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Estimation of post-harvest losses of wheat in Indore (M.P.) India

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Abstract
It is estimated that on an average total post-harvest losses was found to be 1.76 per cent of wheat at farmers' level during different stages of post-harvest process. It is concluded from the data that among the total post-harvest losses of wheat the maximum loss occurred due to "storage losses" 22 kg of wheat per farm (0.51% of total production) followed by loss occurred due to "physical losses" 17 kg of wheat per farm (0.39% of total production), loss occurred due to "mandi losses" 13 kg of wheat per farm (0.30% of total production), loss occurred due to "market processing losses" 9 kg of wheat per farm (0.21% of total production), loss occurred due to "threshing and winnowing losses" 9 kg of wheat per farm (0.20% of total production), loss occurred due to "handling losses" 5 kg of wheat per farm (0.11% of total production) and loss occurred due to "transportation losses" 2 kg of wheat per farm (0.05% of total production) respectively. The data on total post-harvest losses of wheat per household has been calculated and presented earlier i.e. the post-harvest losses occurred during different stages was found to be 75.67 kg per farm. In terms of money the average wheat growers suffer due to Post-harvest losses amounting to Rs.1967.33 per farm which show that it is necessary to protect the post-harvest losses by which an additional income can be gained by wheat growers. The data also shows that among the all size of farmers, the percentage of wheat losses was found to increase with increase in size of holding.

Keywords: small farmers: - those farmer who have less than two (<2) hectare land medium farmers: - those farmer who have two to four (2 - 4) hectare land large farmers: - those farmer who have more than four (>4) hectare land PHL (post-harvest losses):- threshing and winnowing losses, handling losses, physical losses, storage losses, market processing losses, transportation losses, mandi losses

Introduction
Among all the food articles, food-grain constitutes the most significant part of the Indian diet. Neariy 60 per cent of an average Indian's food expenditure gets spent on food grains. India in sixties was dependent on import of food products to feed its teaming millions. The demand for food grains in India is increasing rapidly because of population growth and rising income. At that time the major challenge to the scientific community in India was to increase the food grain production not only to provide adequate food to its ever increasing population but also to create surplus for export to stimulate its overall growth.

For increasing productivity, the combination of more intensive schedules, high yielding varieties with shorter growing periods and more intensive production inputs may be employed. Production in agriculture is seasonal and exposed to natural environment, but post-production operations play an important role in providing stability in the food supply chain. According to a World Bank (1999) study, post-harvest losses (PHL) of food grains in India are 7-10 percent of the total production from farm to market level and 4-5 percent at market and distribution level. Given the total production of around 240 million tonnes at present, the total losses has been worked out to be around 15-25 million tonnes. With the given per capita cereal consumption requirement in India, the above grains loss would be sufficient to feed more than 10 crore people. Losses in food crops occur during harvesting, threshing, drying, storage, transportation, processing and marketing.

Material and Methods
Study area
The present study was confined to Indore district of Madhya Pradesh. The Indore district was purposively selected for study because; this district is one of the important wheat growing tracts in the state. The district Indore was also selected due to availability of data of study and awareness of area by the researcher. The detail description of Indore district is as below:

Sampling procedure
Multi stage stratified random sampling technique was used for drawing a sample for the present study. At first stage of sampling, the block in the district was selected. At the second stage of sampling, the villages in the block were selected. At the third stage of sampling, the wheat growers were selected as respondents.

Selection of block
Indore district comprises of 4 blocks. In first stage-sampling, Indore block was selected purposively due to larger area under wheat cultivation.

Selection of villages
In the second stage of sampling, a list of main wheat growing villages of the selected block was prepared. Out of this list 5 villages were selected randomly.

Selection of respondents
In the third stage of selection, a list of wheat growing farmers in all 5 selected villages was prepared. These farmers was categorized into 3 size groups i.e. small farmers (<2 ha.), medium farmers (2-4.00 ha.) and large farmers (>4ha.). From this list 90 wheat growers were selected randomly using proportional allocation. The detail allocation of farmers (wheat growers) is presented in table.

Allocation of wheat growers

S. No	Size group	Actual wheat growers	Selected wheat growers
1.	Small farmers (<2 ha.)	210	42
2.	Medium farmers (2-4.00 ha.)	150	30
3.	Large farmers (>4.ha.)	90	18
4.	Total	450	90

Computation of Post-harvest losses
To estimate the level of losses of wheat during Post-harvest period at different stages, following plan of work and statistical tools were used. Following observations and calculation was done in the study:

1. Estimation of threshing, winnowing losses
The grain after threshing and winnowing was weighted i.e. Ww. After this the grain rejected during mechanical threshing and winnowing was also weighed as samples of rejection (Wn).

$$\text{Threshing and winnowing loss (\%)} = \frac{Wn}{Ww} \times 100$$

2. Estimation of handling losses
For determining handling losses from threshing yard upto farm house, the wheat grains fallen at threshing yard was collected and weighted as Wt and W was measured at net quantity of grain threshed.

$$\text{Handling loss (\%)} = \frac{Wt}{W} \times 100$$

3. Estimation of physical losses
The physical loss was determined as different between the net quantity of grain which was brought upto farm house (W) and the quantity found to reduce at the time of storing (Ws)

$$\text{Physical loss (\%)} = \frac{Ws}{W} \times 100$$

4. Estimation of storage losses
Losses during storage were assessed at farm level. The difference in weight between storing time (i.e.Wd) and the quantity found to reduce at the time of marketed surplus treated as Wr.

$$\text{Storage loss (\%)} = \frac{Wr}{Wd} \times 100$$

5. Estimation of market processing losses
The losses during market processing were mainly broken, rough and spoilage grains, which was cleaned or separated before marketed. The weight of fresh grain (Wh) and broken and spoilage grain was Wx respectively.

$$\text{Market processing loss (\%)} = \frac{Wx}{Wh} \times 100$$

6. Estimation of transportation losses
For assessing the losses due to transportation at marketing level, jute bags of grain were weighed before loading on the tractor trailer (Wd). The jute bags of grain were randomly selected for weighing during unloading at the market point (Wm). The difference in first and second weighing was give the transportation losses (Wd-Wm=Wp).

$$\text{Trasportation loss (\%)} = \frac{Wp}{Wd} \times 100$$

7. Estimation of mandi losses
The mandi losses were calculated accordingly, suppose actual Wm weight of wheat grain is to be sold. However it may be difference at the time mandi weight due to some losses. The difference between actual grain arrival at mandi (i.e. Wm) and mandi weight was represent Wa then,

$$\text{Mandi loss (\%)} = \frac{Wa}{Wm} \times 100$$

Result and Discussion
Post-harvest losses in wheat cultivation
Post-harvest process occurs after the completion of harvest process of crops on field. This process consists of “threshing and winnowing losses”, “handling losses” from thresh hold point upto farm storage house, “physical losses”, “storage losses”, “market process losses”, “transportation losses” from storage house upto mandi and “mandi losses”. It can be say that Post-harvest management process added the value in the product, on the other hand, Post-harvest losses occurred during these activities reduces the quantity and quality of marketable surplus. The details of Post-harvest losses are estimated and presented in Table

Table: Extent of post-harvest losses of wheat at different Post-harvest stages as per size group of farmers.(q/farm)

S. No	Post-harvest process	Small		Medium		Large		Average	
		Quantity loss (q/farm)	Post-harvest loss (%)	Quantity loss (q/farm)	Post-harvest loss (%)	Quantity loss (q/farm)	Post-harvest loss (%)	Quantity loss (q/farm)	Post-harvest loss (%)
1.	Threshing and winnowing	0.04	0.20	0.07	0.19	0.15	0.21	0.09	0.20
2.	Handling losses	0.02	0.10	0.04	0.11	0.08	0.11	0.05	0.11
3.	Physical losses	0.08	0.39	0.15	0.40	0.27	0.38	0.17	0.39
4.	Storage losses	0.10	0.50	0.19	0.51	0.37	0.52	0.22	0.51
5.	Market processing losses	0.04	0.20	0.07	0.19	0.16	0.23	0.09	0.21
6.	Transportation losses	0.01	0.05	0.02	0.05	0.03	0.04	0.02	0.05
7.	Mandi losses	0.06	0.30	0.11	0.30	0.21	0.30	0.13	0.30
8.	Total losses	0.35	1.73	0.65	1.75	1.27	1.80	0.76	1.76

From the study it is estimated that on an average total Post-harvest losses was found to be 1.76 per cent of wheat i.e. 0.76 quintal per farm was lost at farmers' level during different stages of Post-harvest process. The total losses during different stages of Post-harvest process was found to be minimum 0.35 quintal per farm (1.73%) on small size of holding followed by 0.65 quintal per farm (1.75%) on medium size of holding and 1.27 quintal per farm (1.80%) on large size of holding. The trend of losses clearly depicted that the Post-harvest losses was found to increase with increase in size of holding per farm. Similar finding were reported by Jeelani *et al.* (2006) [5]. Grover and Singh (2013) [3] Nag *et al.* (2000) [6], Sharma and Rathi (2014).

a. Threshing and winnowing losses

Threshing and winnowing are the common practice which refers to the separation of grains wheat from straw. Traditional method of threshing and winnowing practice was not prevalent in study area. As per the farmers, to minimize the drudgery of tedious time consuming and laborious work, it was felt necessary to use mechanical device coupled with engines to do threshing and winnowing operations. Sample farmers used threshers (power and diesel) for threshing and winnowing. On an average, total loss during threshing and winnowing was found to be 0.20 per cent of total wheat production per farm or 9 kg of wheat per farm. The loss during threshing and winnowing in terms of broken grains was found higher than mixture with raw materials.

The study also revealed that the losses of wheat grain due to threshing and winnowing was found to increase in quantity per farm with increase in size of holding. Similar finding were reported by Andales (2000) [1]. The data shows that on small farmers the wheat grain was lost by 4 kg per farm during threshing and winnowing followed by 7 kg on medium farm and 15 kg on large farm per household.

b. Handling losses

The process of handling of grain from threshing yard upto storage house are performed by tractor trolley or bullock cart. In the process of handling of grain there might be some chances of the grain falling on the threshing floor. The wheat grain fallen at threshing yard was collected and the quantity of loss was delineated due to handling. On an average, total loss during handling was found to be 0.11 per cent of total wheat production per farm or 5 kg of wheat per farm.

The study also revealed that the losses of wheat grain due to handling were found to increase in quantity per farm with increase in size of holding. Similar finding were reported by Gupta, S.K. and Mishra, P.K. (2007) [4]. The data shows that on small farmers the wheat grain was lost by 2 kg per farm during handling followed by 4 kg on medium farm and 8 kg on large farm per household.

c. Physical losses

Physical losses occur during cleaning, drying and moisture losses during dumping of wheat grain. In study area farmers generally, un-cleaned wheat is placed at farm house for some period. After some time the bold and small grains of wheat and the dirt is removed from the grain. The clean and graded wheat received higher market price compared to the un-cleaned grains. Again in Post-harvest process, drying was also considered important due to loss in weight found after receiving the finished grains. On an average, total loss during physical process was found to be 0.39 per cent of total wheat production per farm or 17 kg of wheat per farm.

The study also revealed that the losses of wheat grain due to physical process were found to increase in quantity per farm with increasing size of holding. Similar finding were reported by Patel, R.N. (2009) [7]. The data shows that on small farms the wheat grain was lost by 8 kg per farm during physical process followed by 15 kg on medium farm and 27 kg on large farm per household.

d. Storage loss

Storage of wheat is one of the major problems and improper storage causes heavy losses. Sample farmers stored their wheat grain in jute bags; few farmers also stored the wheat in bulk. To avoid the storage loss proper method of storage is necessary for preventing quality and quantity loss of wheat. On the other hand, bulk storage is not found suitable it may be damaged through insect-pest, rodent etc. On an average, total loss during storage process was found to be 0.51 per cent of total wheat production per farm or 22 kg of wheat per farm.

The study also revealed that the losses of wheat grain due to storage process were found to increase in quantity per farm with increasing size of holding. Similar finding were reported by Sharma, H. O. and Rathi, D. (2013) [8] The data shows that on small farms the wheat grain was lost by 10 kg per farm during storage process followed by 19 kg on medium farm and 37 kg on large farm per household.

e. losses during marketing

The clean, bold and graded wheat grain reap highest market price than mixture with few foreign material. For this purpose farmers are performing some process before the marketing of grain. The losses were also determined during market process which was in the form of broken, rough and spoilage grains. On an average, total loss during market processing was found to be 0.21 per cent of total wheat production per farm or 9 kg of wheat per farm.

The study also revealed that the losses of wheat grain due to market processing were found to increase in quantity per farm with increase in size of holding. Similar finding were reported by Gupta, S.K. and Mishra, P.K. (2007) [4]. The data shows that on small farms the wheat grain was lost by 4 kg per farm during market processing followed by 7 kg on medium farm and 16 kg on large farm per household.

f. Transportation losses

Transportation of wheat from farmer's house to mandi is a major problem in rural area. Previously, the major means of transport for agricultural produce was the bullock cart. But now farmers used tractor trolley for transportation of wheat from storage to mandi. The loss of wheat grains during transportation was found to be a minor problem. On an average, total loss during transportation losses was found to be 0.05 per cent of total wheat production per farm or 2 kg of wheat per farm.

The study also revealed that the losses of wheat grain due to transportation losses was found to increase in quantity per farm with increase in size of holding. Similar finding were reported by Alam. A. and Singh, G. (2003) [2]. The data shows that on small farms the wheat grain was lost by 1 kg per farm during transportation losses followed by 2 kg on medium farm and 3 kg on large farm per household.

g. Mandi losses

Agricultural marketing now has widening of the size of the market in which the chain of intermediaries is involved during the marketing. The functionaries who render service during marketing earn a margin and some deduction from the produce. There are some extra losses found which have to be borne by producer. On an average, total loss during mandi process was found to be 0.30 per cent of total wheat production per farm or 13 kg of wheat per farm.

The study also revealed that the losses of wheat grain due to mandi process were found to increase in quantity per farm with increase in size of holding. Similar finding were reported by Sreenivasa *et al.* (2007) [9]. The data shows that on small farmers the wheat grain was lost by 6 kg per farm during mandi process followed by 11 kg on medium farm and 21 kg on large farm per household.

It is concluded from the data that among the total Post-harvest losses of wheat the maximum loss occurred due to "storage losses" 22 kg of wheat per farm (0.51% of total production) followed by loss occurred due to "physical losses" 17 kg of wheat per farm (0.39% of total production), loss occurred due to "mandi losses" 13 kg of wheat per farm (0.30% of total production), loss occurred due to "market processing losses" 9 kg of wheat per farm (0.21% of total production), loss occurred due to "threshing and winnowing losses" 9 kg of wheat per farm (0.20% of total production), loss occurred due to "handling losses" 5 kg of wheat per farm (0.11% of total production) and loss occurred due to "transportation losses" 2 kg of wheat per farm (0.05% of total production) respectively.

Estimates of total physical and monetary losses of wheat

On the basis of data pertaining from sample household, an average total Post-harvest losses in term of quantity kg per hectare and kg per quintal with monetary term were also estimated and the data on the same has been presented in Table

Table: Extent of Post-harvest losses of wheat at different Post-harvest stages as per size group of farmers.

S. No.	Post-harvest losses	Small	Medium	Large	Average
1.	Losses Kg. per farm	35	65	127	75.67
2.	Losses Rs. per farm	910	1690	3302	1967.33
3.	Losses Kg. per hectare	42	38	37	39.00
4.	Losses Rs. per hectare	1092	988	962	1014.00
5.	Losses Kg. per quintal	1.74	1.78	1.84	1.79
6.	Losses Rs. per quintal	45.24	46.28	47.84	46.45

The data on total Post-harvest losses of wheat per household was calculated and presented earlier i.e. the Post-harvest losses occurred during different stages was found to be 75.67 kg per farm. In terms of money the average wheat growers suffered due to Post-harvest losses amounting to Rs.1967.33 per farm which are necessary to protect the Post-harvest losses by which an additional income can be gained by wheat growers.

On the other hand, the data shows that on an average, per quintal Post-harvest losses was found to be Rs.46.45 which in physical quantity terms was 1.79 kg per quintal of wheat production. The Post-harvest losses per quintal basis was determined and found that on small farm the losses occurred was minimum i.e. 1.74 kg per quintal amounting to Rs.45.24 per quintal. The total quantum of Post-harvest losses on per quintal basis was found to increase with size of holding. On medium farm the losses occurred was medium i.e. 1.78 kg per quintal amounting to Rs.46.28 per quintal. On the other hand, on large farm the losses occurred was the highest i.e. 1.84 kg per quintal amounting to Rs.47.84 per quintal. Similar finding were reported by Nag *et al.* (2000) [6].

The total Post-harvest losses of wheat per hectare in physical quantity and monetary terms were also estimated. The data shows that on an average, per hectare Post-harvest losses was found to be Rs.1014 which in physical quantity terms was 39 kg per hectare of wheat production. The Post-harvest losses per hectare basis was determined and found that on small farm the losses occurred was maximum i.e. 42 kg per hectare amounting to Rs.1092 per hectare. The total quantum of Post-harvest losses on per hectare basis was found to decrease with size of holding. On medium farm the losses occurred was medium i.e. 38 kg per hectare amounting to Rs.988 per hectare. On the other hand, on large farm the losses occurred was lowest i.e. 37 kg per hectare amounting to Rs.962 per hectare. Similar finding were reported by Patel, R.N. (2009) [7].

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