Value Chain Strategy of Kinnow in Fazilka District of Punjab

2017 – 18

Under MIDH Project

BY

National Horticultural Research and Development Foundation,

"Bagwani Bhawan", Plot No. 47,

Institutional Area, Pankha Road,Janakpuri, NEW DELHI-110058.

Tele.No:- 011-28524150, 28522211

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Published by: **Dr. P. K. Gupta, Director (Acting)**
National Horticultural Research and Development Foundation
Bagwani Bhawan, Plot No-47, Pankha Road, Institutional Area,
Janakpuri, New Delhi-110058
Phone: 011-28524150,28522211
Telefax: 011-28525129
Email: delhi@nhrdf.com
Website: www.nhrdf.org

Guidance: **Sh. Dinesh Kumar, IAS**
Joint Secretary (MIDH),
Ministry of Agriculture & Farmer Welfare,
Government of India

Complied by: **Dr. P. K. Gupta, Director (Acting)**
Dr. S. K. Singh, Deputy Director (Seed)
Dr. S. K. Tiwari, Sr. Technical Officer, (Horticulture)

Consultant: **Dr. Naveen P Singh,**
Principal Scientist (Agril Econ)
ICAR-NIAP, New Delhi

Coordinator: **Sh. Sudhir Kumar Singh,**
Senior Programmer, NHRDF

Surveyor: Indian Agribusiness Systems Limited, New Delhi.

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It gives us great pleasure to present the report, '*Value chain strategy of Kinnow in Fazilka District of Punjab*" conducted during 2017-18. We extend our heartiest thanks to all the stakeholders involved in providing inputs which have gone into the formulation of this report.

We would also like to thank all stakeholders for the study including officials of Directorate of Horticulture cum Mission Director- State Horticulture Mission, Government of Punjab, MD, Punjab agro Industries corporation, APMC and mandi officials, market intermediaries, Kinnow farmers, Traders and processors across Fazilka and other district of Punjab. Their inputs, feedback and suggestions have been invaluable in crystallizing the value chain strategies and formulating actionable recommendations growth and development of all stakeholders involved in Kinnow ecosystem.

We sincerely hope and believe that the findings and recommendations of this report will help to further the cause of Honorable Prime Minister's vision of doubling farmers' income by 2022 as well as provide relevant insights in dovetailing the recently initiated 'Operation Greens' under the Union Budget 2018-19.

We believe this report will serve as a valuable resource, providing the necessary framework to inform various stakeholders across the Kinnow production and its value chain across the major citrus producing states across the country.

(Dr. P.K Gupta)
Director

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1. Introduction

1.1. Project Background

A detailed study entitled " *Value chain strategy of Kinnow in Fazilka District of Punjab*" was conducted under the aegis of Horticulture Division, Ministry of Agriculture and Farmers Welfare; Department of Agriculture, Cooperation & Farmers Welfare and The National Horticultural Research and Development Foundation (NHRDF), New Delhi.

1.2. About National Horticultural Research & Development Foundation (NHRDF)

The National Horticultural Research and Development Foundation (NHRDF) was established by National Agricultural Co-operative Marketing Federation of India Ltd. (NAFED) and its associate shippers on 3rd November 1977 under Societies Registration Act, at New Delhi. The aim is to guide the farmers, exporters, and others concerned for improving the productivity and quality of horticultural crops to make available sufficient quantity for the domestic requirement and also to boost up the export of onion and other such export-oriented horticultural crops in the country. NHRDF is also a National Level Agency (NLA) under Mission for Integrated Development of Horticulture (MIDH) and National Vegetable Initiative for Urban Cluster, of Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers' Welfare, Government of India, New Delhi. The NHRDF provides services to the farmers through research and developmental activities such as seed production of different crops especially vegetable crops, vermicomposting, and bio-pesticide production and its distribution and laboratory services. Through these services, some revenue is generated to build up a revolving fund for further expansion of research and development activity by NHRDF. The research and development programmes initially started on onion and garlic were included in the mandate crops. Given the vast export potential, the NHRDF has also extended its R&D programmes on some other export-oriented vegetable crops like okra, French bean, chilli, capsicum, drumstick, tomato, bitter gourd, etc.

1.2.1 NHRDF Mandate

- Undertaking / conducting research or providing facilities in research and scientific investigations for the growth and development of varieties of different export-oriented horticultural crops.
- Establishment of institutes, laboratories, research centers, model farms, and study teams for promoting better quality and higher yield of horticultural produce. Better packaging, suitable transportation, and shipping to improve the shelf life of the horticultural produce and conducting experiments and providing funds for the related research work was undertaken. Also

aims to educate farmers and disseminate technical know-how and results derived by conducting training programmes, seminars, farmers' meets, etc.

- Investigating and conducting research experiments for assessing demands of the horticultural produce of the Indian origin in foreign countries through an extensive survey and undertake research and development of horticultural produce with export potential. Also to motivate farmers to grow such varieties of horticultural produce with the object of further developing horticultural exports from India
- Preparation, editing, printing, publishing and circulating books, research papers and periodicals bearing upon the growth and development of horticultural produce or other scientific and research activities connected in addition to that, and to establish and maintain collections, libraries, statistics, scientific data and other information relating to it.
- Conducting all aspects of scientific research and developmental activities in the field of horticulture or otherwise conducive to the objectives of the NHRDF provided, however, that none of the activities of NHRDF will be undertaken for profit nor shall it involve any profit motive. Provided, however, that the NHRDF may receive nominal service charges, wherever found necessary in the interest of maintaining the financial stability of the NHRDF
- The NHRDF shall provide extended services to the farmers in the form of research and developmental activities such as seed development, vermicomposting, bio-pesticide production and distribution and other laboratory services. NHRDF may collect revenue from the farmers to establish a revolving fund or credit to corpus fund for further expansion of research and developmental activities

1.3. Objectives

The specific objectives of the study are as follows:

Objectives

1. To study the on farm, nonfarm and logistics or marketing constraints in kinnow production and marketing in Fazilka district of Punjab
2. To study the current state of kinnow supply chain in Fazilka district of Punjab
3. To analyze the cost of production and margin distribution amongst stakeholder in kinnow value chain
4. To ascertain the losses or wastages from harvest to consumption in kinnow cultivation
5. To study factors influencing the prices of kinnow in the region and,
6. To suggest strategies or policy recommendation for the growth of kinnow in the Punjab region.

2 Background

Under the changing agricultural scenario, horticulture sector plays a vital role in providing a secure livelihood to the farmers. Horticulture sector has emerged a vital source of creating employment and improving the income of the farmers. Mandarin orange is the most cultivated citrus fruit in China, tropical Asia, India, Japan, the Mediterranean, and in Florida in the United States. In India, citrus fruits rank third in production after banana and mango. Among citrus crops, mandarin orange (kinnow mandarin, Nagpur, Khasi, Darjling) covers the most extensive area followed by sweet orange (Musambi, Pineapple, Blood Red and Jaffa) and Acid lime. Among these, kinnow mandarin bears highest place in production, productivity and juice content and fruit quality. Kinnow fruit is medium, oblate, with flattened base, deep orange-yellow and very juicy have a lot of market potential, (Gungwat et al. 2005)

India is the world's second-largest producer of fruits (57.73 million tons) with its projected value touching 98 Mt by the year 2020-2021 (Banerjee, 2009). The production of mandarin orange in India has reached to over 19 states with 3698.99 tons of production. Among these states, Punjab stands first in terms production with the share of 29.97 percent followed by Madhya Pradesh (27.85%) and Maharashtra (19.36%).Agriculture is the backbone of the economy of the Punjab state as 67 percent of the total workers are directly or indirectly involved in agriculture and allied activities.The share of agriculture and allied sectors in Gross State Domestic Product (GSDP) is still around 21.85 percent in 2012-13 (Khanna, 2011; Anonymous, 2013). After the onset of green revolution in Punjab, wheat and paddy have become significant food grain crops grown in Punjab state. However, during the last few decades, sustainability of agriculture has emerged as a threat, and crop diversification from wheat-rice monoculture to other alternative crops consuming less water has been considered as one of the most relevant solutions to revive the agrarian economy of Punjab.

In this context, the study evaluates prospects of promoting kinnow cultivating in Punjab with following objectives.

- To study the income inequality of kinnow farmers
- To assess the status of kinnow cultivation in the study area
- To study the supply chains and values chains of kinnow
- To study the performance of institutional mechanism in onion marketing

1.1 Indian scenario

India is the second largest producer of fruits and vegetable countries in the world after China. In India, citrus fruits rank third in production after banana and mango (NCCD 2015). Among citrus crops, mandarin orange (kinnow mandarin, Nagpur, Khasi, Darjling) covers the most extensive area followed by sweet orange (Musambi, Pineapple, Blood Red and Jaffa) and Acid lime. Among these, kinnow mandarin bears the highest place in production, productivity, and juice content and fruit quality. In India, kinnow is cultivated primarily in Punjab, Rajasthan, Haryana, Himachal Pradesh, Jammu & Kashmir and Utter Pradesh.

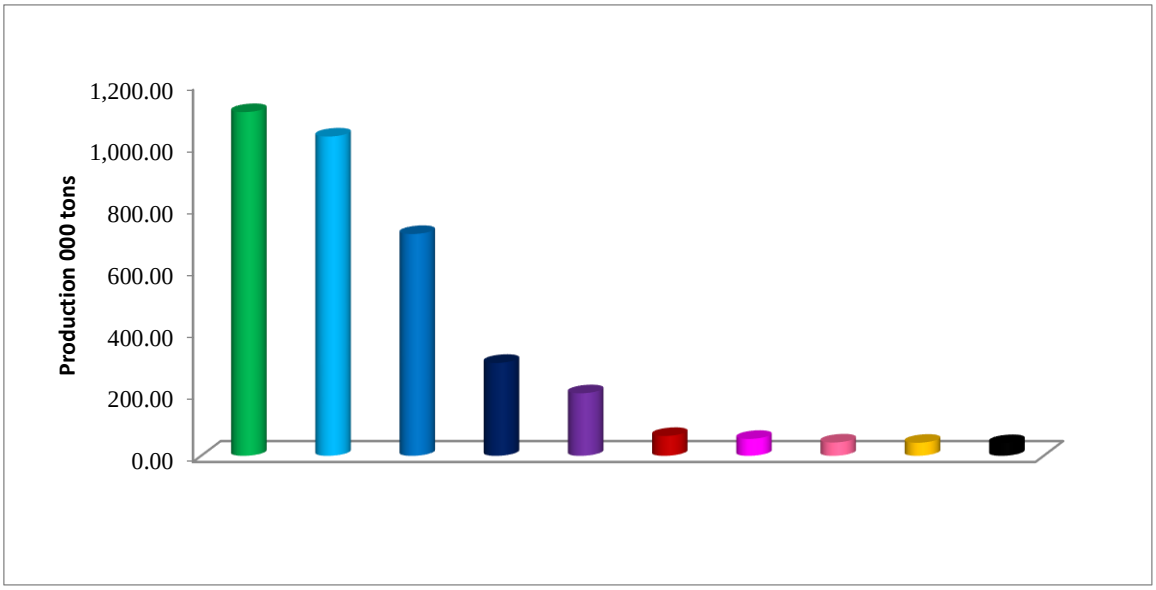
The total mandarin production in India was 3698.99 thousand tons, 29.97 percent of which is produced in Punjab during 2014-15 (Table 1). Thus, Punjab has the first rank in production (2014-15). It is evident from the table 1 and figures one that more than half of mandarin production comes from northern states. Among the southern states, Maharashtra occupies prominent position followed by Karnataka.

Table 1: Production of Mandarin (M. Orange, kinnow, Orange), in India during 2014-15

Sr. No.	State	Production (000 Tons)	Share (%)
1.	Punjab	1,108.62	29.97
2.	Madhya Pradesh	1,030.00	27.85
3.	Maharashtra	716.07	19.36
4.	Rajasthan	300.67	8.13
5.	Assam	202.38	5.47
6.	Karnataka	64.25	1.74
7.	Nagaland	54.8	1.48
8.	Manipur	43.06	1.16
9.	Meghalaya	42.23	1.14
10.	Mizoram	41.2	1.11
11.	West Bengal	39.1	1.06
12.	Tripura	36.52	0.99
13.	Himachal Pradesh	10.96	0.3
14.	Tamil Nadu	4.93	0.13
15.	Jammu & Kashmir	4.01	0.11
16.	Andaman & Nicobar	0.11	0
17.	Kerala	0.06	0
18.	Sikkim	0.02	0
19.	Andhra Pradesh	0	0
	Total	3,698.99	100

Source: National Horticulture Board (NHB)

Figure 1: Top ten states growing Mandarin (M. Orange, kinnow, Orange), Production (2014-15)



1.1.1 Trade potential

India's diverse climate ensures availability of all varieties of fresh fruits and vegetables. It ranks second in fruits and vegetable production in the world, after China. As per the Database published by National Horticulture Board, during 2014-15 India produced 86.602 million metric tons of fruits and 169.478 million metric tons of vegetables. The area under cultivation of fruits stood at 6.110 million hectares while vegetables were cultivated on 9.542 million hectares area. The vast production base offers India tremendous opportunities for export. During 2016-17, India exported fruits and vegetables worth INR 10,369.96 Crores/ 1,552.26 USD Millions which comprised of fruits worth INR 4,448.08 Crores/ 667.51 million USD and vegetables worth INR. 5,921.88 Crores/ 884.75 Million USD. Mangoes, walnuts, grapes, bananas, pomegranates account for larger portion of fruits exported from the country while onions, okra, bitter gourd, green chillies, mushrooms, and potatoes contribute largely to the vegetable export basket. The major destinations for Indian fruits and vegetables are UAE, Bangladesh, Malaysia, Netherland, Sri Lanka, Nepal, UK, Saudi Arabia, Pakistan, and Qatar. Though India's share in the global market is still nearly 1% only, there is increasing acceptance of horticulture produce from the country (http://apeda.gov.in/apedawebsite/six_head_product/FFV.htm). The increase has been due to parallel developments in the areas of state-of-the-art cold chain infrastructure and quality assurance measures. Apart from large investment pumped in by the private sector, the public sector has also taken initiatives, and with APEDA's assistance, several centres for perishable cargoes and integrated post-harvest handling facilities have been set up in the country.

1.1.2 The Processed food products sector in India

The processed food industry is one of the largest in India. It is ranked fifth regarding export, production, and consumption. Over the years, increasing income, changes in our food habits and lifestyles have emerged as drivers of accelerating food processing industry in India. Processed food market accounts for at least 30 percent of the food market (http://apeda.gov.in/apedawebsite/Announcements/Strategy_Paper_Value_Added_Products_IL&FS_Clusters_14915.pdf). Industry sources claimed that the food processing industry would attract investments to the tune of 33 billion US $ spread over ten years and generate a large number of jobs (http://www.ilfsclusters.com/pdf/reprot%205.pdf). The government, on its part, has formulated and implemented several plans and schemes to provide financial assistance, initially to set up food processing units and later to modernize as well. There is excellent support with regard to infrastructure, research and human resource development, in addition to other promotional aspects, to encourage the food processing industry. This value addition in the food processing industry in India is around 20 percent of total food production. The Indian food industry is characterized by the small and unorganized sector that accounts for 75% of the total industry. Despite above facts, the food-processing sector offers attractive business opportunities in the emerging markets like India. India is one of the largest producers of raw material for the food processing industry in the world, though the industry itself is still under development The value addition in the Indian food processing sector is very low as compared to other developed nations; with sector contributing 14% of manufacturing GDP amounting to Rupees 2, 80,000 crores. Of this, the unorganized sector contributes more than 70% of the production regarding volume and 50% regarding value.

The foreign investment has been coming mostly for processing of mushrooms, manufacture of banana paste, fruit pulp, and juice concentrate and in ventures like dehydration of fruits and vegetables and instantaneous freezing of fresh fruits and juice (http://www.ilfsclusters.com/pdf/reprot%205.pdf). The overall exports of agriculture and processed food products have touched US$ 11,023.79 million in the period April-September 2014. The exports of fruits and vegetables, both processed and fresh, have touched US$ 1,153.81 million, while animal products registered US$ 2,570.82 million in exports during the same period of 2014. Overall India shares around 3 percent of the total exports of processed food in the global scenario.

1.1.3 Implication of overall food processing on kinnow

India is the world's 2nd largest producer of fruits and vegetables. Presently 10% of the products in this segment are processed. The expectations are that the processing will grow to 25% by 2025. It is

the highly export-oriented segment as the domestic penetration is low. Domestic demand is expected to grow over the years.

Regarding increasing the income of the farmers processing of kinnow is need of the hour to combat price fluctuation in the market and to minimize the loss. Processing of kinnow would also help in ensuring cheap availability of vitamins particularly Vitamin C and Vitamin A. Government's recent announcement to develop food parks in the major growing center has given a new ray of hope among the small processing firms to compete with large firms through their differentiated products. It will also boost the employment opportunities for youth and reduce the wastage.

As India is among the leading producer of kinnow, there is a need for improvement in food processing infrastructure to harness the benefits from world markets.

Kinnow production in India is highest in winter. In the subsequent summer season there exists a high demand for processed products of kinnow to combat the summer heat. Therefore, due to the recent availability of fruits in immediate past, kinnow processing industry has to incur less cost for cold storage of kinnow and industry can earn a better profit. Increase in industrial profits would lead to diversification of the processed kinnow products and give consumers' choice.

1.2 Punjab-an overview

The plains of Punjab, with their fertile soil and abundant water supply, are naturally suited crop cultivation in India. The state has achieved tremendous growth over the years due to the success of the Green Revolution. For a significant period in the second half of the 20th century, Punjab led the other states of India in achieving self-sufficiency in crop production.

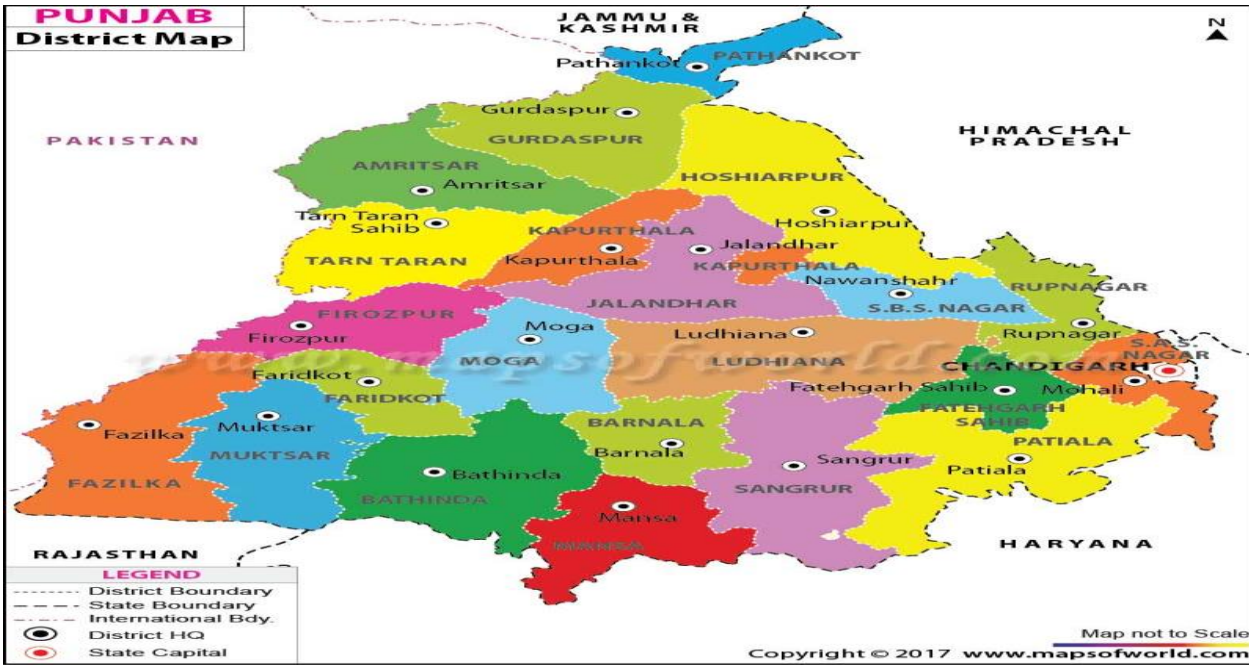
1.2.1 Location

The latitudinal position of the state extends from 29.30^0 N to 32.32^0 N. The longitudinal position of Punjab is between 73.55^0 E to 76.50^0 NE. The total area of Punjab is 50,362 square kilometres which are around 1.54% of the total geographical area of India. Regarding geographical area, Punjab occupies 20^{th} position amongst all the states of India. The agriculture covers almost 82% of the geographical area of the state. Around 5% of the area is covered by forests. Hoshiarpur district has the most extensive forest cover, having almost 34% of the total forests of the state.

1.2.2 Rainfall and climate

The climate of Punjab comes under subtropical semi-arid type. The average annual rainfall in the state is around 500mm (2011-15). The northeast parts of the state, which includes Gurdaspur, Pathankot, Hoshiarpur and Ropar districts, receive the maximum rainfall, with the average rainfall of about 1100mm. Dhar Kalan block in Pathankot district is the wettest part of the state. On the other hand, semi-arid parts in the southwest parts, which includes parts of Fazilka, Firozpur, Mansa and Muktsar districts, receives least the rainfall, the average annual rainfall being around 180 mm. Abohar (Fazilka district) is the driest block in the state. In summers, the temperature during the day remains close to 40-45^0 C. The peak summer season is during the period from mid-May to mid-July. The winters are also harsh in the state. During the peak winter season from mid-December to mid-February, the temperature

Figure 2: Districts map of Punjab



goes down to around zero degree Celsius.

1.2.3 Major land features

Most of Punjab is a fertile plain; toward the south-east one can find semi-arid and desert landscape; a belt of undulating hills extends along the northeast at the foot of the Himalayas. Four rivers, the Ravi, Beas, Sutlej, and Ghaggar flow across the state in a south-west direction. They have numerous small and seasonal tributaries. Also, Punjab is irrigated by an extensive network of the canal system.

1.2.4 Occupation

Farming is the leading occupation in Punjab. The principal crops are wheat, rice, maize (corn), pulses (legumes), sugarcane, and cotton. Among the livestock raised are buffalo and cattle, sheep, goats, and poultry. The principal industries include the manufacture of textiles, sewing machines, sporting goods, starch, fertilizers, bicycles, scientific instruments, electrical goods, and machine tools, and the processing of sugar and pine oil. The state has a number of small, medium and large-scale industrial units. The state contributes 80 percent of wheat and 43 percent of rice to the total national export.

1.2.5 Potential of Horticulture in Punjab

Punjab lies in the north-west corner of the country with subtropical climate having 400-1000 mm annual rainfall concentrated in the months of July-October. Soils are fertile with p^H ranges of 7.5-8.5. Being predominantly an agricultural state and called the granary of India, it is known for quick adoption of new technologies. With shrinking profits in the post green revolution era, the state has recently started shifting slowly to its value segment horticulture with 3.4% and 8.4% (Agriculture Today 2013) of the value of agriculture produce. However, in the liberal regime, stiff global competition in the domestic market has necessitated quality horticulture production at minimal costs. It calls for standardizing latest technologies as per State's agro-climatic conditions and transferring these to farmers' fields for a horticulture revolution. Agriculture continues to be a dominant sector of the economy (Grover 2013) in Punjab; however, due to the predominance of rice-wheat cropping system, the environmental concerns in the state have been escalating, mainly relating to high levels and imbalance among fertilizers, the decline in the water table and loss of land to salinity and waterlogging. It is observed that Punjab state has a tremendous potential for cultivation of fruits especially citrus.

Horticultural crops are being grown in the State in about 2.77 lakh hectares area with an annual production of 51.74 lakh tons (Table 2). The horticulture sector is contributing significantly to GDP in agriculture of the State. Commodity-wise details are given below.

Table 2: Potential of Horticulture in Punjab

Crops	Area ('000ha)	Production ('000mts)
Fruits	71.47	1409.86
Vegetables	178	3674.53
Flowers (Seed Production)	2.04	10.05
Spices & Aromatic crops	18.37	68.21
Flowers (fresh fruit)	7.12	1.29
Total	277.25	5173.64

Source: National Horticulture Mission, Department of Agriculture and Cooperation (DAC), Krishi Bhavan, New Delhi

Among the citrus fruits, kinnow fruit cultivation in Punjab has gained momentum due to its profitability and reasonable market value. Out of the total 67553 hectares under fruit cultivation in the state, kinnow farming is carried out on 38837 hectares, thus, accounting for about 58 percent of the total area under fruits (Anonymous, 2011). Punjab state leads in citrus production among the fruit crops with the most significant production of kinnow. This crop occupies an area of 38837 ha and constituting 64.20% of the total fruit production of Punjab. Kinnow is a hybrid of King mandarin x Willow leaf orange produced by H.B. Frost in 1915, released in 1935 and was introduced by Dr. J.C. Bakhshi at Abohar research station during 1954. It primarily grows in Abohar, Hoshiarpur, Mansa, Muktsar and Bathinda districts.

Table 3: District-wise area, yield & production of kinnow crop during 2014-15 in Punjab

Sr. No	Districts	Area(ha)	Yield(Kg/ha)	Production (M.T.)
1.	Hoshiarpur	6310	22861	144253
2.	Jalandhar	368	19844	7303
3.	Ludhiana	358	18576	6650
4.	Ferozepur	74	21834	1616
5.	Amritsar	427	19150	8177
6.	Gurdaspur	185	18765	3472
7.	Kapurthala	79	18324	1448
8.	Bathinda	3584	20561	73691
9.	Sangrur	149	18218	2714
10.	Patiala	83	19154	1590
11.	Ropar	987	19934	19675
12.	Faridkot	721	22514	16233
13.	Mansa	726	20108	14598
14.	Fatehgarh Sahib	160	19526	3124
15.	Moga	174	20114	3500
16.	Shri Muktsar Sahib	5515	22753	125483
17.	S.B.S Nagar	357	18613	6645
18.	S.A.S Nagar	344	18704	6434
19.	Tarn Taran	120	18606	2233
20.	Fazilka	26926	23608	635669
21.	Pathankot	469	18803	8819
22.	Total	48116	22722	1093327

Source: Department of Horticulture, Punjab

1.3 Need to study

Despite a strong position in the production of agri-commodities, India's contribution in the global food trade is limited to 1.5% (APEDA) which is significantly low as compared to its share in the production. Besides government's sustained efforts to enhance production through a spectrum of

assistance schemes and programmes, implementation of these schemes is to be planned with a strong focus on channelizing the production through the creation of supporting infrastructure and optimizing the value chain that terminates in the domestic and overseas markets for processed food. Some limiting factors afflict Indian fruit export scenario such as:

a. Lack of market-oriented production
b. Inadequate backward linkages
c. Lack of implementation of global food quality and safety management systems
d. Predominance of unorganized sector.
e. Capital intensive nature of the sector
f. Inadequate post-harvest handling and processing infrastructure and low economies of sale
g. The high cost of transportation and low cost of production resulting in the loss of volume and quality of perishables

2. Data and Methodology

2.1 Selection of respondents

Though Punjab is the leading state in kinnow production (*NHB 2015)*, more than 85 percent of the total area under its cultivation is in four districts, namely, Fazilka, Hoshiarpur, Muktsar, and Bathinda. Fazilka district which covers more than half of the total area under kinnow in the state was purposively selected. A sample of 200 kinnow growers was selected randomly. The primary information for the purpose has been collected through primary surveys using pre-structured schedules from growers and other stakeholders. The reference period for the primary data survey was 2016-17.

Fazilka was announced as the 21st district of Punjab by Government of Punjab (India), prior to which it was a part of Firozpur district. It is situated in southwestern Punjab, along with the border with Pakistan, the border is to its west. It has Firozpur to its north, Sri Muktsar Sahib to its east and Rajasthan state to the south. It is about 325 km west of Punjab State Capital Chandigarh, 85 km south-west of the Firozpur and 200 km south of Amritsar. Fazilka is 11 km off the international border with Pakistan.

A random sampling technique is used for data collection. Primary data were obtained through the structured questionnaire to kinnow growers. Percentages, frequencies, and cross-tabulation were used for analyzing the data. Also, we adopted Lorenz curve and Gini coefficient to calculate inequality in income and land distribution among kinnow growers (Ayinde and Muchie 2012). Apart from the primary

survey, secondary data were analyzed to provide insight on kinnow cultivation in Punjab. The methods are detailed below.

2.2 Growth Model

The growth performance of fruit production was influenced by several factors such as the use of physical inputs by farmers, markets, irrigation, credit availability, weather conditions and government policies. It is difficult to analyze the effect of all the variables in a simple framework because these variables affect fruit production through various mechanisms. However, an attempt has been made here to examine the determinants of aggregate growth of fruit production at the national level through the neoclassical growth model (Elumalai-2011), which is described as follows.

The CAGR is obtained using the formula

$$Y_t = Y_0 (1+r)^t \text{----------} \quad (1)$$

The logarithmic transformation of equation (1) is given as,

$$\ln Y_t = \ln Y_0 + t \ln (1+r) \text{ ----------} \quad (2)$$

where, Y_t is the value of the variable at t^{he} period for which growth is calculated, r is the compound annual growth rate.

Now, let $(\ln Y_0) = \beta_1$ and $\ln (1+r) = \beta_2$, the above equation becomes $\ln Y_1 = \beta_1 + \beta_2 t$

β_1 and β_2 are estimated through the Ordinary Least Square (OLS) method, and the compound annual growth rate (r) is obtained by

$$r = (\text{antilog } \beta_2 - 1) \times 100 \text{----------} \quad (3)$$

2.3 Measures of Instability

The measure that is used to estimate instability in a variable over time should satisfy two properties. One it should not include deviations in the data series that arise due to secular trend or growth. Two, it should be comparable across data sets having different means. One way to exclude variations in a data series due to the trend, is, to fit a suitable trend (for example $Y_t = a + b_T + e_t$; where Y is dependent variable like yield, area or production, T refers to time/year, a is intercept and b is slope) and de-trend the series. A measure of instability is done by computing residuals $[e_t = Y-(a+b_T)]$, *i. e.* deviations between actual and estimated trend values, and estimating instability based on et.

As a mean of i_t is always zero, their standard deviation is used to measure instability. The main problem with this is comparability across data sets having different mean values. Instability measure

necessitates the use of the coefficient of variation, instead of standard deviation, to measure dispersion. As "mean" of detrained residuals is zero, it is not possible to compute CV of residuals (e_t). However, researchers have developed some methods to compute CV that was based on residuals. Mehra (1981) used standard deviation in residuals divided by the mean of the variable (area, production or yield) to compute and compare instability in agricultural production before and after the introduction of new technology. The author termed the estimate as the coefficient of variation even though it does not follow the standardized definition of CV. Hazell (1982) developed a new method to make use of residuals to estimate instability, which was slightly different from the measure developed by Mehra (1981). Hazell detrended the data and constructed a variable (Zt) which is computed by adding mean of the dependent variable to residuals e_t as $Z_t = e_t + Y$. The coefficient of variation of Zt is used as a measure of instability. The measures of instability proposed by Mehra (1981) and Hazell (1982) is based on detrended data; they are unit free and impart comparability. However, these methodologies have been criticized for measuring instability around an arbitrarily assumed trend line which dramatically influences inference regarding changes in instability 6 (Ray, 1983a p. 463). Ray (1983b) developed an elementary measure of instability given by standard deviation in annual growth rates. The method satisfies the properties like instability based on detrended data and comparability. Moreover, the methodology does not involve actual estimation of the trend, computation of residuals and detrending, but all these are taken care in the standard deviation of annual growth rate. This method does not suffer from the limitations of arbitrary choice of assumed trend line initially proposed and used by Hazell (1982) and subsequently applied by Larson *et al*., and Sharma *et al*. This paper preferred to use the method proposed by Ray (1983b) and applied by Ray (1983), Mahendradev (1987) and Rao et al., (1988) to estimate instability in agricultural production.

In the present study, instability was estimated using following formulae

Instability index = Standard deviation of natural logarithm (Y_t+1/ Y_t)

Where,

Y_t is the area/production / yield in the current year, and

Y_t+1 is for the next year.

This index is unit free and very robust, and it measures deviations from the underlying trend (log-linear in this case). When there are no deviations from trend, the ratio of Y_t+1/ Y_t is constant and thus standard deviation is zero. As the series fluctuates more, the ratio of Y_t+1 and Y_t also fluctuates more, and standard deviation increases.

2.4 Marketing analysis

The marketing aspect of kinnow was examined by collecting primary data from various stakeholders such as farmers, village level agents, wholesalers, retailers and various other agencies and people involved in the marketing. The issues addressed in the study area is detailed below.

2.5 Marketing cost

$T_c = C_p + M_p$

where,

Tc = Total cost of kinnow fruit marketing

Cp: Cost incurred by the producer

Marketing cost increased by an i^{th} middleman

Marketing margins: Following marketing margins were worked out in the study:

$A_{mi} = P_{mi} – (P_p + M_{ci})$

where,

A_{mi} = The absolute margin of the i^{th} middleman

P_{mi} = The selling price of the i^{th} middleman

P_p = Producer's price for his kinnow produce

M_{ci} = Marketing cost of the i^{th} middleman

2.6 Price spread

Price spread = Consumer price – Producer price

2.7 Marketing efficiency

Marketing efficiency was calculated using the formula given by Acharya and Agarwal (1998). It can be given as:

$$\mathrm{ME} = \frac{FP}{MC + MM}$$

where,

ME = Marketing efficiency

FP = Net price received by the producer-seller

MC = Total marketing cost

MM = Net marketing margin

2.8 Producer's share

$$\mathrm{Ps} = \frac{Pp}{Pc} X100$$

where,

Ps = Producer's share in consumer's rupee

Pp = Producer's price for his produce

Pc = Price paid by the consumer

2.9 Type of marketing costs

The costs of performing various functions in the marketing of kinnow are as under:

The cost of transportation of the produce between two places is one of the essential marketing costs. The farmer seller by weight and distance pays transportation cost from farm to mandi (market). The respective buyer bears further transportation costs of the commodities from the mandi.

Transportation charges:

Loading and unloading charges: It is the payment made to the labourers for rendering services of loading and unloading of the produce from transportation mode. The producer does the loading of produce at his farm, but unloading is done by palledars (porters) in the mandi. Producer-farmer bore the charges for unloading in the mandi. Palledars perform further loading and unloading activities in the mandi and charges are borne by the concerned buyer.

Weighing charges

The buyer bears these charges. Weighing charges vary with the type of container, *i.e.,* baskets, gunny bags, crates, *etc.*

Mandi fee

The mandi for rendering various services in the market area collects the charges. The Mandi fee in case of kinnow was Rs. 0.50 per/kg.

Commission

It is the charge paid to a commission agent for the service rendered by him in the disposal of the produce. The prevailing rate of commission prescribed by the market committee was INR 1.60 per kg is charged by the buyer.

Basket and crate charges

Farmers bring kinnow for sale in the mandi in crates of about 25-30 kg capacity.

Grading, sorting, filling and packing charges

Baskets and crates are used to carry the produce from farm to the mandi and from mandi to the retailers' shops. Grading, sorting, filling and packing are done by the labour present in the mandi at a rate of INR 10 per crate.

Quantity loss

In kinnow marketing, loss in quantity is typical due to packing, spoilage in the process of movement (transportation) and fluctuation of temperature, rough handling, and delay in the sale of the produce, etc.

2.10 Lorenz Curve

The Lorenz curve (the actual distribution of income curve), a graphical distribution of wealth developed by Max Lorenz in 1906, shows the proportion of income earned by any given percentage of the population. The line at the 45º angle shows perfectly equal income distribution, while the other line shows the actual distribution of income. The farther away from the diagonal, the more unequal is the size of the distribution of income.

The *X*-axis of a Lorenz curve records the cumulative proportion of population ranked by income, land, and quantity of kinnow handled. Its range is (0, -1).

The *Y*-axis records the cumulative proportion of income, land, and quantity handled for a given proportion of the population, *i.e.,* the income and land (wealth) share was calculated by taking the cumulated (income and land) of a given share of the population. Then it is divided by the total income and land Y,as follows:

$$L(k/p) = \sum_{i}^{kn} \text{yi}$$

where,

k = 1 ... *n* is the position of each in the wealth distribution,

i = 1 ... *k* is the position of each individual in the wealth distribution,

P……. is the total number of individuals in the distribution,

y_i …… is the wealth of the i^{th} individual in the distribution, and

$\sum_{i}^{k} \text{yi}$ ……is the cumulated wealth up to the k^{th} individual

It is obvious that $\sum_i^k yi$ ranges between 0, for k=0, and Y, for k = n, therefore the equation value ranges between 0 and 1.

A 45° line represents absolute equality, and the Lorenz curve represents the current distribution of the income, as the Lorenz curve reaches farther away from the 45^0 line more inequality dominates the distribution. The Lorenz curve performs as the natural instrument for graphically depicting the Gini coefficient.

2.11 Gini coefficient

According to the IMA journal of management mathematics (2008), Gini-coefficient was defined as a ratio with values between zero and one (0-1). A low Gini-coefficient indicates equal income or wealth distribution, while a high Gini-coefficient indicates unequal distribution. Zero (0) corresponds to perfect equality while one (1) corresponds to perfect inequality. The Gini coefficient, which was derived from the Lorenz curve, can be used as an indicator of economic development in a country. The Gini coefficient measures the degree of income equality in a population. The Gini coefficient can vary from 0 (perfect equality) to 1 (perfect inequality). A Gini coefficient of zero means that everyone has the same income, while a coefficient of 1 represents a single individual receiving all the income.

There are several ways to calculate the Gini coefficient; by referring the most customary method for calculating the Gini coefficient based on the Lorenz curve, the Gini coefficient can be calculated as the ratio of the area between the Lorenz curve and the absolute equality line, divided over the total area under the 45° line,

$$\text{Gini Coefficient} = \frac{\text{Concentration (A)}}{\text{Maximum Concentration Area(A + B)}}$$

Since A+B equals 0.5(Area of equality triangle), the Gini coefficient will be:

$$\text{Gini Coefficient} = \frac{A}{0.5}$$

Gini coefficient = 1-2B

3 Results and Discussion

The significant finding of the study was presented under the following subheadings.

3.1 Socio-economic characteristics of respondents

Table 1 presents the distribution of kinnow farmers according to age. About there a quarter of respondents fall into the category of 31-60 followed by above 60 (18.5%) and below 30 (7%). The age group above 60 of farmers' interviewed. The smallest age group was of those below 30 years representing 7%. It was concluded from the table that farmers of the region are medium aged. According to Tauer (1994; 2000) represents middle age group farmers who are capable of working very hard to increase agricultural productivity. This result indicated that youths are the primary catalyst for change and a backbone of India, hence mobilizing them for national development as in kinnow farming is paramount (Valerie, 2009)

Table 4: Age group of selected kinnow growers in Fazilka district of Punjab

Age group (yrs)	Frequency (n)	Percentage
Below 30	14	7
31-60	149	74.5
Above 60	37	18.5
Total	200	100

Education plays a vital role regarding technology adoption. It was observed from table 5 that majority of the respondents (38.50%) were educated up to secondary, followed by 20.00 percent respondents educated up to graduate. Tiny percentages of respondents were having education up to primary (4.50%) and post-graduation (6.50%). The analyzed data showed that majority of the farmers in the district are well educated, and the district has the potential for technology adoption.

Table 5: Education level of selected kinnow growers in Fazilka district of Punjab

Education level	Frequency (n)	Percentage
Illiterate	21	10.50
Primary	9	4.50
Secondary	77	38.50
High Secondary	40	20.00
Graduate	40	20.00
Post Graduate	13	6.50
Total	200	100.00

The level of improved farm practices improves only under the two conditions one by training and another by experience. Farm experience is the key to success in farming; hence an effort has been

made here to elicit the information concerning farm experience. Majority of farmers has the experience of farm practices ranging from 11-20 years. About 36.5 percent of farmers had farm experience of fewer than ten years, and 11.5 percent of farmers have an experience beyond 20 years

Table 6: The Farming experience of kinnow growers in Fazilka district of Punjab

Farming Experience	Frequency (n)	Percentage
Below ten years	73	36.5
11-20 years	104	52
Above 20 years	23	11.5
Total	200	100

Farm size plays a significant role in terms scale of the enterprise. The data in table 7 indicates that majority of the kinnow farmers of the study area bestowed with the land area above 10 acres. Regarding a percentage, these farmers constituted about 67.5 percent followed by those having a land area of 5-10 acres and up to 5 acres with 22.5 and ten respectively. It can be inferred from the findings that most of the kinnow farmers were having considerable land resources for cultivation. These findings confirmed with the findings of Mankar (2010).

Table 7: Farm size of kinnow growers in Fazilka district of Punjab

Farm size	Frequency (n)	Percentage
Up to 5 acres (small)	20	10
5-10 acres (medium)	45	22.5
Above 10 acres (large)	135	67.5
Total	200	100

Farming today is an expensive operation as the input cost is rising day by day. It is confusing to small farmers to cope up with rising cost. Contract farming is a viable option for such farmers. In the study area, it is evident from the table 8 that majority of kinnow growers (98.5 percent) are landowners.

Table 8: Status of kinnow grower is in Fazilka district of Punjab

Farmer status	Frequency (n)	Percentage
Landowner	197	98.5
Lessee/rent in	2	1
Lessee/rent out	1	0.5
Total	200	100

Today's agriculture seems to be diversified in terms of occupation within the domain. The distribution given in Table 9 indicated that 75 percent respondents had kinnow farming + other crop

agriculture (farming) as their occupation followed by 21.5 percent respondents who were engaged kinnow farming. Remaining 2 percent and 1 percent family heads had a private job and other business in addition to kinnow farming, respectively.

Table 9: Income of kinnow growers in Fazilka district of Punjab

Variable	Frequency (n)	Percentage
Occupation		
kinnow farming	43	21.5
kinnow farming + Other crop	150	75
kinnow farming + Livestock	4	2
kinnow farming + Private job	2	1
kinnow farming + Other	1	0.5
Estimated monthly income (INR)		
Less than 50000	6	3
50,000-1,00,000	20	10
100000-1,50,000	14	7
1,50,000-2.50000	63	31.5
More than 2.50000	97	48.5
The share of kinnow in crop income (%)		
Less than 30	27	13.5
31-50	33	16.5
51-70	22	11
71-90	54	27
91-100	64	32

Indeed, many farmers want to get more income out of the activities they carry out, a practice they adopt and business they conduct. The standard practice that every Indian farmer adopts is crop cultivation and livestock rearing. In the study area, about 75 percent of the farmers' subsidiary activity along with the kinnow growing is the growing other crop followed by only kinnow growing and kinnow + livestock. Majority of the farmers' monthly income is more than 2.5 lakh followed by 1-2.5 lakh and 0.5-1 lakh. In terms of the share of kinnow farming in their income, it is found that 32 percent of the total kinnow growers were mainly dependent on kinnow as a source of their income. It implies that those, who grow kinnow, have an orientation towards specialization.

The status of machine ownership of the kinnow growers was depicted in table 10. The table shows 84.50 percent of kinnow farmers own tractor. A tractor is the essential component of farm operation, and it is also consonance with the fact that state stands first in farm mechanization. Apart from tractor sprayer and tube-well diesel stands second and third, position, respectively among the machine possessed by kinnow growers. One of the respondents also had kinnow processing equipment on his farm. Regarding the solar system and storage, only three respondents had both the facility. 80

percent respondents have plant protection equipment. The results show those engaged in kinnow cultivation have better ownership of farm assets and infrastructure.

Table 10: Distribution of kinnow growers according to their material possession

S. No.	Material Possession	N=200	
		Frequency (n)	Percentage
1.	Tractor	169	84.5
2.	Tiller	55	27.5
3.	Diggi	50	25
4.	Tube-well- Electric	16	8
5.	Tube-well-Diesel	88	44
6.	Drip Irrigation	28	14
7.	Solar system	3	1.5
8.	Sprayer (Plant protection)	160	80
9.	Storage	3	1.5
10.	Kinnow Processing Equipment	1	0.5
11.	Others (if any)	6	3

3.2 Status of fruit production in India

Fruit crop plays a vital role in enhancing the farm income in India. The level of growth in fruit production is an outcome of the significant growth in area under fruits cultivation. During 2001-02, the yield of fruits crops could grow only at 1.15 percent growth as compared to 6.11 percent growth in area under fruits.

The production of fruits has increased from 43 to 88.98 million tons during the same period. Results show that the compound annual growth rate in the area is 6% per annum. The analysis shows that the farmers are diversifying towards the fruit crop in the country that is attributed to various government programmes like National horticulture mission and some state government programmes. The production of fruits has been growing at an annual growth rate of 7 percent with nearly one percent productivity growth rate as a whole. The instability in the area, production and productivity were measured by the instability index. The results showed that instability in productivity (2.68) was high as compare to instability in the area (0.63) and production (0.29).

Table 11: Computation of compound growth rates, CV, and instability in India

Year	Area (000’ ha)	Production (000’t)	Productivity (t/ha)

2001-02	4010	43001	10.7
2002-03	3788	45203	11.9
2003-04	4661	45942	9.9
2004-05	5049	50867	10.1
2005-06	5324	55356	10.4
2006-07	5554	59563	10.7
2007-08	5857	65587	11.2
2008-09	6101	68466	11.2
2009-10	6329	71576	11.3
2010-11	6383	74878	11.7
2011-12	6705	76424	11.4
2012-13	6982	81285	11.6
2013-14	7216	88977	12.3
CGAR	6.11	7.36	1.15
CV (%)	19.01	23.4	6.41
Instability	0.63	0.29	2.68

The production of fruits has increased from 43 to 88.98 million tons during the same period. Results show that the compound annual growth rate in the area is 6% per annum. The analysis shows that the farmers are diversifying towards the fruit crop in the country that is attributed to various government programmes like National horticulture mission and some state government programmes. The production of fruits has been growing at an annual growth rate of 7 percent with nearly one percent productivity growth rate as a whole. The instability in the area, production and productivity were measured by the instability index. The results showed that instability in productivity (2.68) was high as compare to instability in the area (0.63) and production (0.29).

In Punjab citrus is a major fruit crop among which kinnow covered a large area. The area, production, and productivity along with instability are presented in table 12. The area under fruit crops has increased from 19360 hectares in the year 2004-05 to 48182 hectares in 2014-15 and production has increased from 290410 tons to 1108618 tons during the same period. The results showed that area and production grew significantly which shows the high adoption of kinnow in Punjab. During 2004-05 to 2009-10 the per annum growth rate in the area, production and yield were 20.14, 30.98 and 8.95 percent, respectively.

The growth rate in the area, production and yield were lower during 2010-11 to 2014-15 compared to the previous period. The overall growth was high in the area (9.3%), production (12.7%) and yield (3.2%). The instability index shows that the productivity has higher instability compared to that of production and area. The table shows that the instability in the area is higher (5.01) in during (2004-05

to 2009-10) compared to the second period (2010-11 to 2014-15). The overall instability index of the area shows that the area of mandarin was stable during 2004-05 to 2014-15.

Table 12: Computation of compound growth rates, CV and instability of kinnow in Punjab

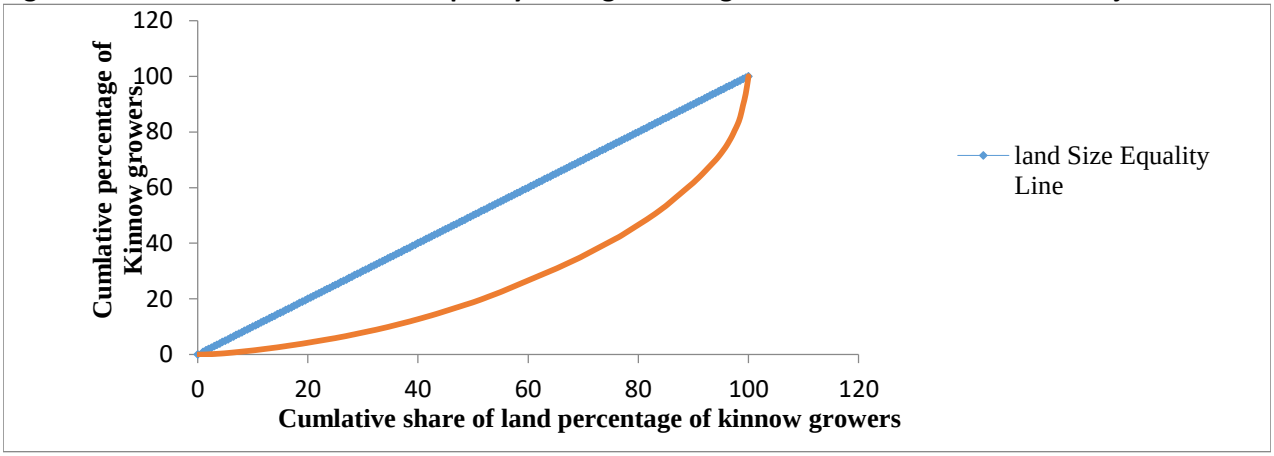
Year	Area(ha)	Production(T)	Productivity(q/ha)
2004-05	19360	290410	150
2005-06	22887	433050	189
2007-07	-	-	-
2007-08	31788	591319	186
2008-09	35619	706645	198
2009-10	38837	876358	225
2010-11	41204	872626	211
2011-12	42795	915005	213
2012-13	43851	988633	225
2013-14	47101	1017725	216
2014-15	48182	1108618	230
CGAR	9.3	12.7	3.2
CV (%)	27.3	35.3	11.4
Instability	0.9	1.3	2.5

Similar results are found in the production and yield. The area and production have increased due to intensive efforts of the government towards the diversification as subsidies, kinnow grower association, and suitability of climatic condition for this high yielding mandarin cultivar.

3.3 Inequality in income distribution of kinnow growers (Lorenz curve analysis)

The primary objective of this analysis is to understand the situation of unequal distribution of income among kinnow grower farmers in Fazilka district of Punjab. The primary purpose of this study was to know why some people have a higher income than others. In Punjab, some people have extra income about their needs, and others have too little to fulfil their necessary food requirements. There are several different indicators (Fletcher 2013) of inequality that used in the literature. The most common measure of inequality is the Gini coefficient that was derived from the Lorenz curve. The Lorenz curve shows the share of income by households ranked by income. The Gini coefficient ranges from zero to one, where zero represents perfect equality, and one represents complete inequality. Based on the field data, of kinnow growers, 2017, the Lorenz curve for gross income indicates that the top 20 percent of farmers earned approximately 50 percent of total household income (Figure 3).

Figure 3: Lorenz curve of income inequality among kinnow growers in Fazilka district of Punjab



Source: Author's computation based on field data, 2017.

The Gini coefficient which is used to identify the equality of income distribution among the farmers indicates. The Gini value is 0.48 income inequality exists among farmers. This indicates among other things, most farmers in the kinnow industry have unequal income distribution which is not a good sign for farmers so far as economic development of Punjab is concerned. The Lorenz curve in below Figure below shows annual income inequality among kinnow producers. The graphical representation from the Lorenz curve indicates there is more income inequality among kinnow producers. The inequality is because the Lorenz curve of income inequality is very far to income equality line of zero (0). Thus, the study is in line with the Anonymous (2008).

3.4 Establishment of kinnow orchard

The cost structure as reflected by share of various inputs in total variable costs is usually determined by the level of technology and use of modern inputs. The per hectare cost of cultivation of kinnow in the study area was presented in Table 13.

Table 13: Year-wise costs of establishing kinnow orchard

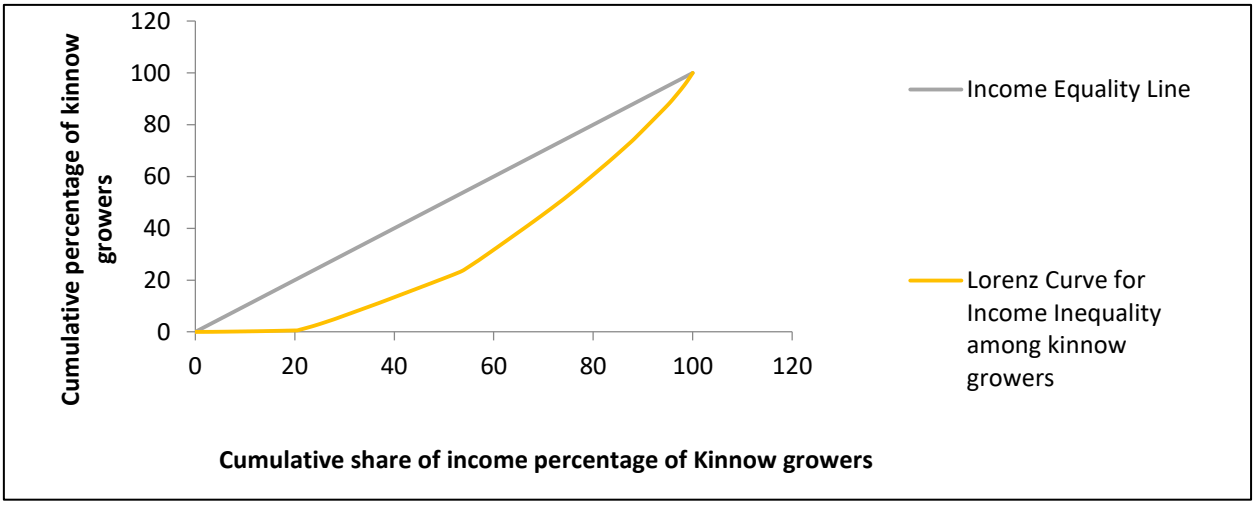
(INR/Acre)

S. No.	Particulars	Year			
		I	II	III	IV
1.	Land & layout preparation	7042.00	5657.67	5742.67	5754.42
2.	Pit digging & filling	3684.96	0.00	3000.00	3000.00
3.	Planting material and cost	4992.81	0.00	0.00	0.00
4.	Cost of irrigation	1761.01	1545.54	1657.08	1576.77
5.	Tube well	96071.43	0.00	0.00	0.00
6.	Digging/ pond	259285.71	0.00	0.00	0.00

7.	Drip installation	103533.33	1000.00	2000.00	2000.00
8.	Electricity/diesel cost	3182.58	3276.17	3300.25	3161.59
9.	Permanent fencing	18908.13	0.00	0.00	0.00
10.	Cost of hired tools and implements	7130.00	5908.37	16004.17	15979.17
11.	Pruning	0.00	1733.86	2317.20	4920.45
12.	Gap filling	300.00	1146.51	1198.10	1189.80
13.	Miscellaneous	6605.35	7201.20	8426.31	10453.48
	Total	512497.32	27469.32	43645.78	48035.67

Among the 13 significant items listed in the table, digging pond is the costliest with INR. 2, 59,285.71 followed by drip system (INR.1, 035, 33.33) and tube well (INR 96, 071.33) for the first year. In the second, third and fourth year Cost of hired tools and implements stands more than the other costs. The cost of land and layout preparation stands the second position in second, third and fourth years of cultivation. It is crucial to note here that the cost of cultivation stands zero for Tube well, pond and permanent fencing starting from the second year of cultivation. It was observed that cost of pruning during the first year of cultivation is zero.

Figure 4: Lorenz curve of annual income inequality among kinnow growers in Fazilka district of Punjab



Source: Author's computation based on field data, 2017.

3.5 Status and promotional activities of infrastructure/facility

The sector is highly responsible for propelling farmers' overall development. Infrastructure sector includes soil testing lab, Agri-clinic, disease forecasting unit, plant health clinic, storage, packaging house and processing units. It is evident from the table 14 that the facilities like soil test lab, packaging house, and primary processing centre are available to the majority of kinnow growers of the district. Regarding

service availed 137 out of 190 farmers availed in soil test lab, and 105 farmers found it useful. However, only 4 out of 157 respondents' availed the service of packaging. Further, only 3 out of 168 respondents availed the service of primary processing center only one farmer availed facilities of disease forecasting unit and organic certification.

Table 14: Status and promotional activities of infrastructure/facility in the study area

Infrastructure/Facility	Availability		Whether service availed		If yes, whether found to be useful	
	Yes	No	Yes	No	Yes	No
Soil test lab	190	10	137	53	105	32
Agri-clinic	39	161	19	20	15	4
Disease forecasting unit	4	196	1	3	1	0
Plant health clinic	18	182	6	12	3	3
Bio Control laboratory	0	200	0	200	0	0
Storage infrastructure	0	200	0	200	0	0
Organic certification	1	199	1	0	1	0
Packaging house	157	43	4	153	3	1
Ripening Chamber	0	200	0	200	0	0
Primary processing centre	168	32	3	165	3	0
Mobile processing centre	0	200	0	200	0	0

Only 19.5 percent respondents confirmed the availability of agri-clinic out of whom only 50 percent availed this service. The service like bio-control laboratory storage infrastructure, ripening chamber and mobile processing are not available in the study area.

3.6 Status of kinnow orchard

Table 15 explains the distribution of kinnow growers according to the area, the density of population, the life of the orchard, the source of irrigation, etc. 49 percent of the kinnow orchard is established through credit and majority of such area fall in 0 to 10 acres. Concerning the density of population per square kilometre is 50-100. Similarly, the majority of farmers have relied on canal irrigation as their source, and the mode of irrigation is flooding with 88.5 percent share.

Table 15: Details about kinnow orchard in Fazilka district of Punjab

Particulars	Frequency (n)	Percent
Credit for establishment	98	49
Area(acre)		
0-10	118	59
11-25	64	32
26-50	16	8
Above 50	4	2
Density (no. of plant/acre)		

50-100	150	75
101-150	50	25
Life of orchard		
0-10	10	5
10-20	109	54.5
Above 20	81	40.5
Source of irrigation		
Canal	186	93
Canal + Diggi	14	7
Mode of irrigation		
Flood	177	88.5
Drip	27	13.5
Both	14	7
No. of year to attain stable yield		
5-7	15	7.5
8-10	185	92.5
Time of first fruit-bearing start (in years)		
3	7	3.5
3-5	188	94
Above 5	32	16
Govt. subsidies on credit for establishment	131	65.5

Crop variety plays a vital role in increasing production. Selection of suitable variety depends on various factors viz. adaptability, availability, etc. Some of the reasons for preference of farmers towards a specific variety can is seen in table 16. The primary reason for preferring variety is the price which it fetches in the market. About 28 percent of the respondents expressed this important criterion while choosing the variety.

About 25 percent of the farmers expressed both price and demand as factors influencing adoption of a variety. Among the least, each of fetches higher price in the market+ easy availability of seed+ productivity is higher than other variety, and higher demand in the market +easy availability of seed+ productivity is higher than other variety has only 0.5 percent of proffered farmers.

Table 16: Major reason for preferring the particular variety in Fazilka district of Punjab

Reason	Frequency (n)	%
Fetches higher price in the market	57	28.5
Higher demand in the market	14	7
Easy availability of seed	3	1.5
Productivity is higher than other variety	1	0.5
Fetches higher price in the market+ higher demand in the market	50	25
Fetches higher price in the market+ higher demand in the market+ easy availability of seed	30	15
Fetches higher price in the market+ easy availability of seed	12	6
Higher demand in the market+ easy availability of seed	31	15.5
Fetches higher price in the market+ easy availability of seed+ productivity is higher than other variety	1	0.5
Higher demand in the market +easy availability of seed+ productivity is higher than other variety	1	0.5

3.7 Economics of the cost of cultivation

Per acre cost of cultivation of kinnow was given in Table 17. The cost per acre for sample farmers is INR. 41510.89. Out of total cost, the maximum cost was in other cost had which include labour cost and maintenance expenses which were about INR5000. Expenses on fertilizers, plant protection, and pruning/staking expenses were the other essential items paid out.

Table 17: Operation- wise cost of kinnow orchards in Fazilka district of Punjab

Items	INR./acre
Cultural operation	4815
FYM	3824
Urea	704
NPK	1227
DAP	2840
Irrigation	647
Plant protection	11743
Pruning	6451
Staking	2735
Harvesting	1520
Another cost	5000

Total Cost	**41510**
Productivity (quintal/acre)	92
Gross return (INR/ha) @910	**83720**

The output disposal patterns of the sample kinnow growers selling through contractor and wholesaler are given in table 18. Out of 200 sample farmers, 184 farmers sold their output through a contractor. The net quantity sold was observed to be 113282 kg of the total production, and 25062 kg was disposed of through the wholesaler whereas a marginal proportion (3000 kg) is sold through contractor + wholesaler.

Table 18: Disposal pattern of kinnow in Fazilka district of Punjab

Channel	Frequency (n)	Quantity sold(Kg)	Sales value(INR)
Contractor	184	113282	901562
Wholesaler	8	25062	414000
Consumer	1	17000	1080000
Contractor + Wholesaler	2	3000	400000

3.8 Supply chains for kinnow in Fazilka district of Punjab

High-value commodities especially fruits and vegetables are susceptible to inaccessibility of markets and high price volatility (Grover 2001). Smallholders face the added problems of high transactions costs due to little marketable surplus and production risk. The following four major marketing channels are identified in the study area for disposal of kinnow (Figure 5).

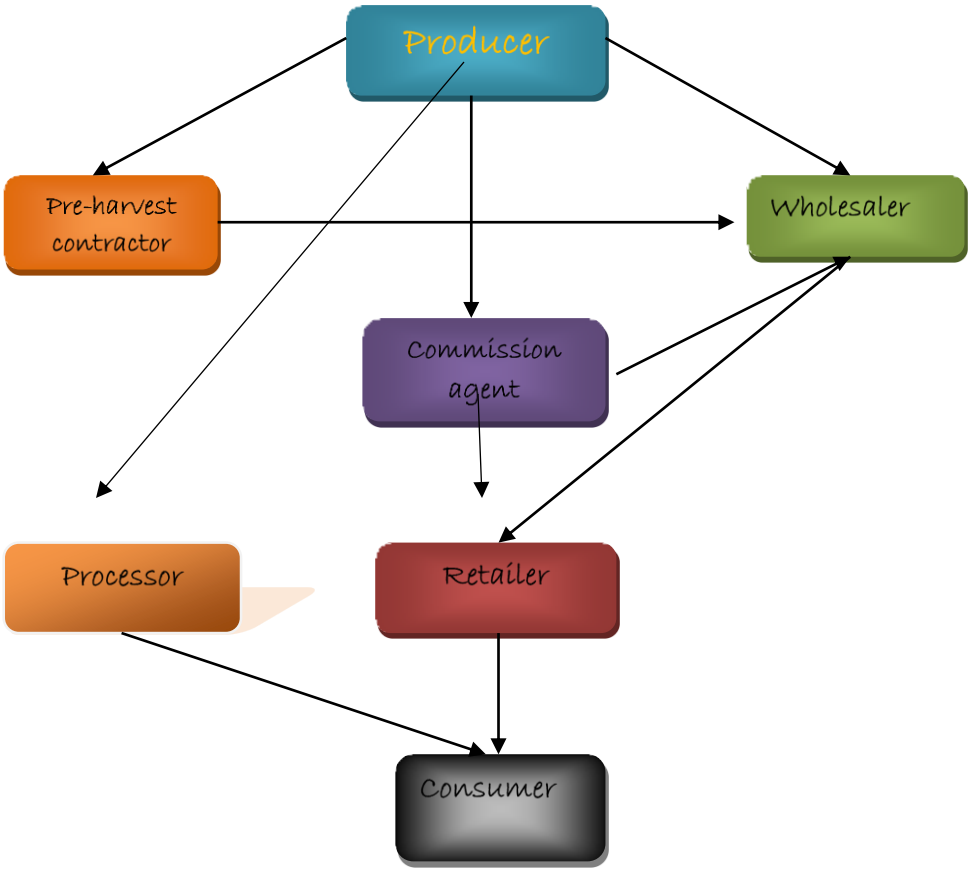
3.9 Value chains in kinnow in the Fazilka district of Punjab

Value chain describes the arrival of kinnow from producer to consumer through various marketing intermediaries. Five value chains were found in the study area, through which kinnow reaches the market and finally to the consumers. Among them, Producer pre-harvest contractor-wholesaler-retailer-consumer channel was the most dominant channel through which nearly 70 percent flow of kinnow occurs. Other innovative channels are also developing. Among them, Producer – new outlet- consumer was emerging, but the level of adoption of this channel is limited to only 2 percent of the farmers in the study area. In channel III farmers directly brought his produce to the market (APMC) and sold to the whole seller, which account 10 percent of total product flow in the market. In channel-IV, farmers directly sell to the consumer which is only 5 percent. These channels were presented in the following figure 5.

3.10 Value chain functions

The value chain is an emerging concept in which various stakeholders play a significant role in increasing the value of the product through different activities like marketing, grading, waxing sorting, etc. The producer is the most dominant agent in the value chain he plays a different role like cultivation, marketing and sorting and grading and many more function. The functions performed by the stakeholders are divided into physical and financial functions. Under physical functions, the primary activities are cultivation, harvesting, grading, cleaning, waxing, and marketing. These functions are essential for increasing produce value regarding price and shelf life of produce. Financial functions help in the smooth flow of product from producer to ultimate consumer. The primary function performed by the stakeholders are price discovery between producer and pre-harvest contractor/wholesaler, risk-taking, providing advance credit to the producer/pre-harvest contractor, etc.

Figure 5: Supply chains for kinnow in Fazilka district of Punjab



3.11 General attributes of kinnow traders

Personal characterizing includes age, education and exporting experience. These attributes of exporters do affect the quality and performance of the business. A mature, well-educated and experienced person can manage the business in a better way as compared to an uneducated person. The survey results showed that average age of the exporters was 39.4 years. The exporters were well educated. They had an average education of 13.4 years. They possessed an experience of about 13.4 years in running the export business. Traders involved in kinnow trading had an average experience of 10 years (Table 19).

Table 19: Personal characteristics of the traders (years)

Characteristics	Minimum	Maximum	Mean	SD
Age	25	56	39.4	11.14
Education	12	16	13.4	2.4
Trade experience	5	30	13.4	11.17
kinnow trade	5	20	10.2	6.9

Considering the perishable nature of fruits, trading them is one of the unjustifiable tasks. Two essential stages identified for easy understanding of constraints faced by traders. Each of these stages has four separate set of constraints encountered by traders. 67 percent of traders faced constraint of facing price quoting followed by bad weather (64 percent) during raw material purchase.

Table 20: Constraints in kinnow trading

Sr. No.	Constraints	Percentage
1.	During the raw material purchase	
a	Fluctuate rate problem	47
b	Farmers fall back on the deal	38
c	Bad weather problem	64
d	The price quoted more the price	67
2.	During marketing of processed products	
a	Lack of transportation	60
b	Fluctuation in rate	58
c	Delay in payment of sold produce	69
d	Lack of market	58

69 percent of farmers evidenced delay in payment of sold produce followed by lack of transportation (60 percent) during the marketing of processed products.

Table 21: Middlemen chosen by the sample farmers (%)

Sr. No.	Middlemen	Small farmers	Large farmers
1.	Village traders	68	8
2.	Wholesaler cum retailers	18	72
3.	Commission agents	14	20
	Total	100	100

There is no market in the world without a middleman. They are the critical facilitator in one market and are a potent inhibitor of trade in another. Table 22 shows that among the reasons to sell

kinnow through village traders, natural method of sale ranks I followed by no commission charges, no commission charges, long-term practice and immediate payment.

Table 22: Reasons for selling kinnow through village traders

Sr. No.	Reasons	Score	Rank
1.	An easy method of sale	78	I
2.	No price difference	54.87	VI
3.	Long-term practice	57.25	V
4.	No transport cost	68	III
5.	No commission charges	72	II
6.	Immediate payment	61.88	IV

Source: Primary data

Today's world is dynamic. Many times this dynamic situation pushes individual to take an unintended decision and to substantiate this move verity of reasons will emerge. Hence reasons are the outcome of reaching something which is not desired and expected. The reasons for selling kinnow through wholesaler cum retailer are ranked and presented in Table 23. Which shows that among the reasons, credit facilities ranks first followed by the natural method of sale, no commission charges and more off-take which are ranked II, III and IV, respectively. The V and VI ranks are assigned to better price and long-term practice, respectively.

Table 23: Reasons for selling kinnow through wholesaler cum retailers

Sr. No.	Reasons	Score	Rank
1.	An easy method of sale	75.67	II
2.	Credit facilities	82.78	I
3.	Long-term practice	61.38	VI
4.	Better price	64.38	V
5.	No commission charges	70.25	III
6.	More off-take	68.71	IV

Source: Primary data

The reasons for the choice of commission agents is presented in below table 24. Most of the farmers prefer the commission agents as their intermediary because the commission agents provide immediate cash after the sale to the farmers whenever they need. Therefore it is ranked first. Other reasons namely availability of credit facilities, better price, and more off-take are ranked III, IV, V and II, respectively.

Table 24: Reasons for selling kinnow through commission agents

Sr. No.	Reasons	Score	Rank
1.	Immediate cash after the sale	81.25	I
2.	Availability of credit facilities	64.28	III
3.	Long-term practice	68.98	II
4.	Better price	60.24	IV
5.	More off-take	5878	V

Source: Primary data.

3.12 Marketing margin and producer's share in consumer's rupee and marketing efficiency

Value chain-wise marketing margin of different intermediaries and producer's share in consumer's rupee is presented in table 25. In channel 5, per quintal percentage markup of the pre-harvest contractor, wholesaler and retailer were calculated to be 59.63, 86.57, and 29.07 percent respectively. Producer's share in consumer's rupee was 31.78 percent. The marketing efficiency of this channel was 0.32. In channel 2, per quintal percentage markup of pre-harvest contractor and retailer were calculated to be 162.43 and 15.93 percent, respectively. Producer's share in consumer's rupee was 35.61 percent. In channel 3, per quintal percentage, markup of wholesaler was calculated to be 62.13 percent. Producer's share in consumer's rupee was 41.34 percent, and marketing efficiency was 0.58. In channel 4, per quintal percentage, markup of the retailer was 94.55 percent. Producer's share in consumer's rupee was found to be 48.68 percent.

The marketing efficiency was 0.83 in channel 5, due to the absence of intermediaries there was direct contact between producer and consumer, and sale price of the producer was found equal to be the purchase price of the consumer. Hence, producer's share in consumer's rupee was found to be 100 percent, and marketing efficiency of the system was 11.52.

The perusal of table 26 indicates that higher the number of value chain stakeholders engaged in the chain, lesser will be the producer's share in consumer's rupee. Marketing efficiency and vice versa as the intermediaries used to purchase the product at lower prices from producers and sell at higher prices and lay away the significant share without much effort.

Table 25: Marketing margin of different intermediaries and producer's share in consumer's rupee and marketing efficiency (INR/q)

Sr. No.		Particulars	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5
A	1	Price received by farmers	1550	1485	1288	990	990
	2	Marketing cost of the producer	123.77	142.27	155.66	-	-
	3	Net price or margin of producer	1426.23	1342.73	1132.34	990	990
B	1	Purchase price of pre harvest contractor	-	-	-	990	990
	2	Marketing cost of pre harvest contractor	-	-	-	155.66	157.59
	3	Sale price of pre harvest contractor	-	-	-	2780	1660
	4	Net margin of pre harvest contractor	-	-	-	1608.15	512.41
	5	Percentage mark up of pre harvest contractor	-	-	-	162.43	59.63
C	1	Purchase price of wholesaler	-	-	1288	-	1660
	2	Sale price of wholesaler	-	-	2335	-	2335
	3	Marketing cost of wholesaler	-		189.45	-	222.93
	4	Net margin of wholesaler		-	800.79	-	1437.07
	5	Percentage mark up of wholesaler	-	--	62.13	-	86.57
D	1	Purchase price of retailers	-	1485	2335	2335	2335
	2	Cost incurred by retailers	-	80.92	96.49	72.95	96.49
	3	Sale price of retailers	-	3050	3115	2780	3115
	4	Net margin of retailers	-	1404	683.51	372.05	683.51
	5	Percentage mark up of retailers	-	94.55	29.27	15.93	29.27
E	1	Purchase price of consumers	1550	3050	3115	2780	3115
	2	Producer share in consumer rupees	100	48.68	41.34	35.61	31.78
	3	Total marketing cost	123.77	223.19	441.60	235.38	477.01
	4	Acharya's Marketing efficiency	0.92	0.83	0.58	0.45	0.32

Hence, channel five was found to be most efficient, and channel 1 was a least efficient channel as the producer's share in consumer's rupee was found to be highest in Channel 5 (100 percent) and least in Channel 1 (31.78 percent).

3.13 Status of an institutional mechanism for organizing production and marketing of kinnow

Regarding organizing and marketing of kinnow the respondents have given clear preference to farmer's cooperative with 136 respondents stated "yes" out of 200. According to the response received. Farmers' producers' organization role in the aggregation of produce, organizing production and marketing of kinnow and alternative marketing channels was absent in the study area.

Table 26: Status of an institutional mechanism for organizing production and marketing of kinnow in Fazilka district of Punjab

Particulars	Yes	No	Purpose	
			Cost Minimization	Improve Bargaining
Aggregation of input	1	199		
Aggregation of produce	0	200		
Farmers cooperatives	136	63	76	124
Farmers producers organization	0	200		
Alternative marketing channels	0	200		

3.14 Distribution of kinnow growers according to their assets, access to information, government support, and planting materials

Asset position of the farmer is vital to describe whether he can hold the risk out farming or not. If the farmer's asset position is appropriate, he has potential to withstand the financial risk arising out of farm operation. It further also helps even to get out of the natural risk such as drought, flood and crop loss due to insect pests. In the above table, it has been showed that majority of the farmers had had tractors with 84.5 percent followed by sprayer (80%) and only 0.5 percent of the farmer has processing equipment. It was found from this study that farmers have less oriented their towards processing aspect and thereby lack of processing machinery which insisted them to dispose of their entire commodity to market irrespective of future price advantage by processing the produce. In the source of planting material more than half of the farmers constituting about 59.9 percent rely on the private nursery. Among the legislative scheme majority of farmers have benefited from the MIDH (Mission for Integrated Development of Horticulture) followed by a small number of farmers got benefits from NFSM and RKVY. Source of information is the primary accelerator in the production. It is evident from the table that majority of farmers rely on personal information (52.5%) followed by electronic (34%) and print media (13.5). As for the supply of fertilizers to the farm is concerned the majority of farmers have relied on input dealer and it as obvious and inevitable for the farmers. The study also revealed that only 17.5 percent of farmers had relied on government. Agencies showed the lack of penetration of such agencies in distributing primary input such as fertilizer. Surprisingly the performance of government, agencies in the distribution of farming equipment is quite well reached to the farmers as more than fifty farmers are procuring from these agencies. It also concludes that farmers satisfied with the equipment supply by government agencies.

Table 27: Distribution of kinnow growers according to their assets

N=200

Sr. No.	Component	Frequency	Percent
1.	Asset		
	Tractor	169	84.5
	Tiller	55	27.5
	Diggi	50	25
	Tube-well- electric	16	8
	Tube-well-diesel	88	44
	Drip irrigation system	28	14
	Solar system	3	1.5
	Sprayer (Plant Protection)	160	80
	Storage facility	3	1.5
	kinnow Processing Equipment	1	0.5
	Others (if any)	6	3
2.	Source of planting material /seed		
	Produced by own	9	4.5
	Agri- Input dealer	0	0
	Private retail shop in the block	28	14
	Procure from universities /KVK	4	2
	Supply of seed by Govt. at subsidies rate/Agriculture office	40	20
	Peer farmers/local villagers	0	0
	Any other (Private nursery)	119	59.5
3.	The beneficiary from the scheme of Govt. department/other agencies		
	NFSM	3	1.5
	MIDH (Mission for Integrated Development of Horticulture)	116	58
	Others	5	2.5
	RKVY+MIDH	2	1
	MIDH + Other	2	1
	MIDH + Other + Drip and Diggi Subsidy	1	0.5
4.	Source of information		
	Personal	105	52.5
	Electronic	68	34
	Print	27	13.5
5.	Input supply (backward linkage)		
A.	Planting material		
	Own farm	8	4
	local trade	48	24
	Input dealer	2	1
	Cooperative & Govt. agency	1	0.5
	Others	141	70.5

B.	Fertilizers		
	Own farm	1	0.5
	local trade	32	16
	Input dealer	122	61
	Cooperative & Govt. agency	35	17.5
	Others	1	0.5
C.	Farming equipment		
	Own farm	5	2.5
	local trade	4	2
	Input dealer	31	14.
	Cooperative & Govt. agency	112	56
	Other	14	7
6.	Member of any professional organization/ Producer association	133	65.00

Horticultural produce is highly perishable and sensitive to high temperature. Lack of transportation and financing in the value chain and inadequate market information facilities adversely affected the income of the producer farmers. Therefore, the state needs to ramp up the availability of cold storage with a focus on rural areas. Almost 50 percent farmers had on the farm (Input cost/quality, un-skill labour, and soil fertility and irrigation water) negative perceptions. It is observed from the table that response of farmers regarding marketing was negative and all of them received assistance.

Table 28: Perception of kinnow growers regarding the on on-farm finance, market, and infrastructure in Fazilka district of Punjab

Particulars	Negative	No Change	Low	Moderate	High
1. On-Farm					
Input cost/quality	1 (0.5)	12 (6)	96 (48)	41 (20.5)	50 (25)
Un-skill labour	3 (1.5)	13 (6.5)	94 (47)	27 (13.5)	63 (31.5)
Soil fertility	1 (0.5)	38 (19)	129 (64.5)	24 (12)	8 (4)
Electricity supply	0 (0)	53 (26.5)	114 (57)	10 (5)	23 (11.5)
Irrigation water	1 (0.5)	18 (9)	82 (41)	48 (24)	51 (25.5)
Climatic condition	0 (0)	11 (5.5)	56 (28)	69 (34.5)	64 (32)
2. Finance					
Poor access to establishment credit	20 (10)	118 (59)	35 (17.5)	26 (13)	1 (0.5)
Rate of interest	0	15	45	75	65

	(0)	(7.5)	(22.5)	(37.5)	(32.5)
No subsidy on planting material	0 (0)	16 (8)	67 (33.5)	46 (23)	71 (35.5)
Lack of insurance of orchard	0 (0)	25 (12.5)	44 (22)	28 (14)	103 (51.5)
Low price of output (market)	0 (0)	5 (2.5)	11 (5.5)	39 (19.5)	145 (72.5)
Lack of forward contract	0 (0)	28 (14)	62 (31)	15 (7.5)	95 (47.5)
Delayed payment	3 (1.5)	27 (13.5)	118 (59)	28 (14)	24 (12)
3. Marketing					
Low price of output	0 (0)	5 (2.5)	11 (5.5)	39 (19.5)	145 (72.5)
Lack of grading facility	3 (1.5)	77 (38.5)	92 (46)	15 (7.5)	13 (6.5)
Lack of waxing facility	3 (1.5)	84 (42)	97 (48.5)	12 (6)	4 (2)
Lack of processing facility	3 (1.5)	83 (41.5)	29 (14.5)	23 (11.5)	62 (31)
Long distance to Mandi	1 (0.5)	56 (28)	81 (40.5)	38 (19)	24 (12)
4. Infrastructure					
Poor transportation facility	3 (1.5)	85 (42.5)	85 (42.5)	14 (7)	13 (6.5)
No/poor financing in value chain	3 (1.5)	56 (28)	46 (23)	58 (29)	37 (18.5)
Poor flow of market information- price, arrival etc.:	0 (0)	20 (10)	61 (30.5)	55 (27.5)	64 (32)

3.15 Major risks in kinnow production

Risks associated with farm operation, and they are like a shadow which follows farm operation at each stage. Probably there is no farmer in the world without facing any farm risk. Table 29 shows the significant risks in kinnow farming. Among the quantified risk regarding ranks on kinnow production majority of the farmers experienced the distribution failure followed by transportation failure and change in financial terms and condition. It is interesting to note here that pest and disease output price change was not found to be the significant risk among the kinnow growers and both of these have been ranked as fifth and sixth respectively

Table 29: Major risks in kinnow production in Fazilka district of Punjab

Particulars	I	II	III	IV	V
Sudden change in output price	6	16	30	32	115
Prolonged decline in output price	6	7	23	84	79
Failure of contractual agreement	112	20	13	29	26
Change in finance terms and condition	115	25	29	11	20
Natural events or disaster	18	18	31	45	87
Pest and diseases related risks	5	5	20	45	125
Transport failure	147	28	13	5	6
Distribution failure	155	27	12	4	1
Change in government policies	107	48	23	11	11

*1= not important 5= more important

3.16 Status of a professional organization or producer association

Professional organization/ producer organizations are well known for their effort in bringing the farmers together for achieving common agenda, say for example cultivation, marketing, etc. The study revealed that contractual arrangement with a food processor, retailers, and exporter ranked 1st among the farmers followed by aggregation of supply and commercialization and extension service. Hence, it can be concluded from the study that contractual arrangement performed well among all the alternatives.

Table 30: Status of a professional organization or producer association in Fazilka district of Punjab

Activity	I	II	III	IV	V
Aggregation of supply and commercialization	120	11	15	22	32
A contractual arrangement with a food processor, retailers, exporter	135	65			
Information and training					
Extension service	113	10	15	28	34

1 = totally ineffective, 5 = fully effective

3.17 Mechanisms for reducing risk

There must be some risk mitigating efforts to curb farmers to enter into the vicious cycle of poverty. Today's agriculture provides some mitigating plans. Many agencies are also trying hard to protect the farmer from various risks. In the study area, farmers' ranked condition in business contracts in which they are involved (156 farmers) as the first mechanism that helps them in reducing risk

followed by formal insurance and crop diversification (Table 31). The study area uses common and regular mechanism and thus, has no unique mechanism for mitigating risk.

Table 31: Mechanisms that help in reducing risk (rank 1 to 5)

Particulars	I	II	III	IV	V
Government polices	126	33	27	6	8
Crop diversification	140	31	14	6	9
A condition in business contracts in which you are involved	156	29	8	5	2
Better infrastructure like better road, telecommunication, storage facilities	131	46	12	5	6
Investment in new equipment, machinery or more advanced technology	113	40	26	16	5
Informal credit and insurance mechanisms (friends and relatives)	125	32	26	13	4
Formal insurance contract	145	38	9	5	3
Assistance from bank	41	21	37	47	54
Personal savings	15	16	25	48	96
Sale of assets	112	45	19	10	14

3.18 Factor in accessing credit

Credit is an essential input in agriculture that has multiple effects on production and farm income. The study area was tested for availing credit and regarding the cost of credit. The primary cost that farmers he to pay were the transaction cost as it has been ranked 1st by as many as 179 farmers. Lack of information on credit product and small scale of operation found to be next major limiting factor that has been ranked by the farmer as first.

Table 32: Major limiting factor in accessing credit in Fazilka district of Punjab

Particulars	1st	2nd	3rd	4th	5th
High interest rates (mention how much)	24	22	42	31	81
Lack of collateral (types of collateral requested to provides)	99	47	23	18	13
High transaction costs	179	8	4	8	1
Lack of information on a credit	163	18	9	7	3

product					
High risk of default in the operation	92	27	24	20	37
Small scale of my operation	150	22	11	7	10

1 = least important 5= more important

3.19 Suggestions for improving kinnow cultivation and marketing in Punjab

Farmers were asked to suggest the measures for improving kinnow cultivation and marketing. The study found that majority of the farmers' suggested reducing trader's cartel in the market. Interestingly about 68.31 percent farmers have recommended eliminating the malpractices, and about 61.85 suggested to improve market information. Thus, only 17.5 percent of the farmers have desired export facility.

Table 33: Suggestions by farmers for improving kinnow cultivation and marketing in Punjab

Sr. No.	Suggestions	Percent of respondent farmers
1.	Traders cartel in the market	74.21
2.	Malpractices eliminated from the market	68.31
3.	Improved market information system	61.85
4.	Creation of cold storage facilities/ processing infrastructure	54.37
5.	Steps to reduce intermediaries in the market	35.64
6.	Provision of input/ machinery subsidy	27.82
7.	Provide disease-free planting material	26.45
8.	Need export facility	17.54

This study also suggested, to upgraded marketing infrastructure which will be made accessible by traditional as well as alternative marketing channels. Besides these interventions, the competitiveness of the farmer will be improved by capacity building. Considering the scope for further improving the sustainability of agriculture, value addition to kinnow is a most crucial factor. Development of various business activities either supporting kinnow processing will add to the income of the kinnow growers.

For entry into the mainstream segment of the world market, 'taste development' has to be the fundamental element of the strategy to promote Kinnow(Dawn, 2018). Many people were not aware kinnow fruit test. For taste development, an extensive campaign of tasting arrangements and free sampling at points of sale would be required. Such a campaign on a small scale is being helped to promote kinnow marketing.

Currently, orange varieties in the world market are already categorized into 'table oranges' and 'juicy oranges.' A similar distinction can be made between table mandarins and juicy mandarins. In the

ethnic market segment, the availability of kinnow needs to be increased. Currently, supplies are intermittent, and a regular demand-supply pattern is not established. Indian government can help overcome this problem by coordinating with importers to stagger their shipments during the entire season.

4. Suggestions and policy implication

The epidemic of inequality has roots in agriculture, as the assessment of inequality starts from the village and village income is sourced from agriculture. It is evident from the present study that inequality is prevalent among the kinnow growers of the study area. Hence in this report, an extended effort has been made to suggest some of the policy measures under the following headings and these are recommendatory and not ideal one.

Production-related:

- Majority of farmers of the study area holding large farm tracts and bestowed with the excellent agro-climatic condition for kinnow cultivation. Hence there is a need for creating awareness to know their land potential and also for expanding the area under kinnow crop.
- Factor abundance with lack of potential use is observed from the study; concerned agencies advised take steps to ensure better resource utilization which would significantly help in reducing income inequality.
- Given the fact that cost of production is rising over the years in kinnow production and the region is in the dearth of guidelines for reducing cost and since prevention is better than cure, farmers lack the information concerning plant protection, early warning of pest and disease attack and climate forecast. Therefore it's it advised establishing an automatic mechanism by involving the various agencies to deliver the early warning messages to farmers for possible risk aversion.
- Yield improvement is noticed over the years, but this has not sufficed to reduce the income inequality. The region demands a higher growth through the technical package that could further stimulate the yield.
- Income inequality in the present study has not been made any empirical proof to conclude unemployment as the reason, but in one or the other form, this sector is facing inequality linked with persistent unemployment that needs to be addressed with a best-fit policy which furthers the employment opportunities.

Infrastructure related:

- There is an urgent need for the establishment of primary processing centres, mobile centres and ripening chambers which acts as a primary guard against spoiling of fruit.
- Improvement of available storage infrastructures and expanding the area of operation and number of existing plant health clinics well as disease forecasting units.

Risk related:

- There is need to improve the distribution channel and transportation facility which is affordable to farmers. Transportation of goods in India is much costlier than the value of product hence farmers often land in risk trap when it comes to transport their produce. Hence government should regulate the transport agencies by capping on the exorbitant price charged by transporters.
- Insurance products are fairly penetrated and need the further involvement of stakeholders with the renewal of existing, new innovative, attractive products to reap the benefits when farm business fails to cover the cost. The insurance reduces the widening of the income gap between individual.
- Farmers adopting kinnow cultivation did not witness any reduction of household expenditure in the study area. Hence, as it is a crucial indicator regarding determining inequality, authorities must caution the farmers.

Markets and value chain improvement

- Volatile market price attributed to less remunerative prices to the kinnow growers and it is suggested to establish a regulatory mechanism that checks the price fluctuation and coordinates it with the farmer to increase their income.
- The pattern of kinnow disposal in the region is not uniform most of the time village traders exploit farmers by delaying their payment for various reasons and even though farmers need to dispose of them because of ease of access. To overcome this transaction of village traders should completely make through a financial institution, which ensures the transparency in money dispersal through e-KYC.
- Farmers of the area witnessed the unfair trade practices which severely affected the entire farming community hence the concerned authorities are advised to extend the online trading platform (e-NAM) to cover the entire kinnow growing area in a phased manner.
- Perishable, value addition has the potential for kinnow. Kinnow heads its way to market from a farm in winter. As summer approaches demand value-added fruit products increases. Kinnow value-added fruits would undoubtedly create market share against other fruit because of

freshness, taste that has not much deteriorated due to short duration storage. With the increasing demand, the new product will emerge and gives consumer choice and chance to farmers for getting more income if they store/ tune their production. It serves the purpose of reducing income inequality

- Farmer is incurring high transaction cost which is hindering factor for accessing credit therefore care should be taken by lending agencies to reduce the transaction cost by giving appropriate credit, removal of intermediaries and introduction of paperless loans that reduce both cost and energy.

Governance-related:

- In India, a top-down approach is entirely unsuccessful, and policies formed thus often looks paralyzed at various levels of implementation. Since the region has strong farmer cooperatives, government agencies must go to bottom-up approach frame their policy instrument by involving cooperative societies in the policy process.
- Cooperative has often failed to trade their produce because of the presence of the trader's cartel in the market hence there must be either legislative mechanism or ground level organization to eliminate this harmful practice.

Above, all there must be a consistency in government policy that backs the farmers under risk and making them feel relief under uncertainties. Since the kinnow is important crop for the livelihood of Punjab farmers' special dedicated package is the need of the hour to achieve the early hours of doubling farmers' income.

5 Conclusion

Fruit-and-vegetable distribution in India suffers significant post-harvest losses in the supply chain primarily due to the perishable nature of fresh produce and its sensitivity to handling damages. No doubt investment in kinnow orchards is a profitable enterprise for the orchardists. However, the stakeholders in the value chain can reduce the loss along the supply chain, and high cost of investment, by utilizing the government incentives. The cultivation of fruit crops like kinnow is one of the options for manifold increase in farm income. The cultivation of kinnow should be advocated among farmers by providing timely information pertaining to crop production and protection technologies. Farmers should be encouraged for cultivation of fruit crops by incentivizing them through implementation of crop development programmes and arrangement for disposal of produce at remunerative prices. The

adequate scientific storage for longer shelf life of fruits and processing facilities may also further increase in value addition and higher returns to growers.

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Appendix-I

Nutritional status of kinnow

Table 34: Nutrient content in kinnow

Physiochemical	Quantity/100 gm
Average Vitamin C (mg/100ml juice)	31.0
Calcium (mg/ 100 ml)	40.0
Iron (mg/ 100 ml)	0.4
Phosphorus (mg/ 100 ml)	18.0
Average TSS (%)	11.5
Average Acidity (%)	0.9
Average TSS/acid ratio	12.0 – 14.0 : 1

Irrigation

Methods of irrigation:

1. Basin system: young plant to 7 – 8 years
2. Flood irrigation: in grown up and old orchard
3. Drip irrigation : due to the scarcity of water

Irrigation water should not be allowed to direct contact with trunks to avoid susceptibility to bark diseases. This can be avoided by providing earth mound around the trunks of the trees well below the stock scion union.

Table: 35 Quantity of water used / month in LPH drip irrigation in kinnow production

Age (yrs)	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.
1	3.5	5.8	7.2	7.5	6.9	6.6	5.4	4.0	2.4	1.5	1.5	2.4
2	8.2	13.0	16.2	16.9	15.5	14.9	12.1	9.0	5.4	3.4	3.5	5.4
3	14.5	23.0	28.8	30.1	27.6	26.5	21.7	16.1	9.5	6.1	6.2	9.5
4	44.4	51.8	64.8	67.8	52.2	59.5	48.7	36.2	21.5	13.6	13.9	21.5
5	58.0	92.1	115.2	120.6	110.5	105.8	86.7	64.3	38.2	24.1	24.6	38.2
6	58.0	92.1	115.2	120.6	110.5	105.8	86.7	64.3	38.2	24.1	24.6	38.2
7	65.2	100.1	120.5	142.0	135.0	120.8	95.7	73.8	58.0	44.0	32.6	58.0

Time of irrigation

March to June: at one-week interval

November to Feb: at 15 days interval

Manuring and Fertilization

1. Pre-plant manuring

Available organic manures should be applied and well mixed with the soil before planting. This practice is widely adopted in many developing countries. Typically, a pit about 1m in diameter and 1m deep is dug; compost is mixed with the soil that has been dug out, and the mixture is then filled into the pit before the tree is planted. Tree planting pits are not used in developed countries, because of the scarcity of organic manure. On acid soils, lime is usually added to the mixture for pH adjustment, or where organic manure is scarce; soil preparation merely consists of liming. On some saline soils in pre-plant irrigation is often used to leach excess salts from the surface soil.

Table 36: Recommended fertilizer doses for plants of different age

Age of the Tree	Dose per Tree		
	FYM (Kg)	Nitrogen (gm)	Potash (gm)
1-3 years	5-20	50-150	25-75
4-6 years	25-50	200-250	125-150
7-9 years	60-90	300-400	175-225
10 years and above	100	400-800	225-450

2. Post-plant fertilizer applications

Table 37: Schedule of fertilizer application during the year

Month	Particulars
Jan– Feb	A full dose of FYM + one-third nitrogen + full dose of P and K
April	One-third of nitrogen (before flowering)
August	One-third of the nitrogen
Micronutrients	Zinc and Manganese
April –May	Zinc sulphate (2.25kg. Zinc sulphate + 1.12 kg of lime 450 lit. of water)
October– Nov	Zinc + Manganese (1.3 kg Zinc sulphate, 900g manganese sulphate, 675g lime, 450 gm urea in 450 lit of water)

Pruning of kinnow

The pruning of citrus-trees begins in the nursery. All branches that start within a few centimetres of the union are removed, leaving about half a meter of the clean straight stem with a few well-placed branches. All unwanted branches are removed once a month during the first year after planting, and once in two to three months in subsequent years. The bearing trees require little or no pruning. After the crop was picked, the branches touching the ground should be cut close to the laterals so that no stubs were formed. All diseased, injured and crossing branches, water-sprouts and deadwood removed periodically

Harvesting season kinnow in India

Table 38: Harvesting season of kinnow in India

The harvesting season in different seasons in different states of India is given in the following table.

State	Start	Peak	End
J&K	Oct	Nov	Dec
H.P.	Nov	Jan	March
Haryana	Nov	Dec- Feb	Feb
Rajasthan	Dec	Jan	Feb
Punjab	Nov	Jan- Feb	March

Climate and fruit quality

- In the hotter and arid location's production of fruits(KrishiSewa, 2018) is high in weight, circumference, and volume.
- Peel thickness and Nitrogen are more than usual along with well-developed colour, flavour, solid acid ratio, and juice content.

Climate and physiological disorders

- Interaction of climate and mineral nutritional bound physiological disorders are widely recognized. Trees showing nitrogen deficiency symptoms produced few flowers irrespective of temperature.
- No. of flowers increases with increasing phosphorus doses from 40-160 mg/ kg provided there is sufficient leaf N (3.0 %) content.

- In arid regions citrus trees are highly prone to heat injury/sunburn, drying fruit, burning, and defoliation of leaves, burning, and death of bark and slight discoloration of fruit skin.
- High temperature and high intensity of solar radiation are two environmental factors causing injury to fruits and trees.
- Wind induces abrasion injury on susceptible fruit (when small) due to rubbing of the leaf against fruit causing lesions.

Diseases and pest of kinnow

1. Gummosis / leaf fall / fruit rot

Symptoms: The disease occurs especially in the high rainfall areas. Gumming takes place on the surface of the attacked bark. The bark shows conspicuous brown staining along with hardened masses of gum on the surface. The fungus *Phytophthora* produces blight symptoms on leaves.

Management: Resistant rootstocks like sour orange (*Citrus aurantium*), *Poncirus trifoliate* or its hybrids like citranges and Cleopatra mandarin are used. Proper drainage facilities are to be provided, and excess irrigation can be avoided. A healthy tree is to be protected by painting the trunk with Bordeaux mixture up to a height of about 50 to 75 cm above the ground level once in a year. Two sprays with drenching either by Fosetyl-Al (2.5g/l) or Metalaxyl MZ-72 (2.75g / one water) covering the whole plant canopy and basin of the affected plant at 40 days interval after the onset of monsoon should be followed. For the control of gummosis, scraping of the affected parts followed by application of Metalaxyl MZ-72 paste is advised (AgriCare, 2018)**.**

Anthracnose / wither tip/ dieback of kinnow

Symptoms: The disease affects branches; the branches begin to wither from the tip downwards. The dieback gradually progresses downward with the leaves turning yellow, withering and drooping and gum formation on the stem.

Management: Such trees may be sprayed thrice with Carbendazim 0.1 percent or Captafol 0.2% after pruning. Drainage facilities should be improved, and trees need irrigation. Periodical spraying with Bordeaux mixture 1.0 % or Ferbam or Zineb or Captan o.2 % gives excellent control. Zinc sulfate, Copper sulfate and lime mixture at 0.6: 0.2: 0.5 kg in 100 liters of water is also sufficient.

3. Greening of kinnow

Symptoms: A diversity of foliar chlorosis occurs. A type of molting position, become leathery and develop prominent veins and dull olive green color. Green circular dots appear on leaves. Many twigs become upright and produce smaller leaves. The side exposed to direct sunlight develops full orange colour, but the other side remains dull olive green.

Management: Removal of affected and unproductive trees and by replanting disease free budded plants raised on rootstock has been recommended. The insect vector is controlled by spraying Monocrotophos 0.05 % at periodical intervals which help to check the spread of the disease. Tetracycline 500 ppm spray at fortnightly interval reduces the incidence by inhibiting the multiplication of the pathogen(Agri Care, 2018)**.**

Post-harvest management

Grading

Fruits graded by their size and color. The fruits that have oblong, high collard, immature, puffy, blemished, deformed, deep green colored, bruised and diseased were removed during the sorting operation (Orange-NHB, 2018).

Storage

Green or fully ripe fruits can be stored in an evaporative cooling chamber at 8-10 ^{0}C & 90-95% relative humidity for three weeks after post-harvest treatment with Bavistin (1000 ppm.). Yellowish green fruits develop beautiful yellowish orange in this chamber(Orange-NHB, 2018).

Packing

The harvested fruits were usually washed with chlorine (1000 ppm.), and after removing the surface water, they are coated with stay fresh high shine wax (2.5%) containing Bavistin (4000 ppm.) and finally dried at 50^0-55^0 C in the tunnel dryer.

Fruits are usually packed in wooden boxes for distant markets, while for local marketing baskets of split bamboo and mulberry are used. Chopped straw and dry grasses were used for padding. The fruits should be cleaned and polished lightly with a piece of cloth, before wrapping them in tissue paper or newspaper. Use of ventilated corrugated fibreboard cartons in place of wooden boxes highly beneficial for proper packing.

Transportation

Mandarins are transported by rail or road as ordinary cargos without refrigeration.