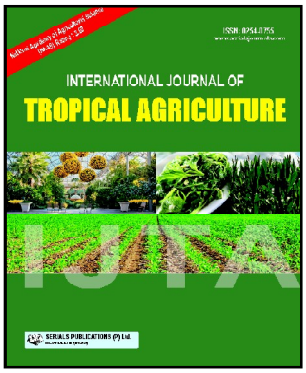

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A Study on the hot spot identification of losses in the Supply Chain of Oranges from Farm to Fork

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Abstract: Orange (*citrus sinensis*) is an important commercial fruit crop of India and Maharashtra is among the leading producers of good quality oranges in the Country. The current study was undertaken with specific objective of studying the supply chain of the oranges from different villages of Vidarbha Region of Maharashtra and 'Hotspot' identification of losses in the orange distribution chain from farm gate (Vidarbha region) to consumer among the different markets in Delhi. The term *'Hotspot'* refers to the area with a relatively higher amount of losses in comparison to its surroundings. The present study was undertaken in Vidarbha region i.e. Nagpur, Amravati, Akola district of Maharashtra which are also among the prime centres of production of Oranges. In first stage, surveys were conducted in Nagpur, Amravati, and Akola district of Maharashtra between February to March 2015 to determine orange losses at the farmers' level in the supply chain using a survey questionnaire about orchard management practices, fruit handling activities, marketing practices, transportation and storage aspects. The results revealed that maximum losses occur while fruits are subjected to sorting and grading during post harvest handling operations. In second and third stage of the study, surveys were conducted at wholesale market (Azadpur Mandi and Okhla Mandi, New Delhi) and retail market outlets (Safal and Reliance Fresh, New Delhi), respectively. On the overall basis, it was observed that post-harvest loss of orange during supply chain is about 20.50%. On studying the losses at different stages of marketing (Farmer-Wholesaler-Retailer), it was observed that the maximum loss was estimated at the producer/farmer level (11.50%) followed by wholesaler (5.0%) and retailer (4.0%). The study also revealed that maximum losses occurred at the producer/farmer level, which are mainly due to improper handling of produce after harvesting. Farmer/producer level was considered as primary *Hot Spot* for losses in the supply chain of oranges from farm gate to consumer. Wholesaler and retailers should take care during handling of packages, storage and transportation so as to minimize the overall losses in the supply chain of orange.

Key words: *Hotspot, Farmer level, Post-harvest losses, Supply chain, Post-harvest*

INTRODUCTION

In last few decades Indian agriculture has seen shift from traditional agrarian community to modern age agrarian society adressing various sectors of agriculture. At present, Indian agriculture is competing in world for being the largest producer of food grains and horticulture produce. One of the most important fact in transforming the agrarian outlook remained that apart from traditional cropping sequences of growing food grains, diversification of agriculture through horticultural plantation came as cost efficient and remunerative option for farmers. Over the last couple of years this has resulted in rise in area under fruit and vegetable crops and has lead to surplus production of horticultural produce. This has been achieved not only through traditional practices of growing crops but bringing in the concepts of mirco-irrigation, high density plantation system and integrated pest and nutrient management techniques resulting in rise in production per unit area deployed. The cultivation of horticultural crops as an option for diversification in agriculture proved to be an appropriate approach of achieving sustainability of smallholdings, increasing employment, improving environment, providing enormous export potential and achieving nutritional security (Hall *et al.*, 2001, Gajanana, 2007).

But, being soft, rich in nutrients and high in moisture, the perishable nature of horticulture produce posed a very big challenge of maintaining the shelf life and quality of harvested produce and to restrict the postharvest losses to the minimum possible extent. Among various challenges, management of harvested produce at farm gate level (bulk handling, sorting, grading, storage, packaging, etc.); during transportation from farm gate to mandi and wholesaler (package unit size, transporting vehicle, cold chain, etc.); movement of produce from local mandi to distant market; availability of cold storage facility, etc. were considered important concerns in light of post harvest management and economic perspective. In overall picture, a value chain of integrated postharvest practices including the preparation of the product for market, storage, packaging, transportation is vital to strengthen the marketing of the produce to distant and local markets.

Oranges are juicy soft perishable produce and needs due care while harvesting, handling, packaging and transportation. Managing the surplus at the peak time of production and making it reach to distant markets becomes a huge challenge for producer. Under the existing marketing system, before reaching to the consumer, such fruits passes through a long chain of intermediaries resulting in poor quality, losses in quantity and lower remuneration to the producer and higher prices being paid by the consumer (Kaur and Singh, 2007; Bhat et al., 2011, Mavi et al.). The study carried out by Ramanathan and Parthasarathy (2014) on fruit wastages from farm gate to retail outlets also identified factors like long travel distances, lack of labor, poor packing methods, damage due to pest attack and removal of damages parts of fruits, as significant sources of wastages. In a study carried out by Gangwar et al. (2007) on estimation of postharvest losses in Kinnow Mandarin, it was suggested that efforts should be made to adopt improved packaging techniques, cushioning material and cold storage facilities at the retail level. The study also revealed that pre-harvest contractors, longer supply chains and market middlemen takes away the profit of producers.

In India, Maharashtra, Assam, Karnataka, MP, Mizoram, Nagaland, Rajasthan, and Tamil Nadu are the major orange producing states. According to national horticulture board in 2013-14 India total production of orange was 3431.4 in ('000 MT) in 330.0 ('000 HA) (NHB Databse, 2014). Nagpur Santra (Mandrain) is also called Robson, it is chiefly grown in satpura hills (Vidarbha region) of central India. The fruits are mostly transported to different terminal markets by road to quicker delivery, using

CFB and Wooden boxes as packaging materials. The unscientific post-harvest management, lack of storage facilities and poor handling of fruits result in substantial losses during transportation from the farm orchard to consumer represent a significant loss.

The quantum of loss is governed by factors like perishable nature, method of harvesting and packaging, transportation, etc. Sweet Orange being a commercial fruit crop, the post-harvest losses are significant in terms of quantity and economic value. Little information is available regarding the post-harvest losses in Sweet Orange 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 current study investigated the extent and causes of the postharvest losses in the Orange fruit value chain in the Vidarbha Region. The study was undertaken with an aim to understand the supply chain of of oranges and identify the extend of postharvest lossess during different stages of handling at farm gate (Vidharbha, Maharashtra) and market (Delhi NCR)

RESEARCH METHODOLOGY

1. Study of the Area

The base line survey was conducted in Nagpur, Amravati and Akola district located in Maharashtra. In view of highest volume of production of the selected crop in these districts and due to large scale marketing activity taking place in relation to these crops in New Delhi and as they are endowed with relatively highest areas under selected Fruit crop, these districts were very much preferred for the present study.

2. Data collection

The data related to production and marketing practices, post-harvest losses, price received and returns from orchards, during the years 2013-14 and 2014-2015 and were collected through personal interview with the help of survey schedule. The information was collected from orange growers on actual, post-harvest losses on a weight basis at the orchard. The respondents were interviewed using a well-structured questionnaire, while for service providers the checklists of questions were employed. Beside this marketing channel through which different producers were sold were also identified. The share of losses at different channels in the sale of farmers' produce was identified. Information was also collected on transportation losses, losses incurred by different agencies on Marketing ot produce till it reaches to consumer for final consumption. The percentage of losses till consumer and share of losses under different marketing channels was also noted. The collected data was tabulated and analyses using Microsoft Excel.

3. Sample Procedure and Sample Size

The study employed random technique for selection of farmers for interview, questionnaries and employes purposive sampling techniques to select farmers, wholesaler/ traders and retailers. The total of 170 respondents was sampled and interviewed. These include 100 farmers, 40 wholesaler/traders (20 each from Azadpur Mandi, Okhla Mandi Delhi) and 30 retailers i.e from mother dairy safal (20) and reliance fresh (10), 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.

Number of Different type of Respondents

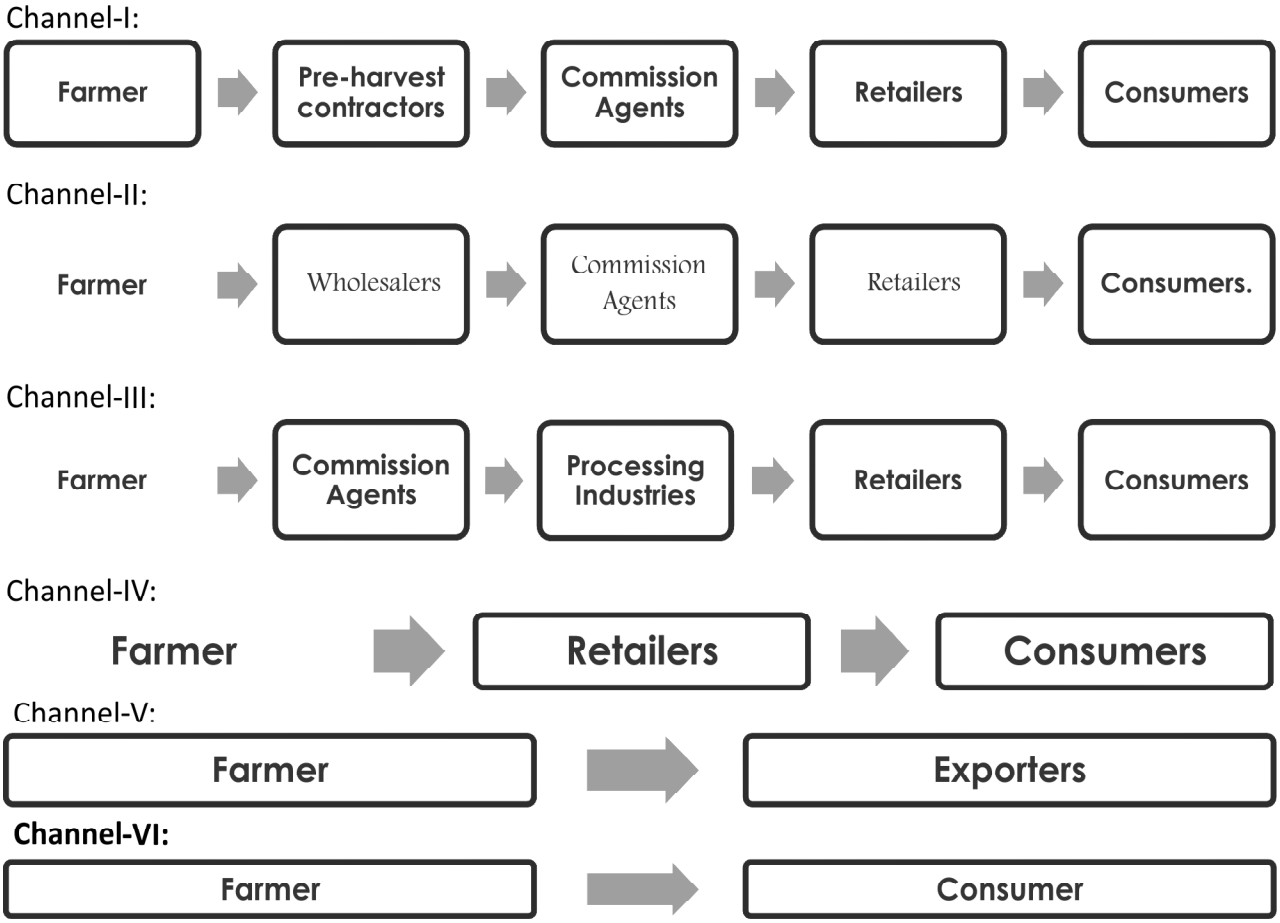
Sr. No.	*Particulars*	*No. of Respondents*
1	Farmers	100
2	Wholesalers	40
3	Retailers	30
Wholesale market survey (Delhi Markets)		*Retail Stores*
Azadpur Mandi (20)		Mother Dairy- Safal (South Delhi) (10)
Okhla Mandi (20)		Mother Dairy- Safal (North Delhi) (10)
		Reliance Fresh- (Central Delhi) (10)

RESULTS

In Maharashtra, orange is harvested by two methods, viz. harvesting with secateurs, 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 post-harvest handling, package of practices, viz. orange harvesting by clipper (with 0.3 cm pedicel), fruit collection and on-farm handling in crates. It was observed that a majority of orange growers follow Method-I to send fruit to the local market and Method-II to send fruit to the distant markets. In orange 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 orange fruits at the orchards level. 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 orange fruits harvested 120 kg were found unfit for consumption during sorting, grading and packing, storage and transportation 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 orange, as the entire production is marketable surplus.

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 orange marketing. Hence, orange growers sell fruits directly in the local market. The orange 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 orange growers send fruits directly to the distant markets. It was found that orange producers in Maharashtra follow several marketing channels, as given below:



(Ref: IIFT study on fruits and vegetables supply chain in india, Mavi *et al.* 2012)

4.1. Losses at orchard level

At orchard level average overall losses were about 11.5%.

(a) losses at farm level: The majority of the respondents (58%) replied that 5% losses losses occur during harvesting or at farm level which includes various pack house operations like sorting, grading, cleaning, etc. Remaining 42% respondents replied that about 6% losses occur st farm gate level. Such losses include lossess due to poor harvesting, impropers harvesting stage, damage by insects/ animals/birds, loss to pest and diseases, etc.

(b) losses during storage: Strorage losses of about 3% were reported by majority of respondents (61%) and remaining 39% respondents reported that about 2 % storage losses are observed at at farm level. Such lossess primaruirly include pathological infestations and loss in weight due to loss of moisture from fruits.

(c) losses during transportation: Average losses observed during transportation were 3.5%. Majority of respondents (70%) reported that 4% losses occur dring transprontation of the produce to wholesaler or market whereas remaining said about % of such lossess occur. Such lossess include bruising, compression damage due to poor handling and improper packaging. Poor transportation conditions and ventilation also adds to the losses.

4.2. Post harvest losses during wholesaler marketing

The loss during transportation and wholesale market level was estimated at two spatially distributed markets, viz. fruits and vegetables market at Azadpur, New Delhi and Okhla Mandi.

(a) Losses during transportation: The loss during transportation and at wholesale market level was estimated at two spatially distributed markets, viz. fruits and vegetables market at Azadpur, New Delhi and Okhla Mandi. Majority of the respondents (70%) replied that 3% losses occur during transportantion and 30% respondents replied that 2% losses occur during transportation.

(b) Losses during storage at wholesaler level: Storage loss (3%) was reported by majority (60%) of respondents and remaining (40%) respondents replied that about 2% storage loss occurred during storage.

It was observed that Orange 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 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.

Orange fruits are transported from the study area to distant markets such as New Delhi, Mumbai Chennai, Bangalore, and Bhubaneswar 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 orange up to distant New Delhi market. The transit time to these markets varies from 1 to 7 days. The loss in orange fruits during transportation and wholesalers' level at Azadpur Delhi market was 5.0 per cent largely due to bad transportation practices, improper packaging materials, lack of infrastructure facilities, lack of cold storage and environment conditions. At this 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 Delhi market.

4.3. Post harvest losses at retail marketing level

a) Losses during transportation: Majority of the respondents (56.67%) replied that 1% losses occur during transportationat retail level followed by remaining respondents (43.33%) indicating about 2% losses occur during transport.

b) Losses during storage: About 3% Storage losses were reported by most of the respondents (70%) and remaining 30% respondents replied that 2% storage loss occurs during retail marketing.

The losses at retailer's level in Delhi market, estimated for 10-12 days of marketing, were 4.0 per cent. The discarded Orange fruits fetched no value to the retailers. These were thrown away by the retailes in the end and eaten by stray animals. The aggregate post-harvest loss from production (orchard level) to consumption level in the Delhi market was estimated around 20.50 per cent

DISCUSSION

Perishable nature of citrus fruits itself is a lead cause of heavy losses. The improper post-harvest management accounted for 20-40 per cent of the losses at different stages of grading, packing, storage, transportation and marketing of citrus fruits like kinnow (Ali, 2005). Other challenges includes inadequate infrastructure for post-harvest management, inadequate price fluctuations, poor market intelligence, price fluctuations during peak and lean seasons, long marketing channels, poor packaging etc. (Verma and Singh, 2005, Mavi *et al,* 2012). The results of current study are in line with

Table
Summary of Lossess from farm gate to cosnumer

Losses Lossess at orchard level	*Respondent types Farmers (100)*	*Loss type*	*losses at farm level*			*Stages of losses losses during storage*			*losses during transportation*			*Losses Total of Avg Loss*
		Respondents (%)	42	58	Avg. (a)	39	61	Avg. (b)	30	70	Avg. (c)	(a+b+c)
		Extent of loss (%)	5	6	**5.5**	2	3	**2.5**	3	4	**3.5**	**11.5**
Losses during wholesaler marketing	Wholesalers (40)	Loss type	Loss during transportation			Loss during storage			-	-	-	-
		Respondents (%)	70	30	Avg. (d)	60	40	Avg. (e)	-	-	-	(d+e)
		Extent of loss (%)	3	2	2.5	3	2	2.5	-	-	-	5.0
Lossess at retail marketing level	Retailers (30)	Loss type	Loss during transportation			Loss during storage			-	-	-	-
		Respondents (%)	43	57	Avg. (f)	70	30	Avg. (g)	-	-	-	(f+e)
		Extent of loss (%)	1	2	1.5	3	2	2.5	-	-	-	4.0
								Total of Average Losses (a+b+c+d+e+f)				20.5

the observations of the other researchers and among various intermediaries in the marketing and distribution channel of oranges the hotspot are indentified is the producer farm where the harbesting takes place. It suggests that strengthening the on-farm primary processing infrastructure and training facilities to farmers would held in reducing the total losses in supply chain of Oranges.

Major concerns of high losses in citrus fruits like mandarin at farm gate level are improper harvesting and handling practices which includes improper plucking stage (immature, over ripen), improper cutting of stalks, stalkless fruits, cracked and spoiled fruits, over heaping, physical damage (scratches, bruises, punctures, bursting), pathological infestations (rotting, fungal attack), pest attack, etc. It is also observed that the producers generally sell the produce before commencement of the harvesting season and do not undertake the proper on-farm packaging of the fruits. If necessary, they either carry the in loose or at the most they carry the fruits in baskets and sometimes in gunny bags which leads to potential losses in quantity and quality (Naqvi and Dass, 1994, Tiwari, 2009). Similar concerns of post harvest losses have also been reported by other researchers in other fruits and vegetables including mango, banana, pineapple, etc. (Srinivas *et al.* 1997, Murthy *et al.,* 2002, Sudha *et al.,* 2002, Kumar *et al.*

2006, Murthy *et al.* 2007, Weinberger *et al.* 2008, Kereth *et al.* 2013, Ezekiel, 2014)

CONCLUSION

This study undertaken in Vidarbha region of Maharashtra on Orange mandarin has shown that the maximum losses occurred at Farmers level. On studying the losses at different stages, it was observed that the maximum loss was estimated at producer level (11.50%) followed by wholesaler (5.0%) and retailer (4.0%). On the overall basis, it was observed that post-harvest loss of orange during supply chain is 20.50 per cent.

The impact of post-harvest losses on the availability of Orange in absolute terms revealed that out of 1000 kg oranges produced and marketed, only 785.4 kg reached the ultimate consumer in the distant Delhi market. It indicated the importance of establishing Orange processing industries for the development of value-added ready-to-serve (RTS) products to minimize post-harvest losses and provide remunerative price to the producers at the time of peak production. The results also indicated that the efforts should be made to adopt improved packaging techniques, cushioning material and cold storage facilities at the retailers' level. Proper care should be taken during the post-harvest handling, packaging in CFB boxes, loading and unloading of boxes to trucks/ canters. It is concluded that the hot-spot identified of losses in the supply chain of oranges from farm gate to consumer and it is at the producers/farmers level i.e. 11.50%.

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