



Economics of different harvesting techniques of wheat in rice-wheat cropping pattern of Punjab, Pakistan

Muhammad Tahir Latif^{1*}, Falak Sher¹, Muzzammil Hussain¹, Muhammad Asghar¹

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ABSTRACT

The field survey was conducted after harvesting of wheat crop 2017 with the objective to estimate economics of different harvesting techniques of wheat. District Gujranwala in rice-wheat cropping pattern of Punjab, Pakistan was selected as population of research study due to more farm mechanization. Twenty one male farmers from each tehsil making a total of 84 respondent farmers were interviewed by convenience sampling method. It was recorded that 55 percent farmers were using wheat thresher to separate grains from chaff after using either reaper (31%) or manual cutting (24%). While 65 percent farmers were employing combine harvester and 37 percent farmers were using wheat straw chopper for making chaff and saving the organic matter of soil by avoiding burning of stubbles. Net benefit for manual cutting then threshing with thresher, reaper cutting then threshing with thresher and combine harvester cutting then chopping with wheat straw chopper was Rs. 69621 ha⁻¹, Rs. 71706 ha⁻¹ and Rs. 76530 ha⁻¹ respectively. As for as chaff recovery was concerned grain to chaff ratio was almost 1:1 for manual cutting and threshing method, 1:0.85 for reaper cutting and threshing method while 1:0.57 for combine harvester cutting and wheat straw chopping was calculated. The method of combine harvesting followed by wheat straw chopper should be preferred for saving precious time for sowing subsequent crops and to overcome the wastage due to rains. Wheat straw chopper is a profitable technology and the cost of this machine needs to be reduced to make it affordable and available to all farmers.

INTRODUCTION

Wheat (*Triticum aestivum*) is a staple food of the people of Pakistan. It accounts for 9.6 percent of the value added in agriculture and 1.9 percent to GDP of Pakistan. Wheat production was estimated at 25.75 million tons during 2016-17 witnessing an increase of 0.5 percent over the last year due to better supply of inputs which contributed in enhancing per hectare yield (GOP 2017). Wheat is cultivated in different cropping systems, such as cotton-wheat, rice wheat, sugarcane-wheat, maize-wheat and fallow-wheat. Of these cropping systems, cotton-wheat and rice-wheat systems contribute about 60% of the total wheat area in the country (Farooq et al. 2007). In Pakistan, wheat harvesting starts from the early March in the South and continues till the end of

July in the Northern parts of the country. Harvesting of wheat crop is carried out when the crop reaches maturity and the grain contains 14-20% moisture content (Pioneer 2013).

In conventional wheat harvesting methods, wheat crop is first cut manually or with a reaper. After harvesting, a stationary wheat thresher is used to separate grains from chaff. Wheat chaff is a common cattle-feed and is mainly used during green fodder shortage period. However, timely folding-up the wheat crop is not possible using conventional method of wheat harvesting, which takes about one month to harvest 30 ha using 10 laborers. Due to uncertainty of weather, there is a great risk to delay the harvesting of wheat because the rain may cause loss of yield and produce quality. For timely harvesting of wheat crop, combine harvesters are gaining a great acceptance in Pakistan now a days and replacing conventional wheat harvesting and threshing methods (Zafar et al. 2002).

¹Adaptive Research Farm, Gujranwala, Agriculture Department, Govt. of Punjab

* E-mail: tahirr_uaf@hotmail.com

Currently, more than 5000 combine harvesters are being used in the country for harvesting wheat and rice crops (GOP 2013). These combine harvesters only collect grains and leave high stubbles and combine-ejected loose straw in the field (Gill et al. 2012). Due to non-availability of a proper technology, about 75% of combine-harvested stubbles and loose straw go as waste besides causing environmental pollution due to straw burning in the field prior to tillage for subsequent sowings (Mangaraj and Kulkarni 2011). This phenomenon raises three major issues: environmental pollution associated with fire hazards, burning of rich soil organic matter and loss of valuable commodity the wheat chaff. Azeem et al. (2015) stated that the burning of wheat straw results losses of 80% Nitrogen (N), 25% Phosphorus (P), 21% Potassium (K) and 4% to 60% Sulphur (S). Thakur et al. (2000) explained that wheat straw can be conserved for making chaff which is a common cattle feed by using a baler or a wheat straw chopper.

Pakistan acquired a tractor operated wheat straw chopper-cum-blower from India in 2002 through Rice Wheat Consortium and demonstrated this technology in the Punjab province. It harvests the anchored wheat stubbles and picks up the combine ejected loose straw from the field, chops it into *bhoosa* and blows it into a trolley hooked at its rear end (Zafar et al. 2002). Now a large number of locally developed wheat straw choppers are in operation in the rice-wheat and cotton wheat cropping systems of the Punjab (Rehman et al. 2011).

The economics of different harvesting techniques of wheat has been calculated by Hafiz (2016) in Southern Punjab. However there was a scope for comparative analysis of harvesting & threshing methods of wheat in combine-harvested wheat fields of rice-wheat cropping pattern (Northern Punjab).

MATERIALS AND METHODS

The field survey was conducted by the researchers of Adaptive Research Farm, Gujranwala to make economic comparison of different methods of harvesting and threshing of wheat i.e. (i) manual cutting and threshing with thresher (ii) reaper cutting and threshing with thresher and (iii) combine harvester cutting and chopping with wheat straw chopper.

The primary data was collected after harvesting of wheat crop 2017. District Gujranwala in agro-ecological zone of Gujranwala was selected as population of research study due to more farm mechanization and agricultural machinery factor (GOP 2016) (Table 1).

Table 1. Statistics of machinery in Gujranwala division (2012-13 data)

District	Tractor	Threshers	Combine harvester	Reaper
Gujranwala	17240	2628	1961	1810
Gujrat	9956	3954	86	1054
Hafizabad	6820	1066	631	660
M.B.Din	9717	3024	174	735
Narowal	8706	3962	163	401
Sialkot	14727	3790	326	1285
Total	67166	18424	3341	5945

Zafar et al. (2002) stated that during 2006 the local manufactures located at Daska, Lahore, Gujranwala, Hafizabad, Faisalabad and Multan were making wheat straw chopper. There were more than 250 operational units resulting in 4.9 million rupees annual financial benefit to the farming community.

To select the farmers from each tehsil of district convenience sampling method was adopted due to time and cost constraint (Latif et al. 2015). Twenty one male farmers from each tehsil (with equal farmers to adopting the said harvesting & threshing methods) making a total of eighty four respondent farmers from all four tehsil were interviewed. A well-structured and pretested questionnaire was employed for data collection. The questions were asked in Punjabi (local language) and then response was translated into English to fill the questionnaire. Besides descriptive statistics net returns/income was calculated. The same procedure was used by Tahir et al. (2003), Naem et al. (2007), Latif et al. (2017) and Muhammad et al. (2016).

RESULTS AND DISCUSSIONS

The survey findings showed that average land holding size was about 8.7 acre. Average land rented in was 6.9 acre with land rent of Rs 74000 ha⁻¹. Mostly surveyed farmers were educated by chance having average schooling years of 8.4. As far as land holding is concerned mostly survey farmers (48%) were having land more than 12.5

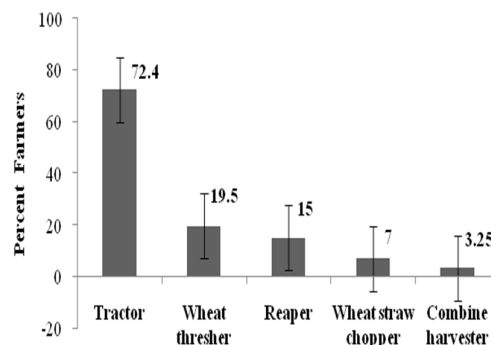


Figure 1. Ownership of farm machinery

acres, 36% had 5-12.5 acre and 16% farmers had below 5 acres of land.

Regarding ownership of farm machinery 72.4 percent farmer had their own tractors for agriculture farming. Similarly 19.5 percent had wheat thresher, 15 percent had reaper and 7 percent had wheat straw chopper. There were only 3.25 percent farmers whom had their own combine harvester machine (Figure 1).

Regarding adoption level of harvesting and threshing methods is concerned, 55 percent farmers were using wheat thresher to separate grains from chaff after using either reaper (31%) or manual cutting (24%). While 65 percent farmers were employing combine harvester and 37 percent farmers were using wheat straw chopper for making chaff and saving the organic matter of soil by avoiding burning of stubbles (Figure 2). Mohammad et al. (2000) stated that a farmer's decision to adopt the combine harvester was influenced by the combined effect of a number of factors like wheat area, education, accessibility of the technology, age, sex, and family size. The major economic incentive for adopting the combine harvester was to avoid harvesting losses.

The field capacity of wheat straw chopper, wheat thresher, reaper and combine harvester were calculated as 0.8 acre hr⁻¹, 8.12 mound hr⁻¹, 0.92 acre hr⁻¹ and 2.5 acre hr⁻¹ respectively. While fuel consumption for wheat straw chopper, wheat thresher and combine harvester were recorded as 5.87 L hour⁻¹, 5.90 L hour⁻¹ and 14.40 L hour⁻¹ respectively.

The operating costs of manual cutting, reaping, threshing and combine harvesting were calculated from the rental prices of these methods

available in that area. Total cost of manual cutting and threshing; reaper cutting and threshing and combine cutting and straw chopping was Rs. 15720 ha⁻¹, Rs. 14250 ha⁻¹, Rs. 10050 ha⁻¹ respectively. This revealed that the cost of combine cutting was the minimum of three methods. Many research studies indicated that combine harvester was an efficient, economical, and less labour demanding machine. It increased grain recovery by minimizing harvesting and threshing losses. AMRI (1987) found 2.2% wheat losses for combine as compared to 4.65% for reapers and about 7.5% for manual harvesting. Bukahri et al. (1983) found losses to the tune of 16% for manual harvesting and threshing as compared to about 12% for manual harvesting plus mechanical threshing and only 3.4% for combine. Sukhbir et al. (2007) and Basavaraja et al. (2007) compared the performance of reaper with conventional method of manual harvesting of wheat crop with sickle to see the feasibility. They recorded 5.8% to 11.8% harvesting losses with reaper. Bala et al. (1980) also reported 4.09% grain losses of wheat by traditional methods of harvesting and threshing.

As for as chaff recovery was concerned grain to chaff ratio was almost 1:1 for manual cutting and threshing method, 1:0.85 for reaper cutting and threshing method while 1:0.57 for combine harvester cutting and wheat straw chopping was calculated. The chaff was sold at average price of Rs. 7.5 kg⁻¹. However Hafiz et al. (2016) recorded the more amount of chaff recovered (60 mound ha⁻¹) with 61.1% chaff recovery.

Net benefit for manual cutting then threshing with thresher, reaper cutting then threshing with thresher and combine harvester cutting then chopping with wheat straw chopper was Rs. 69621

Table 2. Economic comparison of wheat harvesting methods (value ha⁻¹)

Operation	Manual cutting and threshing	Reaper cutting and threshing	Combine harvester cutting and wheat straw chopping
Cutting/harvesting cost (Rs.)	10120	8650	4900
Threshing/chopping cost(Rs.)	5600	5600	5150
Total cost of cutting/harvesting & threshing/chopping(Rs.)	15720	14250	10050
Cost of production excluding harvesting charges*(Rs.)	67678	67678	67678
Total cost of production(Rs.)	83398	81928	77728
Grain yield (40kg)	96.33	98.8	104.98
Total grain value(Rs.) @ Rs1300	125229	128440	136474
Amount of chaff produced (40kg)	92.63	83.98	59.28
Chaff value (Rs.) @ Rs 300	27790	25194	17784
Total value of grain & chaff(Rs.)	153019	153634	154258
Net Income(Rs.)	69621	71706	76530

Note:

*Derived from Agriculture marketing information system, Agriculture Department, Govt. of Punjab (Govt. of Punjab, 2013)

1- Wheat grain price was fixed as Rs. 1300 for 40 kg by Govt. of Pakistan for 2015-16 (GOP 2016)

2- Chaff average price was estimated as Rs. 300 for 40 kg

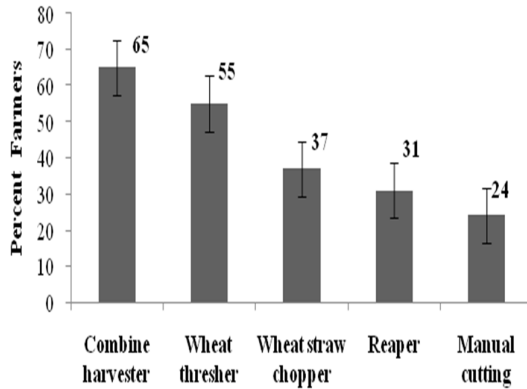


Figure 2. Adoption level of harvesting and threshing methods

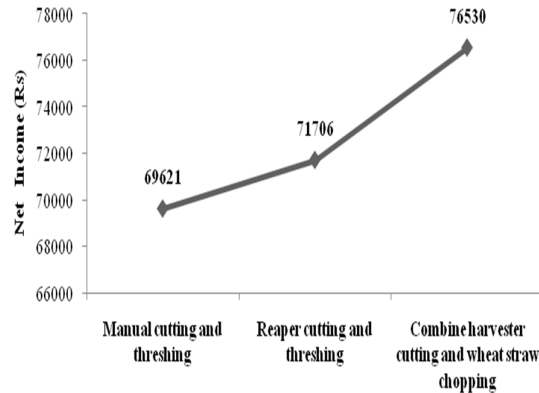


Figure 3. Economic comparison of different harvesting methods

ha⁻¹, Rs. 71706 ha⁻¹ and Rs. 76530 ha⁻¹ respectively. The difference in net benefit of these methods is not so significant, but the folding-up work is significantly expedited in combine harvesting followed by wheat straw chopper. Therefore, this method should be preferred for saving precious time for sowing subsequent crops and saving the wheat crop from damage to rains. Wheat straw chopper is a profitable technology that is getting momentum in combine-harvested wheat fields of the country, which saves chaff for cattle feed and increases the benefit of the farmer. The cost of this machine needs to be reduced to make it affordable to all farmers (Table 2 & Figure 3). Hafiz et al. (2016) calculated the operating cost of wheat straw chopper as Rs. 5,262 ha⁻¹ with recovered chaff worth of Rs. 24042 ha⁻¹. The results are in accordance with the research findings of Sattar et al. (2015).

CONCLUSIONS

The economic analysis revealed that combine harvester cutting and wheat straw chopping was least cost harvesting method, provided more grain yield, saved time for sowing of subsequent crop and secured more net income than other methods of harvesting and threshing of wheat.

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