

SUCCESS STORIES

Impact of Frontline Demonstrations On Farm Mechanization in Haryana

Tractor operated Straw combine



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8. Tractor Operated Straw Combine

In Agriculture, Haryana is the most advanced state which has highest intensity of farm mechanization after Punjab. Haryana is the third largest producer of wheat with a total production of 10.1 million tonnes which is 13.27% of total wheat production of India and ranks first in productivity with an average of 42.32 q/ha. About 50% area of wheat is harvested by combines. Combine harvesting results in saving of time and labour but results in loss of straw (*bhusa*). This causes wastage of around 5 million tonnes of straw worth ₹ 1,000 crores annually in Haryana alone. Combine harvesting leaves considerable amount of long straw and stubbles in the field at an average straw-grain ratio of 1.3:1 for wheat. Farmers usually burn them in-situ to avoid field operational problems for next crop. It has been estimated that one tonne of straw on burning release 3 kg particulate matter, 60 kg CO, 1460 kg CO₂, 199 kg ash and 2 kg SO₂. In majority of cases, the left over straw is burnt. This practice not only leads to environmental pollution but also causes a considerable economic loss of precious biomass widely used as a cattle feed. Therefore, a need was felt to evaluate its economics and adoption level among farmers. This problem can be solved either by incorporation of straw into the soil for decomposition or straw retrieval for use as a cattle feed. The retrieval of straw from combine harvested rice-wheat fields is done either by straw combine or straw baler. In Haryana straw combines were introduced in late 90's and now about 10,731 straw combines are in use. In Haryana, among the area harvested by combine, only 60% area is covered by straw combines. There is a need to cover 40% area left unattended by straw combines. With this, the farmers as well as state will be benefited.

Salient features of Straw combine: A straw combine essentially consists of four main units' viz., stubble cutting and collecting unit, feeding unit, straw bruising unit and "BHUSA" blowing unit. Two different types of straw bruising mechanisms are commonly used in the existing models of straw combines. These include a spike tooth cylinder and serrated saw type mechanisms. Serrated saw type cylinder are mostly used in the straw combines for bruising. Serrated plates are attached on the bars at specific spacing and the bars arranged parallel to drum axis. Straw combine is pulled by tractor (45 hp) with an attached trolley. As soon as this trolley is completely filled with straw, it is unloaded near the dumping site normally located centrally or in the corner of the field. The specifications of straw combine are given in Table 8.1.

Performance of Straw Combine: The test results of straw combine are reported in Table 8.2. The straw split per cent varied from 89.3 to 95.2 and average straw split was 92.36% whereas the length of bhusa varied from 2.1 to 2.4 cm and average length of bhusa was 2.3 cm. The average heights of cut of stubbles varied from 6.04 to 9.8 cm. The straw recovery varied from 62.7 to 81.0 per cent and average straw recovery was 70.7 per cent. The straw recovery mainly depends upon the stubbles height remaining in the field after harvesting by combine harvester. Straw recovery rate varied from 23.5 to 31.8 q/ha and average straw recovery rate was 28.2 q/ha. The grain collected in pan ranged from 141-180 kg/ha and average grain collection was 141 kg/ha.

Table 8.1: Specification of straw combine.

S. No.	Particulars	Value(s)
1.	Source of power	45 hp tractor operated PTO driven
2.	Overall dimension (LxWxH) without straw pipe, mm	3370 x 2450 x 2150
3.	Length of cutter bar, mm	2134
4.	Minimum height of cut from ground, mm	25-50
5.	Size of threshing drum (L x D), mm	1370 x 700
6.	Speed of threshing drum, rpm	530
7.	Size of blower (dia.), mm	280
8.	Speed of blower, rpm	1020
9.	Field capacity, ha/h	0.45 -0.54
10.	Straw output, t/h	0.75-2.0
11.	Weight, kg	1785
12.	Unit price, Rs	1,70,000

Table 8.2: The test results of straw combines

No. of starw combine tested.	Av. Weight of straw before Reaping (g/m ²)	Av. Wt. of straw left after straw Reaping (g/m ²)	Av. Wt. of straw collected by machine (g/m ²)	Straw recovery (q/ha)	Straw recovery (%)	Straw split (%)	Wt. of grain before reaping (g/m ²)	Wt. of Grain left After Reaping g/m ²	Av. Wt. of grain collected (g/m ²)
1	470	162	303	30.3	62.7	93.2	31.4	16.7	14.7
2	394	76	318	31.8	81.0	90.4	29.8	14.9	14.9
3	448	139	308	30.8	68.8	89.3	30.6	16.5	14.1
4	354	111	242	24.2	68.5	93.7	30.4	12.4	18.0
5	333	97	236	23.5	70.7	95.2	31.4	17.7	13.7
Av.	400	117	283	28.2	70.7	92.4	30.7	16.6	14.1

The machine performance is given in Table 8.3. The effective field capacity of the combine harvester varied from 0.45 to 0.54 ha/h and average rate of work was 0.48 ha/h at a forward speed of 3.5 km/h with effective cutter bar width of 2.02 m. The efficiency of the straw combine was found to be 70%. Average fuel consumption was 4.97 l/h or 9.74 l/ha. Average straw split was 91.50%, whereas average length of bhusa was 23 mm at moisture content of 8.5% wet basis. The average height of cut was 52 mm.

The economics of straw combine on custom hiring is given in Table 8.4. The cost of operation was ₹ 800/ha. An entrepreneur can save on an average ₹ 61,600 on custom hiring when area covered by one entrepreneur is 88 ha. The average rate of custom hiring was ₹ 1500/ha and there was net saving of ₹ 700/ha. The pay back period of machine is three year. The cost of machine is ₹ 1, 70,000. The benefit-cost ratio was 1.88 on custom hiring and for own use it is 6.25.

Table 8.3: Performance result of straw combine in wheat crop.

S. No.	Parameters	Values
1.	Average forward speed, km/h	3.0 - 3.5
2.	Effective width of cutter bar, mm	2020
3.	Theoretical field capacity, ha/h	0.69
4.	Actual field capacity, ha/h	0.48
5.	Field efficiency, %	70
6.	Average height of cut, mm	52
7.	Average length of cut straw, mm	23
8.	Average straw split, %	91.50
9.	Moisture content of the straw, % w.b.	8.5
10.	Fuel consumed, l/h	3.5 to 4.0
11.	Fuel consumed, l/ha.	9.74
12.	Av. field capacity, ha/h	0.4
13.	Labour required per ha	2 persons

Table 8.4: Economics of straw combine on custom hiring.

Parameters	Remarks
Total No. of entrepreneur who purchased straw reaper as on 31.03.2010 :	10,731
Cost of operation (₹/ha)	800
Average grain recovery (kg/ha)	80
Average Bhusa recovery (q/ha)	25
Average expenditure ₹ per trolley	300
Out put	10 trolleys per day (1000 kg / trolley or 4 ha/day)
Average rate of custom hiring (₹/ha)	1500 or Rs. 600 per trolley
Av. work done on hiring by one farmer (ha)	88
Saving in cost of operation, ₹/ha	700
37	
Saving by Bhusa recovery, ₹/ha	5000
Saving by Grain recovery, ₹/ha	800
Net saving (₹/ha)	61600
Cost of machine (₹)	1,70,000
Pay back period	Three years
Benefit-Cost ratio	
• Own use	• 6.25
• Custom hiring	• 1.88

Status and adoption of straw combine: Average grain recovery was 80 kg/ha and bhusa recovery was 25q/ha. This machine has been widely accepted by the farmers of Haryana. No specific problem was observed in handling during operation of straw combine in wheat straw field. One skilled operator was required to operate the tractor and straw combine simultaneously. One labour was also required for unloading the trolley at suitable place. The total estimated area covered by straw combine is about 6.0 lakh hectares. The estimated number of straw combines in Haryana is about 10,731. The adoption of straw combine is graphically represented in Fig. 8.1. A view of straw combine in operation is given in Fig. 8.2.

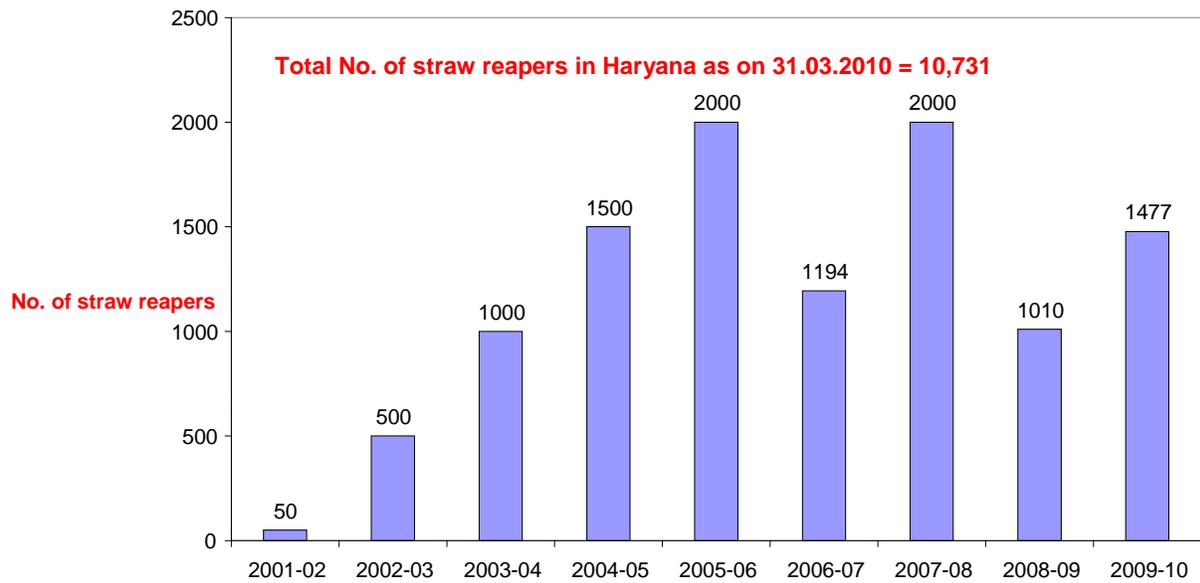


Fig. 8.1: No. of entrepreneurs of straw combine



Fig. 8.2: View of straw combine in operation at farmers fields.

Farmers feed back

- Use of tractors per year has increased
- Saving of time, money and labour
- Bhusa can be obtained as bi-product
- Less fatigue than manual threshing of wheat
- Machine repay its cost within three years
- Small farmers welcome the work to be get done on custom hiring
- Straw recovery is 65 to 70 per cent with good quality.
- The straw split was 92.36% and length of bhusa was 2.3 cm.
- There was an additional grain recovery of 80 kg/ha.
- The cost of grain recovered is almost equal to the amount paid for hiring the machine.
- Straw combine is very economical and now days, it is used extensively by the farmers as the cost of bhusa has risen and usage of combine has increased.
- The operation can be accomplished in less time and crop can be saved from natural hazards.
- It helps to save environmental hazards.

List of straw combine manufacturers

Refer Appendix 'A' {S. No. 3, 5, 10, 15, 17, 19, 20, 25, 29, 31, 32, 36, 39, 40, 41, 45, 47, 54, 55, 57, 61, 62, 66, 71, 79, 80, 91, 92, 95}