



CITRUS SURGE: EXPLORING THE GROWTH TRENDS OF KINNOW PRODUCTION IN PUNJAB

Dr. Jyoti Garg

Assistant Professor and Research Supervisor,
University College Miranpur,
Punjabi University, Patiala

Komal Batta

Research Scholar,
Department of Economics,
Punjabi University, Patiala

ABSTRACT

Kinnow is an important citrus fruit having juicy content, health benefits, great yield and wider adaptation for diverse environment conditions. In India, Punjab state holds the position of being the second greatest producer of kinnow. The present study examines the growth and instability of area, production and productivity of kinnow fruit in Punjab. It has been observed that the province of Punjab has experienced a consistent increase in the area, output, and productivity of kinnow from the year 2000-01 to 2022-23. The compound annual growth rate and average annual growth rate of area, production and yield of kinnow indicate a notable diversification of crops in the region, particularly in relation to this specific fruit. The analysis of decomposition effect shows the area contributes more in the production of kinnow as compared to yield and the interaction of both area and yield. The instability index indicates that both the area and yield instability are responsible for the production instability. But instability in the area is high as compared to yield. So, it has more influence on the production of kinnow. The study highlights the important position of kinnow in total production and area under fruits in Punjab. The district wise analysis in the study shows that largest kinnow producing districts of Punjab are Fazilka, Sri Muktsar Sahib and Hoshiarpur.

Key Words: *Kinnow, environment conditions & production and productivity of kinnow fruit in Punjab*

1. INTRODUCTION

The Mandarin citrus fruit is extensively cultivated in various nations like India, Pakistan, Morocco, United States, Iraq, South Africa, and Spain. In India, the proportion of mandarin types in the overall citrus crop amounts to 42.11 percent. It is observed that mandarin orange varieties such as *kinnow* mandarin, Nagpur, Khasi, and Darjiling occupy a significant proportion. Among the various cultivars of mandarin oranges found in India, the *kinnow* mandarin occupies a prominent position in terms of its production levels, productivity rates, juice content, and nutritional potential as a superfood. The *kinnow*



citrus fruit is a result of a hybrid process conducted in 1915 by Dr. H.B. Frost at the Citrus Research Centre, which is associated with the University of California, Riverside in the United States. This particular hybrid was created by crossing the King citrus nobillis species with the Willow Leaf citrus deliciosa species. Punjab is positioned as the second-largest producer of mandarin, including mandarin orange, *kinnow*, and oranges, under the citrus category. The predominant citrus variety of commercial significance in Punjab state is the Mandarin *kinnow*. Over the past few years, there has been a significant growth in the area, production, and productivity of *kinnow* in the Punjab region. It represents the largest proportion of overall fruit production in the region of Punjab, and its cultivation has experienced a significant increase among fruit cultivators.

2. OBJECTIVES

- To investigate the growth of area, production and yield of *kinnow* in Punjab.
- To analyze the contribution of area, yield and their interaction on production of *kinnow* in Punjab.
- To measure the instability in the area, production and yield of *kinnow* in Punjab.
- To study the share of *kinnow* among the total area and production of fruits in Punjab.

3. METHDOLOGY

The study mostly relies on secondary data obtained from many government sources. The data pertaining to the production of mandarin on a state-wise basis is obtained from the publication titled "Horticultural Statistics at a Glance," which is issued by the Ministry of Agriculture and Farmers' Welfare. The relevant data pertaining to the geographical extent, agricultural output, and productivity of *kinnow* in the Punjab region has been acquired from the Statistical Abstract of Punjab spanning the time period from 2000-01 to 2022-2023. The data related to the number of *kinnow* farmers has been obtained from Directorate of Horticulture, Punjab. In order to examine the expansion of area, production, and yield of *kinnow*, the compound annual growth rate (CAGR) and annual growth rate (AGR) have been computed.



To analyze the percentage contribution of area, yield and their interaction towards the production of *kinnow*, the technique of decomposition has been adopted. The change in the production of *kinnow* between any time periods can be expressed as:

Change in production=Yield effect +Area effect+ Interaction effect

$$\Delta P = A_0 \Delta Y + Y_0 \Delta A + \Delta A \Delta Y$$

Where, $\Delta P = P_n - P_0$, $\Delta Y = Y_n - Y_0$, $\Delta A = A_n - A_0$

A_0 , P_0 and Y_0 are area, production and yield in base year and A_n , P_n and Y_n , are area, production and yield in current year. ΔA and ΔY represent change in area and yield, respectively. This formula is discussed by Dhakre, D.S. and Bhattacharya, D. (2013). The instability index is estimated by the formula called Cuddy Della Valle Index (Cuddy and Della Valle, 1978);

$$I = CV \cdot 1 - \sqrt{1 - AdR^2}$$

where, I = Instability index (in percent)

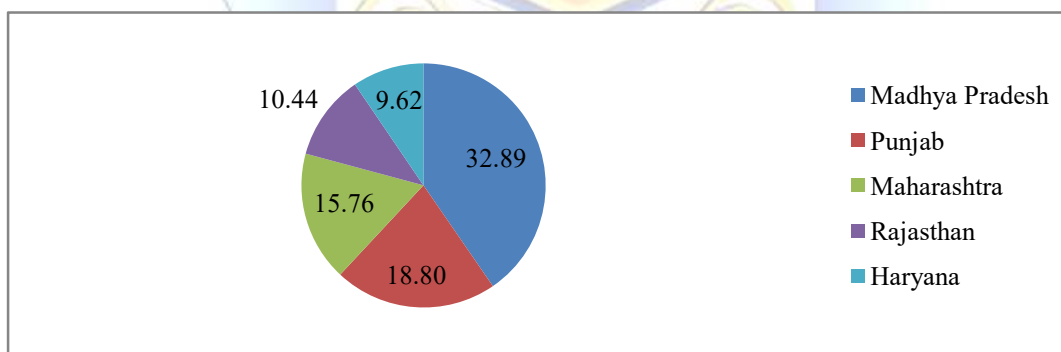
CV = Coefficient of Variation (%)

AdR^2 (Adjusted R^2) = Coefficient of determination

4. KINNOW PRODUCTION IN INDIA

Kinnow, a citrus fruit, is cultivated in several regions across India. However, certain states possess a more favorable climate for the cultivation of *kinnow*. They possess a greater proportion of both the overall land area and the total yield of *kinnow*.

Chart 1 Highest Mandarin (M. Orange, *Kinnow*, Orange) Producing States in India



Source:Data Extracted from Horticultural Statistics at a Glance (2022-23)



In India, Madhya Pradesh is the highest mandarin orange and *kinnow*-producing state which produces 32.89 percent of the overall output of them. Punjab ranks second in terms of mandarin production, accounting for 18.80 percent of the whole output. The states of Maharashtra, Haryana, and Rajasthan also contribute significantly to the production of mandarin oranges.

5. ANALYSIS OF AREA, PRODUCTION AND YIELD OF *KINNOW* IN PUNJAB

5.1 Measure of Compound Annual Growth Rate (CAGR): The state has experienced an increase in the demand for *kinnow* fruit in recent years. The rise in both domestic and international demand for this crop results in a corresponding increase in its economic significance. To analyze the growth, the CAGR has been calculated for area, production and yield of *kinnow* in Punjab in the following Table.

Table 1: Area, Production and Yield of *Kinnow* in Punjab (2000-01 to 2022-23)

Year	Area (Hectares)	Production (Metric Tonnes)	Yield (KG/Hectare)
2000-01	11434	171510	15000
2001-02	12325	201015	16309.53
2002-03	14643	227325	15524.48
2003-04	17189	257835	15000
2004-05	19360	290400	15000
2005-06	22887	343305	15000
2006-07	27606	414090	15000
2007-08	29705	591319	19906.38
2008-09	35619	736645	20681.24
2009-10	38837	876358	22565.03
2010-11	41207	872626	21176.64
2011-12	42795	915005	21381.12
2012-13	43851	988633	22545.28
2013-14	47101	1017725	21607.29



2014-15	48182	1108618	23008.97
2015-16	49356	1140312	23103.82
2016-17	50147	1162455	23180.95
2017-18	51649	1208423	23396.83
2018-19	53359	1254328	23507.34
2019-20	54243	1328996	24500.78
2020-21	44752	1177544	26312.65
2021-22	46841	1254598	26784.18
2022-23	47862	1282211	26789.74
CAGR (%)	6.81	9.91	2.9

Source: Statistical Abstract of Punjab and authors' computation

The Table presented above displays data pertaining to the area of cultivation, production, and yield per hectare for *kinnow* in the Punjab region from the year 2000-01 to 2022-2023. The output of *kinnow* is observed to have a consistent upward trend over successive years. The area under *kinnow* crop also showed a positive growth. The area under *kinnow* has been decreased in last few years due to some marketing and diseases problems in some areas of Punjab. The per-hectare yield of *kinnow* witnessed an increase due to the implementation of diverse seed varieties, insecticides, and enhanced production practices. The CAGR of area is more responsible for the increased production of *kinnow* as compared to yield.

5.2 Measure of Average Annual Growth Rate (AAGR): In Punjab, *kinnow* fruit experienced positive growth in area, production and yield in almost all the years from 2000 to 2023. The following table analyzes the annual growth rate.

Table 2: Annual Growth Rates of Area, Production and Yield of *Kinnow* in Punjab (2000-01 to 2022-23)



Year	Annual Growth Rate of Area (in percentage)	Annual Growth Rate of Production (in percentage)	Annual Growth Rate of Yield (in percentage)
2000-01	-	-	-
2001-02	7.79	17.2	8.73
2002-03	18.8	13.08	-4.81
2003-04	17.38	13.42	-3.37
2004-05	12.63	12.63	0
2005-06	18.21	18.21	0
2006-07	20.61	20.61	0
2007-08	7.6	42.79	0
2008-09	20.00	19.5	32.7
2009-10	9.03	24.01	3.89
2010-11	6.1	-0.42	9.1
2011-12	3.85	4.85	-6.15
2012-13	2.46	8.04	0.09
2013-14	7.41	2.94	5.44
2014-15	2.45	8.93	-0.41
2015-16	2.43	2.85	6.48
2016-17	1.6	1.94	0.41
2017-18	3	3.95	0.33
2018-19	3.31	3.79	0.09
2019-20	1.65	5.95	0.47
2020-21	-17.50	-11.39	7.39
2021-22	4.66	6.54	1.79
2022-23	2.17	2.20	0.02
Average Annual Growth Rate	7.07	10.07	2.88

Source: Computed from Statistical Abstract of Punjab



The table presented above illustrates the annual growth rate, or percentage change, in the area, output, and yield of *kinnow* in the Punjab region. With the exception of the year 2020-21, a positive growth rate has been observed annually. The reason for less production in this year was the warmer temperature during the flowering window period in February and March leading to a decrease in flowering. Some farmers had to uproot their plants which lead to the reduction in the area under *kinnow*. In the year 2022-23, the production increased but it was not much high as there was problem of acute short supply of canal water and unexpectedly higher temperature during the flowering stage of the *kinnow*. The region under *kinnow* exhibits an average yearly growth rate of 7.07 percent. The output of *kinnow* experienced a negative yearly growth rate over the period of 2010-11. The potential cause of the crop's condition could be due to some climate conditions or some crop disease. The *kinnow* production has an average annual growth rate of 10.07 percent. In certain years, the annual growth rate had a negative trend in terms of yield. The primary factor contributing to the growth in production is the expansion of the *kinnow* cultivation area.

5.3 Decomposition Model to Find the Contribution of Area, Yield and Their

Interaction in *Kinnow* Production: With the help of additive decomposition model the percentage contribution of area, yield and their interaction in production of *kinnow* in Punjab has been estimated and presented on the following Table:

Table 3: Contribution of Area, Yield and their Interaction in the Production of *kinnow* in Punjab (2000-01 to 2022-23) (in percent)

Particular/Component	Area Effect	Yield Effect	Interaction Effect
<i>Kinnow</i>	49.19	12.13	38.66

Source: Calculated from Table 1.

The above Table reveals that the contribution of area effect in the production of *kinnow* is higher as compared to the yield and interaction effect. It is 49.19 percent which is quite high. The yield has least effect on the production which is only 12.13 percent. It indicates that the area is more responsible for the increased production of *kinnow* in Punjab.



5.4 Instability Index of Area, Production and Yield of *Kinnow*: The data related to the area, production and yield of *kinnow* in Punjab shows the variability during the time period of 2000 to 2023. The instability in the data has been measured and compared in the following table.

Table 4: Comparison of Instability Index of Area, Production and Yield of *Kinnow* in Punjab

Area	Production	Yield
15.49	13.05	6.52

Source: Computed from Table 1.

The above table depicts that both the area and yield variability are responsible for the production variability. But variability in the area is high as compared to yield.

6. SHARE OF *KINNOW* IN TOTAL AREA AND PRODUCTION OF FRUITS IN PUNJAB

The *kinnow* fruit is often regarded as the dominant fruit variety in the Punjab region, mostly due to its extensive cultivation and significant contribution to the overall fruit production.

Table 5: Percentage Share of *Kinnow* in the Total Area and Production of Fruits in Punjab (2000-01 to 2022-23)

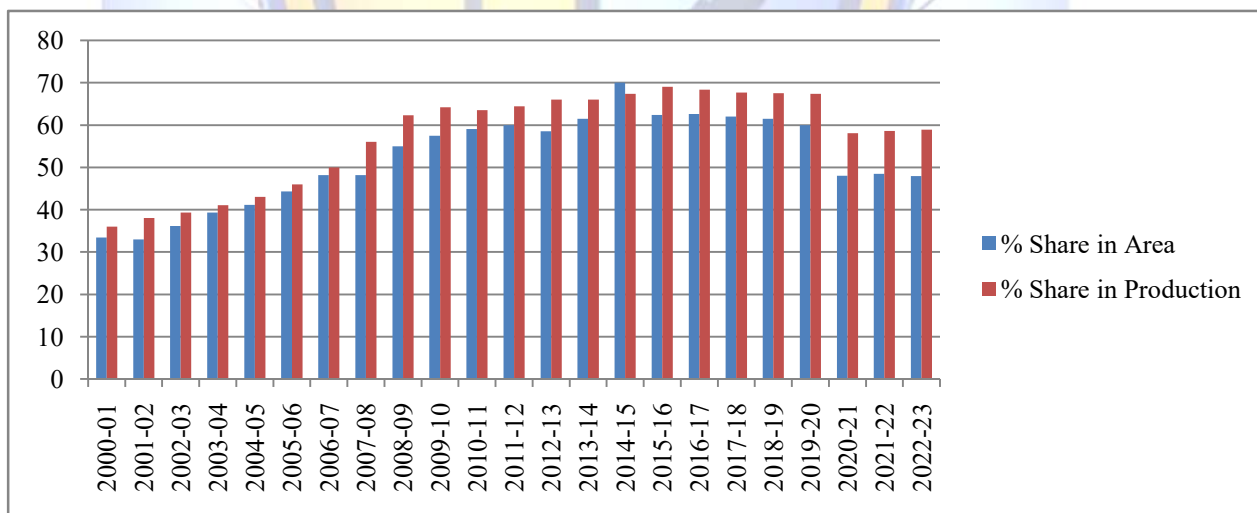
Year	Share in Area	Share in Production
2000-01	33.42	36.00
2001-02	33.00	38.00
2002-03	36.16	39.29
2003-04	39.31	41.04
2004-05	41.11	43.00
2005-06	44.32	46.00
2006-07	48.17	50.00
2007-08	48.20	56.02
2008-09	55.00	62.27



2009-10	57.49	64.19
2010-11	59.02	63.54
2011-12	60.00	64.44
2012-13	58.54	66.00
2013-14	61.49	66.03
2014-15	70.00	67.40
2015-16	62.40	69.00
2016-17	62.62	68.36
2017-18	62.00	67.71
2018-19	61.49	67.55
2019-20	60.00	67.38
2020-21	48.00	58.08
2021-22	48.44	58.57
2022-23	47.97	57.87

Source: Computed from the Statistical Abstract of Punjab

Chart 2 Percentage Share of *Kinnow* in the Total Area and Production of Fruits in Punjab





The data shows that the contribution of *kinnow* to the overall fruit output amounts to a noteworthy 57.87 percent and share in area is 47.97 percent. So, its a highly significant fruit in the region of Punjab.

7. LARGEST *KINNOW* PRODUCING DISTRICTS IN PUNJAB

The *kinnow* fruit is produced in almost all the districts of Punjab. But there are mainly three districts where it is cultivated in huge area.

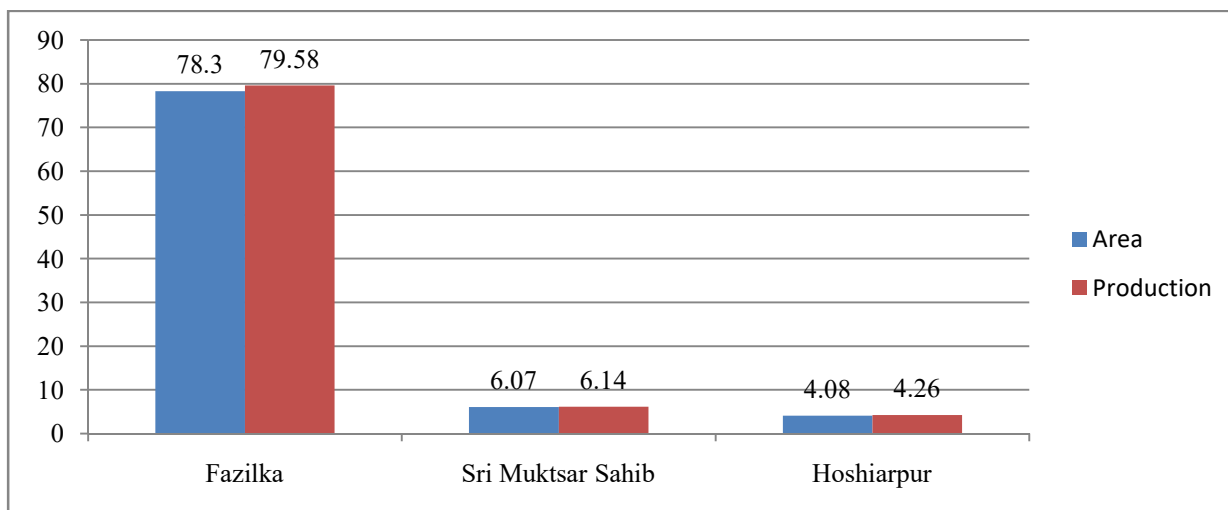
Table 6: Largest *Kinnow* Producing Districts in Punjab

Districts	Area(Hectares)	Production (Metric Tonnes)	Yield (KG/ Hectare)
Fazilka	37479	1020403	27225
Sri Muktsar Sahib	2910	78755	27063.57
Hoshiarpur	1955	54679	27912.12

Source: Statistical Abstract of Punjab 2022-23

The total land area dedicated to cultivating the *kinnow* crop in the Punjab region is to 47,862 hectares. The district of Fazilka holds the top rank in terms of the total area allocated to *kinnow* cultivation, which amounts to 37,479 hectares. On the other hand, Sri Muktsar Sahib and Hoshiarpur occupies second and third rank respectively. The overall production of *kinnow* in the Punjab region amounts to 12,82,211 metric tons. The Fazilka district exhibits the biggest production hub of *kinnow* followed by Sri Muktsar and Hoshiarpur. quantity.

Chart 3 Percentage Share of Largest *Kinnow* Producing Districts in Total Area and Production of *Kinnow* in Punjab (2022- 23)



Source: Computed from the Table 4.

The chart shows that the district of Fazilka possesses the largest proportion of land dedicated to cultivating *kinnow*, accounting for 78.30 percent of the total area. Sri Muktsar Sahib and Hoshiarpur district possesses second and third position respectively in terms of both area and production share.

8. MAJOR FINDINGS

1. It has been found that the compound annual growth rate (CAGR) of area under *kinnow* is 6.81 percent which is higher than the CAGR of yield which is only 2.9 percent. So, the major responsible factor for the high positive CAGR of *kinnow* production (9.91 percent) is area.
2. The investigation of the annual growth rates of area, production and yield of *kinnow* has showed the positive trend but in last three years (2020-2023) the area under *kinnow* and production has been decreased. The problems related to the marketing, crop diseases, water and soil management of this fruit in some area leads to the high fluctuation in the price of this highly perishable fruit. So, a number of farmers have uprooted their *kinnow* orchards and started cultivating the other plants i.e, poplar, safeda and other fruits i.e, litchi, plum, peach for which



- they are getting good price. Some have opted the wheat-peddy cycle due to good economic returns and ease of cultivation.
3. The decomposition effect has showed that the area has more influence (49.19 percent) than yield (12.13 percent) and their interaction (38.66 percent) on the production of *kinnow*. It means the production of *kinnow* has increased mainly because the area under this crop has been increased during these years.
 4. The instability index indicated that the variability in area under *kinnow* (15.49 percent) is more responsible to influence the variability in production as compared to yield.
 5. It is observed that the contribution of *kinnow* to the whole fruit output amounts to 57.87 percent and to the area is 47.97 percent. No doubt the area under *kinnow* has been decreased in recent years but it is still very high as compared to other fruits.
 6. The district wise analysis identified the Fazilka, Sri Muktsar Sahib and Hoshiarpur as the top three districts in terms of area, production, yield and number of *kinnow* farmers in Punjab.

CONCLUSION AND RECOMENDATIONS

The study highlights the significant proportion of *kinnow* within the overall fruit area and output in Punjab. There exist multiple factors that contribute to the high *kinnow* production in Punjab especially in three districts; Fazilka, Sri Muktsar Sahib and Hoshiarpur. Climate suitability, advancements in farming practices, research and institutional assistance, growing market demand, and export potential are some of them. However, it is crucial to acknowledge that despite the favorable progress in *kinnow* production, there exist certain obstacles pertaining to water accessibility, pest and disease control, and market volatility that necessitate attention in order to ensure the continued growth of *kinnow* production. The effective management of heightened production is an additional challenge that is crucial in order to mitigate wastage and optimize the advantages for both farmers and the economy. Several ideas can be proposed to efficiently manage the increased output, including strengthening the supply



chain, improving processing and value addition, implementing quality control measures, fostering research and innovation, promoting exports, and optimizing the utilization of surplus produce.

REFERENCES

1. Ali, S. and Jabbar, A. (2015). Growth and Variability in Area, Production and Yield of Selected Fruit Crops in Khyber Pakhtunkhwa. *Pakistan Journal of Agricultural Research*, 28(1), 64-69.
2. Government of India, Ministry of Commerce and Industry, Agricultural and Processed Food Products Exports Development Authority (APEDA). (2024). *Fresh Fruits and Vegetables*. https://apeda.gov.in/apedawebsite/six_head_product/FFV.htm
3. Government of India, Department of Agriculture and Farmer Welfare. (2024). *Horticulture Estimates*. <https://agricoop.nic.in/en/StatHortEst#gsc.tab=0> accessed on 18-08-2024
4. Government of Punjab, Department of Planning. (2001 to 2023). *Statistical Abstracts of Punjab*.
5. Kumar, R. (2020). Kinnow: Punjab's King of Fruits- A Review. *Just Agriculture-Multidisciplinary E- Newsletter*, 1(1), 294-298.
6. Kashish, Dhawan, V. (2017) A Study on Production and Trade Performance of Fruits in India. *Agricultural Research Journal* 54 (1), 108-113.
7. Ministry of Agriculture and Farmers Welfare. (2022-23) *Second Advanced Estimates of Area, Production of Horticultural Crops*.
<https://pib.gov.in/PressReleasePage.aspx?PRID=1841480> accessed on 12-04-2024
8. Sathiya, R., Naveenkumar, M., Senthilnathan, S., Gurunath, S., Nirmladevi, M., Banumathy, V. (2022) Growth Analysis and Instability in Fruit Area, Production, Productivity and Export in India. *Asian Journal of Agricultural Extension, Economics and Sociology*, 40 (9), 416-424.