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Assessment of Losses in Harvesting and Threshing by Manual Method for Wheat and Maize Crop in Samastipur District, Bihar, India

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Abstract

This research was conducted at Borlaug Institute of South Asia (BISA) Pusa, Bihar to assess the losses in harvesting and threshing by manual methods for wheat and maize. 5 farmers from 15 identified villages were selected from Samastipur district of Bihar for assessing harvesting and threshing losses of wheat and maize crop. A total of 75 farmers were selected for this study from Kabargama Phulhara, Ajana, Gopalpur, Maniarpur, Rampura, Ladaura, Birsingpur, Kalyanpur, Akbarpur, Pratapur, Basudevapur, Dhruvgama, Tera, Mirjapur, Samastipur. A pre-procedure for loss assessment was used to record the details of the harvesting and threshing loss practices. It was observed that the total harvesting loss in all 15 villages were 1.65% and threshing loss 2.30% and maize 1.20%, respectively. Wheat Threshing Loss was found highest at 3.35% in Mirjapur village and the lowest at 1.18% in Rampura. Maize threshing loss was found to be highest in Pratapur village by 1.66% and lowest at 0.85% in Ladaura. The threshing loss was found less in Maize as compared to the harvesting and threshing loss of wheat and Maize due to the low loss, it is because of the long-stalked cubs of corn, in which there is no settling loss. The increase in losses was probably due to delays in harvesting due to unseasonal rains and storms, when the crop was ready for harvesting in some cases and less use of technologies at the agricultural level. There is a need for training farmers while harvesting and threshing of wheat and maize to reduce the loss of grain.

Keywords: Grain loss, harvesting, manual methods, moisture content, threshing

1. Introduction

India is a vast country having 329 mha geographical area with about 166 mha cultivable land and 142 mha net sown area. Food that is suitable for human and animal consumption but is lost without being eaten is referred to as “food loss” (Buzby et al., 2014, Aulakh et al., 2013). There are significant post-harvest losses in the field (15%), during processing (13–20%), and during storage (15–25%) (Abass et al., 2014). Zambia and Zimbabwe reported losses for dried corn on elevated platforms of 3.5% and 4.5%, respectively (Calverly, 1996). For Zimbabwe’s smallholders using manual threshing methods, firepower losses were predicted to be between one and two percent, as opposed to three percent when automated shelling was used (Hodges et al., 2011). Loss of weight attributed to deterioration, loss of quality, loss of nutritive value, loss of viability, and finally economical losses are the main categories for post-harvest losses (Boxall, 2001, Boxall, 2002, Anonymous, 2015). In the range of as 1–2%, these losses can be decreased by using scientific preservation techniques (Obiedziska, 2017, De Lucia and Assennato, 2006).

Reduction in post-harvest losses has been noted. According to more recent extensive research, overall estimate of post-harvest losses of 15% (Parfitt et al., 2010). Estimated quantitative losses for the specific case, grains in Asia, varied from 10–37% in 1994 and 13–15% by 2004 (Anonymous, 2011, Smil, 2004).

One third of the food produced is thought to never be eaten, and there are an estimated one billion hungry people worldwide (Anonymous, 2019). The long food chain has several locations where food can be lost, including the farmer’s field, the processing business, the distribution route, and the consumer houses (Chen et al., 2018). (Borma, 2017). On the other side, farm-level losses are frequently disregarded (Johnson et al., 2018). On the other side, the Sustainable Development Goals (SDGs) state that hunger must be eradicated globally by the year 2030. (Anonymous, 2018).

The production of wheat and maize was sixth at the national level of Bihar post-harvest losses in Bihar were 1.657% in agricultural operations, 1.529% in agricultural storage. In Bihar after harvesting maize, there was a loss of 2.81% of farm



operations, 1.777% of field storage, (Nanda et al., 2012). Post-harvest Food Loss (PHL) is defined as measurable qualitative and quantitative food loss along the supply chain, starting at the time of harvest till its consumption or other end uses (Hodges et al., 2011). The losses in cereals were estimated to be in the range of 4.65% (Maize) to 5.99% (Sorghum). Harvesting, threshing and storage at farm and wholesaler level contributed more towards losses (Jha et al., 2016)

Wheat and maize are ready to be harvested, then farmers store them on the threshing floor after harvesting. After that, they adopt the method of storage. Operation can be done manually (trampling, beating) using animal power, or by any mechanical thresher, Manual threshing is the most common practice developing countries. Grain scattered, incomplete separation of grain from husk, breaking of grain is due to excessive striking, some of the major causes of damage are during threshing Process (Baloch, 1999, Shah, 2013).

In developing countries, more than 40% damage occurs after harvesting and during processing operations (Gustavsson et al., 2011). To reduce these losses, one should bring awareness in farmers so that right stage of intervention can be incorporated and more damage can be avoided. The main research conducted was to assess the losses in harvesting and threshing losses by manual methods for wheat and maize in 15 villages.

2. Materials and Methods

2.1. Observation

The study site of harvesting and threshing loss of wheat and maize was selected to Samastipur district, Bihar. In this district 15 villages and five farmers were selected from each village experiment conducted during *rabi* (April–June, 2022). A total of 75 farmers were selected for the survey on harvesting and threshing. Data on harvesting and threshing of maize and wheat grains were obtained from all these farmers by personal field visit. Methods and equipment for harvesting and other data of wheat and Maize crops were recorded. Almost most of the farmers use (*Hasua*) Sickle to harvest wheat and maize crops. These crops were harvested at the ground level. Harvested Wheat and Maize crops were brought to the threshing floor after windrowing or stacking for further studies.

2.2. Wheat

In order to enumerate the loss, ICAR recommended method was followed. 2×2 m² plots were marked before harvesting. The selected plot was harvested and separated with usual method. The rest area was harvested by farmer as per his choice. The harvested crop of the selected plot was collected separately, bundled and marked. The grains fallen from the selected plot was carefully collected and the weight or number of fallen grains was recorded. In case the number of grains was very small difficult to weigh, then the number of grains were counted gradually. The grain loss was collected based

on the yield from the plot. Yield of the selected plot was recorded after threshing it separately with usual practice. Crop harvesting was performed manually by using hand cutting tools such as sickle, knife, scythe, cutters.

Harvesting loss, was calculated by following equation.

$$HL = \frac{L1 - L0}{Y1} \times 100 \dots\dots\dots(1)$$

Where,

HL= is the percentage harvest loss,

L1 is the grain weight loss recorded after harvest,

L0 is the grain weight loss before harvest and

Y the grain yield. L1, L0 and Y must be expressed in the same units, such as kg.

2.3. Threshing loss

In this operation, the dried crop was threshed to separate grains from the ear heads. Threshing losses were recorded separately only if, the harvesting was performed manually. In case of combine harvesting, these losses were accounted in the harvesting losses only. Threshing of the harvested crop of 2×2 m² plot was done with the usual practice The produce and the straw was weighed separately, sample of 250 g straw and separated grains attached to straw was drawn and the grains were weighed/counted and the number of grains or weight was recorded.

Threshing loss, was calculated by using the following equation.

$$TL = \frac{L}{T+L} \times 100 \dots\dots\dots(2)$$

Where,

TL is the threshing loss on %,

L the weight of grains thrown out of different parts of the thresher and

T the weight of grains collected of the main outlet.

% of broken and husked grains: 4 samples of 100 g of rough wheat were taken from the outlet of the thresher and the wheat combine harvester and then broken. Husked grains were separated manually and weighted.

2.4. Maize

In the case of maize, grains were placed on the cob with or without the shell. The leaves, or the cob, may be shelled and grained for a few months when stored. Some machinery suitable for small scale maize sheller removed maize kernels, to assess the harvest and post-harvest losses by both inquiry and observations developed by Nanda et al. (2012).

2.5. Postharvest losses

Identification of 2×2 m² plot: For this, the observer stands at the southwest corner of the field and measured the length (L) and width (W) of the field in meters.

The diagonal of the field was used to locate the three 2×2 m² plots as shown in Figure 1. The points E, F and G would be the key point from where a plot of 2×2 m² was taken. In case

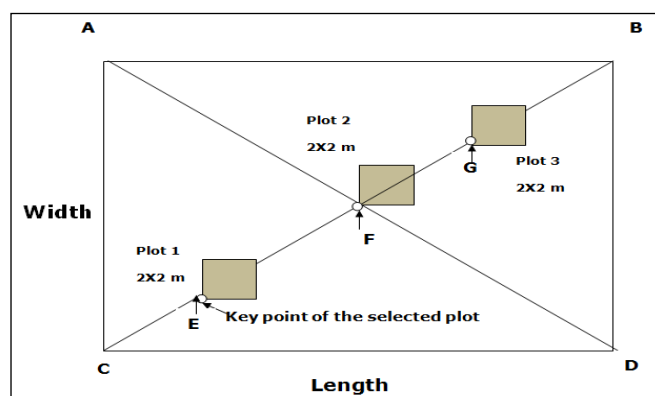


Figure 1: Identification of random plot in a field for field loss measurement

no corner of the plot is in southwest direction, the corner nearest to the southwest direction should be taken base line survey (Anonymous, 2012)

$$BC = (AC^2 + CD^2)^{1/2} \dots\dots\dots (3)$$

CE=0.25 BC, CF=0.50 BC, CG=0.75 BC, Threshing/shelling loss, was calculated by

$$TL = [L / (T + L)] \times 100 \dots\dots\dots (4)$$

Where,

TL is the threshing loss on %,

L the weight of grains thrown out of different parts of the thresher and

T the weight of grains collected of the main outlet.

of broken and threshed grains: Four samples of 100 g of rough maize were taken from the outlet of the thresher and the maize combine harvester and then broken. threshed grains were separated manually and weighted.

3. Results and Discussion

Assessment of losses in harvesting and threshing of wheat and maize grains were conducted by manual methods and results are depicted in Figure 2. Assessed data varied from farmer to farmer. It was observed that almost all the farmers followed manual harvesting and threshing. In the present study, losses on wheat harvesting of village wise were recorded as 2.87%, 2.57%, 2.30%, 2.25%, 2.04 %, 1.92%, 1.72%, 1.27%, 1.66%, 1.48%, 1.17%, 1.00%, 0.90%, 0.80% and 0.78% in Kabargama, Mirjapur, Teera, Dhruvgama, Basudevpur, Pratapur, Akbarpur, Kalyanpur, Birsingpur, Ladaura, Rampura, Maniarpur, Gopalpur, Ajana and Fulhara, respectively.

Likewise, wheat threshing losses in different villages were recorded during study. Mirjapur, Kabargama and Dhruvgama shown highest wheat threshing losses as 3.35%, 3.31%, 3.28%, respectively. While 2.96%, 2.70%, 2.51%, 2.37%, 2.32% and 2.07% wheat threshing losses were recorded in Birsingpur, Teera, Kalyanpur, Basudevpur, Akbarpur and Ladaura village respectively. Whereas, minimum wheat threshing losses were

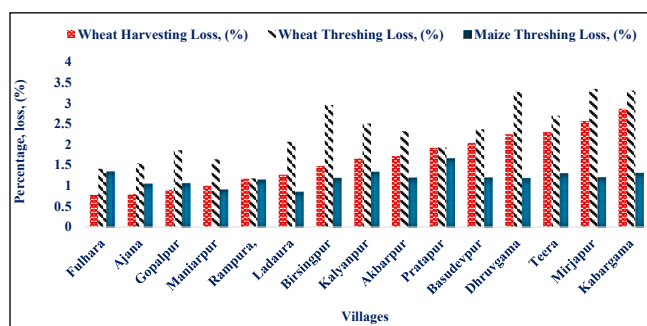


Figure 2: Threshing and Harvesting loss of Wheat and Maize grain

recorded as 1.93%, 1.86%, 1.64%, 1.54%, 1.41% and 1.18% in Pratapur, Gopalpur, Maniarpur, Ajana, Fulhara and Rampura village respectively.

The losses of maize threshing/shelling were found in Fulhara (1.35%), Ajana (1.05%), Gopalpur (1.07%), Maniarpur (0.91%), Rampura (1.14%), Ladaura (0.85%). Birsingpur (1.19%), Kalyanpur (1.34%), Akbarpur (1.19%), Pratapur (1.66%), Basudevpur (1.20%), Dhruvgama (1.19%), Teera (1.30%), Mirjapur (0.21%), Kabargama (1.31%) loss was found.

Harvesting and threshing loss of all 15 villages were depicted in Figure 3. In the present study Kabargama village showed highest (2.87%) wheat harvesting losses while lowest (0.78%) was observed in Fulhara village. Wheat threshing loss was found highest as 3.35% in Mirjapur village and the lowest as 1.18% in Rampura village. Threshing losses in maize was found highest (1.66%) in Pratapur and lowest (0.85%) in Ladaura village. The threshing loss was found less in Maize as compared to the harvesting loss because of the long-stalked cobs of maize in which there is no settling loss. Out of 15 villages, harvesting and threshing losses were recorded as 1.65% and 2.30% respectively in wheat while threshing/shelling losses was found as 1.20% in maize.

Harvesting and threshing of wheat and maize leads to variable losses, whereas the losses in harvesting of wheat in 3 villages Phulhara, Ajana, Gopalpur resulted from threshing and harvesting losses is similar. Basappa et al. (2007) conducted

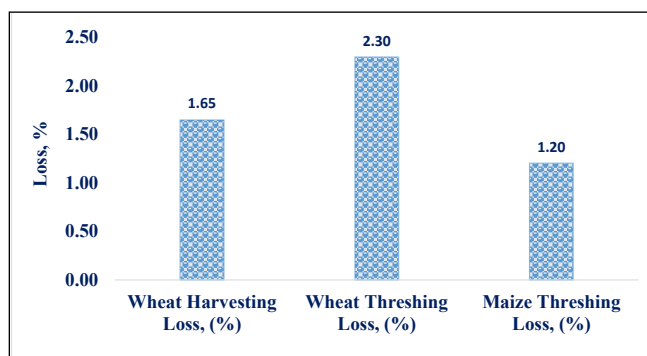


Figure 3: Harvesting and threshing loss of wheat and maize in 15 villages

a study to assess the post-harvest losses in maize at different stages at the farm level in Karnataka during 2003–04 and found that the losses during crop threshing and harvesting at the field level were 0.46% and 0.18%, respectively. Basavaraj et al. (2007), based on agriculture level data collected from one district for each crop in Karnataka, estimated the harvesting and threshing losses of wheat and corn at 0.73% and 0.40% in India.

The study on loss estimates, made by Nanda et al. (2012), is one of the important studies from a national perspective. They collected data by inquiry survey as well as observation, showing losses in wheat harvesting 1.7% in threshing loss 1.6% and Maize harvesting 0.5% and 1.6% in threshing loss was found. Wheat recorded a post-harvest loss of 4.88 ± 1.11 %. In eastern Nepal, a post-harvest loss on wheat of 2.4 ± 1.9 % was discovered by (Boxall and Gillett., 1984). Moreover, it was revealed that the quality of stored wheat was inferior in Nepal's highlands than in the plains (Devkota et al., 2018). The average post-harvest loss in Pakistan is 3.5% for wheat (Baloch, 1999). The loss on maize was estimated to be 4.00 ± 1.18 % after harvest. But according to maize weevil storage losses could reach 32% (Paneru et al., 1996). On the other hand, other research indicated that the grain in those ears that are stored in *Kuniyo* incurred a 30–35% loss. Manandhar and Mainali (2018) reported similar losses in maize storage of 7.44%.

More losses occur before or during the harvesting operation if it is not carried out at adequate maturation and moisture content. Too early harvest of high moisture content increases the cost of drying, making it susceptible to mold growth, invading insects, and causing a large number of broken grains and low grinding efficiency (Baloch, 1999). Leaving mature crops, however, causes large losses when breaking, exposure of birds and rodent attacks, and losses caused by natural disasters (rain, hail, etc.) (Baloch, 1999). Most harvesting is done by hand in developing countries, which is a very laborious and slow process. At the peak of harvest, most countries in the world face a shortage of labor, which causes delays in harvesting and then large losses. Due to large losses associated with the wheat harvest, they increased by about 67% (from 1.5–2.5%) due to delay in harvest (Grover and Singh, 2013) and subsequent losses by 10.3% (1.74 – 1.92 %) due to the lack of appropriate harvesting equipment (Kannan et al., 2013). Recommended optimal moisture content during the harvest of wheat and maize was 14–16% & 23–28%, respectively. In spite of some research done on the loss of grain, wheat and maize harvesting and threshing, the most suitable harvesting and threshing technologies are yet to be developed and disseminated among farmers. There is a need for development of domestic level techniques for harvesting and threshing of various crops.

4. Conclusion

Wheat harvesting & wheat threshing losses were 1.65%

& 2.30%, respectively whereas, maize threshing/shelling loss was 1.20%. Wheat threshing loss was highest 2.87% in Kabargama village and lowest 0.78% in Fulhara village. Wheat threshing loss was found highest 3.35% in Mirjapur village and the lowest 1.18% in Rampura village. Maize threshing loss was found highest in Pratapur village by 1.66% and lowest 0.85% in Ladaura village in Samastipur District, Bihar.

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