Measurement the wheat losses in harvesting stage

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ABSTRACT: Each year a significant portion of the country's wheat production wasted at different stages of production. One of the most important stages of product loss, it is Harvest stage. The first step in planning for waste reduction wheat harvest estimate the amount of losses and factors are identified. In this study during combine wheat harvesting in shahr ood, 8 combines selected and evaluated. Results showed that, the mean of loss in 3 samples was 16.1 %. This amount is out of the acceptable range. The mean of combine total loss at wheat harvesting stage was 6.88 %. The most amount of waste belonged to combine harvester head (5.35%). Crop loss of combine end and natural loss were 1.24 % and 0.49 %, respectively. Harvesting delay and unadjusted combines are the most causes of crop loss. Thus the understanding of growers and combine operators about combine working and its adjusting is effective in loss reduction. Also, results showed that about 90% of the studied combines were more than 13 years old, but results showed that these combines had less loss than newer combines if their operators were skilled and they were adjusted properly. Annually cost of wheat loss in shahrood is more than 3 billions rials. However, combine adjusting is not the only factor to reduce loss. Many factors, such as combine abrasion or management and planning factors are affecting crop loss. Time of harvesting, seed moisture content, weather relative humidity, field topography, correct combine performance and crop characteristics identification are affecting crop loss reduction.

Keywords: Wheat harvesting, Natural loss, Combine loss, Combine adjusting

INTRODUCTION

Wheat sown land in Iran is estimated 6.1 Mha. The most sown land of wheat (10.85%) is related to the Khorasan province. Second and third rate of total wheat sown land, was relate to Fars (9.32%) and Eastern Azar-bayjan (6.72%), respectively. The most yield of the irrigated wheat (4879 kg/ha) related to Tehran province. Number of active combine in 2005 was 9289. However, Number of needed combine was 11963. Operating Combines had more than 13 years old and just 75% of harvesting is covered by combines. Mean of natural, header, threshing and separating unit, processing and total loss were 2.2, 2.62, 2.15, 4.77 and 6.97 percent, respectively. Reducing of the wheat loss at harvesting stage, will increase wheat production. In advanced countries, combine loss is about 2-3percent, while in studied area of this research, combine loss was higher than standard (Anonymous, 2006).

In a research, two combines (JD955, SahandS68) evaluated. Results showed that difference of combine end loss wasn’t significant, but cutter bar loss was significant between two combines and loss of SahandS68 was lower than JD955. Differences of the chaff and half-threshed stalks loss was significant between two combines, and loss of JD955 was lower than SahandS68. Vertical share attaching to one end of head, cutter bar advancing relative to reel, applicant of leader and lift fingers are effective on loss reduction. Harvesting delay, seed moisture reduction and temperature increasing are very important on combine loss (Mehdi-nia, 2007).

Combine loss is one of the most important in agricultural mechanization. Prevent yield loss, is one way to improve performance in the short term. In developed countries, the rate is about 4 percent drop in Combine. While the exact amount is not known in Iran and in some areas reaches 20 percent (Akhiani, 2008).

In a research, 20 combines randomly evaluated. Results showed that ownership break-even area of combine was 433/9 ha. Also, regard to machine capacity, working hours per day (suitable working day), optimum ownership break-even area, estimated 450 ha. Operating costs per hectare is the lowest with 450 ha working in year (qasemi-nezhad, 2006).
In a research, the effect of the rotational speed of the drum and combine type on the wheat losses and waste evaluated. Four types combine (Class, New-holand, JD-995 and JD1165) were as a main-plot and rotational speed of the drum (650, 750, 850) were as a main sub-plot. Results showed that field capacity of the class combine, new-holand combine, JD1165 and JD955 were 1.02, 0.81, 0.62 and 0.26, respectively. Total loss of combine (gathering and processing loss) at 650, 750 and 850 rpm of the threshing unit in class combine was 2.55, 2.76 and 2.83 percent, and in new-holand was 2.37, 2.35 and 2.39 percent, and in JD1164 was 1.44, 1.89 and 1.51 percent, and in JD955 was 2.8, 2.85 and 2.93 percent, respectively (Shaker, 2007).

In order to determine loss of combine, a research in Khorasan, Isfehan, Golestan, Fars and Hamadan was conducted. Lack of adjustment o combine, harvesting timeliness and relative humidity are effective on combine loss. Mean of the total loss in Khorasan, Isfehan, Golestan, Fars and Hamadan was 7.78, 2.3, 6.5, 4.5 and 7 percent, respectively (Rahimi and Khorasani, 2005).

Correct adjustments of combine, increase efficiency of the cutting, threshing, cleaning and separating unit of combine. However, amount of crop waste and or quality of harvested crop is low (fracture, cracking and shattering). Even in optimum situation, combine loss will be 3-5 percent. In the most times, partial adjustment of combine will increase crop production and farmer income (Anonymous, 2005).

In Sudan, wheat planted in 168000 ha. Wheat production is fully mechanized. Wheat harvested by about 300 combines (self-propelled, head width 4.5 m). Combine loss is high (about 18-20 percent). Total loss include pre-harvest, gathering and processing loss. Mean of total loss was 2.5 percent. In order to minimizing the combine loss, a project was begun. First, The objective was extension, educating and media activities. Second, The goal was combine operators. Third, The goal was regulating activities. Fourth, included field investigation in order to estimating harvesting loss and determining of loss source. Results showed that wheat loss was reduced from 20 to 13.2 percent (Taylor et al., 1990).

Grain loss monitors can be helpful for optimizing operating adjustments and combine forward speed. The “area-based” systems with compensation for forward speed provide the most useful signals (Taylor et al., 1990).

When, the wheat moisture content reach to 20 percent, can be harvested. Harvesting timeliness cost is fully related to atmosphere conditions. Also, crop lodging and weeds growth increase crop loss, and reduce income. As compared to each day delay in harvesting, crop yield reduce 12 pound per acre.

The goal of this study, is surveying the effective factors on wheat loss and quantifying loss amount.

METHODS AND MATERIALS

Types of losses before and during of harvesting sage, include, pre-harvesting loss (created by means of natural factors such as wind, animals and rain, cultivar, late maturity, harvesting timeliness and pests), gathering loss (created by means of all mechanism of combine head that engaged with crop), processing loss (created by means of separating and cleaning units) and total loss is The sum of gathering and processing loss.

Necessary tools and equipments for combine loss measuring include, wooden quadrate with 50×50 cm² (0.25m²) dimensions with and without wired or tarpaulin covered, wooden quadrate with 50×80 cm² (0.4m²) with and without wired or tarpaulin covered (quadrate height should be 10 cm), precise scale (with accuracy 0.1gr), meter (50 m), 5 gunny sack, precise scale (50kg capacity), 2 pruning-shears.

COMBINE LOSS MEASURING METHOD

**Natural loss**

Pre-harvesting loss with 4 replication gathered and measured. Before combine entrance in farm, 4 randomly sample of seeds and clusters in wooden quadrate with 50×50 cm² harvested with sickle, present seeds in quadrate weighted and record.

**Head loss**

In order to measuring of gathering loss, wooden quadrate with 50×50 cm² (0.25m²) dimensions is located in back of cutter bar (one third to left or right cutter bar width) and 4 samples gathered. Available seeds and clusters in quadrate gathered and weighted, then cutter bar loss measured.

**Threshing and separating losses**

In order to measuring of processing losses, after combine pass, exited material from combine end, 5 sample gathered. During the combine harvesting, a wooden quadrate 50×80 cm² (0.4m²) with wired or tarpaulin
covered is located in combine end (between rear wheels), then un-threshed and semi-threshed clusters gathered and weighted and threshing loss determined.

**Separating and cleaning losses**

In order to measuring of Separating and cleaning losses, available seeds in covered quadrate, gathered and weighted, then separating and cleaning losses determined.

Losses of various combine parts estimated as follow:

\[ L_G = B - A \]  

Where, \( L_G \) = gathering loss, \( B \) = mean of weighted seeds in gathering loss samples (Kg) and \( A \) = natural loss (Kg/ha, mean of weighted seeds before harvesting).

\[ L_P = \frac{C}{F} \]  

Where, \( L_P \) = processing loss, \( C \) = mean of weighted seeds in processing loss samples (Kg) and \( F \) = relation of gathering width and width of residue bands of combine (Kg).

\[ L_T = L_G + L_P \]  

Where, \( L_T \) = total loss of combine, \( L_G \) = gathering loss and \( L_P \) = processing loss.

**Yield estimating**

During the harvesting, wheat harvested in 25 course (combine width was 4m) gathered and weighted, then wheat yield estimated as follow:

\[ Y = \frac{M \times 10000}{A} \]  

Where, \( Y \) = crop yield (Kg/ha), \( M \) = weight of harvested crop and \( A \) = harvested area (m²).

**RESULTS AND DISCUSSIONS**

Results of farm area, wheat yield, combine type, loss percent (natural, gathering, combine end) and total loss have been showed in table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Rural district</th>
<th>Farm area (ha)</th>
<th>Yield (kg/ha)</th>
<th>Combine Type</th>
<th>Model</th>
<th>Combine loss (%)</th>
<th>Combine yield (kg/ha)</th>
<th>Total loss (%)</th>
<th>Combine C+N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Suburbs</td>
<td>3660</td>
<td>JD955M</td>
<td>1993</td>
<td>5.1</td>
<td>6.1</td>
<td>2.3</td>
<td>8.4</td>
<td>13.5</td>
</tr>
<tr>
<td>3</td>
<td>Maj</td>
<td>5814</td>
<td>JD955M</td>
<td>1989</td>
<td>6</td>
<td>6.8</td>
<td>2.1</td>
<td>8.9</td>
<td>14.9</td>
</tr>
<tr>
<td>4</td>
<td>Maj</td>
<td>5841</td>
<td>JD955M</td>
<td>1980</td>
<td>5</td>
<td>5</td>
<td>4.1</td>
<td>9.1</td>
<td>14.1</td>
</tr>
<tr>
<td>5</td>
<td>Maj</td>
<td>1550</td>
<td>JD955M</td>
<td>1980</td>
<td>3.2</td>
<td>3.21</td>
<td>7.1</td>
<td>10.31</td>
<td>13.51</td>
</tr>
<tr>
<td>6</td>
<td>Maj</td>
<td>1580</td>
<td>JD955M</td>
<td>1985</td>
<td>3.2</td>
<td>2</td>
<td>3.32</td>
<td>5.32</td>
<td>8.52</td>
</tr>
<tr>
<td>7</td>
<td>Maj</td>
<td>2034</td>
<td>JD955N</td>
<td>2005</td>
<td>4.6</td>
<td>3.32</td>
<td>5.52</td>
<td>8.84</td>
<td>13.44</td>
</tr>
<tr>
<td>8</td>
<td>Miami</td>
<td>1879</td>
<td>JD955N</td>
<td>1990</td>
<td>6.7</td>
<td>6.8</td>
<td>1.2</td>
<td>8</td>
<td>14.7</td>
</tr>
</tbody>
</table>

\( M \)= migrant, \( N \)= native

Information of table 1 present that 75% of studied combines in shahrood are migratory combines, and this is the most important reason of harvesting timeliness. Timeliness loss is related to climate. If seed moisture reduce lower than 15%, gathering and natural loss will increase. Also in rainy and muggy weather, seed loss will increase. Opportune harvesting and preventing of wheat loss, is one of the important issue in mechanization. Also in 40% of studied combines, the wheat loss was more than allowed rate (table 1).

Results showed that about 90 percent of inspected combines in this study, aged more than 13 years. Also results showed that just oldness of combines wasn’t only reason of combine losses. As in some cases observed that old combines in compared with new combines had lower losses (Because of operator skill and combine adjusting). Mean of the combine age was more than 17 year, that wasn’t accordant with standard. Usage of old combines in Iran is related to combine expensiveness, petty landowner and economical limitations of farmers for combine purchase.

Results showed that in 3 sample of studied combines, the wheat loss was 16.1 percent, this rate is more than allowed rate (Figure 3). Mean of the combine loss in Shahrood was 6.88 percent, and maximum of the loss related to combine head (5.35 percent). The loss of combine end and natural loss were 1.24 and 0.49 percent, respectively. Loss of property from wheat loss in harvesting stage in shahrood was more than 3 billion dollar. Because
the maximum of loss related to gathering loss (5.35 percent), strategies of preventing combine head loss showed in figure 4.

Figure 1. Natural, processing and gathering losses

Figure 2. Combine and total losses

Figure 3. Correcting wheat harvest losses
However, loss control agents, only the settings are not correct, and many other factors, such as aging management programs combine of factors are involved. Factors such as time of harvest, crop moisture, humidity, topography of the land, reliability and cognitive functioning systems combine the characteristics of the product are effective in reducing yield loss, and people should engage in impression management experience and knowledge in the field have taken action.

CONCLUSION AND RECOMMENDATION

Labor harvesting of grains is difficult, energy and time consuming operation. Combine harvester reduce harvesting and storage losses by greatly increasing the timeliness. Hence, it is absolutely essential to mechanize the harvesting operations. as more than 70% of the people in most Asian countries strive on agriculture for their livelihood (Anon, 1997). Government policies like grain procurement prices have a prominent effect on the purchase of farm machinery by the farmers.

1. Because in more provinces of Iran, wheat harvested timeliness, If harvesting conform opportune, losses will reduce. For opportune harvesting required combines should be provided.
2. Farmers and agricultural machinery manufactures should be supported and loan distribution must be controlled, and in order to combine losses reduction, expert inspector should be employed.
3. In JD955 in order to reach allowed loss, optimum travel speed is 2.6 km/hr. If travel speed of combine to be increased, the loss of combine end will increase.
4. Farmer management during harvesting (presence in farm) is effective on loss reduction.
5. Because of high moisture, operator tiredness and lack of vision, harvesting isn’t recommended after midnight, and farmers and combine operators should be Educated combine adjusting.

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