

Agricultural Economics Research Review
Vol. 20 July-December 2007 pp 315-331

Estimation of Post-Harvest Losses in Kinnow Mandarin in Punjab Using a Modified Formula

L.S. Gangwar¹, Dinesh Singh² and D.B. Singh³

Abstract

This study undertaken in Punjab on kinnow mandarin has suggested to include marketing loss in the estimation of marketing margins, price spread and efficiency and has used a modified formula for it. It has been observed that a majority of kinnow producers sell their orchards to the pre-harvest contractors/ traders at different stages. The aggregate post-harvest losses from orchards to consumers in kinnow in two different markets ranges from 14.87 per cent in Delhi market to 21.91 per cent in Bangalore market. It has indicated the necessity of establishing kinnow processing industries for development of value-added ready-to-serve (RTS) quality products, minimizing post-harvest losses and providing remunerative price to the producers. The results have emphasized that efforts should be made to adopt improved packaging techniques, cushioning material and cold storage facilities at the retail level. The producer's share in consumer's price as estimated by old method has been found higher in local market than Bangalore and Delhi markets, largely because of lower marketing costs and profit margins of traders. The inclusion of marketing loss in the estimation of marketing margins, price spread and efficiency has indicated that the old estimation method unduly over-states the farmers' net price and profit margins to the market middlemen. It is appropriate to use modified method for the estimation of marketing margins and price spread.

Introduction

Kinnow mandarin (*Citrus reticulata* Blanco), the first generation hybrid of (King × Willow leaf), is the most common citrus fruit grown

¹Senior Scientist (Agricultural Economics), Central Avian Research Institute, Izatnagar, Bareilly – 243 122

²Senior Scientist (Plant Pathology), Indian Agricultural Research Institute (IARI), New Delhi 110 012

³Senior Scientist (Horticulture) and Officiating Head, HCP Division, CIPHET (ICAR), Abohar Campus, Abohar, Punjab

commercially in north India, particularly in Punjab, and the adjoining areas of Rajasthan and Himachal Pradesh. The fruits are mostly transported to different terminal markets by road for a quicker delivery, using CFB and wooden boxes as packaging material. The unscientific post-harvest management, lack of storage facilities and poor handling of fruits result in substantial losses during transit and in distant marketing. The fruits wasted in transit from orchards to consumers represent a significant loss. The qualitative loss is more serious when fungus, pathogens, and deep penetration of decay, make the infected produce unsuitable for human consumption (Eckert, 1978; Naqvi and Dass, 1994; Singh and Jain, 2004). Some work has also been reported on the transportation losses due to infection of mycoflora on citrus fruits. A substantial quantity of production is subjected to post-harvest losses at various stages of its marketing. The quantum of loss is governed by factors like perishable nature, method of harvesting and packaging, transportation, etc. Kinnow being a commercial fruit crop, the post-harvest losses are significant in terms of quantity and economic value. Though many studies have been conducted on the estimation of post-harvest losses in several fruits (Gajanana *et al.*, 2002; Sreenivasa Murthy *et al.*, 2002; and Kishore Kumar *et al.*, 2006), little information is available regarding the post-harvest losses in kinnow, especially at different stages of its marketing and their impact on marketing efficiency. The existing procedures for estimation of marketing margins and efficiency do not explicitly include the losses during marketing as a separate item, which could significantly alter the profit margins and the marketing efficiency. To improve the marketing system, it is essential to create awareness among the growers, farm workers and managers, traders and exporters about the extent of these losses and their economic consequences. Keeping this in view, the post-harvest losses of kinnow have been estimated in both physical and value terms at different stages during transportation and marketing in distant markets by using CFB boxes as packaging materials. Further, the impact of post-harvest losses on producer's share, marketing margins, price spread and marketing efficiency in different markets has been studied.

The specific objectives of this study were: (i) to study the marketing practices for kinnow in Punjab, (ii) to work out the losses in physical and value terms at different stages of kinnow marketing in distant markets, and (iii) to envisage the impact of post-harvest losses on farmers' net price, market cost, margins and efficiency.

Methodology

Sampling Procedure

The multi-purpose random sampling technique was used for the selection of study area and the sampling units. Punjab was purposively selected, as it is one of the major producers of kinnow mandarin in India. In Punjab, the Firozpur district was selected because of its maximum contribution (47 per cent) to the total state production (Statistical Abstract of Punjab, 2004). Out of five tehsils in the Firozpur district, two tehsils, namely Abohar and Fazilka, were randomly selected; these accounted for more than 42 per cent of kinnow mandarin area in the district. Then four villages from each tehsil were selected randomly and a list of farmers was prepared from each of these villages and was arranged in the ascending order of land allocated to kinnow orchards. From each village, five kinnow growers were randomly selected from the comprehensive list of all farmers. Thus, a total of 40 kinnow orchards were selected randomly. Three samples representing different fruit lots (harvested) in each orchard were drawn for a better representation. The farmers were divided into three groups, according to the size of orchards, viz. (i) less than 2 ha, (ii) 2-5 ha and (iii) above 5 ha. The data were collected from kinnow growers on actual post-harvest losses on weight basis at the orchard. The data related to production and marketing practices, post-harvest losses, price received and returns from orchards, during the years 2003-04 and 2004-2005 and were collected through personal interview with the help of survey schedule.

Five wholesalers and ten retailers were randomly selected from different kinnow markets and samples were drawn to estimate the post-harvest losses during transport, and at wholesalers and retailers marketing levels. To examine marketing practices in terminal markets, New Delhi and Bangalore were selected because a substantial amount of kinnow produced in Punjab is marketed in these two metro cities. The data were collected during kinnow harvesting and marketing seasons of 2004 and 2005 by using a well structured, pre-tested questionnaire by personal interview.

Analytical Techniques

Keeping in view, the definition of agricultural marketing (Acharya and Agrawal, 2001) as well as the involvement of different functionaries in the marketing of kinnow, viz. producers, pre-harvest contractors, wholesalers, retailers and consumers, three stages were identified to examine the post-harvest losses. These were: orchard level, transportation and wholesaler's marketing level and retailers level. Simple averages and percentages were

used to calculate the post-harvest losses at different stages of kinnow mandarin marketing.

Marketing Margins, Costs and Losses

In the conventional methods, losses at different stages of marketing are not calculated explicitly and are included in either the farmers' net price or middlemen margins. In this study, post-harvest losses were measured at different stages. The modified formulae used for estimating the post-harvest losses during kinnow marketing are given below.

Producer's Net Price

The net price realized by the kinnow grower was estimated as the difference in gross price received by him and the sum of marketing costs incurred and economic value of fruits loss during harvesting, grading, transit and marketing. The value of post-harvest loss of the produce was calculated as gross price received by the grower, as it would have been realized as return if, there was no loss. Thus, producer's net price may be explained mathematically by Equation (1):

$$NP_G = GP_G - \{C_G + (L_G \times GP_G)\}$$

or

$$NP_G = \{GP_G\} - \{C_G\} - \{L_G \times GP_G\} \quad \dots(1)$$

where,

NP_G is the net price received by the kinnow growers (Rs/tonne)

GP_G is the gross price received by kinnow growers or wholesale price to traders (Rs/tonne)

C_G is the cost incurred by the producers during marketing (Rs/tonne), and

L_G is the physical loss in fruits from orchards to local market (per tonne).

Marketing Margins

The margins of market middlemen include profit, which accrue for storage time, interest on capital, trading facility provided and market establishment after adjusting the marketing loss during handling and transit. The expression for estimating the margins for middlemen is :

$$\begin{aligned} \text{Middlemen margin} &= \text{Gross price (sale price)} - \text{Price paid (cost price)} - \text{Cost of marketing} - \text{Loss in value during transit/wholesaling} \\ &\dots(2) \end{aligned}$$

Net marketing margin of the wholesaler is given mathematically by Equation (3):

$$\begin{aligned} MM_W &= GP_W - GP_G - C_W - (L_W \times GP_W) \\ \text{or } MM_W &= \{GP_W - GP_G\} - \{C_W\} - \{L_W \times GP_W\} \end{aligned} \quad \dots(3)$$

where,

MM_W is the net margin of the wholesaler (Rs/kg)

GP_W is the wholesalers gross price to retailers or purchase price of retailer (Rs/kg)

C_W is the cost incurred by the wholesaler during marketing (Rs/kg), and

L_W is the physical quantitative loss in produce at wholesaler's level (per kg).

In the marketing channel if more than one wholesaler is involved, the total margin of the wholesalers is the sum of margins of all wholesalers. Mathematically,

$$MM_W = MM_{W1} + MM_{W2} + \dots + MM_{Wi} + \dots + MM_{Wn} \quad \dots(4)$$

where, MM_{Wn} is the marketing margin of the nth wholesaler.

Mathematically, the net marketing margin to the retailer is given by Equation (5):

$$\begin{aligned} MM_R &= GP_R - GP_W - C_R - (L_R \times GP_R) \\ \text{or } MM_R &= \{GP_R - GP_W\} - \{C_R\} - \{L_R \times GP_R\} \end{aligned} \quad \dots(5)$$

where,

MM_R is the net margin of the retailer (Rs/kg)

GP_R is the price at the retail market or purchase price of consumers (Rs/kg)

C_R is the cost incurred by the retailer during marketing (Rs/kg), and

L_R is the physical loss in produce at the retailer level (per kg).

In the above equations, the first bracket indicates the gross return, second and third brackets indicate cost and loss at different stages of marketing, respectively. Hence, the total margins for the market middlemen (MM) is calculated by Equation (6):

$$MM = MM_W + MM_R \quad \dots(6)$$

Similarly, the total marketing cost (MC) incurred by the producer/ traders and various middlemen is calculated by Equation (7):

$$MC = C_F + C_W + C_R \quad \dots(7)$$

The total value loss due to damage during handling of fruits from orchards till reaching the ultimate consumers is estimated as per Equation (8):

$$ML = \{L_G \times GP_G\} + \{L_W \times GP_W\} + \{L_R \times GP_R\} \quad \dots(8)$$

Marketing Efficiency

The conventional methods, Shepherd's method (Shephard 1965) and Acharya's modified formula (Acharya and Agrawal, 2001) do not mention the loss in produce during marketing process as a separate item. However, reduction due to post-harvest losses is one of the efficiency parameters. Therefore, it is pivot to incorporate the loss component explicitly in the existing marketing ratios to get the correct measures of marketing efficiency while comparing the market channels. The post-harvest loss/marketing loss component was incorporated in the formula given by Acharya and Agrawal (2001) and the modified marketing efficiency (ME) was measured using Equation (9):

$$ME = \frac{NP_G}{MM + MC + ML} \quad \dots(9)$$

The definitions of NP_G , MM , MC and ML were the same as given in Equations (1), (6), (7) and (8)

Results and Discussion

Marketing Practices and Channels

The main factor which plays the key role in decision-making of the growers is the price offered by the traders during harvesting season. The orchard selling to the pre-harvest contractors/traders is a common marketing practice in the area. There was no cooperative society in the study area for kinnow marketing. Hence, kinnow growers sell fruits directly in the local market. The kinnows are marketed locally in plastic crates, gunny bags or loose. For distant markets, CFB boxes of 10-kg capacity or wooden boxes of 20-kg capacity are used by the traders. It was observed that some kinnow growers send fruits directly to the distant markets. It was found that kinnow producers in Punjab follow several marketing channels, as given below:

Channel-I: Producer – Pre-harvest contractor – Wholesaler at local fruit mandi – Retailer – Local consumer

Channel-II: Producer – Wholesaler – Local retailer – Local consumer

Channel-III: Producer – Local retailer – Consumer

Channel-IV: Producer – Local consumer

Channel-V: Producer – Pre-harvest contractor – Wholesaler at distant market – Distant market retailer – Consumer

Channel-VI: Producer – Wholesaler (distant market) – Retailer (distant market) - Consumer

Post-Harvest Loss in Kinnow Mandarin

(i) At Orchards Level

In Punjab, kinnow is harvested by two methods, viz. harvesting with secateur, followed by dropping on ground (Method-I), and harvesting with clipper, followed by collection of fruits in crates/ bags (Method-II). The study was undertaken to estimate the fruit loss in adoption of improved post-harvest handling, package of practices, viz. kinnow harvesting by clipper (with 0.3 cm pedicel), fruit collection and on-farm handling in crates. It was observed that a majority of kinnow growers follow Method-I to send fruit to the local market and Method-II to send fruit to the distant markets. The two harvesting methods were compared for fruit plucking capacity of labour, per unit cost of harvesting, and fruit loss during harvesting, collection, sorting and grading. In kinnow marketing, quality of packaging material has prime importance because, it not only protects the fruits from mishandling and transport hazards, but also slows down the undesirable physiological changes, viz., off-flavour, moisture loss and pathological deterioration.

The post-harvest loss due to harvesting injuries, culled, brushes, insect damage, button holes and punchers in kinnow fruits were worked out to be 10.63 per cent in harvesting Method-I and 2.51 per cent in Method-II, at the orchards level (Table 1). All the thrown away or discarded fruits at the orchards were treated as post-harvest loss. These fruits were neither marketed nor consumed in any form. It indicates that out of 1000 kg of kinnow fruits harvested by Method-I, 106.3 kg were found unfit for consumption during sorting, grading and packing at the orchards level.

The grower/ pre-harvest contractor has to bear this post-harvest loss, irrespective of the marketing channel. Since sorting, grading and packaging is the first function to be performed in the marketing process, any loss during this process is considered as post-harvest loss. It is more appropriate in the perishable commodities like kinnow, as the entire production is marketable surplus.

(ii) Post-harvest Loss during Transportation and Wholesale Marketing Level

The loss during transportation and wholesale market level was estimated at two spatially distributed markets, viz. fruits and vegetables market at Azadpur, New Delhi, representing the medium distant market (transport distance up to 400 km) and the Bangalore market, representing the long

Table1. Post-harvest loss at orchards level in kinnow mandarin in Punjab

Particulars	Method -I	Method -II
Weight of harvested fruits (tonnes/day/ labour)	1.058	0.627
Harvesting cost* (Rs/tonne)	80.3	135.6
Collection wages (Rs/tonne)	73.8	48.2
Total harvesting cost (Rs/tonne)	154.1	183.8
Average size of fruit sample drawn (kg)	71.30	79.40
Number of fruits	428	476
Good fruits in sample (kg)	64.10	77.50
Number of fruits	384	464
Damaged/ injured fruits (kg)	7.20	1.90
Number of fruits	44	12
Fruits damaged during harvesting to packaging (%)	10.09	2.39
Fruits discarded after packing (%)	0.54	0.12
Total fruits damaged/ injured (%)	10.63	2.51

Note: Labour wages @ Rs 85/ day for 6 working hours

distance terminal market (transport distance up to 2500 km). Kinnow fruits were packed in different packaging materials such as CFB boxes (5-7 ply having holes) and wooden boxes. The CFB boxes and wooden boxes having capacity of 10.0 kg and 20.0 kg, respectively were used for transportation of fruits to medium- and long-distant markets. In a CFB box, 24 to 84 fruits were packed in two or three layers, while in a wooden box, 36-132 fruits were packed in three or four layers.

Kinnow fruits are transported from the study area to distant markets such as New Delhi, Chennai, Bangalore, Bhubaneswar and Bombay, by trucks and canters. The tractor trolley is used for transportation of fruits to the local market. The farmers/ traders preferably use canters, instead of trucks to transport kinnow up to medium distant New Delhi market. The transit time to these markets varies from 1 to 7 days. The loss in kinnow fruits during transportation and wholesalers' level at Azadpur Delhi market was 2.30 per cent (Table 2), largely due to bad transportation practices, improper packaging materials, lack of infrastructure facilities, lack of cold storage and environment conditions. The physical damage due to bumped and press fruits accounted for 49 per cent of the post-harvest losses, while the rotten fruits due to pathological diseases accounted for 51 per cent of post-harvest losses.

The loss during transit and at wholesalers' marketing level at Bangalore was found to be 5.70 per cent. In this case, damage due to the physical injury/press and bumped fruits accounted for 43 per cent, while rotten fruits due to diseases accounted for 57 per cent of post-harvest loss. At this

Table 2. Post-harvest loss during transit and wholesale marketing level in kinnow mandarin

Particulars	Medium-distant market (Delhi)		Long-distant market (Bangalore)	
	Quantity (kg) *	Percentage to total	Quantity (kg)*	Percentage to total
Average quantity of sample drawn	153.81	100.0	149.80	100.0
Good kinnow fruits	150.26	97.70	141.26	94.30
Damage due to press/ bumped	1.74	1.13	3.68	2.45
Damage due to disease/ rotten	1.80	1.17	4.86	3.25
Total discarded due to bumped and diseases	3.54	2.30	8.54	5.70

Note: * For packaging, corrugated fiberboard boxes (5 ply) of approximate 10-kg capacity were used.

stage, the market discard included fruits, which were not sold and were thrown away by the traders. It is evident from study that during transit and at wholesale marketing level, the post-harvest loss was higher when fruits were sold in long-distant Bangalore market than medium-distant Delhi market.

(iii) Post-harvest Loss at Retail Marketing Level

The losses at retailers level in Delhi and Bangalore market, estimated for 10-12 days of marketing (Table 3), were 10.06 per cent and 13.7 per cent, respectively. The main cause of loss in the both markets was the damage due to press/ bumped and physical injury, which accounted for 24.45 per cent loss in the Delhi market and 17.22 per cent in the Bangalore market. The other loss was due to rotting and disease infection in fruits at the tip of attachment, which accounted for 75.55 per cent and 82.77 per cent of the total loss in Delhi and Bangalore markets, respectively. The discarded kinnow fruits fetched no economic value to the retailers. These were eaten by stray animals or thrown away by the retailers. The aggregate post-harvest loss from production (orchard level) to consumption level in two different markets ranged from 14.87 per cent in the Delhi market to 21.91 per cent in the Bangalore market.

The overall post-harvest losses up to medium-distant Delhi market were comprised of 2.51 per cent at orchards level, 2.30 per cent during transportation and at wholesalers' level and 10.06 per cent at retailers' level. The corresponding losses up to the Bangalore market were 2.51 per cent, 5.70 per cent and 13.7 per cent, respectively. The study revealed that the

Table 3. Post-harvest loss at retail marketing level in kinnow mandarin

Particulars	Medium-distant market (Delhi)		Long-distant market (Bangalore)	
	Quantity (kg) *	Percentage to total	Quantity (kg)*	Percentage to total
Average quantity of sample drawn	51.20	100.00	59.60	100.00
Good kinnow fruits	46.05	89.94	51.43	86.30
Damaged due to pressed/ bumped fruits	1.26	2.46	1.41	2.36
Damage due disease/ rotten	3.89	7.60	6.76	11.34
Total discarded fruits	5.15	10.06	8.17	13.70

Note: * For packaging, FB boxes (5 ply) of approximate 10-kg capacity were used.

Table 4. Aggregate post-harvest loss in kinnow mandarin

Particulars	Loss at Delhi market			Loss at Bangalore market		
	%	Absolute@, kg	Share in total, %	%	Absolute@, kg	Share in total, %
Orchard level	2.51	25.1	16.88	2.51	25.1	11.46
Transit and at wholesale market level	2.30	22.4	15.47	5.70	55.6	26.02
Retail market level	10.06	95.8	67.65	13.70	125.9	62.53
Total loss	14.87	143.3	100.00	21.91	206.6	100.00

Note: @ For a quantity of 1000 kg kinnow fruits produced and marketed.

main loss was at the retailers' level; 67.7 per cent in Delhi and 62.5 per cent in Bangalore markets. It indicated that the overall post-harvest loss increased by 47.3 per cent when kinnows were marketed in the Bangalore market.

The impact of post-harvest losses on the availability of kinnow mandarin in absolute terms revealed that out of 1000 kg kinnows produced and marketed, only 856.7 kg reached the ultimate consumer in the medium-distant Delhi market and 793.4 kg in the long-distant Bangalore market (Table 4). It indicated the importance of establishing kinnow processing industries for the development of value-added ready-to-serve (RTS) products, minimize post-harvest losses and provide remunerative price to the producers at the time of good production. The results revealed that the efforts should be made to adopt improved packaging techniques, cushioning material and cold storage facilities at the retailers' level. The study has suggested that proper care should be taken during the post-harvest handling, packaging of CFB boxes, loading and unloading of boxes to trucks/ canter.

Costs, Margins, Losses and Strategies for Kinnow Marketing

The results obtained through new and old methods in the three marketing practices and their implications have been given in Table 5.

Marketing Costs

The estimation of marketing costs with the addition of post-harvest loss had no relevance as the costs incurred towards transportation and packaging material did not have any relationship with the quantitative/ qualitative loss in economic terms. The marketing cost of kinnow mandarin was estimated to be Rs 1.94/ kg in the local Abohar market, Rs 9.05/ kg in the Delhi market and Rs 14.34/kg in the Bangalore market. It was observed that a majority of kinnow growers had sold orchards to pre-harvest contactors/ traders. Some of the growers involved themselves in the marketing by sending their produce directly to the distant markets. The cost of washing, waxing, grading and packaging, CFB boxes, truck freight, commission and marketing fee were the major components of the marketing cost. The higher marketing cost in the long-distant Bangalore market was obviously due to higher cost on packaging material and transportation. It is evident from Table 5 that the retailer had incurred less cost on kinnow retailing in Delhi market (Rs 1.63 /kg) than Bangalore market (Rs 2.87/ kg).

Marketing Loss

In the old methods of estimation, marketing loss component was not estimated separately. It was included under profit margins of either producer or market middlemen. In the new method, loss was calculated at different stages of marketing along with the functionaries who had actually incurred the loss with relevant prices. The total marketing loss due to discarded fruits in local Abohar market amounted to Rs 1.96/ kg. The retailer had accounted for 46 per cent of the loss (Re 0.91/ kg), which was higher than that of producers' (43 per cent) and wholesalers' (11 per cent) share. The marketing loss accounted for 13.2 per cent of consumer's price in the local Abohar market. In the medium-distant Delhi market, the marketing loss was significantly higher at Rs 3.79/ kg (Table 5). The loss in value terms at producers/ orchards level and wholesaler and retailer level were estimated based on the price realized by them. The pattern of sharing of marketing loss was similar to that in the local market channel with retailer accounting for Rs 2.99/ kg (80 per cent) of market loss in Delhi market. In the long-distant Bangalore market, the aggregate loss was estimated to be Rs 5.09 per kg, which accounted for 13.43 per cent of the consumer's price. The share of retailer in the aggregate marketing loss was much higher (64.10

per cent) in comparison to the loss incurred during transportation and at wholesalers' (25.25 per cent) and producers' (10.8 per cent) levels. Thus, the study revealed that in local, medium- and long-distant markets, the retailers had to bear most of the loss in terms of economic value during marketing due to poor cold storage and other infrastructure facilities available with them.

Profit Margins

The producer's net price as calculated by the old method was the highest when they sold kinnow mandarin in the Bangalore market. The kinnow producers could reap a substantially higher net price of Rs 10.99/ kg in the Bangalore market as compared to Rs 7.93/ kg in the Delhi market and Rs 5.63/ kg in the local Abohar market. The profit margins of the retailers at Delhi and Bangalore markets were significantly higher because of higher risk of loss in terms of economic value as compared to that in the local market (Table 5). When marketing loss was taken into account for the estimation of profit margins of different marketing intermediaries, which was more relevant, it was found that the old estimation method had over-estimated the profit margins. For example, in the new method of estimation, the kinnow producer's net price in the local market Abohar was estimated to be Rs 5.03/ kg in comparison to Rs 5.63/ kg by the old method. The loss incurred by kinnow producers'/orchardists due to discards and damaged fruits during harvest, collection, sorting, etc. at the orchard level (Rs 0.84/ kg) was included in producer's net price in the old estimation method. Same was the case with other two channels of marketing; the extent of over-estimation was limited to about 5 per cent. The impact of inclusion of marketing loss in estimation of wholesalers' and retailers' margins was apparent with over-estimation ranging approximately from 27.0 per cent to wholesalers in the Delhi market to 39.0 per cent in retailers margins in the Bangalore market. It indicated that when marketing loss was taken into consideration, the profit margins of market middlemen reduced substantially.

In the medium-distant Delhi market, middlemen realized a combined net profit of Rs 11.72/ kg as compared to Rs 15.40/kg in the old estimation method. The loss during wholesale and retail marketing was calculated to be Rs 3.68/kg which was included in the profit margins. Similar results were observed in the distant Bangalore market sale with substantial reduction in profit margins to market intermediaries. Hence, it was concluded that by excluding one of the prime components in the marketing process, viz. post-harvest loss, the profit margins of different market intermediaries were unduly over-estimated. This will have further bearing on the share of market middlemen in consumer's price and policy decisions of the government related to agricultural marketing.

Table 5. Impact of post-harvest loss on producer's share, marketing costs and margins in kinnow mandarin

Particulars	Local Abohar market			Delhi market			Bangalore market		
	Old	New	Differ. (%)	Old	New	Differ. (%)	Old	New	Differ. (%)
Marketing costs (Rs/kg)									
Producers	1.02	1.02	0.00	7.14	7.14	0.00	10.84	10.84	0.00
Wholesalers	0.19	0.19	0.00	0.28	0.28	0.00	0.63	0.63	0.00
Retailers	0.73	0.73	0.00	1.63	1.63	0.00	2.87	2.87	0.00
Sub- total	1.94	1.94	0.00	9.05	9.05	0.00	14.34	14.34	0.00
Marketing loss (Rs/ kg)									
Producers	0.00	0.84	100	0.00	0.38	100	0.00	0.55	100
Wholesalers	0.00	0.21	100	0.00	0.36	100	0.00	1.28	100
Retailers	0.00	0.91	100	0.00	2.99	100	0.00	3.26	100
Sub total	0.00	1.96	100	0.00	3.73	100	0.00	5.09	100
Profit margins (Rs/kg)									
Producers' net price	5.63	5.03	-10.65	7.93	7.58	-4.41	10.99	10.44	-4.99
Wholesalers	1.15	1.12	-2.61	2.31	1.68	-27.27	3.79	2.55	-32.72
Retailers	5.22	4.69	-10.15	13.09	10.08	-22.99	13.22	8.03	-39.26
Sub total	6.37	5.81	-8.79	15.40	11.72	-23.90	17.01	10.58	-37.80
Share in consumers' price (per cent)									
Producers	37.84	33.80	-10.68	26.62	25.45	-4.40	28.98	27.53	-4.99
Market middle-men	49.12	44.80	-8.79	43.00	32.72	-23.90	33.20	20.65	-37.80
Marketing cost	13.04	13.04	0.00	30.38	30.38	0.00	37.82	37.82	0.00
Marketing loss	0.00	8.36	0.00	0.00	11.45	0.00	0.00	14.00	0.00
Price spread (Rs/kg)	8.31	9.71	16.85	24.45	24.50	0.21	31.35	30.01	-4.27
Marketing costs	23.35	19.98	-14.43	37.01	36.94	-0.19	45.74	47.78	4.46
Marketing margins (%)	76.65	59.84	-21.1	62.99	47.84	-24.05	54.26	35.26	-35.02
Marketing loss	0.00	20.18	0.00	0.00	15.22	0.00	0.00	16.96	0.00
Marketing Efficiency (Index)	0.68	0.5	-23.53	0.32	0.31	-3.12	0.35	0.35	0.00

Distribution of Consumer's Price

The producer's share in consumer's price as estimated by the old method was found higher at 37.84 per cent in the local market sale channel than Bangalore market sale (28.98 per cent) and Delhi market sale (26.62 per cent), largely because of the lower marketing costs and profit margins of the traders. The net aggregate profit to marketing functionaries was estimated to be 49.1 per cent, 43.0 per cent and 33.2 per cent, respectively in the local,

medium-distant and long-distant markets. The share of marketing cost in consumer's price was highest in the Bangalore market due to higher transportation cost, risk and involvement of number of market functionaries. The marketing losses estimated by using the modified method, were found to be 8.36 per cent, 11.45 per cent and 14.00 per cent, respectively in the local, medium-distant Delhi and long-distant Bangalore markets. The impact of inclusion of post-harvest loss was on the share of producer's price and profit margins of the market middlemen as these losses were borne by them. It was observed that the producer's share in consumer's price decreased to 33.8 per cent, 25.4 per cent and 27.5 per cent, respectively in local, Delhi and Bangalore markets (Table 6.). The aggregate shares of combined profit margins to wholesaler and retailers were also reduced to 44.8 per cent, 32.7 per cent and 20.6 per cent, respectively in local, Delhi and Bangalore markets sale, after accounting for marketing costs and losses at various stages.

Price Spread

The price spread in kinnow mandarin was found to range from Rs 8.31 per kg in the local market sale (55.8 per cent of consumer's price) to Rs 31.35 per kg in the distant Bangalore market sale (82.7 per cent of consumer's price) in the conventional method. The main component of price spread was marketing margin, which accounted for 76.7 per cent in the local, 63.0 per cent in the Delhi and 54.3 per cent in the Bangalore market sale channels. The marketing loss, which was earlier included in the producer's price and middlemen's profit margins was separated and indicated as a different component (new) under the price spread. The impact was increase in price spread by 16.85 per cent in local market sale channel. However, the price spread in the distant Bangalore market sale channel decreased by 4.27 per cent. The aggregate shares of marketing loss in price spread in all the channels were in the range of 15 to 20 per cent. Therefore, the marketing costs, followed by marketing loss, were the two prime factors accounting for nearly 52 per cent of the price spread in kinnow mandarin. It has been suggested that the proper post-harvest management, use of improved quality-packaging material, development of cold chain facility and efficient means of transportation should be adopted to minimize post-harvest losses in kinnow mandarin.

Marketing Efficiency

The marketing efficiency indices were worked out through both Acharya's method and modified method (Table 5). To compare the marketing efficiency of different channels, the time, place and form of commodity at

the beginning and at the end of the channel should be the same (Acharya and Agrawal, 2001). In the present study, no two-market channels could be compared for their efficiency. The marketing efficiency was found higher in the local market than distant market channels, primarily because of lower marketing costs and higher price realized by the kinnow producers in both the methods of estimation. However, by inclusion of marketing loss in the equation, the marketing efficiency declined. It revealed the fact that post-harvest loss was also one of the pivot factors in deciding the marketing efficiency and the relationship was found inverse, i.e. 'higher the post-harvest loss, lower will be the efficiency'. The lower marketing efficiency index of the medium-distant and long-distant markets, though not comparable, should not be interpreted as inefficiency in the existing marketing system. The marketing efficiency index was low because of higher marketing costs and profit margins to the middlemen, even though the kinnow producers had reaped maximum share in consumer's price in these channels. There were other factors, especially the production catchments and distance of terminal market that determine the marketing costs and profit margins, as it happened in the present study. However, higher marketing cost, in general, was not an indicator of inefficiency of the marketing system as similar findings were expressed in other studies.

Conclusions

This study undertaken in Punjab on kinnow mandarin has suggested to include the marketing loss in the estimation of marketing margins, price spread and efficiency. The aggregate post-harvest loss from orchards to consumers in kinnow in two different markets has ranged from 14.87 per cent in the Delhi market to 21.91 per cent in the Bangalore market. The emphasis should be given to establish kinnow-processing industries for the development of value-added quality ready-to-serve (RTS) products, minimize post-harvest losses and provide remunerative price to the producers. The efforts should also be made to adopt improved packaging techniques and cold storage facilities at the retailers' level. The marketing cost of kinnow mandarin has been estimated to be Rs 1.94/ kg in the local Abohar market, Rs 9.05/ kg in the Delhi market and Rs 14.34/ kg in the Bangalore market. The cost of CFB boxes, truck freight, commission and marketing fee are the major components that contribute to the aggregate marketing cost. The producer's share in consumer's price, as estimated by the old method has been found higher in the local market sale channel. The net profit to marketing functionaries has been estimated to be 49.1 per cent, 43.0 per cent and 33.2 per cent, respectively in the local, medium-distant and long-distant markets. The inclusion of marketing loss, which so far has been ignored in the

estimation of marketing margins and efficiency has indicated that the existing methods have unduly over- stated the farmers' net price and profit margins of market middlemen. It is concluded that the marketing loss is inversely proportional to the marketing efficiency.

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Appendix I**Marketing cost, price and margins in kinnow mandarin**

(Average charges/ wages paid in Rs/tonne)

Particulars	Local market (Abohar)	Delhi market	Bangalore market
Labour wages (harvesting, collection and loading)	154.10	183.80	183.80
Transport cost (orchard to waxing plant)	-	134.20	117.75
Charges for plastic crates	73.40	71.30	67.40
Cost of washing, waxing and grading	-	1293.40	1159.60
Labour wages (collection, packing and loading of truck)	-	84.80	86.90
Cost of packaging material			
(i) CFB boxes	-	1342.00	1348.00
(ii) Wooden boxes	-	1224.00	1228.00
Tractor trolley/truck/ canter freight	157.70	834.30	3929.20
Commission charges	394.40	753.60	839.60
Market fee	317.20	904.30	1362.60
Wages for unloading in the market	47.60	126.50	134.80
Miscellaneous expenses	83.70	189.70	386.00
Total marketing cost	1154.70	7141.90	10843.80
Producer's sale price	5629.00	7933.00	10992.00
Average wholesale price	7930.00	15072.00	21828.00
Average retail price	14878.00	29793.00	37918.00
Producer's share in consumer's rupee (%)	37.84	26.63	28.99