	168	0	4	1.55	1.574
TV	168	0	4	1.67	1.561
Contractors	168	0	4	1.68	1.841
University	168	0	4	1.73	1.856
Others	168	0	4	.92	1.667

Do you have any book on citrus orchard management? In response to this question, less than one third of respondents reported to have any book on citrus orchard management (See Table 58: Do you have any book on citrus orchard management?).

Table 58: Do you have any book on citrus orchard management?

	Frequency	Percent	Cumulative Percent
Yes	53	31.5	31.5
No	115	68.5	100.0
Total	168	100.0	

- **Extension Department**

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. It clearly shows that popularity of the extension department among the citrus growers is quite low. This phenomenon is further evident from another related finding of the survey i.e. only 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 (Table 59: Did you ever request Extension Department for any assistance).

Table 59: Did you ever request Extension Department for any assistance

Request for assistance (Ext)	Frequency	Percent	Cumulative Percent
Yes	11	6.5	6.5
No	157	93.5	100.0
Total	168	100.0	

- **Contractors**

Contractors were consulted by around 13 percent of the respondents. It indicates that they were consulted more than the extension workers. This is primarily due to the factor of proximity i.e. citrus growers remain in stronger communication with the contractors than the extension workers. However, around 62 percent reported that the advice did not prove to be effective (Table 60: Did you ever request assistance from the contractors?). It indicates that there is an urgent need of upgrading the skills and knowledge of the contractors as well.

Table 60: Did you ever request assistance from the contractors?

Request for assistance (Contractors)	Frequency	Percent	Cumulative Percent
Yes	21	12.5	12.5
No	147	87.5	100.0
Total	168	100.0	

- **Record of the Operations**

Around 14 percent of the respondents informed that they had the practice of keeping documented record of all operational management activities at their orchards (Table 61: Documentation of practices performed at citrus orchards). This is one of the best management practices. However, probing lead to the finding that such record mainly covered the financial account of the orchard. All who reported to have record reported that they were using registers for this purpose. In none of the cases, use of computer was reported.

Table 61: Documentation of practices performed at citrus orchards

Documentation	Frequency	Percent	Cumulative Percent
Yes	23	13.7	13.7
No	145	86.3	100.0
Total	168	100.0	

- **Training and Development**

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. None reported to have any training from any pesticide or fertilizer company or from any NGO. Less than seven percent of respondents reported to have availed training from more than one sources (Table 62: Have you attended any training on citrus production and management?).

Table 62: Have you attended any training on citrus production and management?

		Frequency	Percent	Cumulative Percent
-	Not attended any	85	50.6	50.6
A	FFS/FVDP	46	27.4	78.0
B	PMO / Global Gap	13	7.7	85.7
C	Extension Department	11	6.5	92.3
D	Fertilizer/pesticide	0	0.0	92.3
E	NGOs	0	0.0	92.3
F	Any other	2	1.2	93.5
G	C & D	3	1.8	95.2
H	A & C	4	2.4	97.6
I	A & B	3	1.8	99.4
J	B & C	1	.6	100.0
	Total	168	100.0	

10.2 Contractors

How do the contractors get information and technical guidance, how do they keep their business records, and what are their training needs are discussed hereunder:

- **Sources of market information**

- **Newspapers:** Only 25 percent respondents termed newspapers as a useful source of information on the market situation
- **Electronic boards at markets**: All respondents indicated electronic boards installed in the markets as very useful source of information.
- **TV and radio**: None reported TV and radio any useful source of information
- **Mobile phones**: All respondents termed mobile phones as very useful tools for accessing to market information.
- **Agricultural Marketing Department (AMD):** Only 20 percent of respondents termed AMD as useful source of information.

10.3 Record keeping

All of the respondents from contractors reported that they were keeping records of the following:

- Supplies
- Trade
- Contract agreement with farmer and related record
- Inventory management

10.4 Training needs of Contractors

Survey results indicate that top most training need is farm / orchard management, followed by plant protection management and negotiation skills.

11. Extension System

Extension Department is responsible for providing the technical assistance to the farmers. Agricultural Extension and Adoptive Research of the Department of Agriculture, Government of Punjab has following objectives (Government of Punjab, 2008):

1. To increase agricultural production for fulfilling local requirements as well as surplus production for foreign exchange through dissemination of latest production technology among farming community.

2. Transfer of technology to the farmers through personal and group contacts, demonstrations at farmers' fields, print and electronic media, checking of pesticide and fertilizer quality to ensure the purity of both inputs.

3. Besides, Extension Wing is also responsible for testing the research findings through Adaptive Research under local conditions and subsequent amendments if needed.

As mandate of the Extension Wing is very crucial for the citrus sector development in the provinces, therefore, views of the officials assigned on the job of extension services were also taken. A semi-structured questionnaire was constructed to elicit their responses. Findings of the survey of the extension workers are given in the following sub-sections.

11.1 Profile of Respondents from Extension Department

In total 66 extension workers were interviewed. Their profile is given in the following sub-sections:

- **Designations**

Around 79 percent of the respondents were field assistants (FAs) who actually remain in direct contact with the farmers and remaining 21 percent were in officer categories including Deputy District Officers (DDOs) and District Officers (Dos). See Table 63: Designation of respondents from extension department.

Table 63: Designation of respondents from extension department

Designation	Frequency	Percent	Cumulative Percent
DDO / DO	14	21.2	21.2
Field Assistant	52	78.8	100.0
Total	66	100.0	

- **Education**

On overall basis, highest education among the extension workers was PhD and lowest was the matriculation. Out of 66 workers, around 60 percent were matriculate and 18 percent were having degrees in MSc (Hons) – 18 years education.

In the category of FAs, highest education was Intermediate (12 years schooling) and lowest was Matriculation (10 years schooling). Out of 52 field assistants, 75 percent were matriculate and remaining 25 percent were intermediate. However, all FAs had diploma certificates.

On the other hand, in the category of officers, minimum education was BSc (Hons) – 16 years education (including 4 years university education), and highest education was PhD. See Table 64: Education of respondents from extension department.

Table 64: Education of respondents from extension department

Education	Frequency	Percent	Cumulative Percent
Matric	39	59.1	59.1
Intermediate	13	19.7	78.8
BSc (Hons)	1	1.5	80.3
MSc (Hons)	12	18.2	98.5
PhD	1	1.5	100.0
Total	66	100.0	

- **Length of experience**

Experience of the respondents ranged from less than a year to 32 years. More than half of the extension workers had experience exceeding 15 years. It is interesting to note that mere 10 percent of the extension workers fall in the experience bracket of 6 to 15 years. In the category of officers none was in the range of experience from 6 to 10 years. Moreover, 50 percent of the responding officers were having experience less than 6 years. It appears that induction in the extension wing was put at halt for quite a long time and it resumed during last 5 years (Table 65: Experience of the Extension Workers).

Table 65: Experience of the Extension Workers

(Percentage in parenthesis)

Years	Designation		Total
	Agri Officers	Field Assistant	
Less than 5 years	7 (50)	16 (30.77)	23 (34.85)
6 – 10 years	0	2 (3.85)	2 (3.03)
11 – 15 years	1 (7.14)	4 (7.69)	5 (7.58)
16 – 20 years	2 (14)	11 (21.15)	13 (19.70)
21 – 25 years	3 (21.43)	13 (25)	16 (24.24)
Above 25 years	1 (7.14)	6 (11.54)	7 (10.61)
Total	14 (100)	52 (100)	66 (100)

- **Fields of Specialization**

Only three officers were reported to have specialization in horticulture. In citrus growing belt, this number is quite small. Moreover it is also important to note that the region had only one specialist of Plant Pathology, one of Entomology and one of Marketing. Post harvest losses in case citrus are in excess of 30 percent. So the region needs to have adequate expertise in agricultural marketing as well (Table 66: Specialization of Extension Workers).

Table 66: Specialization of Extension Workers

Field of specialization	Frequency	Percent	Cumulative Percent
Agricultural Extension	1	1.5	1.5
Agricultural Marketing	1	1.5	3.0
Agronomy	2	3.0	6.1
Diploma	52	78.8	84.8
Entomology	1	1.5	86.4
Horticulture	3	4.5	90.9
Plant Breeding and Genetics	3	4.5	95.5
Plant Pathology	1	1.5	97.0
Soil Science	2	3.0	100.0
Total	66	100.0	

- **Perceived knowledge of the Extension Workers**

EWs were asked to rate their current knowledge about citrus production. None of the respondents rated level of their knowledge as poor or very poor. However, only 12 percent were of the view that they had excellent knowledge about the citrus production technologies and practices. See Table 67: Current knowledge of extension workers about citrus production.

Table 67: Current knowledge of extension workers about citrus production

Current Perceived Knowledge Level	Frequency	Percent	Cumulative Percent
Somewhat good	31	47.0	47.0
Very Good	27	40.9	87.9
Excellent	8	12.1	100.0
Total	66	100.0	

Around 58 percent of the Extension Workers informed that they were completely updated with last knowledge and skills relating to citrus production management (Table 68: Are you completely updated with recent developments in citrus?). However, remaining respondents indicated that they needed to be updated in certain areas.

Table 68: Are you completely updated with recent developments in citrus?

Updated with recent developments	Frequency	Percent	Cumulative Percent
No	28	42.4	42.4
Yes	38	57.6	100.0
Total	66	100.0	

- **Number of training courses participated**

How many training courses relating to citrus production you have participated during last five years? Results of survey indicate that number varied greatly i.e. from zero to 8, with mean of 3.30 (SD = 2.112). See Table 69: Courses relating to citrus production.

Table 69: Courses relating to citrus production

Number of courses	Frequency	Percent	Cumulative Percent
No	6	9.1	9.1
1	11	16.7	25.8
2 – 4	25	37.9	63.6
5 – 7	21	31.8	95.5
Above 7	3	4.5	100.0
Total	66	100.0	

- **Types of latest training courses participated**

Latest training course participated by the extension workers during last five years is given below, with number of respondents given in parentheses:

1. Garden and farming (30)
2. Fertilizer management and control of diseases and insects (19)
3. Training of facilitators (TOFS) (4)
4. Integrated Pest Management (IPM) (3)
5. Marketing (3)
6. Importance of Tensiometer (water requirement of citrus) for citrus or cloned for irrigation (2).
7. Modern techniques of harvesting citrus (2)
8. In-service agriculture training. (1)
9. Looking after the garden and crops. (1)
10. Seminar (1)
11. Citrus Bearing (1)
12. Training course on capacity building of agriculture professional at water hotel resorts (1).
13. Training of fertilizer, in which participatory approach, learning by doing (1).
14. Marketing, Harvesting of early food variety. (1)
15. Pruning (1)

- **Usefulness of training courses participated**

Were these courses useful? Very small percentage of respondents (1.7 percent) termed these training interventions not beneficial. Otherwise, majority of the respondents (95 percent) rated the courses as beneficial to highly beneficial.

Table 70: Usefulness of the training courses

Usefulness of the course	Frequency	Percent	Cumulative Percent
Not at All	1	1.7	1.7
Not beneficial	2	3.3	5.0
Beneficial	45	75.0	80.0
Highly Beneficial	12	20.0	100.0
Total	60	100.0	

- **Training needs of Extension Workers**

There are 12 areas, wherein the Extension Workers believed, they needed training. Respondents from the Extension Workers were asked to weight to each training area from zero (lowest important training need area) to 5 (most important training area). MS Office emerged as the top most training area, with mean value of 4.20 on a scale of 5. It was followed by the use of internet, marketing management and pest management. See Table 71: Training needs of the extension workers

Table 71: Training needs of the extension workers

Training Courses	N	Mean	Rank	Std. Deviation
MS Office	59	4.20	1	1.412
Use of Internet	63	4.05	2	1.408
Marketing Management	57	3.70	3	1.309
Pest Management	61	3.34	4	1.209
Horticultural practices	66	3.30	5	1.123
People Management	51	3.24	6	1.350
Communication Skills	55	3.22	7	1.499
Soil/Fertility Management	61	3.16	8	1.267
Water Management	56	3.09	9	1.405
Writing Skills	57	3.00	10	1.476
Survey Skills	59	2.98	11	1.503

- **What are your sources of knowledge about citrus?**

Around 88 percent of the respondents reported that they did not have access to a library where they could access the latest literature on the citrus orchards management etc. See Table 72: Access to **Library**.

Table 72: Access to Library

Library Access	Frequency	Percent	Cumulative Percent
No	58	87.9	87.9
Yes	8	12.1	100.0
Total	66	100.0	

However, around 70 percent of the respondents indicated that they had access to some magazine relating to agriculture. See Table 73: Agriculture Magazine

Table 73: Agriculture Magazine

	Frequency	Percent	Cumulative Percent
No	20	30.3	30.3
Yes	46	69.7	100.0
Total	66	100.0	

In today's world computers are important tools for learning and managing learning interventions. Around three fourth of the respondents informed that they had no access to computers. See Table 74: Availability of Computers.

Table 74: Availability of Computers

	Frequency	Percent	Cumulative Percent
No	48	72.7	72.7
Yes	18	27.3	100.0
Total	66	100.0	

Internet offers tremendous opportunities for learning and development. Internet facility was reportedly in access of only just over 15 percent of the respondents. See Table 75: Internet.

Table 75: Internet

	Frequency	Percent	Cumulative Percent
No	56	84.8	84.8
Yes	10	15.2	100.0
Total	66	100.0	

Respondents were asked, what the most important sources of knowledge are for them. They identified several sources which are given below, in order, with number votes of the respondents given in parentheses:

1. Departmental literature (43)
2. Radio (30)
3. TV (26)
4. Training Courses (16)
5. Experts (13)
6. Newspapers (11)
7. TOF (9)
8. Training material (manuals etc.) (6)
9. Internet (5)
10. Colleagues and higher officials (4)
11. Books (3)
12. CABI (3)
13. AARI (2)
14. University of Agriculture, Faisalabad (2)

15. Magazines (2)
16. Field visits (1)
17. Global GAP (1)
18. Official meetings (1)
19. Personal visits to institutions (1)
20. Projects (1)
21. Seminar (1)

11.2 Access to transport facilities

No transport facility was available to around 49 percent of the respondents. Only 9 percent of the respondents reported to have access to the jeeps for visiting the fields. See Table 76: Access to Transport .

Table 76: Access to Transport

Access to Transport	Frequency	Percent	Cumulative Percent
Jeep	6	9.1	9.1
Bike	26	39.4	48.5
Both	2	3.0	51.5
No transport	32	48.5	100
Total	66	100.0	

11.3 Citrus Growers' visits with Extension Workers

Number of farmers visiting the extension workers (reported by them) ranged between 2 to 200 per month, with average of around 52. More than 50 percent of the respondents (extension workers) reported that number of farmers who visited them during last month ranged from 11 to 50. In some cases, the figures reported by the extension workers seem to be over-stated. See Table 77: Number of farmers who visit you in a month.

Table 77: Number of farmers who visit you in a month

Number of visits	Frequency	Percent	Cumulative Percent
Less than 10	7	10.6	10.6
11 – 50	34	51.5	62.1
51 – 100	17	25.8	87.9
101 – 150	5	7.6	95.5
Above 150	3	4.5	100.0
Total	66	100.0	

How many citrus growers frequently visit you? Number of citrus growers who visit an extension worker frequently ranged between 2 to 75, with average number of around 15. More than 60 percent

of the respondents reported that only upto 10 farmers visit them frequently (Table 78: How many growers you visit most frequently?). The growers who visit the extension workers frequently are more likely to have demonstrated benefits of the technical advices, they sought. Thousands of farmers fall in the domain of each extension worker. The number of farmers who visit the extension workers frequently seems very small.

Table 78: How many growers you visit most frequently?

Number of farmer	Frequency	Percent	Cumulative Percent
Upto 10	41	62.1	62.1
11 – 20	12	18.2	80.3
21 – 30	4	6.1	86.4
31 – 40	6	9.1	95.5
Above 40	3	4.5	100.0
Total	66	100.0	

Question is why citrus growers visit the Extension Workers? They identified six reasons why farmers visit them. They are listed below, in order, along with number of votes of the Extension Workers given in parentheses:

1. Control of diseases and insects i.e. plant protection measures (20)
2. Orchard management (14)
3. Citrus production technology (4)
4. Nutrients management (4)
5. Irrigation management (3)
6. Selection of rootstock and scions (1)

How many growers you visit at their farms each month? Number of growers visited each month by each extension worker ranged from 10 to 550, with average of 131 (SD = 152.713). Around half (47 percent) of the extension workers informed that each month they visit upto 50 citrus growers (Table 79: How many growers you visit at their farms each month?)

Table 79: How many growers you visit at their farms each month?

Number of growers	Frequency	Percent	Cumulative Percent
Upto 50	31	47.0	47.0
51 – 100	13	19.7	66.7
101 – 200	10	15.2	81.8
201 – 400	10	15.2	97.0
Above 400	2	3.0	100.0
Total	66	100.0	

11.4 Do the farmers act upon the advice of the Extension Workers?

A vast majority (97 percent) of the Extension Workers reported that farmers generally cooperate with them, while only 3 percent held a different view point. See Table 80: Do the farmers cooperate with you? They indicated that farmers never cooperate with them and never pay them due attention.

Table 80: Do the farmers cooperate with you?

	Frequency	Percent	Cumulative Percent
Yes	64	97.0	97.0
No	2	3.0	100.0
Total	66	100.0	

What proportion of the farmers do not act upon your advice? Almost half of the Extension Workers pointed out that proportion of farmers who do not act upon their advice are up to 20 percent. This proportion reported by the Extension Workers ranged from 2 percent 100 percent, with average of around 37 percent farmers (SD = 24.514). Quite a small number (3 percent) of the respondents reported that proportion of such farmers was in excess of 80 percent. See Table 81: What proportion of the farmers do not act upon your advice?

Table 81: What proportion of the farmers do not act upon your advice?

Do not act upon the advice	Frequency	Percent	Cumulative Percent
Upto 20	31	47.0	47.0
21 – 40	12	18.2	65.2
41 – 60	11	16.7	81.8
61 – 80	10	15.2	97.0
Above 80	2	3.0	100.0
Total	66	100.0	

Why do not farmer act upon your advice? The Extension Workers identified 11 reasons. They are listed below, in order, along with number of votes of the Extension Workers given in parentheses:

1. Financial and economical difficulties. They do not have resources which is why they don't act upon the advice in time (55)
2. Non-availability of inputs, especially fertilizer during critical time (6)
3. High prices of inputs. Lack of proper control on the market prices. It is eroding profit (4)
4. Illiteracy (4)
5. Orchard management is difficult so they do not act (3)
6. They are laggard in nature (2). Old traditions inherited from forefathers.
7. Laziness (1)
8. Worsening conditions of market (2)
9. Lack of knowledge and proper training (2)
10. Labour is expensive and is mostly non-available (2)
11. Quality issues of inputs (1)

11.5 Effectiveness of extension services

A significant proportion (70 percent) of the respondents termed the effectiveness of extension services provided by them as high to very high. However, remaining 30 percent showed dissatisfaction with effectiveness of their services. See Table 82: Effectiveness of extension services.

Table 82: Effectiveness of extension services

	Frequency	Percent	Cumulative Percent
Low	5	7.6	7.6
Just okay	15	22.7	30.3
High	31	47.0	77.3
Very High	15	22.7	100.0
Total	66	100.0	

11.6 What is the yield potential of citrus orchards?

Each Extension Workers has a specific territory. In each territory, situation varies with respect to size of farms, soil conditions, water availability, transportation facilities, and core competencies and core rigidities of the citrus growers. So each Extension Worker was asked to indicate highest, lowest, average and potential yield in his territory. Results indicate that highest yield range from 110 to 475 maunds per acre, with mean of 350 maund. Average yield reported by the extension workers range from 100 to 300 mounds with mean of 216 maunds per acre. There is huge difference between maximum potential yield and the current average yield. See Table 83: Descriptive Statistics.

Table 83: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Highest Yield	66	110	475	350.97	70.941
Lowest Yield	66	40	300	138.30	53.658
Average Yield	66	100	300	215.59	63.799
Potential Yield	66	275	650	470.97	86.200

Lower citrus tree density in Pakistan as compared to that in Australia is one of the factors responsible for poor yields in Pakistan (Khurshid, and Baxter, 2006, p. 4).

Yield of citrus in Pakistan is quite low as compared to that in Brazil, USA, and China. Average national yield of citrus in Pakistan is around 90,760 hectogram her hectare, while according to FAO Statistics of 2007 per hectare yield of citrus is 151,652 hectogram in China, 129,950 hectogram in Turkey and 285,714 in USA.

11.7 What are issues and problems responsible for low yield of citrus?

The Extension Workers identified several issues responsible for low yield. They are discussed below, in order:

- **Issues related with inputs:**
- **Financial problem**: Farmers have serious financial constraints. Therefore they are unable to use capital intensive technologies or make timely purchase the inputs. Situation has gotten

worse with the high rate of increase in the price of fertilizer. Management of quality orchards has high financial implications. Around 85 percent of the orchards growers informed that they had no access to any credit line (Table 84: Do you have access to any credit facility?). Zarai Taraqiati Bank Limited (ZTBL) is a major financial institution which offers credit for the farm businesses. Credit limit for one borrower is Rs. one million. Against each acre of mature citrus orchard, credit limit of ZTBL is Rs. 34,000 (ZTBL, 2008). During 2007, ZTBL dished out loans of worth Rs. 6.206 million only to 164 orchard growers (ZTBL, 2008b). It is not clear that out of Rs. 6.206 million, how much proportion was given to the citrus orchards growers. Even this amount is quite small and is just a fraction (0.01 percent) of total loan disbursed (Rs. 56 Billion) in 2007. It clearly indicates the level of priority given by the ZTBL to the orchard growers.

Table 84: Do you have access to any credit facility?

	Frequency	Percent	Cumulative Percent
Yes	26	15.5	15.5
No	142	84.5	100.0
Total	168	100.0	

- **Shortage of fertilizer during critical time:** The dealers are in the habit of hoarding and black marketing during high demand times, in order to boost prices and make abnormal profits. It was reported that sometimes other businessmen (usually known as 'investors', i.e. people who are in some other business but have surplus capital) also buy large quantities of fertilizer and hoard to sell when the prices have rise beyond a certain limit. The farmers therefore are facing problems. Another implication of this phenomenon was adulteration of fertilizer.
- **Imbalance use of fertilizer**: Deficit application of nitrogen and phosphorus negatively impacts the size of fruit and that of potash impacts the colour and the taste of the fruit. Balanced use of fertilizer reduces number of immature fruits falling down. But farmers lack proper training in when, how, how much, and which fertilizer should be used. As a result, the citrus trees most often face malnutrition. Problem is further compounded due to deficiency of nutrients and organic matter. Inadequate application of the phosphorous and potassium related fertilizers is another issue. That is primarily due to lack of knowledge and the high price of the fertilizers.
- **Poor quality of pesticides:** Fruit fly damages the fruits, and citrus canker causes damage to the colour of the fruits. Citrus canker – a bacterial disease which causes necrotic spots on fruits, leaves and stems of citrus fruits, was epidemic initially in Japan, and the phenomenon later spread in South America (Stall & Seymour, 1983, p. 581). Citrus canker originated in Southeast Asia (Stall & Seymour, 1983, p. 583). Farmers lack capacity in diagnosing the disease at proper time, and deciding what to do on timely manners. Pesticide dealers put all efforts in selling pesticides of their own choice to maximize their profit while putting interest of the farmers aside.

- **Issues related with environment and nature**

The respondents identified following issues related with environment and nature:

a. **Brackish water**. Canal water is not available in adequate quantity. Tube well water is used when the canal water is short and there have been no rain. So sub-soil water is used to irrigate the orchards, which is usually brackish, hence creates different problems. Poor water management practices: Inadequate canal water for irrigation. In some cases, water is applied in excess quantity especially in winter season. Ground water is mostly brackish and is not fit for irrigation purpose. Canal water is sometimes not available when needed in the orchards.
b. **Poor quality of soil:** In some cases, soil is having problems like soil salinity and water logging.
c. **Vagaries of weather:** High temperature causes damage to the quality of fruits.

- **Issues related with technology**

The respondents from the Extension Department identified three major problems associated with technology. First is the non-availability of true type citrus plants. Secondly, the nurseries mostly have low yield cultivars. Thirdly, the nurseries, generally, have poor quality nursery plants of citrus, which are infected with diseases etc. Fourthly, non-availability of machinery needed in the orchard management is also a big constraint. All these factors lead to low yield and poor quality of fruits.

- **Issues related with management practices**

The respondents identified several issues related with management of orchards. They are listed below:

a. **Design of the orchards**: Most of the farmers do not pay proper attention to the guidelines while developing layout plans and planting the citrus plants. For example, size of the hole should be 3' x 3' x 3' but this advice is mostly not acted upon. Appropriate distance from plant to plant to not maintained. It is mostly ignored that proper aeration and availability of sufficient quantity of sunshine helps in improving quality of fruits.
b. **Mismanagement of orchard:** Lack of cleanliness and lack of proper pruning and trimming practices are common issues. Weeds are not removed on timely basis.
c. **Intercropping:** Farmers have the tendency to grow multiple crops in the orchard land, and this practice negatively impact the productivity of the orchard.
d. **Lack of knowledge about business**: Orchard management is not treated as a business. Citrus growers lack basic business management skills.
e. **Economies of scale:** Most of the farms are small in size to such an extent that citrus production becomes unviable. Besides, in most of the cases, land is also fragmented which makes it difficult for the farmers to manage.
f. Lack of proper attention paid to the small plants.
g. **Poor marketing practices**: Citrus growers' and/or contractors profitability erodes due to inefficient and ineffective marketing practices. Moreover, post harvest losses are very high. Poor marketing practices of the producers empower the middlemen and others to exploit them. Market distortions lead to low returns to growers, therefore, there remain no incentive for the citrus growers to increasing productivity. Situation is getting worse as cost of production is rising due to rising prices of the inputs. Moreover, market situation remains volatile making growers highly vulnerable to the market risks.

11.8 Suggestions for increasing citrus yield

The respondents from the Extension Department gave following suggestions for improvement in the yield of citrus:

- **Quality of Nursery Plants:**

Quality of nursery plants needs drastic improvement. To bring improvement in this context, all nurseries should be registered with the Extension Department. Secondly, training of the nursery owners and the labour responsible for growing nursery should be arranged.

- **Skill development of growers:**

Farmers field schools specifically for citrus production should be setup in major areas of citrus production regions. The schools should focus on following areas for the capacity building of the farmers:

a. farm management practices
b. nutrients management
c. improved technologies of production management

d. pruning and trimming
e. Insects, pests and diseases management
f. efficient practices of water management
g. Capacity building of the growers, in how to manage their orchards systematically
h. Training in proper record keeping and record management of farm activities

- **Soil Management:**

Extension Department should launch campaigns for the following:

a. Awareness regarding importance of the soil analysis should be created among the growers. Orchards should not be raised in un-suitable land.
b. Proper nutrition, timely provision of fertilizer.
c. Organic fertilizer should be applied
d. Leguminous crops should be grown in the summer season.
e. Soil structure must be improved by different practices and proper management is required
f. Farmers apply organic fertilizer in the month of May or June but the proper time is December.

- **Water Management:**

Department of On Farm Water Management should evolve a strategy for following interventions:

a. Laser leveling technology should be made accessible to all farmers. Use of this technology will not only ensure efficient use of water but will also improve use of the fertilizer application.
b. Fit irrigation water. Proper managed irrigation
c. Adequate availability of irrigation water should be ensured so as to make up the deficiency of water. Ground water test should necessarily be got done before installing tube wells.
d. Most of the tube wells installed under Salinity Control and Reclamation Programme (SCARP) are out of order. They should be repaired.

- **Marketing management:**

Agricultural Marketing Department should build up the capacity of citrus growers and integrate them with the citrus value chain. It should evolve a comprehensive strategy to bring reforms in the agricultural marketing system but improving the quality of roles of various key stakeholders like citrus growers, contractors, middlemen, processing factory owners and exporters.

- **Access to cheaper finances:**

Farmers should be given easier access to cheaper and soft credit. ZTBL should fix yearly targets for loaning to the citrus growers as well. ZTBL should encourage loaning for the purchase of machinery required for orchards management like machinery for: pruning, application of fertilizer and spraying etc.

- **Production Management:**

Following are the suggestions for the improvement in the production management system:

a. **Best Management Practices:** Adoption of best management practices by the farmers should be facilitated.
b. **Economies of scale:** Small growers should be provided with state land on lease so that scale of operations becomes economically feasible or alternatively farmers should be encouraged to form cooperatives in order to meet economies of scale. Legislation is required to discourage land subdivision and fragmentation.
c. **Practice of intercropping** should be discouraged.

d. **Protection from weather**: Small plants should be protected from any injuries and vagaries of weather.
e. **Availability of Fertilizer** at market price should be ensured at the application time in the season.
f. **Establishment of labs** for biological control on commercial scale.

11.9 What are issues and problems responsible for low quality of citrus?

The respondents identified several issues and problems responsible for low quality of citrus. They are listed below, in order of weight assigned by the respondents:

a. Poor Plant Protection Management Practices (PPMPs):
   - Insect pest attack at fruit set, fungal attack,
   - improper plant protection measures.
   - Blind application of pesticides
b. Poor fertility management practices:
   - Untimely and unbalanced fertilization.
   - Deficiency of phosphorus, potash and micro nutrients in the soil
c. No proper pruning
d. Shortage of canal water and unfit underground water
e. Improper rootstock & scion: There are lots of problems with nurseries as well. Quality of nursery plants is poor. Plants obtained from the nurseries are generally not healthy and disease free. Available root stock and scions are generally of inferior quality. Seed is not treated with chemicals before sowing.
f. Intercropping
g. Lack of knowledge for looking after fruits trees after bearing of fruits
h. Traditional method of Kinnow picking/ non-availability of trained labour.
i. Improper time of picking
j. Poor picking technologies
k. Improper grading, packing practices

11.10 Suggestion for improvement in quality of Kinnow

What is needed to improve quality of Kinnow and what should be done is briefly stated below:

- **What is needed?**

The respondents identified following areas for improvement in quality of citrus fruits:

1. **Taste:** Should be sweet and good in taste. Good nursery plants (1)
2. **Size of the fruit:** Size should be standardized. Uniform. Good nursery plants (5)
3. **Colour:** Colour should be orange / reddish yellow, shining colour. Should be attractive. Good nursery plants (6)
4. **Skin:**
   a. Skin should be clean, free from any mark and oily. (4)
   b. Skin should be thin. (2)
5. **Shape of fruit**: Good looking shape. It should be round. Good nursery plants (1)
6. **It should be juicy**:
7. **Weight**: The citrus fruit should be of appropriate weight (1)
8. **Hardness**: The fruit should be hard enough that it is not depressed when packed.
9. **Disease free fruit:** Free of diseases like citrus Canker or Malanose and Scabe. greening. Free from symptoms of disease and pest attack. Free of insect attack and

free of soothe mold. Should be free from fruit fly. Good nursery plants. Insects should be controlled in time. (5)

- **How to do all of above?**

The respondents suggested following measures to make advancements on the above areas:

1. Timely and regular cleaning in the orchards
2. Timely trimming and pruning, proper cutting
3. **Nursery plants**: Good nursery plants (diseases free and true type plant). Only certified nurseries of Kinnow may be allowed to operate. The government should set up nursery stations to provide good quality nursery plant of citrus to the farmers.
4. **Plant Protection Measures:** Insects (especially the fruit fly) and diseases (citrus canker) should be controlled in time. This would require market intervention by the government agencies to ensure that pesticides are available in the market as and when needed in the orchards. Use of Integrated Pest Management (IPM) practices should be promoted. Training of the growers in how to look after the orchards, apply cultural and biological controls etc.
5. **Soil management: Fertilizers** (especially the phosphorous and potash) and micro-nutrients should be applied at proper time and in balanced amount. This requires availability of the fertilizers in the market during critical time.
6. **People management** skills should be developed
7. **Good orchard management techniques**
8. **Irrigation** should be applied at proper time and in proper amount. At least during critical period of times, the availability of canal water must be ensured.
9. **Capacity building of farmers:** The farmers/citrus growers should be imparted training in orchard management, fertilizer and pesticides application, use of micro-nutrients, management of water, latest technologies related to citrus production etc.
10. **Training of the labour** in the following areas:
    a. Orchard management
    b. Application of water, fertilizers, and pesticides
    c. Application of cultural and biological practices
    d. Pruning and trimming
    e. Picking of fruits
    f. Grading of fruits
    g. Packing of fruits
11. **Communication gap between the growers and the citrus exporters should be bridged.**
12. **Proper pre-harvest and post-harvest handling of citrus fruits:** The fruit should be protected from injuries and damages during pre-harvest and post-harvest operations. It should be properly packed.
13. **Capita**l should be provided to the growers at soft terms and conditions

11.11 Problems and issues of Extension Department

The respondents from the Extension Department identified following issues and problems of their department:

1. Lack of facilities for training like multi-media projector and other audio visual aids, charts, markers, stationery, pictures of insects, insect zoo etc.
2. Inadequate budget
3. Shortage of staff: Several positions are lying vacant in the extension department. Eventually, the coverage area for each extension agent is very large and is unmanageable. So the staff remains over burdened.
4. Some of the extension workers have been hired on contract basis, they do not have security of job, so their frustration is rising. Moreover, project allowance is not available to the staff.
5. Lack of transport facilities for movement of the extension staff to the field. In case transport is available, the, there is problem of inadequate availability of POL. Besides, there are no

incentives for the field staff to visit the farmers. Salaries are low and budget available for the TA/DA is very limited.
6. When extension staff visits the field, it is not necessary, that the farmers are available or have time to meet with them.
7. Most of the times, farmers do not act upon advises of the extension staff. It indicates lack of confidence of the farmers in the government extension staff or the inability of the farmer to act upon the advice due to lack of resources.
8. Inefficiency in social mobilization techniques and skills.

11.12 Suggestion for improvement in performance of the extension services

The respondents suggested following measures to bring improvement in the efficiency and effectiveness of the extension services available for the citrus growers:

a. Provision of facilities to the extension staff
   - Mobility, transport, TA/DA
   - Training equipment and necessary items
   - Trainings: Capacity building, Refresher courses and social mobilization skills.
   - Mechanism to provide timely solutions to critical problems raised during the crop season by farmers
   - Funds to make arrangements for the training of the farmers
   - Provision of literature and other learning material for the extension staff.
   - Establishment of libraries.

b. Career development for the extension staff:
   - Regularization of staff
   - Opportunities for improving education
   - Refresher courses before the beginning of each season.
   - Field visits to other countries and regions

c. Appropriate compensation and rewards:
   - Attractive salary packages for staff
   - Appropriate performance targets related to % increase in production and quality of produce rather than simple increase in the plantation area or increase in the number of plants in the area.

d. Provision of sub offices in the field should also be there.
e. Targets should be more realistic
f. Human resource management
   - Extension department should be strengthened with competent professionals. Vacant positions of the extension department should be filled on urgent basis.
g. Mobile phones should be provided to the extension staff so that farmers can access them as and when needed.
h. Organization of the fairs for Kinnow should be regularly organized. Competition of quality Kinnow should be arranged, and winners should be given awards so as to promote the culture of quality.
i. Extension field staff should be empowered to monitor quality of fertilizer and pesticides.

12. Institutional Linkages

Farming system has five types of institutions i.e. farms, extension department, research and development centres, educational institutions and other supporting institutions like banks, and export promotion agencies (Figure 7: Farming system). These all five institutions need to have strong integration with each other. However, in reality, there are institutional gaps, eventually, initiatives taken by the government for improvement in the farming system have not been able to yield any big breakthrough.

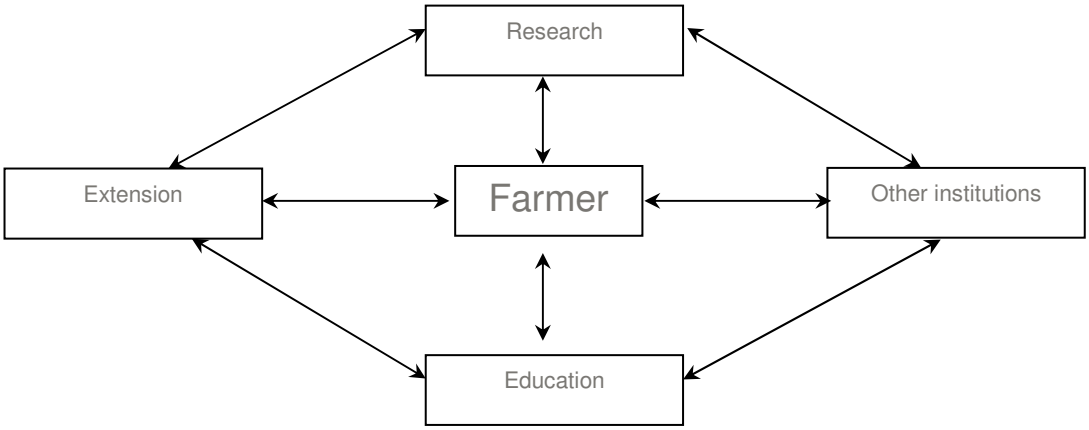

Figure 7: Farming system

Currently, there are week linkages of farmers with all other institutions. The citrus growers are poorly organized. Only 38 percent of the respondents from the citrus growers reported to have membership of any related organization. Out of which 31 percent were associated with FFS and about 7 percent with PMO. Only less than one percent of the sampled citrus growers had membership of both groups (Table 85: Type of Membership).

Table 85: Type of Membership

Type of Membership	Frequency	Percent	Cumulative Percent
Farmers Field School	52	31.0	31.0
PMO (GLOBAL GAP)	11	6.5	37.5
Both	1	.6	38.1
No membership	104	61.9	100.0
Total	168	100.0	

In Sargodha district it was reported that there are 172 citrus processing factories, out of which only six are HACCP certified, 22 have been audited, six are at the application phase and five have been ISO 22000 certified.

There is relatively better integration between research and academic institutions, though substantial potential exists for improvement. There are weak linkages between extension and research and between extension and academic institutions.

Previous Chapter extensively discusses the services and effectiveness of the existing extension system. Discussions lead to the conclusion that owing to lack of accountability, extension system remains weakly integrated with farms, and hence remain ineffective.

There are some newly created institutions, which aim at the development of horticulrure sector. Pakistan Horticulture Development and Export Board (PHDEB) and Agribusiness Support Fund (ASF) are two of such institutions. ASF is a public sector company set up under section 42 of the Companies Ordinance 1984. Produce Marketing Organizations (PMOs) and farms are being supported by the ASF for GlobalGap certification. Under the arrangements, participating PMO has to bear 50 percent of the cost of certification, while remaining 50 percent is borne by ASF. The said certification is a pre-requisite for the export of fresh fruits including Kinnow to European countries.

PHDEB has been established to promote the export of fruits and vegetables from Pakistan. One of the objectives of the PHDEB is to impart new technologies and techniques to growers and processors. Another objective of the Board is to develop linkages and networking with relevant institutions i.e. R&D, banks, training/HRD, joint venture arrangements/commercial linkages with international companies, technology transfer, sub-contracting.

How to develop integration among all these institution? ICT can be used as an effective instrument in developing and strengthening integration among various institutions related with farming systems. The Chapter 15 discusses in details how ICT can be employed to achieve the objective of integration.

13. Export of Citrus from Pakistan

13.1 Situation of Kinnow export

Export of fruits and vegetables from Pakistan is very small. However, statistics of last two years indicate that export of fruits and vegetables from Pakistan exhibited considerable growth in terms of both quantity and per unit price. Quantity grew by over 20 percent and unit price by about 6 percent. The cumulative impact was 27.32 percent. See Table 86: Export of fruits and vegetables

Table 86: Export of fruits and vegetables

Parameter	2007-08	2006-07	Change (%)
Qty. 000 K.G.	413,726	343,424	20.47
Value (000, US$)	144,676	113,635	27.32
A.U.P. per K.G. (US$)	0.35	0.33	5.68

Market analysis suggests that export of fruits to USA dwindled from US$ 4.4 million in 2006-07 to US$ 2.4 million in 2007-08. In UAE market, it increased from US$ 13.6 million to US$ 21.6 million during the respective period.

During 2007-08, Kinnow remained leading export earner among the fruits. Pakistan exported Kinnow of worth US$ around 53 million during the referenced period. Kinnow has great potential for growth in its exports, which is evident from the latest available statistics. During 2007-08, earnings from the export of Kinnow increased by about 62 percent over previous year (TDAP, 2008). During the same year, with the opening of free trade with China, export of fruits Pakistan to China increased manifold from mere US$ 43,000 in 2006-07 to US$ 549,000 in 2007-08 (TDAP, 2008).

Export of Kinnow to Central Asian States (CASs) has also begun through Afghanistan. Respondents (exporters) revealed that there are some parties operating in Afghanistan which import Kinnow from Pakistan and then re-export to the CASs. Pakistani commercial counselors stationed in CASs need to workout strategy to integrate Pakistani Kinnow exporters with the Kinnow importers in their respective countries.

Moreover, METRO Group Buying International (MGBI) and METRO Cash & Carry Pakistan have also initiated a programme for exporting Pakistani Kinnow to eight countries including China, Belgium , Germany, Poland, The Netherlands, Ukraine and Russia (FreshPlaza, 2008).

13.2 Potential for the export of Kinnow

Only 4 percent of total citrus production of the country is exported and around 40 percent of the total citrus production is wasted (Ali, 2004, p. 251). It means reduction in losses from 40 percent to 30 percent would lead to increase in market surplus for export by 250 percent.

Growth in export of Kinnow depends upon several factors. Export price is the most important factor. Haleem, Mushtaq, Abbas, and Sheikh (2005) have estimated exports 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. It implies that there exists substantial potential for growth in the export through improvement in quality etc.

Exchange rate of Pak Rupee is another factor which impacts the export. Haleem, Mushtaq, Abbas, and Sheikh (2005) estimated exchange rate elasticity to be 1.31. So the current depreciation of Pakistani Rupee from Rs. 60 = 1, to Rs. 80 is likely to have very positive impact on the export of citrus. If the same parameters hold true then it is estimated that this year export of citrus may go up by around 75 percent. But it would depend upon availability of export surplus of the citrus.

Potential can be exploited through diversifying the markets of Kinnow. Traditional markets for the Pakistani Kinnow include Saudi Arabia, UAE, Philippines, Indonesia, Sri Lanka and Afghanistan (ASF, 2007, p. 16). Several opportunities are available. Emerging leading markets for the Pakistani Kinnow include Russian Federation and Iran (ASF, 2008). Non-traditional markets need to be focused more. In this context, commercial counselors stationed in Central Asian States, Europe, and Far East need to develop strategy for the promotion of Kinnow in their countries and integrating Pakistani exporters with their markets.

USA is the biggest market for citrus fruits. Citrus is on the top of list in term of per capita consumption of various fruits in USA (Boriss, 2006). This market needs to be explored by Pakistani Kinnow exporters.

13.3 Processing Industry

USA and the Brazil are the largest citrus processing countries in the world. Sao Paolo (Brazil) and Florida (USA) account for around 85 percent of the citrus juice produced in the world. Around 99 percent of the citrus juice produced in Brazil is exported (Rodrigo, & Zacarias, 2006, p. 294).

The world market for processed citrus products is undergoing several trends. Pure juices with pulp are replacing the conventional juices. For example, in US market CitraPac has introduced a new product 'CitraBits™' (it is a pure juice and pulp of fresh Florida oranges and grapefruit) to capture the snacking market (Gunner, Langberg, and Wodecki, 2005). Such trends offer great deal of opportunities for Pakistan.

Currently, Pakistan has very small and under-developed citrus processing industry. It is in the stage of infancy. There are around 200 citrus factories in Sargodha District. Exporters/processors operating in Sargodha and Bhalwal and Toba Tek singh were interviewed and their facilities visited. Most of the exporters have 3-4 employees working around the year and about 100-200 employees working during the season, which begins in November and lasts till April. Most of the exporters are growers as well as processors. The processing factories which do not have their own cold storage facility sell their product to other processors who export or sell to the wholesales from Baluchistan and NWFP. These wholesalers export Kinnow to Iran, Afghanistan and the CIS states by road. The processed fresh Kinnow is also sold to buyers from Karachi who supply to the local market and also export.

Processing generally involves operations like washing, drying, waxing, re-drying, grading, packing and labeling. In the processing factories, these processes are done mechanically. Sanitary condition of most of the Kinnow processing factories is not good. Similar findings were also reported by Mahmood and Sheikh (2006).

Now foreign companies are entering in the processing industry of Pakistan. For example, Citropak is a citrus fruit processing unit. It was originally an American company called Kargil which later on sold its operations to its employees. The company is now called Citropak now. They produce products other than citrus pulp as well from the citrus fruit. Fresh Juices Limited is another company which is currently exporting Kinnow pulp. Similarly, Al Rabie Group of Saudi Arabia has expressed interest for investment in the citrus pulp. It indicates that potential exists for attracting foreign investment in the citrus industry in Pakistan.

13.4 Awareness about WTO

WTO and Globalization are going to offer both opportunities and threats for the farmers form the developing countries. Estimated real international prices of fruits and vegetables will increase by 2.8 percent following the complete liberalization of trade (World Bank, 2007, p. 106).

Results of the survey of the exporters reveal that all of them knew something about WTO. On the other hand, Mahmood and Sheikh (2006) have reported that around 80 per cent of the exporters of Kinnow had awareness about Agreement of Agriculture, under WTO. It implies that over time, the awareness relating to WTO has increased among the exporters.

13.5 Quality of Citrus

A majority of the respondents from the exporters (62 percent) rated the quality of available Kinnow in the country as good to excellent, however, a small number of disagreed to such opinion. Almost one third (33 percent) termed it just okay and remaining 4 percent held the view that the quality was poor.

In a survey conducted by Mahmood & Sheikh (2006) exporters gave opinion that quality of Kinnow had gradually deteriorated. Diseases and insect pests were mainly responsible for it. Poor crop management practices (planting, pruning, fertilization, irrigation and spraying) had also contributed towards deterioration of quality and lower value in the international market (Mahmood & Sheikh, 2006).

Table 87: Satisfaction with quality of Kinnow

	Frequency	Percent	Cumulative Percent
Poor	1	4.2	4.2
Average	8	33.3	37.5
Good	10	41.7	79.2
Excellent	5	20.8	100.0
Total	24	100.0	

Most of the importers, especially from the developed countries demand certification in HACCP [Hazard Analysis and Critical Control Points] from the exporters. Objective of the HACCP to provide a mechanism of systematic preventive approach to food and pharmaceutical safety while addressing physical, chemical, and biological hazards (Kinnow, 2008). GlobalGap is one of the bodies which set standards for certification in HACCP. As of December, 2007, GlobalGap had certified 80,000 producers, from 80 countries. India had 1637 certified producers (GLOBALGAP, 2008). Findings of the survey reveal that 75 percent of the surveyed exporters had certification either in HACCP or in GlobalGap or in both. That clearly indicates that quality consciousness among the citrus exporters in Pakistan has improved.

Table 88: Certification

Type ofCertification	Frequency	Percent	Cumulative Percent
HACCP	6	25.0	25.0
Global GAP	1	4.2	29.2
Both	11	45.8	75.0
None	6	25.0	100.0
Total	24	100.0	

Respondents of the survey i.e. exporters highlighted several issues related with quality of Pakistan Kinnow. First issue relates with skin of the fruit. They indicated that skin of Pakistani Kinnow is thick and blemish, while in the international market, citrus fruits with skin which is easily pealable and is free from any mark or spot is preferred. Second issue pertains to the shape of the fruit. They pointed out that shape of the fruit is not round in all cases, eventually, its acceptance in the international market is negatively affected. Third issue identified by the respondents is the deterioration in the quality of fruit before and during shipping. Due to variation in the temperature in the cold storages, and containers, quality of Kinnow is affected. However, some of the respondents also reported that they exported Kinnow to Iran through Chaman, and Central Asian States through Afghanistan in open trucks without affecting the quality.

The respondents pointed that due to quality issues, per unit price earned by Pakistani Kinnow was low. How to deal with issues of quality? Respondents (exporters) were asked to indicate priority to various suggestions aiming at improvement in the quality of Kinnow. Analysis of the data reveals that top three suggestions include improvement in cold storage facilities, improvement in picking practices and improvement in transport facilities (Table 89: Suggestions for improvement in quality of Kinnow).

Table 89: Suggestions for improvement in quality of Kinnow

Suggestion	N	Minimum	Maximum	Mean	Std. Deviation
Cold storage facilities	24	1	5	3.88	1.227
Picking practices	24	2	5	3.83	1.049
Transportation facilities	24	2	5	3.79	0.833
Disease & pest management	24	1	5	3.71	1.367
Post-harvest handling	24	2	5	3.54	1.062
Genetic capabilities	24	1	5	3.29	1.042
Horticultural practices	24	1	4	3.17	1.007

Box 1: Iran could ban Pak Kinnows

By Aftab Maken

ISLAMABAD: Iran has conveyed its concerns with government of Pakistan for banning Kinnow exports, as the exporters with the nexus of a public department responsible for awarding phyto-sanitary certificate are not complying with the agreed procedures for the exports of produce, reliable sources told The News on Thursday.

Pakistan's commercial counsellor in Tehran have written to the concerned ministries to take corrective measures for strict enforcement of MoU and controlling issuance of fake certificates as well as illegal trade by road, said an official of the commerce ministry, but wished not to mention his name over the issue.

The exporters are shipping sub-standard produce by road supported by fake phyto-sanitary certificates, commercial counsellor in Tehran stated in a written complaints to the concerned quarters in Islamabad.

The Plant Protection Ordinance (PPO) of Iran requires cold treatment against the fruit flies. It also required cold treatment at certain degree for ten days prior to the loading of the consignment.

Then it is transported through reefers to the Iranian border at Tuftan. Pakistan Horticulture Development & Export Board (PHDEB) with the consultation of MinFAL has set a target of exporting 225,000 tones Kinnow during the crop season 2008-09, and the main markets of Pakistani fruit would be Russian Federation, Iran and UAE. The exporters reported that about 1.7-1.8 million tones Kinnow crop would be available during the crop season 2008-09.

The Department of Plant Protection (DPP) issued no objection certificates (NoCs) only to the exporters who have grafted to the officials of DPP by bypassing the set criteria for the exports of Kinnow to some destinations particularly to Iran, an exporter alleged when asked for not complying the Iranian PPO. "The DPP officials take graft of Rs100,000 to Rs200,000 for issuing NoCs phyto-sanitary certificate to Kinnow exporters," he added. Contrary to the DPP official obligation to supervise the cold treatment of Kinnow exports by road to Iran, the same exporter, who requested not to be named for obvious reasons, further claimed, "The certificate is issued to those exporters who do not have cold storage facility without proper cold treatment."

They (DPP officials) issued exports certificates against the MoU signed with Iran which allows export only by sea and also DPP official are also lenient inspection thus encouraging the illegal practices, said another exporter. Rejecting all the allegations, Director General DPP, Dr Tasneem Ahmed from Karachi told this correspondent, "There is no reality in exporter's allegation as the department is awarding certificates vigilantly by following the rules and procedures."

Source: The Daily News, Saturday, November 29, 2008

13.6 Training needs of the exporters

Analysis suggests that knowledge of the exporters was low in case of WTO and its agreements, government policies, working of and facilities offered by export promotion agencies, and quality standards (Table 90: Perceived knowledge of exporters in various areas). These are areas where they need training. Moreover, use of IT in various activities like maintaining the record of supplies, procurements and marketing was reported by only 38 percent of the respondents. It reflects the need of training of exporters in the use of IT.

Table 90: Perceived knowledge of exporters in various areas

Knowledge Of	N	Minimum	Maximum	Mean	Std. Deviation
Competitors	23	2	5	3.67	1.065
New markets	23	2	5	3.48	.947
Quality Standards	23	1	5	3.39	1.196
Export promotion agencies	23	1	5	3.39	1.158
Government Policies	23	1	5	3.09	1.041
WTO and its agreements	23	1	5	2.65	.982

14. Issues and Constraints

According to ACIAR (2008), following are the key constraints in the citrus production and marketing in Pakistan:

1. Poor orchard and nursery practices,
2. Unreliable supply of certified seeds and bud wood,
3. Inefficient fruit production and irrigation practices,
4. Inadequate pest and disease management strategies (Gummosis and canker disease),
5. Lack of cultivars and rootstocks,
6. Unavailability of seedless cultivar,
7. Overproduction and post harvest losses
8. Lack of coordination between Research, Education, Extension and Farmers.
9. Lack of cold storage facilities,
10. Dysfunctional research and extension system,
11. Small scale farming,
12. Pre harvest contract system (advance sale to middle men),
13. Disadvantaged growers with lack of knowledge, and
14. Literacy and access to information.

The present study also found most of these problems as discussed in the following sub-sections:

14.1 Issues and challenges in citrus production

The survey has identified several issues and challenges in citrus production, which are discussed below:

- **Risk involved in the citrus production**

Citrus production is a risky venture as its success largely depends upon several exogenous factors like weather, market situation etc. Around half of the respondents termed the citrus orchard management as risky but profitable. See Table 91: Is citrus orchard management a risky venture?

Table 91: Is citrus orchard management a risky venture?

	Frequency	Percent	Cumulative Percent
Risky but profitable	88	52.4	52.4
Risky but unprofitable	7	4.2	56.5
Not risky but profitable	70	41.7	98.2
Not Risky and not profitable	3	1.8	100.0
Total	168	100.0	

Citrus growers identified seven leading problems which include availability of plants, poor quality, orchard management, market research, land ownership, land ownership, relationship with buyers and transportation facilities. Lack of marketing research emerged as top most problem with mean score of 3.17 on a scale of 5 followed by lack of transportation facilities with mean score of 3.14.See Table 92: Major problems of citrus growers. They are of the view that if these problems are addressed, citrus production can be substantially improved.

Table 92: Major problems of citrus growers

Major Problems	N	Minimum	Maximum	Mean	Std. Deviation
Availability of plants	142	1.00	4.00	2.4437	1.16403
Quality	134	1.00	4.00	2.7910	.94252
Orchard management	141	1.00	4.00	2.3050	1.10804
Market research	138	1.00	4.00	3.1739	.89535
Land ownership	114	1.00	4.00	2.5000	1.22835
Relationship with buyers	115	1.00	4.00	2.0348	1.09968
Transportation	130	1.00	4.00	3.1385	.98637

- **Low germination of Kinnow rootstock**

Kinnow in Pakistan has higher transplantation success ratio while low germination ratio of Kinnow rootstock (the actual rootstock in Kinnow is "Rough Lemon"). Nasir, Mohar, Aziz, Ahmad, and Rehman (2006, p. 163) found around 93 percent transplantation success ratio among the rootstock seedlings of Kinnow during the year 2004.

Kinnow rootstock has very low ratio of germination i.e. only 62 percent as compared to 94 percent in case of rough lemon during 2002 in Sargodha (Nasir, Mohar, Aziz, Ahmad, & Rehman, 2006, p. 163). Researchers need to attend this issue and develop cultivars with higher germination ratio.

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- **High Yield Varieties**

As discussed earlier (see section of Yield of Citrus), yield of Kinnow in Pakistan is low as compared to several other countries. Yield can be improved in three ways: 1) by introducing new varieties with higher yield potentials; 2) by improving production practices; and 3) by using these two ways simultaneously. Pakistan needs improved varieties with higher potential of yield and higher quality.

- **Price of fertilizer**

Price of fertilizer has increased manifold in both domestic and international markets, during the recent years. For example, average international market price (FOB) of urea (black sea) increased from mere US$ 79.3 per metric ton in 1999-2000 to US$ 255.8 per metric ton in 2006-07. During the corresponding period, average market price of DAP rose from US$ 153.5 per metric ton to US$ 320.8 per metric ton.

In the domestic market, the prices also rose following the same trends. For example, price of urea increased from Rs. 324 per bag of 50 kg in 1999-2000 to Rs. 527 in 2006-07. Similarly, price of DAP surged from Rs. 632 per bag to Rs. 993 during the afore-said period.

- **Pests and Diseases:**

There are several pests and diseases which are common threats to the citrus farming in Pakistan. Diseases Pests include Aphids, Citrus Leaf Minor, Lemon Butterfly, Citrus Whitefly, Red Scales, and Foot Rot, and diseases are Withertip, and Citrus Canker (Pakissan.com, 2008). Citrus Canker is caused by the bacterium *Xanthomonas compestris. pv. citri* (Burhan, Sahi, & Ahmad, 2007, p. 1867).

Table 93: Ordered Ranking of Citrus Pests in USA

1950	2001
1. Citrus rust mite	1. Citrus rust mite
2. Texas citrus mite	2. California red scale
3. California red scale	3. Florida red scale
4. Purple scale	4. False spider mite
5. Glover scale	5. Citrus black fly
6. Mexican fruit fly	6. Mexican fruit fly
7. Chaff scale	7. Brown soft scale
8. Fire ant	8. Texas leafcutting ant
9. Florida red scale	9. Chaff scale
10. Leaf-footed bug	10. Root weevil
11. Southern green stinkbug	11. Fire ant
12. Melon aphid	12. Texas citrus mite
13. Brown soft scale	13. Citrus leafminer

Source: Anciso and et al (2002, p. 3).

Citrus Psylla is the brown coloured insect. It attacks the leaves and branches which results in substantial reduction in yield. Citrus Leaf Minor also attacks the leaves, turning them curled and deformed. Lemon Butterfly mainly attacks the fresh leaves. Citrus Whitefly attacks the leaves sucks the sap and thus causes damage to quality and loss in yield. Red Scales are sucking type of insects and cause damage to Kinnow and sweet oranges. They are mainly prevalent in the province Punjab and have the capability to survive throughout the year. Foot Rot is a fungus. It attacks the roots of trees to such an extent that tree gradually gets dried.

Withertip is a disease makes the branches and fruits of the affected trees, gradually dry up. And Citrus Canker is a bacterial disease, which cause damage to leaves and the fruits by forming canker (like spots) on the leaves and stems, resulting into loss in quality and reduction in yield.

Losses due to diseases, insects and pests are very high. Researchers and Extension Workers have their roles to play in dealing with this issue.

- **Research Activities**

In order to alleviate poverty and achieve the MDGs, it is an imperative that agricultural research agenda must be broadened from mere cereal crops to horticultural products (Weinberger & Lumpkin, 2005, p. 16). Current R&D facilities are insufficient (Ali, 2004, p. 18) and inefficient in the country. Following are the priority areas which need urgent attention of the researchers:

  - **Development of seedless Kinnow**

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, ud). 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 & 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. 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, u.d).

- **Off-season 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.

- **Organic citrus fruits**

Application of pesticides to the citrus trees erodes competitiveness of the citrus fruits in the international market. One option to deal with such situation is to substitute the pesticides with extracts of *neem.* Panhwar (2005) of the opinion that neem can be used to deal with several insects and pests of citrus like citrus aphid etc. Such intervention will help in transforming the citrus production from convention system to organic system. In this way, competitiveness of Pakistani Kinnow will substantially improve. The researchers need to look into the matter on how to propagate effective use of need in the PPM.

- **Major problems of the Contractors**

Contractors identified seven leading problems which include load shedding of electricity, skilled staff for packing, non-availability of good quality packing material, lack of farm management skills, lack of skills in marketing, lack of information about markets, and lack of negotiation skills.

14.2 Issues and challenges in citrus marketing

Marketing is a core area where more focus is needed. The study has identified following issues and challenges in the citrus marketing in Pakistan:

- **Post-harvest losses**

There are several studies which have highlighted the issue of high post harvest losses in Pakistan. For example, Johnson (2006, p. 2) has estimated that post-harvest losses of citrus fruits in Pakistan are estimated at 40 percent Similarly, according to ACIAR (2008), 35 percent of the total produce of citrus in Pakistan is lost during pre and post harvest stages, and these losses are attributed to poor disease management practices, vagaries of weather, delays in harvest, poor harvesting practices, poor road conditions and cold storage facilities and over supply of the product in some years. Another reason for high post-harvest losses of the Kinnow is its soft skin (Khan, u.).

Researchers need to bring improvement in its skin. Therefore, several research studies, for example, one by Aujla, Abbas, Mahmood, and Saadullah (2007) suggests that more research should be initiated focusing on post-harvest losses.

- **Lack of storage facilities**

There are inadequate cold storage facilities in the country. The exporters and traders usually store the fruit in cold stores available in the vicinity of vegetable markets. Moreover, quality of cold storage facilities is very poor but their rents are high. (Mahmood & Sheikh, 2006)

Total storage facility for all fruits and vegetables in the country is around 0.7 million tones out of which only 0.07 million tones capacity is generally available to the citrus fruits during the peak period (Ali, 2004, p. 279).

- **Non-availability of quality packing**

Lack of quality packing material is another constraint in the value addition. In most cases, Kinnows are packed in the cardboard boxes, which cannot sustain the pressure of weight during transportation, eventually, Kinnow quality is impaired. (Mahmood & Sheikh, 2006)

- **Poor transportation facilities**

The transport related problems include shortage of refrigerated containers, high rent of containers. Drivers of the refrigerated containers used to switch off the refrigeration to reduce the consumption of fuel (diesel), thus affecting the quality of fruit. (Mahmood & Sheikh, 2006).

During the peak season of Kinnow crop production, gap between demand and supply of the refrigerated containers grows enormously, making refrigerated transportation very expensive and a compromise on quality of services. The refrigerated containers are required to maintain a temperature of around 4^{o}C, however, very few refrigerated transport facility providers do maintain such standard. (Mahmood & Sheikh, 2006)

Around two third of the exporters had used refrigerated containers (Mahmood & Sheikh, 2006).

- **Exploitation by the middlemen**

Sharif, Farooq, and Malik (2005) estimated that producer's share in consumer rupee was 35 percent, followed by contractor as 32 percent and retailers as 20 percent. They found the returns to capital (ROC) to be 16 percent for contractors, 82 percent for commission agents, 86 percent for wholesalers, and 164 percent for retailers (p. 690).

14.3 Issues and problems in citrus export

The survey of Kinnow exporters has identified 11 major problems, they are facing (Table 94: Major problems in the export of citrus). "High freight charges" emerged as the top most problem. Freight charges have been rising over time, eroding the competitiveness of exporters from Pakistan. Moreover, deterioration in law and order situation lead to rise in the insurance charges, which further negatively, impacted the competitiveness.

Table 94: Major problems in the export of citrus

Problem in Export	N	Minimum	Maximum	Mean	Std. Deviation
High freight charges of shipping companies	18	1	5	3.50	1.155
High cost of insurance	18	1	5	3.31	1.182
Cost of refrigerated containers	18	1	5	3.31	1.316
Lack of cold storage facility	18	1	5	3.28	1.406
Lack of information about price and market demand	18	1	5	3.25	1.708
Lack of processing capacity	18	1	5	3.22	1.353
Availability of quality produce	18	1	5	3.05	1.026
Quarantines and other laws in foreign countries	18	1	4	3.00	.953
Lack of skilled staff at factory	18	1	5	2.88	1.219
Lack of information about price and market demand	18	1	5	2.80	1.265
Shortage of refrigerated containers	18	1	5	2.60	1.298

- **Role of facilitating institutions**

In several countries specialized institutions have played an instrumental role in the development of citrus industry. For example, Citrus Board of South Australia (CBSA) has played an instrumental role in the development of citrus industry in Australia (CBSA, 2001). Institutions like PHDEB and ABF need to put more efforts in the development of linkages along the citrus value chain and in the development of the sector.

- **Taste and preferences in the World Market**

Share of oranges, and Grapefruit & Pomelos in global production of citrus dwindled from 67 percent and 7 percent, respectively, in 1980 to 59 percent and 4 percent in 2004. on the other hand, share of easy peelers, lemons & limes, and other citrus increased from 14 percent, 8 percent and 4 percent, respectively, in 1980 to 21 percent, 11 percent and 5 percent in 2004 (Government of South Australia, 2005, p. 11).

Kinnow is regarded as B grade citrus (due to too many seeds) for European markets and the boxes that are sent are labelled as 'B grade Citrus'. Therefore it is not possible to get higher prices. Only Germany imports 350,000 Tons of citrus/annum which is more or less equal to the total exports of citrus from Pakistan. However, Pakistan is unable to access higher paying markets due to low quality of its Kinnow.

Kinnow is being replaced by other easy peelers e.g. seedless Tangerines from China, seedless orange from China and seeded Mandarins also from China.

The Kinnow juice is reddish in color therefore only limited quantity is used as a blending ingredient in orange juice.

15. Role of ICT in the Development of Citrus Value Chain

ICT offers several opportunities for the citrus production and marketing management. India and West Africa have made major advancements towards linking the farmers with markets through IT. During 2000-2007, the agribusiness division of ITC Ltd. established 6,400 Internet kiosks (named as e-Choupals) in 38,000 villages of nine Indian states to link 4 million farmers with the markets. The e-Choupal acts a purchase point of ITC Ltd., for 13 agricultural commodities (World Bank, 2007, p. 121).

Following sections presents survey findings related with infrastructure of IT, identify potential for the use of ICT in the citrus value chain, and suggests a framework for the use of ICT in the development of citrus value chain.

15.1 Current Infrastructure of ICT

What is current status of the Information Communication Technologies (ICT) infrastructure in the citrus production system is discussed below:

- **Citrus Growers**

ICT plays an important role in catalyzing the process of adoption, diffusion and innovation among the citrus growers. In this respect, necessary infrastructure was studies:

The infrastructure for ICTs is well developed in the city. The landline phone, all the wireless local loop service providers and the six mobile service providers are covering the district.

There is a fairly well developed IT market in the city housed in the Trust Plaza Sargodha. There are about 70-75 shops in the market which sell new and second hand imported branded hardware. About 50% of these shops also provide repair services. There are about 4-5 outlets providing additional services like setting up networks etc. The customers at this market range from home users to schools, government offices and the various armed forces' offices.

The same market houses about 70-80 mobile phone retailers. These sell not only the mobile phone handsets but also serve as outlets for mobile phone services.

- **Electrification**

Only 13 percent of the respondents reported that their farms had the facility of electricity. However, 97 percent of the respondents had this facility at their homes. See Table 95: Do you electricity at the orchard and at home?

Table 96: Do you electricity at the orchard and at home?

		Electricity at orchard		Electricity at home	
		Frequency	Percent	Frequency	Percent
Valid	Yes	22	13.1	163	97.0
	No	146	86.9	5	3.0
	Total	168	100.0	168	100.0

- **Television**

Only 5 percent of the respondents reported that they did not have TV at their homes. However, out of remaining 163 respondents, 81 percent had access to PTV (Pakistan Television, a terrestrial channel of Pakistan Government) only while remaining 19 percent had access to cable TV i.e. several (60-70 channels on the average inclusive of local and international channels) satellite TV channels. See Table 97: Do you have access to TV?

Table 97: Do you have access to TV?

	Frequency	Percent	Cumulative Percent
Cable TV	31	19.0	19.0
PTV	132	81.0	100.0
Total	163	100.0	

Just over 4 percent of the respondents reported that they watch programmes on farming only. However, on an overall basis, more than half (51.2 percent) of the respondents reported to watch programmes on agriculture. It is surprising to note that less than 7 percent of the respondents reported to have approached the extension workers for any assistance and almost half of them showed dissatisfaction on the outcome of advice. See Table 97: What type of programmes do you watch most on TV ? On the other hand, fairly a large number of respondents have reported to have benefited from the TV programmes on farming. As discussed in earlier sections, TV has not been rated as most important source of information for citrus orchards management. These conflicting findings are due to the fact that time given by the TV programmes to the citrus orchards management is quite small. The discussion leads to the conclusion that no doubt TV can play an important role in the dissemination of information relating citrus orchards development, but currently it is not being used to its optimal level.

Table 98: What type of programmes do you watch most on TV ?

	Programmes	Frequency	Percent	Cumulative Percent
	None	27	16.1	16.1
A	Plays	4	2.4	18.5
B	News	30	17.9	36.3
C	Agriculture	7	4.2	40.5
D	Talk shows	1	.6	41.1
E	Movies	0	0	41.1
F	Cartoons	0	0	41.1
G	Business related programs	0	0	41.1
H	Songs	0	0	41.1
I	B & C	33	19.6	60.7
J	B & D	7	4.2	64.9
K	A & B	5	3.0	67.9
L	A B & H	8	4.8	72.6
M	B C & G	5	3.0	75.6
N	B C & D	14	8.3	83.9
O	A B C D & H	27	16.1	100.0
	Total	168	100.0	

- **Radio**

Only one third of the respondents reported that they listen to various programmes on radio including programme on farming (Table 99: Do you listen to radio?). It indicates that though popularity of radio has dwindled over time, however, still a significant proportion of people associated with farming benefit from radio. Radio programming needs to be improved on farming in general and on orchards management in particular.

Table 99: Do you listen to radio?

	Frequency	Percent	Cumulative Percent
Yes	58	34.5	34.5
No	110	65.5	100.0
Total	168	100.0	

- **Telephone**

Around 45 percent of the respondents were reportedly not having any landline telephone. However, use of Internet was quite insignificant. Only 3 percent of the respondents informed that they were using land lines for using the internet facility (Table 99: What do you use your land line phone for?).

Table 100: What do you use your land line phone for?

Use of Land Line Phone	Frequency	Percent	Cumulative Percent
Valid No	75	44.6	44.6
Only Telephone	88	52.4	97.0
Tel & Internet	5	3.0	100.0
Total	168	100.0	

Around 14 percent of the respondents reported that they had a computer at their home. See Table 101: Availability of computer.

Table 101: Availability of computer

PC available at	Frequency	Percent	Cumulative Percent
Not Available	145	86.3	86.3
Village House	17	10.1	96.4
City House	3	1.8	98.2
At both Houses	3	1.8	100.0
Total	168	100.0	

Around 70 percent of the respondents reported to use mobile phone. See Table 102: Which Mobile Phone Service do you use? It was reported by most of the respondents that mobile phones had facilitated them in getting advices or information on citrus production and marketing from various sources.

Table 102: Which Mobile Phone Service do you use?

	Frequency	Percent	Cumulative Percent
NA	52	31.0	31.0
U phone	3	1.8	32.7
JAZZ (Mobilink)	57	33.9	66.7
Warid	5	3.0	69.6
Telenor	51	30.4	100.0
Total	168	100.0	

- **Contractors**

What kind of ICT skills and infrastructure are available with contractors are stated in following sub-sections:

- **Computer literacy and use of internet**

None of the respondents was computer literate. None of the reporting firm had any email address or any website for the purpose of publicity and marketing.

- **Electronic devices**

All of the respondents reported having devices like TV and Mobile Phones. However, none of the respondents had internet connection while 75 percent of them had land phones. Almost 50 percent had access to cable TV. Only 10 percent had computers. Only 20 percent of the respondents reported to have radio.

- **Exporters / processors**

Around 42 percent of the respondents (exporters) did not have any computer in their offices, which clearly indicates the current level of the use of Information Technology (IT) in the export firms (Table 103: Availability of computers). Moreover, 46 percent of the respondents did not have access to the facility of Internet.

It implies that a large proportion of the exporters are using traditional methods of marketing (exploring new markets, contacting with buyers etc).

Table 103: Availability of computers

Availability of Computers	Frequency	Percent	Cumulative Percent
Not Available	10	41.7	41.7
One computer	2	8.3	50.0
2-3 computers	6	25.0	75.0
4-5 computers	5	20.8	95.8
Above 5 computers	1	4.2	100.0
Total	24	100.0	

Use of IT in maintaining the record of supplies, procurements and marketing was reported by only 38 percent of the respondents (Table 103: Use of IT in maintaining the supplies/procurements and marketing). Only 8.3 percent respondents reported that they were using their IT system for any other purpose like process tracking etc. It reflects the potential for the use of IT.

Table 104: Use of IT in maintaining the supplies/procurements and marketing

Use of IT based programmes	Frequency	Percent	Cumulative Percent
Not Used	15	62.5	62.5
Yes	9	37.5	100.0
Total	24	100.0	

Website is an important tool for marketing these days. Survey results reveal that only 46 percent of the Kinnow export firms had their websites. It implies that there exists substantial potential for the improvement in the export marketing practices. It is suggested that the PHDEB should assist the exporters in developing and launching their own websites.

Table 105: Do you have website of your company?

Do you have a website	Frequency	Percent	Cumulative Percent
Yes	11	45.83	45.83
No	13	54.17	100.0
Total	24	100.0	

15.2 Potential for the use of ICT

Traditionally the approach for agriculture helplines has been used to provide information to the farmers (one stake holder) on farm production related issues, primarily on disease/pest, soil issues or on other issues related to production. This approach has been observed to have the following shortcomings:

a. Farmers also need information on government policies, inputs, trade, and ways of value addition etc. But existing helpline/extension facilities are designed to provider only production related information and do not offer information about other levels of the chain
b. Coverage of all crops by a single helpline requires a huge backup support of experts. Since dedicated experts are not available, the response time increases to unproductive levels.

There are success stories around the world. For example, in India, the Ministry of Agriculture has created AgMark Net, which collects information on prices of agricultural commodities from the wholesale markets of India and disseminate it through Internet (World Bank, 2007, p. 119). Similarly, in West Africa, TradeNet has been set up under public private partnership, which facilitates establishment of connection between sellers and buyers on the Internet and through cell phones (World Bank, 2007, p. 120). Several other countries like Kenya, Mozambique and Senegal are using mix of technologies like Internet, short message service (SMS), voice mail, radio and market chalkboards (World Bank, 2007, p. 120).

15.3 Suggested ICT Framework for Citrus Value Chain

ICT can be used as an instrument in bringing improvement in the citrus value chain in general and the citrus production in particular. It is suggested that a knowledge portal cum help line may be created for this purpose covering the entire value chain.

Extension Department, PHDEB and other related departments may be involved in creating this knowledge portal cum help line. The knowledge portal and the associated helpline will work as a single point of information for citrus production, marketing, processing, all related Government rules, regulations and policies etc.

The farmers and other stakeholders would be able to submit their queries and problems through telephone and the Internet / email. The answers to which will be given using the same mode of communication which was used to send the query. This single source would be used to answer the stakeholders' queries directly and also to send text and voice based sms to the stakeholders for sending information alerts.

The portal cum help line will be used to not only provide information to the stakeholders, but the queries from the stakeholders will be organized in to FAQ's available on the portal. In this way a knowledge base that can be used directly at the grassroots level by the farmers, extension workers will be built.

It is suggested that the portal also host moderated online discussion forums, targeted at groups like extension workers, processing/export industry etc. These forums will provide a discussion space and an excellent source of capturing local knowledge and also of voluntary diffusion of knowledge by the members to the members. The academic institutions / universities and research institutions will continuously review the queries of farmers and online forums and will align their research agenda with contemporary issues and problems.

Another knowledge area suggested for the portal is inclusion of best practices in Citrus commodity chain. This could be in the form of short video clips or pictorial manuals. The research output and publications of universities and the research institutions should also be made part of the portal.

16. Conclusion

Findings of the survey reveal that knowledge gaps exist at each transfer point of the Kinnow value chain. Eventually, Kinnow orchards have low productivity, citrus growers earn low returns, volume and value of Kinnow exports are small, and there are lesser number of employment opportunities.

One of the major reason for the knowledge gaps is the lack of integration among the various institutions involved in the farming system i.e. farms, research institutions, extension services, supporting institutions and others. Resultantly, the stakeholders of the citrus production and marketing system do not have quality information available on timely basis.

ICT can play an instrumental role in catalyzing the process of integration among these institutions and help in boosting productivity in both production and marketing system of Kinnow in the country. ICT can help in bridging knowledge gaps of citrus growers in the areas related with production practices like selection of quality rootstock, developing appropriate layout plans, management of soil fertility and pests and diseases, efficient use of water, proper trimming and pruning practices, proper picking, packing, loading and transporting Kinnow. ICT can also help in reducing post-harvest losses through improvement in knowledge and skills of the citrus growers, and contractors. ICT can also facilitate improvement in the citrus production system by providing a mechanism of learning and development and dissemination of information to the extension workers. Besides, ICT would also help the researchers and academicians in tracking the contemporary issues and problems of the citrus production system.

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