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Research Paper

An economic study of post-harvest losses of banana in Durg district of Chhattisgarh

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ABSTRACT : An attempt has been made in the present study to estimate the physical post-harvest losses in banana and to identify the causes of losses in Durg district of Chhattisgarh. The explicit evaluation of the impact of post-harvest losses at different stages of marketing on farmers' net price, marketing costs, margins and efficiency have been presented. The results indicated that there are two major marketing channels *viz.*, wholesaler channel and commission agent channel. The post-harvest losses were as high as 18 kg per quintal in the wholesale channel; comprising 31.67 per cent at the field and assembly level, 33.06 per cent at the wholesale market level and 35.28 per cent at the retail level. The total physical losses in the second marketing channel which was through commission agent were 18.95 kg per quintal with 28.50, 33.25 and 38.26 per cent in the corresponding stages. Small fruits, sun burn, harvesting injury and cracks and cankers at farm level; physiological dryness, physical damage and pressed and crushed fruits, over ripening loss at wholesale market level; physically damaged fruit and over ripened fruit at retailers level were the major causes responsible for post-harvest losses in banana. Further it was found that by separating out marketing loss at each stage of marketing, the producers' net share and wholesaler and retailer margins have been reduced substantially. It can be inferred that marketing efficiency is inversely proportional to the volume of post-harvest losses.

KEY WORDS : Post-harvest losses, Marketing channel, Banana growers, Farmers' net price, Marketing efficiency, Intermediaries' margin

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INTRODUCTION :

Banana (*Musa paradisica* L.) is the largest produced and maximum consumed fruit crop cultivated in India and accounts for about 39.8 per cent of the total fruit production in India. (Ramesh *et al.*, 2013). Banana belongs to the family Musaceae and it is considered as one of the most important one both in terms of production, productivity and export potential in India. Globally, India ranks first both in terms of area and production of banana in the world contributing around 15 per cent of the total global area under banana and about 29 per cent of the total world's production. But in the case of developing country like India, the postharvest losses noticed close to 50 per cent of the total fruits and vegetables production which badly affects the availability of fruits and vegetables to the consumers (Sudheer and Indira, 2007).Due to high water activity, fruits and vegetables are considered more

perishable and nearly 33 per cent of total produced fruits and vegetables have been spoiled during harvesting to marketing (Kader, 2005). Salami *et al.* (2010) stated that total 30-40 per cent fruits and vegetables wastage occurred within harvesting to consumption. In the case of developed and developing countries, the losses of fruits and vegetables estimated around 5-30 per cent and 20-50 per cent, respectively (Kader, 2002). In the case of developed countries the range of losses was observed 10-50 per cent (Kantor *et al.*, 1997). However, with the help of modern techniques and approaches, developed countries have minimize the postharvest losses upto some extent but due to less mechanized methods, developing countries are still facing a big challenge (Hodges *et al.*, 2011). Improper handling, storage, preservation techniques and microorganism spoilage increase the postharvest losses in fruits and vegetables upto 40 per cent (Singh *et al*., 2014).Due to unavailability of suitable harvesting equipment, storage structure for storing the fruits and vegetables, hygienic packaging and appropriate transportation facilities caused the major deterioration infruits and vegetables (Anonymous, 2006). Reduction in the quality, storage duration and shelf-life can be minimized with the help of adequate storage, transportation and environment conditions (Ilic *et al.*, 2009).

Banana production plays an important role in Chhattisgarh with largest share of 26.64 per cent of the total fruit production in the state.Durg district ranks second in the production of Banana in the state with contributingabout 9.44 per cent of total production of banana in the state.There has also been considerable post-harvest loss of the horticultural produce in Chhattisgarh due to lack of post-harvest management practices causing nearly 25- 40 per cent losses of products after harvesting due to inefficiency (State Horticulture Mission, Raipur 2013-14). As per National Centre for Cold Chain Development, "The biggest wastage happens during the transportation of horticulture products from the farm gate to mandi and thereafter while the adequate cold storage facilities are available for just about 10 per cent of India's horticulture production. Post-harvest losses during handling, transport, storage and distribution are the major problems in agrarian economy, especially in perishable fruits and vegetables. Besides resulting in low per capita availability and huge monetary losses, these increase transport and marketing costs also (Subrahmanyam, 1986). Banana is a high valued commercial crop and the post-harvest losses results in significant revenue loss to the nation besides depriving its availability to the large population. Though many studies have attempted the estimation of post-harvest losses in Banana (Gauraha, 1997; Srinivas *et al*., 1997; Gajanana *et al*., 2002; Sreenivasa Murthy *et al*., 2003 and Sudha *et al.*, 2002) buy very little information is available with regard to the impact of the post-harvest losses at various stages of marketing on marketing margins and costs, price-spread and marketing efficiency. Sreenivasa Murthy *et al.*, 2007 in his study on marketing and post-harvest losses of banana in Karnataka found that the existing methods tend to overstate the farmers' net price and marketing margins of intermediaries. Similarly, the producers' net share and wholesalers' margins also decrease substantially and that marketing efficiency is inversely proportional to the marketing losses. The need for an appropriate procedure for loss estimation was highlighted in a study on grapes, as these variations could significantly alter the profit margins and efficiency of marketing (Sreenivasa Murthy *et al.*, 2004). In the present study, the methodology used for quantifying the post-harvest losses in both physical and value terms at various stages of marketing has been estimated for banana. The results have been compared with conventional methods of estimation of marketing margins and efficiency. The impact of post-harvest losses on producers' net share, marketing margins and marketing efficiency due to separating out the marketing loss has also been assessed. The present paper has addressed these issues with the following specific objectives.

Objectives of the study:

– To estimate the physical post-harvest losses at farm, wholesale and retail level and to identify the causes of these losses.

– To examine the impact of post-harvest losses on farmers' net price, marketing costs, margins and efficiency.

MATERIALS AND METHODS :

This study is based on the data collected from marginal, small and medium banana cultivators selected from Dhamdha block of Durg district of Chhattisgarh state in India. The study covers 132 banana growers spread over 8 villages in Dhamdha block. The data was collected from these 132 sample growers for estimation of field level loss in banana. To estimate the physical losses at wholesale and retailer market level, 40 banana

marketers (15 wholesalers/commission agents and 25 retailers) were randomly selected. Bhilai powerhouse fruit mandi situated in Durg district which is an unregulated primary market of fruits was selected purposively for the present study as it was only largest fruit mandi in Durg district situated near the selected block. Primary data from banana growers and intermediaries involved was collected with the help of pre tested schedule by interviewing selected cultivators and traders personally for the year 2017-18.

Estimation procedure :

Based on the definition of post-harvest losses associated with the marketing chain (Acharya and Agarwal, 2001 and Kohls and Uhl, 2002) and from the present context of marketing of banana, three stages were identified to estimate the post-harvest losses, *viz.*, field level, transit and wholesale marketing level and retail marketing level. Simple averages and percentages were used for estimation of post-harvest losses at these three stages. Post-harvest losses occurring in banana at various stages in the marketing network has been accessed by physical assessment. Post-Harvest losses was assessed at following three levels namely:

– Field level at the time of harvest

– Wholesale market level

– Retail market level.

Post-harvest losses at these three levels have been further classified into different categories based on the cause of loss as physical losses occur due to various different causes.

In the conventional estimation procedures, the losses at different stages of marketing are not considered explicitly as an item of cost. It is considered either as part of net income received by the farmer or the margin of the market intermediaries. The modified formulae, described below, were used for estimating separately the losses in value terms at different stages of marketing as well as for estimation of producers' share and marketing margins (Murthy *et al.*, 2007).

Farmers' net price:

The farmers' net price was expressed mathematically as:

$$NP_F = GP_F - \{C_F + (L_F \times GP_F)\}$$

where,

NP_F = The net price received by the farmers (Rs./kg)

GP_F = The gross price received by farmers or wholesale price received by the farmer (Rs./kg)

C_F = The cost incurred by the farmers during marketing (Rs./kg) and

L_F = The physical loss in produce from harvest till it reaches the market (kg).

Marketing margins:

The general expression for estimating the margin of the intermediaries is given below:

$$MM_W = \{GP_W - GP_F\} - \{C_W\} - \{LW \times GP_W\}$$

where,

MM_W = Net margin of the wholesaler (Rs./kg)

GP_W = The wholesalers' selling price or purchase price of retailer (Rs./kg)

C_W = The cost incurred by the wholesalers during marketing (Rs./kg) and

L_W = The physical loss in the produce at the wholesale level (per kg).

Net marketing margin of the retailer is given by:

$$MM_R = \{GP_R - GP_W\} - \{C_R\} - \{LR \times GP_R\}$$

where,

MM_R = Net margin of the retailer (Rs./kg)

GP_R = Price at the retail market or purchase price of the consumers (Rs./kg)

L_R = Physical loss in the produce at the retail level (per kg) and

C_R = The cost incurred by the retailers during marketing (Rs./kg).

Similarly, total marketing cost (MC) incurred by the producer/seller and by various intermediaries was calculated as;

$$M_C = C_F + C_W + C_R$$

Total marketing loss (ML) in value of produce due to injury/damage caused during handling of produce from the point of harvest till it reaches the consumers was estimated as per Eq. (6):

$$ML = \{L_F \times GP_F\} + \{L_W \times GP_W\} + \{LR \times GP_R\}$$

Marketing efficiency:

The present study, therefore, incorporated 'marketing losses as one of the components in the denominator of the formula suggested by Acharya and Agarwal (2001) for the measurement of marketing efficiency. The modified formula was expressed as:

$$ME = NP_F / MM + MC + ML$$

RESULTS AND DATA ANALYSIS :

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Marketing pattern of banana in Durg district:

There are three major marketing channels in this area through which banana fruit is transacted from producers to consumers. The identified channels are:

Channel-I: Producer → Wholesaler→ Retailer→ Consumer

Channel-II: Producer → Commission agent → Retailer → Consumer

Channel-III: Producer → Commission agent → wholesaler → Retailer → Consumer.

Fig. 1. Marketing channels for banana in Durg district, Chhattisgarh

The marketing of banana through various channels in the study region has been depicted in Fig. 1. About 83.12 per cent of banana was marketed through Channel-1 (hence, forth referred to as wholesale channel) and Channel-2 (Commission agent channel).In the wholesale channel, the wholesalers play an important role and they procures banana fruit from the farmers for a mutually agreed price. Then the bananas are transported to the primary market *i.e.* Bhilai powerhouse fruit mandi and the fruits are put in cooling chambers owned by the wholesalers themselves for 4-5 days at 16-18 degree Celsius for ripening. After which, the fruits are sold to the retailers according to the demand. In the second channel *i.e.* the commission agent channel, banana fruits are harvested and transported to the commission agent in the primary market *i.e.* Bhilai powerhouse fruit mandi by the growers themselves with their own expenses to the primary market where the fruits are further sold to the retailers after ripening.

Post-harvest losses (PHL):

The post-harvest losses in the study area revealed that it was as high as 18 kg per quintal in the wholesale channel; comprising 31.67 per cent at the field and assembly level, 33.06 per cent at the wholesale market level and 35.28 per cent at the retail level. The total physical losses in the second marketing channel which was through commission agent were 18.95kg per quintal with 28.50, 33.25 and 38.26 per cent in the corresponding stages. The losses in wholesale channel were higher in the first stage of handling, *i.e.* assembly level and lower in the later stages of marketing. The losses at the field and assembly levels accounted for as high as 28.50 per cent of the total loss in the commission agent channel compared to about 31.67 per cent in the wholesale channel. Procurement of quality produce and rejection of substandard produce by the wholesaler might be the reason. Losses at wholesale and retail stages in the wholesale channel accounted for 33.06 per cent and 35.28 per cent, respectively, compared to 33.25 per cent and 38.26 per cent in other channel. Better loading and transportation, acceptance of good quality produce at the time of procurement contributed to the lower losses at the later stages of marketing in the wholesale channel. Further, market-wise analysis revealed that the losses were higher during retailing than in other stages of marketing (Murthy *et al.,* 2007). In the commission agent channel, postharvest losses at the retail level accounted for 38.26 per cent, while it was 35.28 per cent in the wholesale channel. Hence, it can be inferred that the maximum losses in banana occurred at the retail level (Mitrannavar Yeledalli, 2014).

Post-harvest losses of banana at farm level and its causes :

The post-harvest loss in banana at the field level was estimated to be 5.7 kg/qtl and 5.4 kg/qtl for the wholesale and the commission agent channel, respectively. The overall picture of post-harvest losses depicted in the Table 1 indicated that small fruits accounted for maximum losses at farm level which was around 42.11 per cent in the wholesale channel and 40.74 per cent in the commission agent channel. The resulting losses at farm level in wholesale channel was mainly due to the small fruits (42.11%) followed by sun burning of fruits due to exposure of fruits in high temperature for prolonged period (26.32%), mechanical injuries during harvesting (21.05 %) and lastly losses due to cracks and cankers formed in the fruits (10. 53%). While the causes for the post-harvest losses in the second channel *i.e.* commission agent channel, the resultant loss was due to small fruits (40.74%) followed by harvest injury (25.93%), sun burning (23.15%) and lastly due to cracks and cankers (10.19%). The overall result of the assessment of physical losses at farm level reveals that there is very slight difference in the losses occurring in the two selected channels as it can be seen that the overall losses at farm level was more in wholesale channel (31.67 % of the

total losses in the channel) as compared to the commission agent channel (28.50%). The losses in wholesale channel was greater at farm level because of the greater losses due to small fruits and sun burn. This might be due to the rejection of small fruits by the wholesalers at the farm.

Losses of banana at wholesaler's level and its causes:

The post-harvest loss in banana at the wholesale level was estimated to be 5.95 kg/qtl and 6.3 kg/qtl for the wholesale and the commission agent channel, respectively. The resultant losses was mainly due to physiological weight loss due to drying of the fruit during post-harvest handling of the banana fruit which accounted for around 36.97 per cent in case of wholesale channel and 33.33 per cent in case of the second channel *i.e.* commission agent channel. This might be due to the fact that the wholesaler tend to go to the far distances than for collecting the produce which causes more dryness in the banana fruit. The second important reason for the post-harvest losses in the wholesale market level was found to be physical damage to the fruits during the transport of the produce which accounted for around 26.89 per cent in case of wholesale channel and 28.57 per cent in case of the second channel. Next in order, was losses due to the pressed and crushed fruits which occurs during the transport of the produce which accounted for 23.53 per cent in case of wholesale channel and 25.40 per cent in case of the second channel. The physical losses during the transit of the produce *i.e.* losses due to the physical damage to the fruit and the pressed and crushed fruit was more found more pronounced in case of commission agent channel which might be due to the poor packaging technologies of the banana for the transport purpose. The results are inline with Roy and Pal (1991); Madan and Ullasa (1991) and Rao and Manohar, 1995. Last in the order of causes at wholesale market level comes the ripening loss due to the over

Table 1: Post-harvest losses in banana at different stages of marketing in Chhattisgarh

Sr.No.	Different stages	Wholesaler channel		Commission agent channel	
1.	Farm level loss due to	Losses in kg/qtl	Percentage loss	Losses in kg/qtl	Percentage loss
	Small fruits	2.4	42.11	2.2	40.74
	Sun Burn	1.5	26.32	1.25	23.15
	Cracks and cankers	0.6	10.53	0.55	10.19
	Harvesting Injury	1.2	21.05	1.4	25.93
	Loss at farm level	5.7 (31.67)	100	5.4 (28.50)	100
2.	Wholesale market level loss due to				
	Physiological weight loss (Dryness)	2.2	36.97	2.1	33.33
	Physical damage	1.6	26.89	1.8	28.57
	Pressed /crushed	1.4	23.53	1.6	25.40
	Over ripening	0.75	12.61	0.8	12.70
	Loss at wholesale market level	5.95 (33.06)	100	6.3 (33.25)	100
3.	Retailer level loss due to				
	Over ripened fruit	3.5	55.12	4.05	55.86
	Physically damaged fruit	2.85	44.88	3.2	44.14
	At retail level	6.35 (35.28)	35.28	7.25 (38.26)	100
	Total loss	18 (100)	100	18.95 (100)	100

Note: Figures in the parenthesis denotes the percentage of the total loss

Table 2 : Losses during marketing of banana in Durg district, Chhattisgarh **(Rs./kg)**

Different stages	Wholesaler channel	Commission agent channel
Farm level	0.97	1.16
Wholesaler market level	1.29	1.41
Retailers level	1.76	2.01
Sub total	4.02	4.58
Share in the consumer's price (%)	14.35	16.35

ripening of the banana in the ripening chambers which accounted for 12.61 per cent in case of wholesale channel and 12.70 per cent in case of the second channel. Over ripening of the banana occurs due to the prolonged storage in the ripening chambers by wholesalers and the commission agents which vary according to the demand of the fruits during different seasons.

Losses of banana at retailer's level and its causes:

The loss in banana at the retailer's level is given in Table 1. It may be observed that the losses in banana was to the extent of 6.35kg/qtl in wholesale channel while it was 7.25 kg/qtl in case of commission agent channel which constitutes around 35.28 per cent and 38.26 per cent of the total post-harvest loss in the channel, respectively. The major cause of losses at the retail level were over ripened fruit and phycically damaged fruit which accounts for 55.12 per cent and 44.88 per cent of the total losses at the retail level of the wholesale channel. While in case of commission agent 55.86 per cent loss was found due to over ripened fruit while 44.14 per cent losses was due to the physically damaged fruit.

Marketing losses:

The marketing losses are rarely included as an explicit item of marketing cost. In the present study, the losses at various stages of marketing were separately estimated for the major channels and the results have been presented in Table 2. The marketing losses ranged between Rs. 4.58/kg in the commission agent channel and Rs. 4.02/kg in the wholesale channel which accounted for 16.35 per cent and 14.35 per cent of the consumers' price, respectively. The losses occurred at the retailing level were higher in the commission agent channel. The marketing losses incurred by the farmers during harvesting and marketing were Rs. 0.97/kg in the case of wholesale channel and to Rs.1.16/kg in the commission agent channel.

Impact of marketing loss on margins and efficiency:

In general, the marketing costs and margin analysis do not separately consider the post-harvest losses at different stages of marketing and hence, these get absorbed in either the farmers' net margin or margins of the market intermediaries. An attempt was made in this study, by separately accounting for the losses, for a more precise estimation of the marketing margins. The farmers' net price, margins of market intermediaries, pricespread and efficiency indicators as estimated by the conventional and new method have been presented in Table 3.

Farmers' net price:

It can be seen from Table 3 that the net price received by the farmers for banana was higher in the commission agent channel. The net price received by the farmers, as estimated using the conventional method, was Rs.17.85/kg in the commission agent channel and Rs.16.92/kg in the wholesale channel. But after separating the marketing losses, the netprice received by the farmers was reduced to 15.48 Rs./kg in the wholesale channel compared to about 16.33 Rs./kg in the commission agent channel.

Wholesalers' and retailers' margin:

The wholesalers' margin as estimated using the conventional method, was greater in the wholesale channel (2.88 Rs./kg) than the margin of commission agent in the second channel (2.25 Rs./kg). But after separating the marketing losses, margin of the wholesalers was reduced to 15.48 Rs. /kg in the wholesale channel compared to about 1.04Rs./kg in the commission agent channel. The separation of the post-harvest loss from the gross margins and accounting it as a separate item reduced the retailer's margin from Rs. 5.40/kg to Rs. 64/kg in the wholesale channel while in case of channel of commission agent the retailers' margin was reduced to 3.38 Rs./kg from 4.90 Rs./kg.

Table 3 : Impact of marketing losses on farmers' net price, margin, efficiency index and price-spread in banana in Chhattisgarh (Rs./kg)

Particulars	Before separating losses		After separating losses	
	WS channel	CA channel	WS channel	CA channel
Farmers' net price	16.92	17.95	15.48	16.33
Wholesalers' margin	2.88	2.25	1.58	1.04
Retailers' margin	5.40	4.90	3.64	3.38
Marketing efficiency	1.52	1.45	1.31	1.23
Price spread (Rs./kg)	11.08	10.05	12.52	11.67

Price spread:

As regards the impact of consideration of loss as a separate item, it was observed that the price-spread increased to Rs.11.08/kg in the wholesale channel and to Rs.12.52/kg in the commission agent channel. It was due to the decrease in the producers' share and market intermediaries margin on one hand and inclusion of marketing loss as a separate component of the cost, on the other hand. The losses accounted for 32 per cent of the price-spread in wholesale channel and 39.24 per cent in the commission agent channel. This signifies the importance and necessity of accounting post-harvest losses as an item of marketing cost.

Efficiency index:

The modified marketing efficiency ratio was higher in the wholesale channel mainly due to reduced marketing costs. The separation of the post-harvest loss from channels reduced the marketing efficiency from 1.52 to 1.31 per cent in the wholesale channel while in case of channel of commission agent it was reduced to 1.23 per cent from 1.45 per cent. As regards pricing efficiency, which referred to the structural characteristics of marketing system, where the sellers were able to get the true value of their produce and the consumers received the true worth of their money (Acharya and Agrawal, 2001), the wholesale channel was found more efficient.

Conclusion and Suggestion:

The study has revealed that there two major channels of marketing of banana in the study area *viz.*, wholesale channel and commission agent channel through which major portion of banana is moved. The post-harvest losses were as high as 18 kg per quintal in the wholesale channel; comprising 31.67 per cent at the field and assembly level, 33.06 per cent at the wholesale market level and 35.28 per cent at the retail level. The total physical losses in the second marketing channel which was through commission agent were 18.95 kg per quintal with 28.50, 33.25 and 38.26 per cent in the corresponding stages. The losses at farm level was more in the wholesale channel whereas at the wholesale and retail market level the losses were found to be more in the second channel through commission agent. Procurement of quality produce and rejection of substandard produce by the wholesaler might be the reason.

The major causes of the post-harvest losses at the farm level were found to be losses due to small fruits, sun burning of fruits, physical losses due to harvesting injuries and cracks and cankers to some extent. Small and immature fruits problems may be overcome by the correction of nutrient disorder in the cultivation practices by adopting proper package of practices. While the post-harvest loss can be minimized by careful harvesting and dressing of the bunch through skilled labour. At the wholesale market level major causes of the post-harvest losses were found to be weightloss in the banana fruits due to physiological dryness during transport added by the physical damage to the banana during transport and over ripening loss of banana during the post-harvest handling of the produce. At the retail level the maximum losses occurred due to the over ripening of the fruits and the physical damage to the fruits during transit.

It has been observed that the existing methods tend to overstate the farmers' net price and margins of the intermediaries. So, by separating out marketing loss at each stage of marketing, the actual margins of intermediaries have been reduced. Similarly, the producers' net share and wholesaler and retailer margin have also been reduced substantially. It can be inferred that marketing efficiency is inversely proportional to the volume of post-harvest losses. Thus, for precise estimation of margins and efficiency, it is appropriate to account for the marketing losses separately.

It could be concluded that creating institutional support through creation of market infrastructure (cold chain transport, grading and packaging house, cold storage etc.) can help in reducing the post-harvest losses thereby increase the returns to the producers and also improve the marketing efficiency in perishable horticultural produce. Modern market infrastructure may be built up with the public-private partnership to bring efficiency in the marketing of banana as well as other fruits and vegetables. Banana growers in the study area also needs to be trained on this line through extension programmes to improve awareness about the proper harvesting techniques and post-harvest handling of the banana so that the losses at the farm level may be reduced.

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