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Performance of self-propelled vertical conveyor reaper for harvesting rice (*Oryzae sativa*) and wheat (*Triticum aestivum*) in Uttar Bastar Kanker district of Chhattisgarh state

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ABSTRACT : Use of appropriate machinery is one of the major factors for reducing labour requirements and production costs of second crop cultivation after rice. A feasibility study was undertaken on reducing the cost of cultivation and ease of operation in paddy and wheat through mechanizing harvesting operations at Krishi Vigyan Kendra, Kanker, and also in the farmer's field during two seasons (*Kharif* and *Rabi*) in year 2012-13. A self propelled vertical conveyor power reaper was used for harvesting paddy and wheat in *Kharif* and *Rabi* season in year 2012-13, respectively. The overall performance of the vertical conveyor reaper was quite satisfactory. The actual field capacity for paddy harvesting was 0.276 ha/hr whereas for wheat it was found 0.311 ha/hr with fuel consumption 6.12 l/ha and 5.29 l/ha, respectively. Cost of mechanical harvesting with reaper was found 47.11% less for paddy and 44.4% for wheat as compared to the manual harvesting. The cost of cultivation of paddy and wheat crop could be reduced through mechanization of harvesting operations.

KEY WORDS : Self-propelled vertical conveyor reaper, Mechanization, Field capacity, Field efficiency, harvesting

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Rice is life for almost half of the global population and majority of the Indian people. India is one of the world's largest producer of white rice, accounting for 20% of all world rice production. Rice is the chief grains and staple food of India. Moreover, this country has the biggest area under rice cultivation, the total area planted under rice crop in India is 42.20 million hectares, which is the largest in the world as against total area of 148.40 million hectares (Anonymous, 2011; Chaudhary and Varshney, 2003)). Rice is the basic food crop and being a tropical plant, it flourishes comfortably in hot and humid climate. It demands temperature of around 25 degree Celsius and above and rainfall of more than 100 cm. Rice is also grown through irrigation in those areas that receives comparatively less rainfall.

Wheat is the second most important cereal of India. Area under wheat accounts for 14 per cent of the total gross cropped area. The area under wheat cultivation has increased from 97.46 lakh hectare in 1950-51 to 274 lakh hectares in 1999- 2000 showing a net increase of 181 % during the last 49 years (Anonymous, 2010).

Rice along with wheat forms the bedrock of Indian food security and to meet the country's stated goal of ensuring food for all, farmers will have to produce more rice from lesser land, using less water, energy and other inputs and keeping in harmony with the fragile environment (Annonymous, 2011). Based on the estimates of population growth, projection for future rice requirement and supply up to the year 2030 is given in Table A.

Climate change with its impact on agricultural production and productivity is looming large over the horizon. The challenges in rice and wheat production like enhancing yield and quality, preventing or combating of pest, diseases and weeds and generating crops adapted for future environments are issues that require urgent attention. Erratic monsoon behaviour also affects the grain production, especially in rainfed areas which occupy 62% of the total rice area of the country. A variety of factors including (i) declining yields and less land, water and labour, ii) effects of economic growth, (iii) pressure on land use, and (iv)

Table A : Rice requirement at various levels of per capita availability and projection at different production growth rate

Year	Population, (million)	Projected demand (mt)
2005	1116	94.5
2010	1210	100.7
2015	1288	106.8
2020	1370	112.8
2025	1445	117.3
2030	1523	121.6

*Kumar *et al.*, 2000

climate change, threatens future rice production.

There are huge gaps between yields currently obtained by farmers and that achieved with improved varieties and management practices. Post-harvest losses are estimated to be about 20–30%. Efficiencies of utilization of nitrogen fertilizer or water remain 30–50% below levels that can be achieved with good management. The priority, therefore, would be on closing yield and efficiency gaps, reducing postharvest losses, and adding more value to cropping or farming systems to enhance rice production, increase farmers' income while keeping the environment clean (Annonymous, 2011).

In view of the labor shortage and the need to reduce cost of cultivation, mechanization of rice and wheat farming is to be required. Crop harvesting is faced with lack of labour and high wages which is a major problem. On the other hand low work efficiency with manual harvesting delays harvesting operations of the rice crop. Choice of suitable harvesting method not only reduces production costs but also increases yield and quality produced.

The objective of this study was to assess performance and operational costs of reaper which was used for rice and wheat harvesting and compare them with manual harvesting method.

METHODOLOGY

Rice and wheat crop was sown in demonstration plots at Krishi Vigyan Kendra, Kanker (20° 14'42" N and 81°30'40" E , 421 m above mean sea level) of Chhattisgarh state during *Kharif* and *Rabi* in the year 2012-13 (Table 2). The demonstrations were also carried out in the farmer's field during *Kharif* and *Rabi* season (20°12'24" N and 81°30'12" E , 418 m above MSL). Crop details in respect of crop, variety, date of paddy transplanting/sowing and harvesting, etc. are presented in Table B.

Bambleshawri for paddy and Sujata for wheat variety were selected for the trials. Paddy was transplanted in the KVK and farmers field whereas wheat crop was sown with tractor drawn seed cum fertiliser drill. Both paddy and wheat crop were harvested with vertical conveyer reaper.

A self propelled vertical conveyer reaper (KAMCO make 3.5 HP single cylinder 4 stroke, air cooled, petrol start, kerosene run engine) was used for paddy and wheat harvesting in *Kharif* and *Rabi* season, respectively. It has a fixed cutting width of 120 cm with an adjustable cutting height of 10 - 30 cm from ground level. The crop was left aside after cutting at the right side of the machine (Fig. A and B).

Table B : Crop details

Sr. No.	Particulars	*Kharif* 2012-13	*Rabi* 2012-13
1.	Crop	Paddy	Wheat
2.	Variety	Bambleshwari	Sujata
3.	Date of nursery raised	17/06/2012	-
4.	Date of transplanting/sowing	02/07/2012	07/12/2012
5.	Power source	Manually	Tractor drawn seed cum fertiliser drill
6.	Date of harvest	12/11/2012	22/03/2013

Fig. A : Comparison of wheat harvested with reaper and manually

Fig. B : Paddy harvesting with reaper

Table C : Specification of self propelled vertical conveyer reaper

Sr. No.	Parameter	Specifications
1.	Make	Kerala Agro Machinery Corporation Ltd. (KAMACO), Kerala
2.	Model	KR 120
3.	Engine	Single cylinder 4 stroke, Petrol start, kerosene run
4.	Dimensions (L × W × H)	239 × 147 × 90
5.	Fuel and tank capacity (lits)	Kerosene-3.5 lits, Petrol-0.5 lits
6.	Power (kW)	2.7
7.	Weight (kg)	116
8.	No of rows	4
9.	Field capacity (ha/hr)	0.3
10.	No. gears	3
11.	Type of cutting device	Reciprocating knife bar
12.	Working width (cm)	120
13.	Effective height of cutting from ground level (cm)	10
14.	Forward speed of machine (km/hr)	3.5

The detail technical specification of the paddy reaper is shown in Table C.

The field observations of paddy and wheat harvesting during both (*Kharif* and *Rabi*) season were recorded and analysed. Actual field capacity of reaper was calculated based on area covered in unit time and actual time taken for covering marked area including the time lost in turning and filling.

Average labour saving by using reaper compared to manual harvesting was also observed. Cost of mechanical harvesting per hectare was worked out considering the fixed cost, labour cost, fuel cost, and field capacity of the equipment and was compared with the manual crop harvesting.

RESULTS AND DISCUSSION

In *Kharif* season paddy crop was harvested using vertical conveyor power reaper. With working width of reaper 1.2 m and average speed of harvesting were 2.3 km/hr, the performance of reaper was found satisfactory. An average field capacity of reaper was found 0.276 ha/hr. The labour requirement for collection and binding for paddy were 88 man-hr/ha where as in manual cutting, collection and binding it was 216 man-hr/ha. Average fuel consumption required for per hectare of paddy harvesting with reaper was 6.12 litres (Table 1).

Wheat was harvested in *Rabi* season with reaper. An average forward speed of reaper was found 2.6 km/hr more compared to paddy harvesting. The average actual field capacity and field efficiency for paddy and wheat were 0.311ha/hr and 74.05%, respectively.

Manually paddy and wheat crop was harvested in *Kharif* and *Rabi* season. The total labour requirement for paddy was found 212 man-hr/ha whereas for wheat it was 162 man-hr/ha for harvesting collection and binding. The total cost of harvesting paddy and wheat was Rs. 2700 and Rs. 2000 per hectare (Table 2).

The overall performance of the vertical conveyor reaper was quite satisfactory for both crop (paddy and wheat)

Table 1 : Performance of self propelled vertical conveyer reaper

Sr. No.	Parameters	*Kharif* 2012-13	*Rabi* 2012-13
1.	Crop	Paddy	Wheat
2.	Area	1.0	1.0
3.	Harvesting date	12/11/2012	22/03/2013
4.	Labour required for collection and binding (day/ha)	11	08
5.	Fuel consumption (l/ha)	6.12	5.29
6.	Average speed of harvesting (km/hr)	2.3	2.6
7.	Actual field capacity (ha/hr)	0.276	0.311
8.	Theoretical field capacity(ha/hr)	0.420	0.420
9.	Field efficiency (%)	65.71	74.05
10.	Cost	1428	1112

Table 2 : Manual harvesting of paddy and wheat

Sr. No.	Parameters	*Kharif* 2012-13	*Rabi* 2012-13
1.	Crop	Paddy	Wheat
2.	Area	1.0	1.0
3.	Harvesting date	12/11/2012	22/03/2013
4.	Labour required for collection and binding (day/ha)	27	20
5.	Actual field capacity (ha/hr)	0.005	0.006
6.	Cost of of cutting, collecting & Binding (Rs/ha) (labour @Rs. 100/day)	2700	2000

harvesting. The labour requirement in mechanical harvesting with manual collecting and building of the paddy crop was 11man days per hectare as compared to 27 man days per hectare in case of manual harvesting, collecting and building of the crop with 8 man-hr/days. Thus, there was a saving of 16 man days of labour per hectare, whereas for wheat crop saving of 12 man days saved using vertical conveyer reaper.

It was also found that average speed, field capacity and field efficiency were more in *Kharif* paddy harvesting to that of *Rabi* wheat harvesting, it may be due to tiller per plant in paddy was more, more soil moisture condition during paddy harvesting than that of wheat harvesting, tire slippage was more during paddy harvesting, row to distance was more in wheat crop compared to paddy.

Conclusion :

From the study, it can be concluded that the self propelled vertical conveyor power reaper could be used successfully with a labour saving of about 27 man days per hectare for paddy and 12 man days per hectare for wheat harvesting. Also mechanical harvesting could help in reducing the drudgery on the labourers. Thus, mechanization in paddy and wheat is a feasible solution to reduce the cost of harvesting without any yield reduction.

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