



# Constraints in Adoption of Improved Kinnow Production Technology in Rajasthan, India: The Farmers Perspective

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## Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

## Article Information

DOI: <https://doi.org/10.9734/jeai/2024/v46i123153>

## Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/126527>

Original Research Article

Received: 07/09/2024

Accepted: 10/11/2024

Published: 23/12/2024

## ABSTRACT

The present study highlights the various barriers to the adoption of the improved kinnow production technology under National Horticulture Mission (NHM) by the farmers. Analysis of the constraints, including technical constraints, environmental constraints, financial constraints, marketing

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**Cite as:** Meena, Sanju, Manmeet Kaur, and Y. K. Singh. 2024. "Constraints in Adoption of Improved Kinnow Production Technology in Rajasthan, India: The Farmers Perspective". *Journal of Experimental Agriculture International* 46 (12):474-83. <https://doi.org/10.9734/jeai/2024/v46i123153>.

constraints and socio-personal & psychological constraints as experienced by the kinnow growers was the main objective of the investigation. Sri Ganganagar district of Rajasthan state was purposely selected as the district had highest numbers of registered farmers under NHM compared to other districts in the state. Findings of the study revealed that the major constraints faced by the kinnow growers in the adoption of improved kinnow production technology under NHM were “unsuitable land for kinnow orchard”, “scarcity of water for irrigation”, “inadequate subsidy”, “no timely sale of produce” and “traditional nature of farmers”. This might be due to the lack of awareness and training on the part of the kinnow growers regarding improved practices of kinnow cultivation. So, in order to mitigate these constraints more periodical training on various aspects of improved kinnow production technology should be organized and imparted to the kinnow growers at the grass root level to acquire more knowledge about the new techniques/improved practices of kinnow cultivation.

*Keywords: Constraints; farmers; adoption; improved kinnow production technology; NHM.*

## 1. INTRODUCTION

Horticulture is one of the most growing sectors in agriculture. It also provide nutrition food along with help and supply of raw material for construction, good wages for workers, ample job opportunities and create income source for the farmers family (Choudhary, 2013). Due to rapid increase in the cultivation and production of horticultural crops, it is known as “Golden Revolution”. According to financial year 2021 as per the first advance estimates production of horticulture crops in India was estimated at a record 326.6 million (Anonymous, 2021). It is also worth noting that with only 2.4 percent of the land area, India can support about 17 per cent of the world's population. Globally, it appears that we are slowly moving towards the global food crisis (Neeraj et al., 2017).

In this regard, the attention was paid to the development of the horticulture sector in the country through the National Horticulture Mission (NHM) inaugurated by the Department of Agriculture and Cooperation, Ministry of Agriculture and Farmers Welfare, Government of India in the year 2005-06. In which Government of India contributes 85% of the total outlay for development programmes in all the states and 15% share by the State Governments. India has a wide range of climate and soil on which a large number of horticultural crops are grown such as fruits, vegetables, ornamental, medicinal & aromatic plants, plantation crops, spices, cashew and cocoa (Jain, 2019). In terms of total fruits in India, citrus ranks second after mango in terms of area and third in production after mango & banana. The total horticulture crop production in India is 295164 MT from an area of 24926 thousand hectares (Kumar, 2019) and the total

fruit production is 98579 MT from an area of 6648 hectares and the production of that citrus crop is 13200 MT from an area of 1034 hectares. The area under kinnow has been increased from 618.5 mha in 2001-02 to 846.6 mha in 2010-11 and has also been increased to 1034 mha in 2018-19 (Anonymous, 2018-19). According to third advance estimate, the area of kinnow in India is 4.79 lakh hectares and the production is 63.97 lakh tons (Anonymous, 2020a).

Kinnow is successfully cultivated in Punjab, Haryana, Himanchal Pradesh, Western Rajasthan and Uttar Pradesh. Kinnow (hybrid mandarin) is ranked first among all citrus fruits in area and production in the state of Rajasthan. It is an important fruit crop that thrives in all climatic conditions of Rajasthan. Sri Ganganagar district of Rajasthan is favorable for Kinnow cultivation as compared to other regions of Rajasthan state and is well covered by NHM. Sri Ganganagar district covers an area of 9009 hectares under kinnow cultivation and the production is 215308 MT (Anonymous, 2020b). The kinnow, a hybrid mandarin is cross between Citrus Nobilis Lour and Citrus Deliciosa Tan. Kinnow has successfully replaced the traditional citrus fruits such as sweet orange and local mandarin (Gora et al., 2011). After achieving highest area and production of kinnow crop in Sri Ganganagar district farmers facing many problems in kinnow cultivation like poor management of kinnow orchards, heavy insect-pest & disease infestation during crop growth period, fruit drop & relatively higher cost of mechanization, less availability of required planting material and limited availability of FYM at the time of planting. The reasons behind these problems are lack of knowledge of the farmers about improved kinnow production technology and their less contact with the

extension personnels' or agencies. In this context, there is a dire need to increase the scope for higher production and quality improvement in kinnow cultivation in the region. The National Horticulture Mission has been successfully creating more possibilities for kinnow cultivation, so that the income and production of kinnow growers can be increased. Therefore, realizing the importance of kinnow cultivation under NHM, the present study was conducted with the objective to delineate the constraints being faced by the kinnow growers in the adoption of improved kinnow production technology.

## 2. MATERIALS AND METHODS

The present study was conducted in Sri Ganganagar region of Rajasthan state which was selected purposely on the basis of highest area and production of kinnow cultivation. Sri Ganganagar region comprises two districts namely Sri Ganganagar and Hanumangarh districts. Three *Panchayat Samitis* namely Sri Ganganagar, Sri Karanpur and Padampur were purposely selected for the present study on the basis of highest area and production of kinnow. For selection of respondents, a comprehensive *Panchayat Samiti*-wise list of Kinnow growers who were benefitted under NHM was procured from the Department of Horticulture, Sriganaganagar, Rajasthan for current study. With the help of proportionate random sampling method, the respondents who were benefitted under NHM were selected and they were called as beneficiary respondents. To constitute the other half of the sample size, same number of kinnow growers who were not benefitted under NHM were also selected randomly from the same *Panchayat Samitis* and they were designated as non-beneficiary respondents. Thus, total 180 respondent's *i.e.* 90 beneficiary as well as 90 non-beneficiary respondents were selected from the selected three *Panchayat Samitis* for present study. Here, the total sample size from selected *Panchayat Samitis* was 180 respondents. An interview schedule was designed for collection of data from the respondents. The pre-testing of the interview schedule was conducted with the help of 25 non-sampled respondents who were not included in the study. The personal interview method was used for the collection of the data. The data were analysed with the help of different statistical tools like mean percent score, rank correlation and t-test etc.

## 3. RESULTS AND DISCUSSION

Constraint refers to a reduction on the degrees of freedom of the elements of a system exerted by some collection of elements, or a limitation or bias on the variability or possibilities of change in the kind of such elements (Umerez & Mossio, 2013). Constraints are projections of collective sentiments rather than simple mirror of objective conditions (Bora, 1990). In the present investigation, the constraints were operationalized as the obstacles and hurdles confronted by the kinnow growers in the adoption of improved kinnow production technology. To measure the constraints responsible for hindering the adoption of improved kinnow production technology by the kinnow growers, a suitable schedule was developed. All the possible constraints being faced by the beneficiary and non-beneficiary kinnow growers were grouped into five major categories namely technical, environmental, financial, marketing and socio-personal & psychological constraints. In order to study various types of constraints, the kinnow growers were asked to give the response on three point continuum. After that on the basis of scores in each category of constraints Mean Percent Score (MPS) was calculated for each dimension.

**Technical constraints:** The data in Table 1 shows that technical constraints *viz.* 'unsuitable land for kinnow orchard' was ranked first by beneficiary kinnow growers with 69.62 MPS, followed by 'general carelessness of private and govt. agencies in the area' (60.37 MPS), 'inadequate knowledge about kinnow production' (36.66 MPS), 'lack of knowledge about machinery' (35.92 MPS), 'problem of intercropping & intercultural operations' (34.81 MPS) and 'lack of technical guidance' (32.96 MPS) were ranked second, third, fourth, fifth and sixth, respectively. Whereas, in case of non-beneficiary kinnow growers the first rank was assigned for 'lack of knowledge about machinery' with 87.40 MPS, followed by 'unsuitable land for kinnow orchard' (85.92 MPS), 'general carelessness of private and govt. agencies in the area' (54.44 MPS), 'lack of technical guidance' (53.33 MPS), 'inadequate knowledge about kinnow production' (50.40 MPS) and 'problem of intercropping & intercultural operations' (50.37 MPS) which were ranked second, third, fourth, fifth and sixth, respectively.

**Table 1. Ranking of items under technical constraints**

S. No.	Technical Constraints	Respondents					
		Beneficiary Respondents (n= 90)		Non-beneficiary Respondents (n=90)		Overall Respondents (N =180)	
		MPS	Rank	MPS	Rank	MPS	Rank
1.	Inadequate Knowledge about Kinnow Production	36.66	III	50.40	V	43.53	IV
2.	Lack of Technical Guidance	32.96	VI	53.33	IV	43.14	V
3.	Lack of Knowledge about Machinery	35.92	IV	87.40	I	61.66	II
4.	Problem of Intercropping & Intercultural Operations	34.81	V	50.37	VI	42.59	VI
5.	Unsuitable Land for Kinnow Orchard	69.62	I	85.92	II	77.77	I
6.	General Carelessness of Private and Govt. Agencies in the Area	60.37	II	54.44	III	57.40	III
	Pooled	45.05		63.64		54.34	

$r_s$ = rank correlation  
MPS= Mean Percent Score  
NS= Non Significant

$r_s = 0.43$   
 $t = 0.95^{NS}$

Further, the data in Table 1 also illustrates that 'unsuitable land for kinnow orchard' (77.77 MPS) was ranked first by majority of the overall kinnow growers, followed by 'lack of knowledge about machinery' (61.66 MPS) ranked second, 'general carelessness of private and govt. agencies in the area' (57.40 MPS) ranked third, 'inadequate knowledge about kinnow production' (43.53 MPS) ranked fourth, 'lack of technical guidance' (43.14 MPS) ranked fifth and 'problem of intercropping & intercultural operations (42.59 MPS) was ranked sixth under technical constraints category. Here, the value of calculated rank correlation ( $r_s$ ) was 0.43 which was found non-significant, leading to conclusion that there was a similarity found in the rank assignment pattern of technical constraints faced by the beneficiary and non-beneficiary kinnow growers in the adoption of improved kinnow production technology, though there was a difference in the magnitude of MPS of beneficiary and non-beneficiary kinnow growers. Thus, from the above findings it may be concluded that majority of the kinnow growers reported that unsuitable land for kinnow orchard, lack of knowledge about machinery, general carelessness of private and govt. agencies in the area and problem of intercropping & intercultural operations is very high and as the major constraints. No uses of organic manure, compost and cow dung are the reason behind for

being a problematic and barren land. The findings are in line with the findings of Rai et al. (2012) and Bhat et al. (2015) who reported that careless nature of agriculture officer and lack of technical knowledge were the major constraints faced by the farmers in the adoption of orange production technology and citrus cultivation. The findings are contradictory with findings of Singh (2019) and Sharma & Upadhyaya (2020) who observed that problem of intercropping & intercultural operations and lack of technical know-how were the major constraints faced by the farmers in the citrus cultivation.

**Environmental constraints:** The data in Table 2 shows that major environmental constraints faced by the beneficiary kinnow growers were 'scarcity of water for irrigation' (70.37 MPS) which was ranked first, followed by 'over exploitation of nutrients' (65.92 MPS), 'unfavorable weather conditions like frost, drought, erratic rainfall etc.' (58.89 MPS), 'more insect, pest attack during crop growth period' (58.80 MPS), 'improper drainage facility' (56.66 MPS) and 'higher incidence of weed' (48.51) which were ranked second, third, fourth, fifth and sixth, respectively. Further examination of the Table 2 reveals that the major constraints perceived by the non-beneficiary kinnow growers were 'unfavorable weather conditions like frost,

drought, erratic rainfall etc. (88.88 MPS) which was ranked first, followed by 'scarcity of water for irrigation' (79.25 MPS) ranked second, 'higher incidence of weed' (77.40 MPS) ranked third, 'improper drainage facility' (76.29 MPS) ranked fourth, 'more insect pest attack during crop growth period' (75.18 MPS) ranked fifth and 'over exploitation of nutrients' (70.40 MPS) was ranked sixth, respectively. If we look at the data in Table 2 irrespective of beneficiary and non-beneficiary kinnow growers, the data depicts that 'scarcity of water for irrigation' (74.81 MPS) was ranked first by the overall respondents, followed by 'unfavourable weather conditions like frost, drought, erratic rainfall etc.' (73.88 MPS) ranked second, 'over exploitation of nutrients' (68.16 MPS) ranked third, 'more insect pest attack during crop growth period' (66.99 MPS) ranked fourth, 'improper drainage facility' (66.47 MPS) ranked fifth and 'higher incidence of weed' (62.95 MPS) was ranked sixth, respectively. This might be due to that canal water is not sufficient for irrigation because of irregular and sporadic supply of water. The findings are in line with the findings of Tulsiram (2012) and Saryam & Jiril (2020) who reported that shortage of irrigation water was the major constraint faced by the farmers in the adoption of orange cultivation technology. The findings are contradictory with the findings of Rana et al. (2019) who concluded that problem of insect and diseases was the main constraint faced by the farmers in Khasi mandarin cultivation. The value of calculated rank correlation ( $r_s$ ) was 0.08 which was found non-significant, leading to conclusion that there was a similarity in rank assignment pattern of environmental constraints faced by the beneficiary and non-beneficiary kinnow growers in the adoption of improved kinnow production technology, though there was a difference in the magnitude of MPS of beneficiary and non-beneficiary kinnow growers.

**Financial constraints:** The data in Table 3 shows that financial constraints faced by the beneficiary farmers in the adoption of improved kinnow production technology were 'high cost of pesticides and fertilizers' (66.31 MPS) which was ranked first, followed by 'inadequate subsidy' (66.29 MPS), 'lack of credit facility' (57.40 MPS), 'high initial cost in establishing kinnow orchard' (55.92 MPS), 'labour wages are high' (42.96 MPS) and high cost of transportation' (39.62 MPS) were ranked second, third, fourth, fifth and sixth, respectively. Further examination of the Table 3 depicts that

the major constraints perceived by the non-beneficiary kinnow growers were 'lack of credit facility' (78.51 MPS) which was ranked first, 'high initial cost in establishing kinnow orchard' (77.77 MPS) ranked second, 'inadequate subsidy' (77.40 MPS) ranked third, 'high cost of pesticides and fertilizers' (75.18 MPS) ranked fourth, 'high cost of transportation' (74.81 MPS) ranked fifth and 'labour wages are high' (70.74 MPS) was ranked sixth, respectively. If we look at the data in Table 3 irrespective of beneficiary and non-beneficiary kinnow growers, data reveals that major constraints perceived by the overall kinnow growers in the adoption of improved kinnow production technology under National Horticulture Mission were 'inadequate subsidy' (71.84 MPS), followed by 'high cost of pesticides and fertilizers' (70.74 MPS) which were ranked first and second, respectively. While, 'lack of credit facility' (67.95 MPS) was ranked third, 'high initial cost in establishing kinnow orchard' (66.84 MPS) ranked fourth, 'high cost of transportation' (57.21 MPS) ranked fifth and 'labour wages are high' (56.85 MPS) was ranked sixth, respectively. It might be due to reason that government plays less role in motivating the farmers and storage & infrastructure facilities are not available at subsidized rates. The value of calculated rank correlation ( $r_s$ ) was 0.21 which was found non-significant, leading to conclusion that there was a similarity in rank assignment pattern of financial constraints faced by the beneficiary and non-beneficiary kinnow growers, though there was a difference in the magnitude of MPS of beneficiary and non-beneficiary kinnow growers.

The findings are in line with the findings of Laxman (2011), Deshmukh et al. (2021) and Chauhan et al. (2023) who found that high labour wages, high cost of fertilizers and no subsidy on organic fertilizers or pesticides were the major constraints faced by farmers in orange cultivation technology and PKVY. The findings are contradictory with the findings of H.S. et al. (2019) who observed that credit facility was the major constraint faced by the farmers in kinnow cultivation.

**Marketing constraints:** The data in Table 4 indicates that major marketing constraints perceived by the beneficiary kinnow growers were 'no timely sale of produce' (84.07 MPS) which was ranked first, followed by 'lack of storage facility in area' (69.25 MPS) ranked second, 'existence of middleman' (63.70 MPS)

ranked third, 'low price of produce' (54.07 MPS) ranked fourth and 'non-availability of local market' (49.25 MPS) was ranked fifth, respectively. The data in Table 4 also shows that major marketing constraints faced by the non-beneficiary kinnow growers were 'no timely sale of produce' (90.37 MPS) which was ranked first, followed by 'lack of storage facility in area' (75.55 MPS) ranked second, 'low price of produce' (65.55 MPS) ranked third, 'existence of middleman' (62.96 MPS) ranked fourth and 'non-availability of local market' (58.51 MPS) was ranked fifth, respectively.

Further, Table 4 also depicts that major marketing constraints faced by overall kinnow growers were 'no timely sale of produce' (87.22 MPS) which was ranked first, followed by 'lack of storage facility in area' (72.40 MPS) ranked second, 'existence of middleman' (63.33 MPS) ranked third, 'low price of produce' (59.81 MPS) ranked fourth and 'non-availability of local market' (53.88 MPS) was ranked fifth, respectively. Further, Table 4 also illustrates that major marketing constraints faced by overall kinnow growers were 'no timely sale of produce' (87.22 MPS) which was ranked first, followed by 'lack of storage facility in area' (72.40 MPS) ranked second, 'existence of middleman' (63.33 MPS) ranked third, 'low price of produce' (59.81 MPS) ranked fourth and 'non-availability of local market' (53.88 MPS) was ranked fifth, respectively. This might be due to that the government does not take active participation with the farmers in creating local markets, cooperatives, and online marketing platforms; hence the produce is not sold on time. Here, the value of calculated rank correlation ( $r_s$ ) was 0.9 which was found significant at one per cent level of significance, leading to conclusion that there was a similarity in rank assignment pattern of marketing constraints faced by the beneficiary and non-beneficiary kinnow growers in the adoption of improved kinnow production technology, though there was a difference in the magnitude of MPS of beneficiary and non-beneficiary kinnow growers.

The findings are supported by the findings of Choudhary & Bangarva (2013), Kaur & Singla (2016), Wankede et al. (2017), Sohi & Mathura (2018) and Regmi et al. (2020) who reported that existence of middleman, low price of kinnow fruit and lack of storage facility were the major constraints

faced by the farmers in the adoption of kinnow production technology and orange cultivation.

#### **Socio-personal and psychological constraints:**

The data in Table 5 reveals that major socio-personal and psychological constraints perceived by the beneficiary kinnow growers in the adoption of improved kinnow production technology were 'traditional nature of farmers' (81.11 MPS) which was ranked first, followed by 'low consumption of kinnow in local area' (67.41 MPS) ranked second, 'general unawareness about kinnow by-product' (66.67 MPS) ranked third, 'small land holding' (62.96 MPS) ranked fourth and 'low literacy rate of farmers' (60.37 MPS) was ranked fifth, respectively. The data in Table 5 also indicates that major socio-personal and psychological constraints encountered by the non-beneficiary kinnow growers were 'traditional nature of farmers' (83.33 MPS) which was ranked first, followed by 'general unawareness about kinnow by-product' (77.03 MPS) ranked second, 'low consumption of kinnow in local area' (76.66 MPS) ranked third, 'low literacy rate of farmers' (65.55 MPS) ranked fourth and 'small land holding' (63.70 MPS) was ranked fifth, respectively.

Further, Table 5 also depicts that major socio-personal & psychological constraints faced by the overall kinnow growers were 'traditional nature of farmers' (82.22 MPS) and 'low consumption of kinnow in local area' (72.03 MPS) which were ranked first and second, respectively. 'General unawareness about kinnow by-product' (71.85 MPS) was ranked third, 'small land holding' (63.33 MPS) ranked fourth and 'low literacy rate of farmers' (62.96 MPS) was ranked fifth. The reason behind non-adoption of modern approach to kinnow cultivation was ignorance of success stories of successful farmers and lack of information about incentives received in National Horticulture Mission regarding improved kinnow production technology. Here, the value of calculated rank correlation ( $r_s$ ) was 0.8 which was found significant at five per cent level of significance, leading to conclusion that there was a similarity in rank assignment pattern of socio-personal and psychological constraints faced by the beneficiary and non-beneficiary kinnow growers in the adoption of improved kinnow production technology, though there was a difference in the magnitude

of MPS of beneficiary and non-beneficiary farmers.

The findings are supported by the findings of Roy et al. (2018) and Passah & Tripathi (2020) who reported that small land

holding was the major problem faced by the farmers in the adoption of mandarin cultivation. Cheema and Jamali (2020) also concluded that low literacy rate was the major constraint faced by the farmers in the adoption of citrus cultivation.

**Table 2. Ranking of items under environmental constraints**

S.No.	Environmental Constraints	Respondents					
		Beneficiary Respondents (n= 90)		Non-beneficiary Respondents (n= 90)		Overall Respondents (N= 180)	
		MPS	Rank	MPS	Rank	MPS	Rank
1.	Over Exploitation of Nutrients	65.92	II	70.40	VI	68.16	III
2.	Scarcity of Water for Irrigation	70.37	I	79.25	II	74.81	I
3.	More Insect, Pest Attack during Crop Growth Period	58.80	IV	75.18	V	66.99	IV
4.	Improper Drainage facility	56.66	V	76.29	IV	66.47	V
5.	Higher Incidence of Weed	48.51	VI	77.40	III	62.95	VI
6.	Unfavorable Weather Conditions (Frost, Drought, Erratic Rainfall) etc.	58.89	III	88.88	I	73.88	II
	Pooled	59.85		77.90		68.87	

$r_s$ = rank correlation  
MPS= Mean Percent Score  
NS= Non Significant

$r_s = 0.08$   
 $t = 0.53^{NS}$

**Table 3. Ranking of items under financial constraints**

S.No.	Financial Constraints	Respondents					
		Beneficiary Respondents (n= 90)		Non-beneficiary Respondents (n=90)		Overall Respondents (N=180)	
		MPS	Rank	MPS	Rank	MPS	Rank
1.	Lack of Credit Facility	57.40	III	78.51	I	67.95	III
2.	Inadequate Subsidy	66.29	II	77.40	III	71.84	I
3.	Labour Wages are High	42.96	V	70.74	VI	56.85	VI
4.	High Cost of Transportation	39.62	VI	74.81	V	57.21	V
5.	High Initial Cost in Establishing Kinnow Orchard	55.92	IV	77.77	II	66.84	IV
6.	High Cost of Pesticides and Fertilizers	66.31	I	75.18	IV	70.74	II
	Pooled	54.75		45.73		56.57	

$r_s$ = rank correlation  
MPS= Mean Percent Score  
NS= Non Significant

$r_s = 0.21$   
 $t = 0.43^{NS}$

**Table 4. Ranking of items under marketing constraints**

S.No.	Marketing Constraints	Respondents					
		Beneficiary Respondents (n= 90)		Non-beneficiary Respondents (n= 90)		Overall Respondents (N= 180)	
		MPS	Rank	MPS	Rank	MPS	Rank
1.	Lack of Storage Facility in Area	69.25	II	75.55	II	72.40	II
2.	Existence of Middle Man	63.70	III	62.96	IV	63.33	III
3.	Non-Availability of Local Market	49.25	V	58.51	V	53.88	V
4.	Low Price of Produce	54.07	IV	65.55	III	59.81	IV
5.	No Timely Sale of Produce	84.07	I	90.37	I	87.22	I
	Pooled	64.06		70.58		67.33	

$r_s$ = rank correlation  
 MPS= Mean Percent Score  
 \*\*= significant at 0.01 level of probability

$r_s = 0.9$   
 $t = 3.56^{**}$

**Table 5. Ranking of items under socio-personal and psychological constraints**

S.No.	Socio-personal and Psychological Constraints	Respondents					
		Beneficiary Respondents (n= 90)		Non-beneficiary Respondents (n= 90)		Overall Respondents (N= 180)	
		MPS	Rank	MPS	Rank	MPS	Rank
1.	Traditional Nature of Farmers	81.11	I	83.33	I	82.22	I
2.	Low Literacy Rate of Farmers	60.37	V	65.55	IV	62.96	V
3.	Small Land Holding	62.96	IV	63.70	V	63.33	IV
4.	General Unawareness about Kinnow By- Product	66.67	III	77.03	II	71.85	III
5.	Low Consumption of kinnow in Local Area	67.41	II	76.66	III	72.03	II
	Pooled	67.70		3.25		70.48	

$r_s$ = rank correlation  
 MPS=Mean Percent Score  
 \*= significant at 0.05 level of probability

$r_s = 0.8$   
 $t = 2.26^*$

#### 4. CONCLUSION

From the above findings, it is concluded that the main constraints faced by the kinnow growers in the adoption of improved kinnow production technology under National Horticulture Mission were “unsuitable land for kinnow orchard”, “scarcity of water for irrigation”, “inadequate subsidy”, “no timely sale of produce” and “traditional nature of farmers”. So, in order to mitigate these constraints, farmers should use soil amendments as well as organic manure, compost, cow dung, inorganic supplement like zinc, lime can also be added for the reclamation of problematic soil as barren land was one of the inhibiting factors in the production of kinnow fruits in the study area. The only source of water for irrigation in the locale of study was Indira Gandhi

Water Canal which was not sufficient for these farmers due to irregular and sporadic supply of water. To cope with the paucity of irrigation water, government should motivate farmers and create suitable infrastructure for rain water harvesting and other water storage facilities at subsidized rates. The government should actively participate in creating local markets, cooperatives, online marketing platforms to ensure timely sale of farmers’ produce. Suitable facilities should also be created to ensure smooth transportation of produce to distant markets, if necessary. Success stories of successful farmers should be publicized so as to bring about a change in the present attitude of the farmers and attract them towards modern approaches of production technology to handle their produce efficiently. There should also be a



provision of incentives to encourage better performing farmers and other farmers as well.

### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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