

## HARVEST LOSSES OF WHEAT CROP

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### ABSTRACT

Harvest losses (10-30%) in wheat represents one of the major factors affecting grain yield. these losses may be during harvesting and/or threshing operations. Although combined harvester is gaining popularity however, In most parts of Pakistan, wheat crop is still manually harvested and then mechanically threshed. Therefore, the current study was conducted on Latif farm of Sindh Agriculture University, Tando Jam to evaluate the harvest losses during the manual harvesting and threshing operations in wheat. Three popular wheat varieties (SKD-1, TJ-83 & KIRAN-95) were selected for this study. Wheat crop was manually harvested and then harvest losses were estimated by harvest losses were estimated on the basis of collection and analysis of leftover / spilled earth head in the freshly harvested field. Threshing losses were estimated by calculating the proportions of broken, unbroken grains and unthreshed ear heads. The study focused on harvesting and threshing operations and their impacts on crop production. The study depicted that harvesting operation was performed manually and threshing by tractor threshing charges were 05 and 10 percent of the crop production respectively while harvesting losses were high at the time of 16 percent due to over drying and unskilled labors used in the field. Technological advancements in agriculture machinery led to reduce the harvesting and threshing losses and therefore, the study suggested that necessary steps of mechanized operation may be taken for minimizing the losses.

Keywords: Post harvest, wheat crop, harvesting, threshing,

### INTRODUCTION

Pakistan is the eighth largest producer of wheat in the world and wheat is one of the most important food crops in Pakistan. If we look into Pakistan's conditions, agriculture is the mainstay of its economy. It contributes about 32% to the gross nation product and accounts for 57% of its live hood. In Pakistan, it achieved the largest share of total farm area under cultivation and accounts 1.7% of Pakistan's GDP. As a staple food crop of Pakistan, wheat crop meets major proportion of calories and protein (82%) intake in its various forms (GOP, 2018). In spite of important cereal crop wheat suffers 10 to 18% loss every year during harvesting, threshing and storage. Out of which 2 to 6% losses are due to improper threshing techniques (Sheikh et al., 1980). Threshing is a major post-harvest operation. It is the process of detaching or removing grains from the plants by treading, striking or rubbing. Separating and cleaning of grain from straw and chaff is also a part of threshing operation (Choudhry et al., 1983; Kumar et al., 2021). Previously threshing of wheat was done manually by dragging a "mahlah" behind animals as there was no mechanical thresher available. This was a time consuming and difficult operation. Usually, the threshing season was late for about 1 ½ month and unpredictable weather conditions at that time necessitates threshing in a short time. In that method of threshing losses usually occur during

winning (Khan, 1979; Pirzado et al., 2021b). One of the greatest challenges of the 21<sup>st</sup> century will be to feed world's population, because food resources are limited, and the world population is increasing at an alarming rate. About 10 to 30% of total world grain production is lost after harvest (Gangwar et al., 2014). Because of inefficient handling, inadequately implemented post-harvest technologies. If these losses are eliminated by applying an integrated system approach, which combines engineering, economics and biological principles, the world food supply can be increased by 10 to 30 % using very few additional basic resources (land, water, and capital) and energy consumption. To protect resources and ensure sufficient food supplies for the world population, development in post-harvest technologies provide considerable opportunities for scientists and engineers. Harvest losses (i.e harvesting and threshing) represent the most important harvest attribute. These losses not only reduced the farmer's profit by reducing the average yield and quality of wheat grains but also reduces the level of nitrogen from soil system (Ibanez et al., 2014; Jones and Dalal, 2017; Sarfraz et al., 2020). Few studies reported the losses of wheat crop during harvesting operations (Prabhakar, 2000; Gadge, 2004). Therefore, keeping in mind the importance and necessity of harvesting and threshing of wheat crop, the present study was focused for assessment of post-harvest losses of wheat crop.

## MATERIALS AND METHOD

### *Description of Experimental Site*

The study was conducted during wheat threshing season of 2013 at Latif farm of Sindh Agriculture University Tandojam. Three popular wheat varieties (SKD-1, TJ-83 & KIRAN-95) were selected on experimental land of Latif farm for observation. The wheat crop grows on 260 acres on Latif farm of Sindh Agriculture University, Tandojam. These varieties were harvested manually starting from 1<sup>st</sup> week of April. After sun drying, harvested crop was collected and transported to the thrash yard and threshing was started with mechanical thresher from 25<sup>th</sup> April. The thresher and its adjustment were kept constant. The threshing was done from 12 noon to 8 pm.

### *Sample collection*

The samples of freshly harvested wheat were randomly selected by encircling 1 meter square in the field (Kumar et al., 2017; Pirzado et al., 2021a). The harvest losses were estimated on the basis of collection and analysis of leftover / spilled earth head in the freshly harvested field. The collected samples were put in the plastic bags of suitable size and labeled. After the collection of grain samples of different wheat varieties,

all these samples were transported safely from field to Laboratory of Farm Structure Department, Faculty of Agriculture Engineering. In the laboratory, each sample was analyzed by separating grain from boosa and foreign materials as per design. The harvest losses were estimated on the basis of collection and analysis of leftover / spilled earth head in the freshly harvested field. It was recorded that the number of leftover panicles per sq-meter of harvested field.

### *Threshing*

The threshing operation involves the detachment of kummels or grain from the panicle and can be achieved by impact method which is most popular method of threshing wheat grain. The most mechanical threshers primarily utilized the impact principle for threshing. During threshing operation in the field, six samples were taken from two sources, one from pure grain and other from boosa respectively, of 400 grams. The 3 samples from each source after the interval of 20 minutes, each sample was taken in triplicate. After the collection, grain samples were transported to the laboratory of farm structure department, faculty of agriculture engineering. The moisture percentage of grain was determined by wet method in electric oven at 104 °C for 20 h (Kumar et al., 2017).



Fig. A site map of experimental field at Latif farm of Sindh Agriculture University Tandojam

The moisture percentage:

$$= \frac{W_w - W_d \times 100}{W_w}$$

$W_w$  = Wight of wet sample (g)

$W_d$  = Wight of dry sample (g)

To estimate threshing losses, broken, unbroken grains unthreshed ear heads were separated, and un-threshed ear heads were threshed and the percentage of all these components was determined.

#### Data analysis:

The collected data were analyzed using descriptive as well as inferential statistics by using Statistical Package for Social Sciences (SPSS Inc).

## RESULTS AND DISCUSSION

The mode of harvesting and threshing operation is shown in table 1. The data indicates that harvesting operation in the study area was 100% manually performed, while threshing operations was performed

100% by tractor thresher (mechanical method). The harvesting results showed that harvesting operation was performed by skilled and unskilled labors. The rate of harvesting operation 80kg / acre and threshing operation was 04kg / 40kg from privet sector on charges basis.

The moisture percentage of grain at harvesting and threshing time is shown in table 2. The data indicated that maximum moisture percentage 12.5% was observed in SKD-1 followed by KIRAN-95 (12.4%) while minimum (11%) was recorded in TJ-83 variety. At threshing time, maximum moisture content (11.7 %) was recorded in SKD-1 variety followed by KIRAN-95 (11.5%). The overall moisture percent at both operations was observed as low due to over drying of the crop in the field.

**Table 1. Mode and rate of harvesting and threshing operation on the farm**

Activities	Mode	Rate
Harvesting	Manual	80kg grains / acre harvesting
Threshing	Tractor threshing	04kg grains / 40kg threshing

**Table 2. Moisture percentage of grain at harvesting and threshing time**

Name of variety	Moisture % at harvesting	Moisture % at threshing time
SKD-1	12.5	11.7
TJ-83	11.0	10.8
KIRAN-95	12.4	11.5
MEAN	11.96	11.33

**Table 3. Description of varieties of wheat crop grown in the study area**

Varieties	Yield per acre (kg/ac)
SKD-1	1726.3
TJ-83	1449.5
KIRAN-95	1695.5
Mean	1623.7

*Sources: office of farm manager Latif farm*

Table 3. represented the yield data on three popular wheat varieties (SKD-1, TJ- 83 and KIRAN-95) grown on Latif farm. The maximum yield of 1726.3kg / ac was produced by SKD-1 followed by KIRAN-95 (1695.5 kg / ac). The lowest yield 1449.5kg / ac was obtained by TJ-83 variety. The yield data were reported by farm manager of latif farm. The mean yield productivity of wheat crop was 1623.7667 kg per acre. The preliminary data of harvesting losses in different wheat varieties are shown in table 4. The data indicated that nine samples of each variety (SKD-1, TJ -83 and

KIRAN -95) were taken random from the field. The wheat grain was founded in 2 sources one from ear head and other was fallen directly on the ground/ earth. The maximum mean value of 0.076 (kg /m<sup>2</sup>) was recorded by TJ- 83, followed by KIRAN-95 (0.064 kg/m<sup>2</sup>). The lowest mean value of 0.055kg/ m<sup>2</sup> was obtained by SKD-1 variety. The overall data showed that due to unskilled labor used in harvesting, the loss in ear head was found greater than shuttering losses in all three varieties. The results further showed that

SKD-1 variety proved better in harvesting losses as compared to TJ-83 and KIRAN-95 varieties.

The harvesting losses in experimental study area under three varieties (SKD- 1, TJ-83, and KIRAN-95) are shown in table 5. The maximum total harvesting losses were produced by TJ- 83 (0.076 kg /m<sup>2</sup>), followed by KIRAN – 95 (0.062 kg /m<sup>2</sup>). The minimum total harvesting losses were obtained by SKD- 1 variety (0.055kg /m<sup>2</sup>). The maximum loss per acres was produced in TJ- 83 (307.572 kg), followed by KIRAN - 95 (250.914 kg) and the minimum loss per acre was obtained by SKD- 1 variety (222.585 kg), the mean loss value of three varieties were 260.357 kg/ acre.

Overall harvesting charges and losses on university farm are shown in table 6. The data indicated that harvesting charges of 80 kg per acre provided to private sector, the total crop production was 10554 md and the cost of the production at the rate of R.s 1200 become 12665 million total harvesting charges on 260 acres at the rate of 80 kg per acre was R.s 0.624 million, the percentage of harvesting charges on total cultivated area (260acre) was 05%. The data further

showed that the total harvesting losses of wheat grain was 16% of the total cultivated area. The results of harvesting losses are in line with Ahmed and Afzal (1984). They reported that in Pakistan harvesting and threshing losses are at the time 13.2%. The preliminary data of threshing losses in different wheat variety are shown in table 7. Six samples were collected randomly during thrashing the approximate sample weight wheat was 400g after the interval of 20 minutes and also from straw which was approximately 300g. The maximum percentage of broken grain, unthreshed grain and grain in straw was recorded 0.64%, 0.11% and 0.88% followed by KIRAN-95 (0.76). The minimum total loss 0.75% was obtained by SKD- 1 variety. Overall results of threshing wheat crop on Latif farm showed that machines and operators' performance was found satisfactory. The mean percentage value of broken grain was recorded 0.06% and the mean percentage value of un-threshed grain was 0.086% from the sample of 400g. The mean percentage value of grain in straw was 0.11% from the sample of 400g.

**Table 4. Preliminary data of harvesting losses in different wheat varieties**

V1: SKD-1, V2: TJ-83, V3: KIRAN-95, HL: Harvesting loss, EHL: Ear head loss, SL: Shuttering

Sample	HL (kg/m <sup>2</sup> )		THL (kg/m <sup>2</sup> )	Sample	HL (kg/m <sup>2</sup> )		THL (kg/m <sup>2</sup> )	Sample	HL (kg/m <sup>2</sup> )		THL (kg/m <sup>2</sup> )
	EHL	SL			EHL	SL			EHL	SL	
V1			V2			V3					
S1	0.024	0.027	0.051	S1	0.049	0.035	0.084	S1	0.042	0.022	0.064
S2	0.016	0.018	0.034	S2	0.055	0.026	0.081	S2	0.045	0.019	0.064
S3	0.022	0.017	0.039	S3	0.039	0.030	0.069	S3	0.055	0.025	0.080
S4	0.036	0.030	0.066	S4	0.036	0.043	0.079	S4	0.031	0.035	0.066
S5	0.031	0.035	0.066	S5	0.035	0.040	0.075	S5	0.028	0.036	0.064
S6	0.029	0.022	0.051	S6	0.032	0.038	0.070	S6	0.030	0.038	0.068
S7	0.042	0.031	0.073	S7	0.045	0.021	0.066	S7	0.048	0.016	0.064
S8	0.040	0.030	0.070	S8	0.065	0.025	0.090	S8	0.039	0.010	0.049
S9	0.030	0.015	0.045	S9	0.058	0.012	0.070	S9	0.024	0.015	0.039
mean	0.030	0.025	0.055	mean	0.046	0.030	0.076	mean	0.038	0.024	0.062

loss, THL: Total harvesting loss

**Table 5. Harvesting losses of experimental study area.**

Variety	HL (kg/m <sup>2</sup> )		THL (kg/m <sup>2</sup> )	Loss per acre (Kg)
	EHL	SL		
V1	0.030	0.025	0.055	222.5
V2	0.046	0.030	0.076	307.5
V3	0.038	0.024	0.062	250.9

V1: SKD-1, V2: TJ-83, V3: KIRAN-95, HL: Harvesting loss, EHL: Ear head loss, SL: Shuttering loss, THL: Total harvesting loss.

**Table 6. Overall harvesting charges and losses on university farm.**

Harvesting charges per acre (kg)	Total area under wheat crop (acre)	Total crop production (md)	Cost of production at the rate Rs.1200/md	Total harvesting charges Rs.	Total harvesting charge in	Harvesting loss per acre (kg)	Total harvesting losses on 260 ac (kg)	Total cost of losses in Rs.	Total loss in %
80	260	10554	Rs.12665380/= (12.665 million)	624000/= 0.624 million	05	260.35	67692.82	20,30,784.6	16

**Table 7. Preliminary data of threshing losses in different wheat variety**

Samples	Variety	Grain loss				Grain in straw		Total loss (%)
		Broken grain		Un threshing				
		Wt. in gram	%	Wt. in gram	%	Wt. in gram	%	
1	SKD-1	2.32	0.58	0.68	0.17	0.39	0.13	0.88
2		2.53	0.63	0.00	0.00	0.33	0.11	0.74
3		1.96	0.49	0.00	0.00	0.36	0.12	0.61
4		2.08	0.52	0.84	0.21	0.27	0.09	0.82
5		2.60	0.65	0.36	0.09	0.33	0.11	0.85
6		2.20	0.55	0.00	0.00	0.12	0.04	0.59
Mean		2.28	0.57	1.88	0.08	0.30	0.10	0.75
1	TJ-83	3.00	0.75	0.68	0.17	0.33	0.11	1.03
2		2.56	0.64	0.52	0.13	0.39	0.13	0.9
3		2.32	0.58	0.00	0.00	0.42	0.14	0.72
4		3.24	0.81	0.60	0.15	0.57	0.19	1.15
5		2.53	0.63	0.85	0.21	0.36	0.12	0.96
6		1.72	0.43	0.00	0.00	0.27	0.09	0.52
Mean		2.56	0.64	0.44	0.11	0.39	0.13	0.88
1	KIRAN-83	2.60	0.65	0.64	0.16	0.27	0.09	0.90
2		2.56	0.64	0.64	0.16	0.21	0.07	0.87
3		2.34	0.58	0.00	0.00	0.39	0.13	0.71
4		2.36	0.59	0.00	0.00	0.33	0.11	0.70
5		2.53	0.63	0.40	0.10	0.18	0.06	0.79
6		1.80	0.45	0.00	0.00	0.42	0.14	0.59
Mean		2.36	0.59	0.28	0.07	0.30	0.10	0.76

**Table 8. Threshing losses of wheat varieties**

Variety	Grain loss				Grain in straw		Total loss %
	Broken grain		Un threshed grain				
	Wt. (g)	%	Wt. (g)	%	Wt. (g)	%	
SKD-1	2.28	0.57	0.32	0.08	0.10	0.10	0.75
TJ-83	2.56	0.64	0.44	0.11	0.13	0.13	0.88
KIRAN-95	2.36	0.59	0.28	0.07	0.10	0.10	0.79
MEAN	2.3	0.6	0.35	0.086	0.33	0.11	0.79



**Table 9. Summary of harvesting and threshing charges and losses of wheat crop**

Total production (md)	Operations	Area under crop (ac)	Charges per acre 4	Total charges Rs. 5=(3x4)	Charges in %	Total loss in (md)	Loss in %
10554 (Rs.665 million)	Harvesting	260	80 kg/ac	0.624 million	05	1662	16
	Threshing	260	4 kg /40kg	1.266 million	10	--	--
	Total	---	---	2.184 million	15	1692	16

Figure in brackets shown total cost of the production at the rate of Rs. 1200/= (according to Govt: rate)

The mean percentage of total threshing losses was 0.79%. the threshing results revealed that TJ- 83 variety gave maximum broken grain loss of 0.64% followed by KIRAN-95 (0.59%) while in un-threshed grain loss TJ – 83 gave maximum 0.11% loss followed by SKD-1 (0.08%). While considering the loss in straw, TJ- 83 gave maximum 0.13% loss followed by SKD-1 and KIRAN-95 (0.10%). The overall results also showed that TJ -83 gave maximum 0.88 % loss followed by KIRAN-95 (0.76%). The threshing results revealed that mean loss of 0.79% is within the acceptable range due to proper functioning of threshing machine.

The table 8 shows the threshing losses of wheat varieties (SKD-1, TJ-83 and KIRAN-95). The mean percentage value of broken grain was recorded 0.06% and the mean percentage value of un-threshed grain was 0.086% from the sample of 400g. The mean percentage value of grain in straw was 0.11% from the sample of 400g. The mean percentage of total threshing losses was 0.79%. the threshing results revealed that TJ- 83 variety gave maximum broken grain loss of 0.64% followed by KIRAN-95 (0.59%) while in un-threshed grain loss TJ – 83 gave maximum 0.11% loss followed by SKD-1 (0.08%). While considering the loss in straw, TJ- 83 gave maximum 0.13% loss followed by SKD-1 and KIRAN-95 (0.10%). The overall results also showed that TJ -83 gave maximum 0.88 % loss followed by KIRAN-95 (0.76%). The threshing results revealed that mean loss of 0.79% is within the acceptable range due to proper functioning of threshing machine.

Summary of harvesting and threshing charges and losses in wheat crop on latif farm is shown in table 9. The results depicted that harvesting charges at the rate of 80 kg per acre of total 260 acres was Rs. 0.24 million and threshing charges at the rate of 04 kg / 40 kg of total production 10554 md was 1. 266 million. The total charges of both wheat operations (harvesting & threshing) were 1.890 million say 15 % of total production of wheat crop. The results further revealed

that harvesting losses produced by skilled and unskilled labors was recorded as 16% while threshing losses was in acceptable range (below one percent). The present study suggests that necessary steps be taken by minimizing the harvesting and threshing charges through mechanization as to save production losses of wheat crop.

The results are in line with Ali and Khalid, (2015) and Kumar et al. (2017) they reported that grain losses during conventional harvesting was above 7% and 19 % respectively. The result further confirmed the statement of Ali and Khalid, (2015) they reported that if machine is properly set for operation during threshing of wheat crop the threshing losses would come below one percent. The results are also in line withManzoor et al. 2020) they reported that post-harvest losses of wheat in Pakistan is 5- 16% which greatly depends on the experience of skilled and unskilled labor involve in harvesting and threshing operations. They also mention that among total post-harvest losses, 9.5% occurred during storage period and remaining 13.2% during harvesting and threshing.

#### CONCLUSION

It is concluded from the above results that average harvesting losses in manual harvesting of three wheat varieties was 16% which could be reduced by mechanized harvesting. Furthermore, the harvesting charges and time consumption in manual harvesting is also higher as compared with mechanized harvesting or combined harvesting and threshing. Therefore, it is suggested that mechanized harvesting should be promoted for wheat harvesting operations in order to minimize harvest losses and also time saving.

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