International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 1219-1222

Received: 09-09-2018
Accepted: 13-10-2018

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Economic analysis for self-propelled reaper binder over manual harvesting

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Abstract
The harvesting of crops in North India is mainly done by custom hire farm labours. It is time-taking and hard job to harvest the crop with traditional harvesting equipment sickle. Also, the shortage of labour at peak harvesting time restricts farmers going for higher cropping intensity on its field. The modern harvesting techniques are available but they remain to large land holding farmers or rich farmers. This paper addresses on of major issue which farmers' of North India face during the harvesting time of crops. Also, a comprehensive comparison of three different harvesting techniques - Wheat harvesting using self-propelled reaper binder along with crop bundle collection in the field manually, Wheat harvesting using self-propelled vertical conveyer reaper wind-rower along with crop bundles making and their collection in the field manually, Manual harvesting using sickle, crop bundle making and collection in the field.

Keywords: reaper binder, vertical reaper and serrated sickle etc

Introduction
Harvesting of wheat crop in eastern UP is mainly done manually by hand using sickle which is labour intensive and delayed due to labour shortage to overcome. This problem combine harvester come from Punjab and Tarai region of Uttarakhand during harvesting season for harvesting wheat crop on custom hire. Due to shortage of labour harvesting is delayed and sometime whole crop is damaged due to weather hazard the labour wage rate for harvesting and threshing rate 100-150 per days. But in this reason harvesting is commonly done on barter basis. The labours take about 1/5th to 1/8th of harvesting crop. Only for harvesting and keeping it at nearby threshing flavours. Even at this higher cost of harvesting labour availability is a quiet problem.

In the second half of the 19th century combine harvester was developed to harvest and thresh the crop. In the first stage of development of combines were large, heavy and unman equivareable machines. In addition to the United States the North America combines vision to be used in Australia, Canada than in the Argentina the first Uropian century that after word war vision to use combine harvester was Soviet Union. In the period between the wars in Germany tractor driven combine harvester was developed this however only the introduction of combine machine was in Western Europe. Since the end of World War II combine harvesters have found a wild application of all Uropian country.

The harvesting machine including combine harvester were introduced in northern India particularly in state like Punjab and Haryana for harvesting of wheat and paddy crops in early 1970 which coincided with the advent of "green revolution" now it's usage has spread in the entire country.

Material and Methods
To study the comparative performance of self-propelled reaper binder for wheat crop harvesting experiment were conducted at farmer fields using following treatments.

Table 1: The Technical Programme of comparative performance of self-propelled reaper binder for wheat crop.

S. No.	Treatments	Description
1	T_1	Wheat harvesting using self-propelled reaper binder + crop bundle collection in the field manually
2	T_2	Wheat harvesting using self-propelled vertical conveyer reaper wind-rower + crop bundles making and their collection in the field manually.
3	T_3	Manual harvesting using sickle, crop bundle making and collection in the field.

Self-propelled reaper binder

It is a crop harvesting machine suitable for harvesting cereals crops. It has a cutter bar of 1.2 m wide and operated by 10.5 hp diesel engine. Four forward and one reverse gears are provided in the machine. It is steered by hand operated brakes and foot operated pedal for turning left or right. The crop row dividers help the standing crop to enter the machine, by the 'raising ups' gently push the crop towards cutter bar and push the crop on to the crop conveying chain. The star wheel keeps the cut crop in upright position towards crop conveyers. The crop is gathered at the knotter mechanism when sufficient quantity of crop is gathered; the bundle is tied and ejected by the ejecting fingers out of machine. An auxiliary conveyer carries the bundle away from the machine on the ground. The bundle size is adjustable with in limit.

Serrated sickle

With serrated sickle blade, the unit predominantly follows he friction and shear principles to cut the plant. The cutting force is drastically reduced compared to traditional sickle which uses impact principle. It consists of serrated blade, ferrule and wooden handle. The unit is suitable for harvesting wheat, rice grasses and other thin stalk crops.

Speed of operation

The speed of operation of planter was determined in test plots by putting two marks 20 m apart (A & B). The time was recorded with the help of stop watch to travel the distance of 20 m. The speed of operation was calculated in km/h as given below:

$$S = \frac{72}{T}$$

Where,
S = Speed of operation, km/h
T = Time needed to cover 20 m distance, sec

Fuel consumption

For measuring the fuel consumption of self-propelled rice transplanter and tractor, its fuel tank was filled to full capacity before and after the transplanting/sowing operation. The amount of refilling measured after the test was the fuel consumption (litres) for that particular operation and it was expressed per unit time. When filling up the tank, careful attention was paid to keep the tank horizontal and not to leave empty space in the tank and for checking proper level of the tank, sprit level was used.

Effective field capacity (EFC)

The actual operating time along with time lost for every event such as turning, filling seed, seedling and fertilizer in boxes and also uploading of nursery and adjustments were recorded in the field test area. The effective field capacity of the machine was calculated as follows:

$$\text{EFC} = \frac{\text{A}}{T_P + T_I}$$

Where,
EFC = Effective field capacity, ha/h
A = Area covered, ha
T_P = Productive time, h
T_1 = Non-productive time, h
(Time lost for turning, filling seed, seedling & fertilizer and adjustments excluding refueling and machine trouble)

Field efficiency

It was calculated as follows from the field test data,

$$\text{EFC} = \frac{\text{EFC}}{C_T} \times 100$$

Where,
E_f = Field efficiency, %
C_T = Theoretical field capacity, ha/h= $\frac{\text{W} \times \text{S}}{10}$
W = Average working width of equipment, m
S = Average speed of travel, km/h
EFC = Effective field capacity, ha/h

Results and Discussion

Table 2: Cost saving w.r.t. different harvesting machine

S. No.	Particulars	System of harvesting		
		T_1	T_2	T_3
1	Cost of harvesting	2481.59	634.50	4068.75
2	Cost of bundle making		1181.25	1181.25
3	Cost of bundle collection in the field	421.87	337.50	3375.50
4	Cost of harvesting + bundle making + collection	2903.46	2153.25	5587.50
5	Cost saving w.r.t T_3	2684.04 (48)	3434.25(61)	-------
6	Cost saving w.r.t. T_1	---------	750.21(26)	--------
7	Labour requirement			
(a)	Harvesting	5.3	5.6	217
(b)	Bundle making		47+16*=63	47+16*=63
(c)	Collection	22	18	18
(d)	Total	27.3	86.60	298
8	Labour saving w.r.t.T_3	270.7(91)	211.40(71)	--------
9	Labour saving w.r.t.T_2	59.3(68)	---------	--------

Table 3: Harvesting, collection and tying losses:

S. No.	Particulars	Losses (%)		
		T_1	T_2	T_3
1	Harvesting losses	2.20	2.15	1.15
2	Bundle making losses		1.05	1.10
3	Collection losses	0.40	0.50	0.50
4	Total losses	2.60	3.70	2.75

Economic aspect

The harvesting cost of operation under T_1 WAS Rs 2903.45/ha and under T_3 on was Rs 5587.5/ha. The harvesting loss in T_1 in the form of grain loss were worth of Rs 1136.20/ha in treatment T_3 grain loss was worth of Rs 1215.50/ha. Thus total cost of harvesting including losses in both the system was worth of Rs 4039.7/ha and Rs 6803/ha under T_1 and T_2 respectively. The labour requirement with self-propelled reaper binder was also quit low 5 man-h/ha where as in case of manual harvesting required 217 man-h/ha. At the same time when self-propelled vertical conveyer reaper wind-rower used under treatment T_2 there were harvesting cost Rs 2153.25/ha. The total cost of harvesting including loss in system T_2 was Rs 3580.45/ha.

The results obtained during study have been analyzed and discussed under the following subheads:

Breakeven point of self-propelled reaper binder in wheat crop

The data showed that as the labour wage rate increased the machine unit cost of harvesting decreased in comparison to manual system. At labour wage rates of 100/day both the machine system should lower cost of harvesting than manual system. At labour wage rate of Rs 250/day the self-propelled reaper binder cost of harvesting was approximate same as of self-propelled vertical conveyer reaper wind-rower.

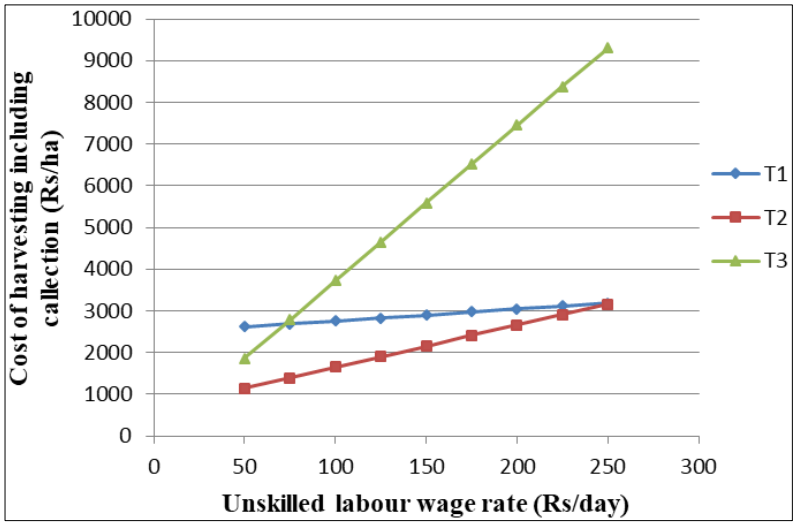

Fig 1: Breakeven point of self-propelled reaper binder in wheat crop.

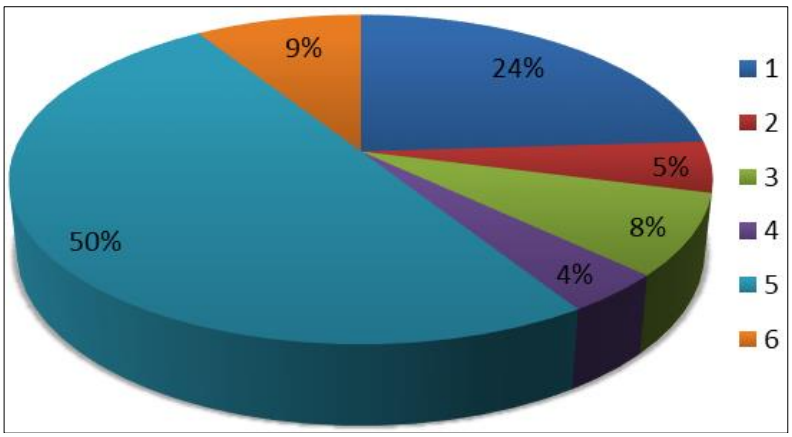

Fig 2: Distribution of cost of operation self-propelled reaper binder harvesting including collection for wheat crop.

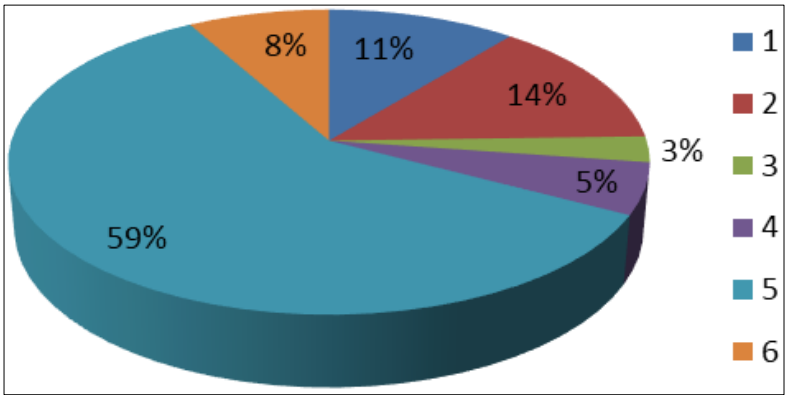

Fig 3: Distribution of cost operation self-propelled vertical conveyer reaper wind-rower harvesting including collection for wheat crop.

Conclusions

The performance self-propelled reaper binder was field evaluated with four replication for harvesting of wheat crop. The machine economics was also calculated in comparison to manual harvesting and self-propelled walking type VCR. In harvesting of wheat crop comparison was done with manual harvesting and harvesting by self-propelled vertical conveyer for calculating the economics of self-propelled reaper binder machine grain losses with respect to harvesting were taken into consideration.

The following conclusions from the study were drawn:

1. Harvesting by the self-propelled reaper binder saved Rs. 2684.05/ha in wheat crops in comparison to manual harvesting.
2. The effective field capacity of self-propelled reaper binder having 1.2 m size of cutter bar in wheat crops was 0.19 ha/h corresponding field efficiency was 74.8%.
3. The effective field capacity of self-propelled vertical conveyor reaper wind-rower having 1.2 m size of cutter bar was worked out as 0.18 ha/h.
4. Average fuel consumption of self-propelled reaper binder was found 0.8l/h.
5. The harvesting by the self-propelled reaper binder of wheat crops at 15.38% wet basis moisture content of grains. Minimum total grain loss by the machine i.e. 2.2%.
6. Total average grain loss by self-propelled reaper binder and self-propelled VCR was about 2.6% and 3.2% in wheat crops respectively. Whereas by manual harvest it was 2.75% in wheat crops.
7. Pay back periods of self-propelled of reaper binder was found at 539.25h or 102.46ha.
8. Breakeven point of self-propelled reaper binder was found 14.8ha in case of wheat crops of harvesting in comparison to manual wheat harvesting.

References

1. Mishra RS. Field trail on reaper binder. Journal of Agril. Engg. 1983; 17:2.
2. Devnani RS, Pandey MM. Development of field evaluation of vertical conveyer reaper wind-rower. Journal of Agril. Engg. ISAE. 1984; 21:4.
3. Bailing. Wheat and paddy reapers in China. Pages in small farm equipment for developing countries. Institute 105 Banes, Philippines, 1985.
4. Stickney RE, Salazar GC, Manaligod HT, Juarez FS, Duff B, Bocknlop CW *et al*. Caams-Irri mechanical Reaper experience in the Philippines. In small farm equipment for developing countries. Proceeding of the International conference on small farm equipment for developing countries. Past experience and future properties. 2-6 Sept. The International Rice Research Institute Philippines. 1985, 341-356.
5. Singh Gajendra, Amjad Chaudhary P, David Gee Clough. Performance Evaluation of Mechanical Reapers in Pakistan. Journals of Agricultural Mechanization in Asia, Africa & Latin America. 1988; 19:3.