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# PADDY STRAW RETRIEVAL BY USING STRAW BALER FOR USE AS ANIMAL FEED

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## SUMMARY

The demand of livestock products is increasing due to increase in human population and change in feeding habits of peoples as they are shifting towards milk products, eggs and meat. To fulfil this demand higher cattle population is required, which will impress upon the need to produce higher feed and fodder from the decreasing land resources. These situations call for use of alternative sources of feed and fodder to bridge the gap between demand and supply of the fodder. In the present situation, the use of rice straw as animal feeding is an option as the majority of rice straw is burnt in the field. This straw can be retrieved from the field by using hay rakes and straw balers. Keeping in view a study was carried out at Krishi Vigyan Kendra, Fatehabad (Haryana), India to evaluate the performance and economic feasibility of straw baler in paddy variety PB - 1509. The field capacity of straw baler increased from 0.34-0.85 ha/h, net income increased from Rs. 1100 to Rs. 2800/ha, B : C ratio increased from 1.20 to 1.78 and break-even point decreased from 225 to 83 h/year if straw baler is operated after using hay rake.

**Key words :** Bailing efficiency, field capacity, fuel consumption, hay rake, straw baler

As per 19th Livestock Sensus, the livestock population of India was 512 million. The number of milch animals had increased by 6.75 % as compared to 18th sensus in 2007 (Anonymous 2012). The livestock sector alone contributes nearly 26 % of value of the output at current prices of total value in agriculture and allied sectors. This sector contributes nearly 4.11 % in total GDP at prevailing prices. This sector is very important for rural economy, especially for small and margional farmers (Ghosh *et al*. 2016). The demand of livestock products is increasing due to increase in human population and change in feeding habits of peoples as they are shifting towards milk products, eggs and meat (Ghosh and Palsaniya, 2014b). To fulfil this demand higher cattle population is required, which in will impress upon the need to produce higher feed and fodder from the decreasing land resources. The area under fodder cultivation is only 8.4 million hectare and has been static during last two decades. The scope of further increase in fodder area is very low due to increasing human pressure for food crops and other demands for land (Ujala *et al*., 2020). Presently, the country is facing net deficit of 35.60 % green fodder, 10.95 % dry fodder and 44.00 % concentrate feed ingrediants (IGFRI, Vision, 2050). Moreover, in forages, the seasonal and regional deficiencies are more important then national as it is not economically viable to transport fodder to long distances (Ghosh *et al*. 2013) mainly due to lower bulk density (Yiljep, 1993; Mangaraj and Kulkarni, 2011). These situations call for use of alternative sources of feed and fodder to bridge the gap between demand and supply.

In the present situation, the use of rice and wheat straw as animal feed is an option. The wheat straw can be easily retrieved from field by using straw combines (Kumar et al. 2010) and normally used as animal feed, but removal of paddy straw ia a problem and majority of rice straw is burnt in the field (Singh *et al.,* 2010b). It is considered as inferior quality feed due to lower content of lignin and higher content of silica (Van Soest, 2006, Singh and Sidhu, 2014). However, paddy straw could be considered an important feeding material during dry seasons when the availability of pasture decreases and other feeds are inadequate. This surplus paddy straw can be used directly or by treating the straw with protein or nitrogenous compounds (Kumar *et al.,* 2014). The treated paddy straw feed enhanced milk and meat yield when compared with untreated paddy straw (Wanapat *et al.*, 2009). It has found that the nutritional value of rice straw can be improved by microbial inoculants and some physical treatments for animal feeding during dry seasons (Kumar *et al.,* 2014 and Zayed, 2018). But, before its utilization there is need to bring out this paddy straw

from combine harvested paddy fields. This can be done by using rakes and balers (Thakur, *et al.*, 2000; Singh, *et al.*, 2006 and Senthilkumar *et al.*, 2016), which reduces cost of transportation and storage (Gupta *et al.*, 1994).

## MATERIALS AND METHODS

The crop and field parameters *viz*. crop variety, soil moisture content, bulk density, moisture content of straw, stubble height etc. were measured and initially the straw chopping operation was done by using rotary slasher in the field. The straw baler (John Deere-328) whose specifications are presented in Table 1 was then evaluated with and without using hay rake in combine harvested paddy fields for its performance and economic feasibility as per standard procedures. The performance was evaluated in terms of field capacity, field efficiency, fuel consumption, lifting efficiency and bailing efficiency at Krishi Vigyan Kendra, Fatehabad (Haryana), India during November 12-16, 2019. The cost of operation, break-even point, B:C ratio and payback period was considered for economic evaluation of straw baler.

TABLE 1
Specification of straw baler

| S. No. | Particulars | Value (s) |
|---|---|---|
| 1. | Source of power | Tractor operated |
| 2. | Power requirement, hp | 35 PTO hp |
| 3. | Pickup width, mm | 1879 |
| 4. | Tooth bar/teeth | 4 bar/104 teeth |
| 5. | Auger diameter, mm | 410 |
| 6. | Auger length, mm | 1549 |
| 7. | No. of knitters | 02 |
| 8. | Bale Dimension (Cross section), mm | 360 × 460 |
| 9. | Length adjustment, mm | 310 - 1270 |
| 10. | Stroke length of plunger, mm | 762 |
| 11. | Speed of plunger | 80 strokes per minute |
| 12. | Flywheel diameter, mm | 686 |
| 13. | Flywheel weight, kg | 103 |
| 14. | Compression chamber length, mm | 1168 |

## RESULTS AND DISCUSSION

### CROP AND FIELD PARAMETERS

The variety of paddy crop was PB - 1509. The crop and field parameters are presented in Table 2. The moisture content and bulk density of the experimental field varied from 15.4-16.5 % and 1.32-1.35 kg/m$^3$, respectively. The height of standing stubble before and after harvesting was 32 - 45 cm and 3.50 - 6.10 cm, respectively. The moisture content of straw varied from 22 - 28 % (*w.b.*) and total straw availability varied from 52.5 - 57.8 q/ha.

TABLE 2
Crop and field parameters of paddy

| 1. | Particulars | Ranges |
|---|---|---|
| 2. | Variety | PB -1509 |
| 3. | Soil moisture content, % | 15.4-16.5 |
| 4. | Bulk density, kg/m$^3$ | 1.32-1.35 |
| 5. | Number of hills/m$^2$, no. | 18-21 |
| 6. | Plant population/m$^2$, no. | 290-320 |
| 7. | Weight of loose straw, g/m$^2$ | 245-330 |
| 8. | Length of loose straw, cm | 30-55 |
| 9. | Height of standing stubble before harvesting, cm | 32-45 |
| 10. | Height of standing stubble after harvesting, cm | 3.50-6.10 |
| 11. | Weight of standing stubble before harvesting, g/m$^2$ | 245-330 |
| 12. | Weight of stubble after harvesting, g/m$^2$ | 20-35 |
| 13. | Stubble diameter, mm | 4.3-5.5 |
| 14. | Moisture content of straw, % (w.b.) | 22-28 |
| 15. | Straw availability, t/ha | 5.25-5.78 |

### PERFORMANCE PARAMETERS

The performance of shrub master, hay rake and straw baler were evaluated in field (Figs. 1, 2 & 3) and results are presented in Table 3. The field capacity of shrub master was 0.72 ha/h with field efficiency of 80 %. The fuel consumption was 3.7 l/h. The field capacity of hay rake was 1.5 ha/h with efficiency of 75 %, if operated at a speed of 4.5 km/h. The fuel consumption was found 3.5 l/h in hay rake operation. The field capacity of straw baler was 0.34 ha/h with efficiency of 75%, if operated directly after use of shrub master. The field capacity of straw baler increased from 0.34 to 0.85 ha/h, if operated after shrub master and hay rake operation. The higher field capacity was due to more field area coverage by the baler with less number of rounds. The fuel consumption in straw baling operation decreased from 12.35-5.30 l/ha by the use of hay rake before operating straw baler. The lifting efficiency of straw baler slightly decreased after use of hay rake that might be due to availability of higher mass of straw per unit width of straw baler. The bailing efficiency was found 80 % in both the cases. The average size of bale was 90 × 46 × 36 cm with weight of 22 kg per bale.

### ECONOMIC PARAMETERS

The economic parameters of straw baler with and without use of hay rake are presented in Table 4. The cost of straw baling operation increased from Rs 1800 to Rs 2550 per hour if operated after using hay rake operation and that was mainly due to use of one additional implement, but the cost of operation in terms of area coverage (Rs/ha) decreased from Rs. 4500 to

TABLE 3
Performance evaluation of shrub master, hay rake and straw baler in paddy crop

| S. No. | Parameters | Range | | | |
|---|---|---|---|---|---|
| | | Shrub master | Hey rake | Straw baler | |
| 1 | Field condition | After harvest of paddy | After shrub master operation | After shrub master operation | After shrub master and hey rake operation |
| 2 | Speed of field operation, km/h | 5.00 | 4.50 | 2.80 | 2.50 |
| 3 | Total working width, m | 1.80 | 4.50 | 1.60 | 4.50 |
| 4 | Theoritical field capacity, ha/h | 0.90 | 2.00 | 0.45 | 1.13 |
| | Actual field capacity, ha/h | 0.72 | 1.50 | 0.34 | 0.85 |
| 5 | Field efficiency, % | 80.00 | 75.00 | 75.00 | 72.00 |
| 6 | Fuel consumption, l/h | 3.70 | 3.50 | 4.20 | 4.50 |
| 7 | Fuel consumption, l/ha | 5.14 | 2.33 | 12.35 | 5.30 |
| 8 | Lifting efficiency, % | - | - | 85.00 | 83.00 |
| 9 | Bailing efficiency, % | - | - | 80.00 | 80.00 |
| 10 | Size of bale, cm | - | - | 90 × 46 × 36 | 90 × 46 × 36 |
| 11 | Weight of bail, kg | - | - | 22.00 | 22.00 |
| 12 | Straw recovery, q ha-1 | - | - | 44.00 | 44.00 |

TABLE 4
Economic evaluation of straw baler with and without hay rake in paddy field

| S. No. | Parameters | Shrub master + Straw baler | Shrub master + Hay rake + Straw baler |
|---|---|---|---|
| 1 | Cost of operation, Rs/h | 1800 | 2550 |
| 2 | Cost of operation, Rs/ha | 4500 | 2800 |
| 3 | Cost of thread, Rs/ha | 1000 | 1000 |
| 4 | Total cost of operation, Rs/ha | 5500 | 3800 |
| 5 | Net Income, Rs/ha | 1100 | 2800 |
| 6 | Straw recovery, q/ha | 44 | 44 |
| 7 | Gross Income, Rs. | 6600 | 6600 |
| 8. | B:C ratio | 1.20 | 1.78 |
| 9 | Break-even point, h/year | 225 | 83 |
| 10 | *Pay back period, years | 10.0 | 2.0 |

*If operated for 300 hours/year, Sale Price of bale = Rs. 150/q.

Fig. 1. Shrub master in operation in field.

Fig. 2. Hay rake in operation in field.

Rs. 2800 per hectare mainly because of higher field capacity of straw baler. The net income increased from Rs. 1100 to Rs. 2800/ha if baler is operated after using hay rake. The cost was calculated after considering bale sale price of Rs. 150/q. The B:C ratio increased from 1.20 to 1.74 and break-even point decreased from 225 to 83 h/year. The pay back period of the straw baler reduced from 10 to 2 years if used after hay rake and operated for 300 hours per year.

## CONCLUSIONS

Removing paddy straw from the field is a major problem faced by the farmer in India. It can be

Fig. 3. Straw baler in operation in field.

successfully removed by use of straw baler and its use for livestock feeding would be the win-win situation. The field capacity of straw baler increased from 0.34 – 0.85 ha/h, if operated after use of shrub master and hay rake operation. The net income is increased from Rs. 1100 to Rs. 2800/ha if operated after using hay rake. The B : C ratio was more than unity (1.78) that means investment in straw baler for collecting and bailing of straw is economically viable option mainly if it is operated after using shrub master and hay rake operation.

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