



A MIXED-METHOD STUDY TO ENHANCE FOOD SECURITY BY REDUCING POST-HARVEST WHEAT LOSSES IN PUNJAB, PAKISTAN

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Abstract

Purpose of the study: The major purpose of this study was to enhance food security by reducing wheat losses.

Methodology: A mixed-method research was used for data collection. Six focus group discussions and six key-informant interviews were conducted to cover qualitative aspects while 400 face-to-face interviews were conducted. The study was conducted in three randomly selected districts of Punjab. Six tehsils, two from each district were further selected randomly. From each selected tehsils, four hundred farming households were selected through a proportionate sampling technique, and data were collected through an interview schedule. For the qualitative aspect thematic analysis was used to analyze data. The quantitative data were analyzed through the statistical package for social sciences (SPSS)

Main Findings: The result of the present study shows that majority of respondents having old age were doing wheat post-harvest activities and they have only a primary level of education. The farmers who have access to extension services had less level of losses rather than others. Qualitative results show that the farmers who are trained with techniques to manage post-harvest activities have fewer losses as compare to the farmers who are not trained.

Applications of this study: It is concluded that hurdles regarding canal water, marketing, transportation, and practices of traditional methods for wheat storage lead to post-harvest losses as well. It is a sheer need of time to train the people (involved in postharvest management activities) to reduce the postharvest losses according to their needs.

Keywords: Food Security, Post-harvest, Wheat Losses, Training Needs, Wheat Production, Bread Quality.

INTRODUCTION

Post-harvest losses occurred due to different factors start from harvesting to its consumption e.g. traditional practices used in harvesting, processing, handling, drying, and others. Agricultural production is also lost due to sudden changes in the condition of weather, the decision of managerial activities, available facilities of transportation, availability, and infrastructure of financial markets. Post-harvest losses mechanization chain effects from many stages like as: the moment of harvesting, lack of knowledge, and inadequate practices. These practices vary from country to country (Kalsa et al., 2019). In less developed countries, for example, where technology level is less mechanized, high illiteracy level prevail, increased poverty, marketing infrastructure are less developed and high food insecurity is experienced, high losses incurred at drying, transportation, handling, and storage stages (Aulakh & Regmi, 2013). Post-harvest losses occur due to improper infrastructure, practical uses of traditional ways, insufficient knowledge, and skills, monopoly of the marketing system, insufficient management strategies and skills (Kiaya, 2014).

Postharvest losses measured through quantitative and qualitative ways in quantitative type: reduction of weight or volume of food grains and in qualitative type: loss of nutritional or processing quality, including contamination with aflatoxins) and economic (e.g. reduced value or access to some markets) Delgado et al. (2020). The post-harvest loss occurred at different stages of the post-harvest management chain affecting crop quality and food security efforts. Understanding the circumstances around harvest and post-harvest of a given crop may help reduce post-harvest losses and improve the income of farm households (Dessalegn et al., 2014; Muroyiwa et al., 2020).

In 2050, it is expected that the population all around the world, especially in the developed countries where the agricultural sector is largely depending upon smallholder farmers, will be increased to 9.1 billion ultimately their food requirement will also be increased by up to 70% (Food and Agriculture Organization, 2009). The condition will be somewhat how different in some countries such as South Africa, Brazil, and China where there are equal opportunities for both small and large landholder farming communities. It is there need of time to find out the way to reduce post-harvest losses as well as wastage of food to improve food security and improve the wellbeing of the society (Hodges et al., 2011; Khader et al., 2019).

Pakistan has ranked 11th faced the risk of food insecurity among other countries. In Pakistan, 1/3 of the population living under the poverty line. Pakistan's estimated inhabitants are above 187 million, making it the world's sixth most populous

country and rising at the rate of 1.8%, advances countless disquiets. Massive and growing population cause frequently increasing demand for food, extending the issues of food security. Food is lost or wasted throughout the supply chain, from preliminary agricultural production down to final household consumption. In developing countries commodities to a substantial extent are wasted at the growing, harvesting, and consumption stage ([Atta et al., 2020](#)). With the rise in the global population to over nine billion by 2050, the necessity for improved strategic food accessibility is vital. Declining post-harvest losses leads to achieving food security. Appropriate postharvest management techniques need to be prioritized. Globally rural people faced an issue of postharvest losses of food grains that needs to be addressed ([Shamim et al., 2016](#) and [Parfitt et al., 2010](#)). Post-harvest is a concluding activity in agriculture to secure the food and other crops ([Kenny, 2015](#); [Hodges & Stathers, 2012](#) and [Amin et al., 2009](#)).

Wheat is considered a major staple and cereal crop of Africa. The demand for wheat grains increasing in Sub-Saharan African countries because of income growth, urbanization, and dietary diversification ([Jayne et al., 2010](#)). Increasing domestic production to meet local demands is not enough to make Ethiopia self-sufficient in wheat production. A more meaningful means of improving food security in sub-Saharan Africa would be to improve post-harvest protection practices aimed at protecting the harvested wheat throughout the wheat value chain ([World Bank, 2011](#)). Understanding where improvements can be made, and how best to make them, will optimize efforts in these areas ([Dessalegn et al., 2017](#)).

Reducing postharvest losses is an essential need of both developing and less developed countries leads to fulfilling the requirement of food needs without an additional need for agriculture productivity. In many developing countries food grains fulfilled basic food requirements. Due to poor post-harvest operations losses reached up to 50 to 60 percent in cereal grains. Majority of losses at storage level (usage of traditional storage practices, inadequate knowledge, and lack of access to new knowledge and awareness). In developing and less developed countries, reducing post-harvest losses can provide a sustainable solution to food security, improve rural livelihoods, reduce poverty and increase incomes ([Hodges et al., 2011](#); [Minot et al., 2019](#)).

In Pakistan, the estimated consumption of wheat flour is 124/k.g./capita which is the highest amount all over the World. It is exceeded from China and India although have a higher level of income and population than Pakistan ([Rashid & Ayaz, 2015](#); [Prikhodko & Zrilyi, 2013](#)). Due to having the agricultural economy of Pakistan, the development of the agricultural sector is very necessary for maintaining food security. Among other food crops, wheat is considered is the key crop for the survival of human beings as well as a major shareholder in the economy along with other major crops ([Yu et al., 2017](#); [Worku et al., 2019](#)).

The sustainable solution for the reduction of poverty and increases the level of development of rural people by improving the situation of the agri-business of farmers. It is estimated that up to 2030, the drivers of postharvest losses different like as: in the developed world, include public and private sector partnerships, education campaigns at the consumer level, sharing the responsibility for the reduction of postharvest grain losses. On the other side, in less developed countries drivers are different from developed countries includes education campaign at the level of farmers for the causes of food grains reduction, better marketing infrastructure for the connection of small-farmers to middle-man; training at the farmer level to adopt better technologies to reduce losses during the supply chain of postharvest ([Hodges et al., 2011](#); [Priya & Mitra, 2020](#)).

Reducing post-production losses of wheat grains by 5% means that saving more than one million tons of wheat for consumption while maintaining product quality. These losses can be minimized through creating awareness among the public especially lived in rural areas to the basic strategies for post-harvest management of small-scale grain storage to large-scale grain storage and better transportation system ([Ahmad, 2009](#); [Singh et al., 2011](#)).

It cannot be denied that the reduction of post-harvest losses is most important to ensure food security, as well as the reduction of these losses, will ultimately increase the opportunities of food production and help in the alleviation of poverty and uplift in rural development in the developing countries ([Hodges et al., 2011](#)).

Wheat loss factors

a. Biotic

In the wheat loss, the main biotic factors include insect pests, moulds, and birds which mainly damage the crop at the time of harvesting. The major insects of the wheat crop are Khapra beetle, lesser grain borer, Rice Weevil, and Red flour beetle which are found in developing countries and are the major factor in decreasing the wheat quality. Humidity which affects the storage conditions, the temperature which is the major cause of deterioration, and the respiration system of the grains are also included in biotic factors. Due to the increasing temperature, the respiration in grains increases which results in the production of carbon dioxide and provides the environment for spoilage of grains. Humidity has a direct relationship with spoilage as the humidity increases, the spoilage will also be increased. The use of mud or concrete constructed material help in the reduction of humidity, but they have the major disadvantage that they provide a favourable environment for various pests of wheat. Similarly, the use of jute bags will also lead to the attack of insect pests. To avoid spoilage, the best alternate



method is the sun drying of the grains. A proper aeration system also reduces the growth after harvesting, insect pest attacks, and respiration as well as helps in restoring the aesthetic value of the grain ([Baloch, 1999](#); [Zachetti et al., 2019](#); [Portell et al., 2020](#)).

b. Climate

The factors such as the condition of grain at the time of storage, storage period, insect pest control methods, and climatic conditions also affect the quality of grain. All these factors are closely linked with each other, so it is not easy to isolate them as each factor plays an equal role in the post-harvest loss ([Baloch, 1999](#)).

Objectives

- To study the socio-economic and cultural characteristics of the respondents.
- To find out the knowledge and practices used in post-harvest activities.
- To find out the measures to enhance food security by reducing losses.

The hypothesis of the research

Hypothesis 1: Access to extension services is correlated with wheat post-harvest losses

Hypothesis 2: Post-harvest losses of wheat are associated with hurdles in canal water.

Hypothesis 3: Easy access to the market is associated with post-harvest losses of wheat.

Hypothesis 4: Post-harvest wheat losses are affected by the condition of the road from farm to market, Type of Irrigation, Practice of Harvester, the method used for packaging of wheat, type of transport you used, Farming Experience (In Years), Distance of village From the market in Km, storage practices.

METHODOLOGY

The methodology is the collection of practices, processes, and guidelines used by those who operate in a discipline or undertake an investigation. [Dornyei \(2007\)](#) revealed that the research design of the qualitative or quantitative study should be practised systematically. In the present research, an organized methodology was followed by the researcher.

Research Area

Punjab (Pakistan)

The estimated population of Punjab province is, 110,012,442, and this is the most populous of other provinces, it is second largest by area ([Government of Pakistan, 2017](#)). It is also known as the land of five rivers. Punjab is a prominent agricultural province and famous for its two distinct cropping periods. The “*RABBI*” season runs from November-April and the starting of the “*KHARIF*” season from May-November every year ([Rashid & Ayaz, 2015](#)).

Study Districts

There are 36 districts in Punjab ([Government of Pakistan, 2019](#)). In the present research, studied were three districts (Okara, Faisalabad, *Chiniot*) from Punjab, selected through randomly. All three (study areas) districts hold tremendous potential for agriculture. See highlighted study districts in the below picture.

Research Design

A research design used for an operation, performed for the test of a particular hypothesis ([Bless et al., 2006](#)). While [Wellman et al. \(2005\)](#) described research design as a plan for selecting participants to study and gather information.

Mixed research methods were used for data collection. Both quantitative and qualitative research methods were employed. In quantitative types like as surveys and experiments, in qualitative type in-depth interviews, focus the discussion, and key-informants interviews. The best uses of this method when required a deep understanding of the research issue ([Alise & Tedlie, 2010](#)).

Study Population

The farming household who are growing a wheat crop, residing in the study districts (Okara, Faisalabad, *Chiniot*) were considered as the population for the study.

Statistical Analysis (Quantitative Data)

Quantitative data were evaluated using different statistical techniques, for example: univariate, bi-variate, and multi-variate. Univariate analyzed data in terms of frequency, percentage. On the other side bi-variate analysis defines the relationship between pairs of variables **Chi-Square, Co-efficient of Determination**. Multivariate analysis **Multiple Regression Co-efficient of Multiple Correlation** indicates how important independent variables are to explain dependent variables. The nature of the study determines the choice of statistical tests and models.

Analysis (Qualitative Data)

Development of the themes

The themes in the current study were developed by passing through the following stages. The qualitative data is not simply analyzed rather it is a complex task involving many consistent steps. Following are important steps that the researcher adopted for the construction of themes.

Steps of Theme Development

The first step that the researcher adopted while carrying out qualitative data analysis was familiarizing the data that was collected by the researcher. It is a very key phase as at this stage the researcher understands the data.

The second step was to transcribe the data from Urdu/Punjabi to English. As the data had to be presented in English hence it was important to transcribe the data. In addition to that audio recordings were also transcribed.

In the third step, the researcher organized the transcribed data into different categories. These categories helped the researcher in identifying the themes.

In the last step, the researcher identified and formulated themes of the study. These themes were based on primary data and a literature review conducted by the researcher at the earlier stage of the study.

RESULTS

This chapter has two parts, one part has a statistical analysis of quantitative analysis, and the second part has qualitative data analysis.

Quantitative Data Analysis

Table 1: Distribution of respondents as to their age, education, and marital status

The Respondents' Age		
Age	Frequency	Percent
15-25	44	11.0
26-35	83	20.75
36-45	116	29.0
46 and above	157	39.25
Educational Status		
Education	Frequency	Percent
Illiterate	114	28.5
Primary	191	47.3
Middle	50	12.5
Matric	24	6.0
Secondary and above	21	5.7
The Respondents' Marital Status		
Marital Status	Frequency	Percent
Married	326	81.5
Unmarried	62	15.5
Widow/Widower/Divorced	12	3.0
Total	400	100.0

In the present study, findings indicate that more than one-fifth (11.0%) of farmers were aged 15-25, about one fifth (20.75%) of respondents belonged to the age group 26-35, nearly one-third (29.0%) of respondents were 36-45 years of age, and the majority (39.2%) of respondents aged between 46 and above years.

Table 1 represents the level of education of respondents: nearly one-third (28.5 %) of farmers were illiterate, while the majority (47.3 %) of farmers had primary education, more than one-tenth (12.5 percent) of respondents were middle-level of education, and 6.0 percent of respondents had matric level of education and only 5.7% of respondents had higher secondary education level.

Table 1 about marital status shows that a large majority (81.5%) of respondents were married, more than one-tenth (15.5%) were unmarried, and a few (3.0%) of respondents were widow/widower/divorced.

Table 2: Respondents' distribution regarding per acre wheat yield and satisfaction level about per acre yield

Per Acre Yield of Wheat		
Wheat Yield	Frequency	Percent
Less than 30 Maund	35	8.8
31-40	207	51.8
41 and Above	158	39.5
Satisfaction Level of Farmers About Per Acre Wheat		
Response	Frequency	Percent
Very satisfied	25	6.3
Satisfied	78	19.5
Neutral	36	9.0
Unsatisfied	243	60.8
Very Unsatisfied	18	4.5
Total	400	100.0

The results of Table 2 shows that one-fifth (8.8%) of respondents had per acre wheat production was less than 30 maunds, a major portion (51.8%) of respondents had per acre production was 31 to 40 maunds, and (39.5%) of respondents' per acre production was 41 and above maunds. Result demonstrates that only a few respondents (6.3%) were "Very Satisfied" about their per acre production, about one-fourth (19.5%) of respondents were satisfied per acre wheat yield, less than one fifth (9.0%) of respondents was their response was neutral. A majority of respondents (60.8%) were opinion was completely unsatisfied about their per acre production of wheat, and only (4.5%) of respondents were "very unsatisfied".

Table 3: Respondents' distribution according to information about grinding wheat flour (flour quantity, consumption days of wheat flour, and taste of wheat flour)

Flour Quantity at Once (Grinding Floor)		
Response	Frequency	Percent
10-20 Kg	25	6.3
21-30 Kg	82	20.5
More than 30 Kg	293	73.3
Consumption Days of Wheat Flour		
Days	Frequency	Percent
Less than 10 days	9	2.3
11-20 days	84	21.0
21-30 days	154	38.5
more than 30 Days	153	38.3
Taste form One Day to Till Last Day		
Flour taste	Frequency	Percent
Not same Taste	175	43.8
Some-how different	164	41.0
Same taste	61	15.3
Total	400	100.0

Results of this table 3 show that (6.3%) of respondents grinding flour quantity at once was 10-20 kg, about one fourth (20.5%) of respondents 21-30 kg wheat flour at once, and the majority of respondents (73.3%) grinding wheat flour more than 30 kg at once.

The study demonstrates that only (2.3%) of respondents consume wheat flour was less than 10 days, more than one fifth (21.0%) of respondents consumed flour between 11 to 20 days, a majority of respondents (38.5%) used between 21 to 30 days, and (38.3%) respondents used flour more than 30 days.

The present study shows that response of the farming community from 1st day of wheat bread taste to till last day. A majority of respondents (43.8%) said that taste of the bread was not the same, less than half (41.0%) respondents said that bread taste was somehow different, and one-tenth and more (15.3%) of farmers reported that the taste of wheat bread was same from 1st day to till last day. People save flour for more time and flour affected from larva if save for a short time as well as flour save from larva (Lund et al., 2020).

Table 4: Distribution of the respondents’ response regarding wheat post-harvest losses they faced

Approximately losses of wheat post-harvest		
Losses	Frequency	Percent
1-5% of total production	89	22.3
6-10% of total production	137	34.3
11-15% of total production	111	27.8
16% and above of total production	63	15.8
Total	400	100.0

The present study in table 4 describes that more than one fourth (22.3%) of farmers said that they faced post-harvest wheat losses was 1-5% of total production, a majority of respondents (34.3%) responded that they faced 6-10% of wheat post-harvest losses, about a third (27.8%) of farmers faced losses was 11-15% of total production, and more than one-tenth (15.8%) of respondent response was 16% and above losses of wheat post-harvest they faced every year.

Hypothesis 1:

Table 5: Access to extension services is correlated with wheat post-harvest losses

	Value	Asymp. Std. Error ^a	Approx. Sig.
Ordinal by Ordinal Spearman Correlation	.137	.050	.006 ^b
N of Valid Cases	400		

a. Not assuming the null hypothesis.
 b. Based on normal approximation

Extension services equip the farmers with all new technologies. Farmers are trained with techniques to handle all wheat post-harvest activities from harvesting to the utilization of crop as a source of income or as seed for the next crop season. In this study, it was approved by the hypothesis testing that, farmers with and without extension services have different levels of post-harvest losses of wheat. The significant results in the above table support the aforementioned idea.

Hypothesis 2:

Post-harvest losses of wheat are associated with hurdles in canal water.

Table 6: Cross-tabulation of Hurdles of Canal water and wheat post-harvest losses

Hurdles of Canal water	wheat post-harvest losses				Total
	1-5% of total production	6-10% of total production	11-15% of total production	16% and above of total production	
Yes	69	122	88	50	329
No	20	15	23	13	71
Total	89	137	111	63	400

Pearson Chi-Square Value = 6.730 df = 3 Asymp. Sig. (2-sided) = .05

In Pakistan, canal water is a major and cheap source of irrigation. Most of the canal system was built before the partition of the Pak-Indo subcontinent. Many canal walls are weak and get damaged and leaking. During the year supply of canal water gets interrupted and many hurdles are created. The interrupted supply causes the weak wheat yield and post-harvest losses incur. The same inkling was upheld by the study. It is concluded that hurdles in canal water lead to wheat post-harvest losses as well. [The government of Pakistan, 2017](#) reported that due to improper use of agricultural inputs, poor irrigation methods, insect pest attack, poor harvesting techniques, poor transportation, and improper storage facilities, lead to post-harvest losses.

Hypothesis 3:

Easy access to the market is associated with post-harvest losses of wheat.

Table 7: Cross-tabulation of easy access for market and wheat post-harvest losses

Easy access for market	Wheat post-harvest losses				Total
	1-5% of total production	6-10% of total production	11-15% of total production	16% and above of total production	
Yes	56	70	76	31	233
No	33	67	35	32	167
Total	89	137	111	63	400

Pearson Chi-Square Value = 10.567 df = 3 Asymp. Sig. (2-sided) = .014

The transportation of wheat from far-off areas to the market is an important factor that plays an active role in wheat post-harvest losses. The hypothesis is accepted as chi-square results are significant. So, it was proved by the study that easy market access has an association with wheat post-harvest losses.

Hypothesis 4:

Post-harvest wheat losses are affected by the condition of the road from farm to market, Type of Irrigation, Practice of Harvester, the method used for packaging of wheat, type of transport you used, Farming Experience (In Years), Distance of village From the market in Km, storage practices.

Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.281 ^a	.079	.062	.96616

a. Predictors: (Constant), condition of the road from farm to market, Type of Irrigation, Practice of Harvester, the method used for packaging of wheat?, type of transport you used, Farming Experience (In Years), Distance of village From the market in Km, storage practices.

“R” (the multiple correlation coefficients) presents the quality of the model which is 28 percent. So here it could be said that the quality of this model was of moderate level.

The Coefficient of determination shows that 7 percent of variation on the dependent variable can be explained by the above-mentioned predictors.

Table 9: NOVA

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	31.320	7	4.474	4.793	.000 ^b
1 Residual	365.920	392	.933		
Total	397.240	399			

a. Dependent Variable: Wheat post-harvest losses

b. Dependent Variable: the condition of the road from farm to market, Type of Irrigation, Practice of Harvester, the method used for packaging of wheat?, type of transport you used, Farming Experience (In Years), Distance of village From the market in Km, storage practices.

The significant results in the table show that independent variables predicted the dependent variable significantly with $F(7, 392) = 4.793, p < .0005$ which means that this regression model is a good fit of the data.

Table 10: Estimated Model Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.213	.432		7.432	.000
Practice of Harvester	-.117	.055	-.105	-2.137	.033
1 Type of Irrigation	-.216	.071	-.148	-3.025	.003
Farming Experience (In years)	.083	.039	.109	2.149	.032
method used for packaging of wheat	.092	.057	.081	1.598	.111

type of transport used	-.232	.084	-.138	-2.767	.006
Distance of village From market	-.008	.005	-.084	-1.627	.104
condition of road from farm to market	.115	.082	.071	1.401	.162
Storage Practices	-.003	.001	-.038	1.767	.001
a. Dependent Variable: Wheat post-harvest losses					

The general form of the equation that can be drawn from the above table is

Wheat Losses = 3.213 – (0.117 x Practice of Harvester) – (0.216 x type of irrigation) + (0.83 x farming experience) + (0.092 x method used for packaging of wheat) – (0.232 x type of transport used) – (.008 x distance of village from market) + (.115 x condition of road from farm to market) – (.003 x storage practices).

The directions (-/+) in the B column of the coefficient table show that an increase in practices of harvesters, type of irrigation, type of transport used, and distance from the market will decrease the losses. However, worsening the conditions of roads will increase the losses and the same is the case with farming experience and packaging type.

In the model Practice of Harvester, Type of Irrigation, Farming Experience (In Years) and type of transport used showed the significant effects on wheat losses as predictors.

Qualitative Data Analysis

Themes of the present study

The themes of the present study have been formulated with the help of both primary and secondary data. The use of both primary and secondary data was used simultaneously to describe the themes and further provide evidence about a particular theme.

Following is the list of important themes and sub-themes of the current study.

1. Post-harvest activities of wheat
2. Factors involved in post-harvest losses
3. Household practices used for storage of wheat (traditional and modern)
4. Responses of the farming community towards modern technologies
5. Suggestions According to the opinion of experts
 - I. How to overcome the gap between farmer and new technology
 - II. How much food is secured if losses are reduced
 - III. Structure of training
 - IV. Policies of wheat

DISCUSSION

Age is an important variable that determines one's behavior about the practices of the new technology of wheat grains. The majority of respondents old-aged were doing wheat post-harvest activities. Same results found that [Chattha & Lee](#) after the study of Sindh, Pakistan conducted in (2014) a large majority of farmers (43%) age ranged 41-50 years had participated in post-harvest activities. In the educational case, (42%) of farmers had no/less level of education in rural Sindh areas ([Kitinoja et al., 2018](#)). Education is being an important indicator of social status. The majority of respondents in this research were at the primary level of education. [Aulakh & Regmi \(2013\)](#) said that in less developed countries, for example, where technology level is less mechanized, high illiteracy level prevail, increased poverty, marketing infrastructure are less developed and high food insecurity is experienced, high losses incurred at drying, transportation, handling, and storage stages. [Balai et al. \(2018\)](#) noted that, in India, the average post-harvest wheat loss is 7 to 10 percent during production to harvesting, and, at the time of transport and marketing, that loss is as high as 4 to 5 percent. Currently, the country produces 240 million tons of food, of which 15 to 25 million tons are wasted annually, and this loss is sufficient to meet the food needs of 0.1 billion people. These losses usually occur during harvesting, threshing, drying, storage, transport, processing, and marketing ([Stathers et al., 2020](#); [Kumar & Kalita, 2017](#) and [Lundqvist et al., 2008](#)).

During the discussion of qualitative data (FGDs) in district Okara male said that *“they all are satisfied with the per-acre production of wheat grains but they faced post-harvesting issues especially in moon soon weather when the moisture level is high in the air”*. During discussion research explores about satisfaction level, in this district farmers used market seed as compare domestic saved seed as well as farmers more uses of fertilizer sprays, etc. But on another side in Chiniot and



Faisalabad districts during discussion respondents said that *“they are very unsatisfied about wheat yield because they have issues regarding canal water they have low/no access to canal water for irrigation their crops”*.

A majority of farmers faced losses of wheat post-harvest, a large amount of wheat grains waste or loss due to many factors like as: in Pakistan majority of farmers are illiterate and rely on traditional practices as comparing modern practices some of them did not aware of modern methods, that’s why they prefer traditional practices. [Begum et al. \(2020\)](#) explored that in Bangladesh, the post-harvest losses were estimated at farm level in wheat by using survey data collected randomly from 76 wheat growing households for the year 2009-2010. The post-harvest losses were maximum due to late harvesting (0.96 kg/quintal in wheat). The household size and post-harvest losses of the farmers in both districts had negative and significant relationships with their probability of food security which implies that the households are food secured in both areas ([Fabi et al., 2020](#); [Amentae et al., 2017](#); [Basavaraja et al., 2007](#) and [Onyene and Bakare, 2011](#)).

During the discussion of a key-informant interview conducted in district Chiniot, qualitative data endorsed that, *“these losses start from harvesting of wheat to till its consumption, but major losses we are all faced in storage (grains storage and flour storage) aspect. Because we are all did not know about new storage methods and techniques. We have listened to new methods and techniques from T.V., Radio, etc. in some areas agri-extensionist visits and meet with male farmers but due to cultural constraints they did not allow to meet with female farmers/female members of the family and in storage aspects major part performed by female members of the family”*. The data shows that this situation is very alarming for future scenario especially in rural areas of Pakistan because female performed duty to store wheat grains and flour for household consumption, seed storage, and business purposes but they did not allow to take training/information (how to store wheat grains or flour) from outside home or male *extensionist*. That is why losses are higher in the storage aspect as compare to other aspects ([Hengsdijk & De Boer, 2017](#); [Bartholomeu et al., 2017](#)).

[Ahmad \(2009\)](#) mentioned that the intensive training program is related to minimizing grain issues quantitative and qualitative losses. Establishment of grain storage centers/research institutes for the conduct of research and training on safe grain storage, in particular, to reduce the quantitative and qualitative losses to avoid post-harvest losses through the training of farmers, extension workers, and renovation of existing storerooms. ([Bala et al., 2010](#); [Bhattacharjee, 2012](#)) explored that training significantly reduces the inefficiency of farmers, while extension services have a significant positive correlation with the inefficiency of farmers ' production. Farmers who have received training from the extension department are more efficient to train those who have not been trained. Training is superior to consultation and there is no alternative to training in the transfer of modern technologies through training. The [Planning Commission of Pakistan \(2015\)](#) reported that in the past, policymakers have not paid serious attention to these two areas: the post-harvest chain and the agricultural marketing system. The recent food crisis in food grains (wheat, rice, and barley) has highlighted losses in two areas: the agricultural marketing system and traditional storage practices ([Luo et al., 2020](#); [Mogale et al., 2017](#); [Christopoulos & Ouzounidou, 2020](#)).

In qualitative data one of key-informant from the Chiniot district said that *“I want to go market for wheat selling, but I don't have enough knowledge about marketing and secondly marketing is far-away from my village”*.

Another key-informant from the Okara district said that *“I can easily go market but when I go market for wheat selling I confuse middle-man behavior and middle man monopoly regarding wheat prices”*.

CONCLUSION

In developing and less developed countries, reducing post-harvest wheat losses can provide a sustainable solution to food security, improve rural livelihoods, reduce poverty and increase incomes. Pakistan has ranked 11th faced the risk of food insecurity among other countries. The reduction of post-harvest losses is most important to ensure food security, as well as the reduction of these losses, which will ultimately increase the opportunities of food production and uplift in rural development in developing countries. Pakistan faced biotic (insect pests, moulds, and birds) as well as the climatic type of losses. The major objective of this study was to enhance food security by reducing post-harvest wheat losses in rural Punjab. It is concluded that a majority of farmers faced losses of wheat post-harvest, a large amount of wheat grains waste or loss due to many factors like as: in Pakistan majority of farmers are illiterate and rely on traditional practices as comparing modern practices some of them did not aware modern methods, that’s why they prefer traditional practices. Due to improper use of agricultural inputs, poor irrigation methods, insect pest attack, poor harvesting techniques, poor transportation, and improper storage facilities, leads to post-harvest losses and food insecurity is experienced. Appropriate postharvest management techniques need to be prioritized. The post-harvest handling and storage training needs and postharvest problems of each farmer are likely to differ, and it is, therefore, important to develop an awareness of this and to understand that the training program will need to be flexible enough to cope with this. Effective training starts from a needs assessment.

LIMITATION AND STUDY FORWARD

The limitation of the study is that this study focused on only one cereal crop. For the future will focus on all cereal crop losses. In the future social scientist and agronomist should be combined for clearance of results.



AUTHOR'S CONTRIBUTION

Miss Adeela Manzoor is a primary author of this research and this research is a part of her doctoral research.

Dr. Ashfaq Ahmad Maan supervised this research.

Dr. Izhar Ahmad Khan helped in data collection and article compiling.

Dr. Babar Shahbaz helped in the review of this paper.

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