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# Comparative evaluation of mechanized and manual threshing options for Sahbhagi rice variety in Khunti district of Jharkhand

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**Abstract**
Rice is the major staple food of Jharkhand. Jharkhand produces 2.88 million tonnes, in area of about 1.59 million hectare with average production of 1.81 tonne per hectare. Paddy cultivation involves different operations like sowing of paddy for seedlings growing, puddling, seedling uprooting & transplanting, weeding, spraying of insecticides/pesticides, harvesting and threshing. Among these operations paddy threshing is an important operation which is carried out manually. Paddy threshing is tedious, less efficient and expensive operation carried out manually by most small-scale farmer in Jharkhand. To address these problems pedal and motor operated threshers were tested and evaluated. These threshers were evaluated in laboratory as well as in field condition. Data were recorded and analyzed. The mean threshing capacity of foot and motor operated paddy thresher were 80.62 kg/hr and 238 kg/hr compared with manually threshing 52.27 kg/hr, respectively. The machine can be adopted by farmers to cost effective reduce the drudgery and cost of threshing by adopting either pedal or motor operated paddy thresherseed yield per plant. These traits may be considered for selection and to improve the yield of mustard genotypes.

**Keywords:** Paddy thresher, threshing capacity, threshing efficiency and threshed grain percentage

## 1. Introduction
Rice (*Oryza sativa* L.) is one of the most important crops of India. It, annual production amounts to 104.41 million tonnes from 43.50 million hectare area with average production 2.4 tonne per hectare (Anon, 2018) [2]. India ranks second in production of paddy, after China. However, India ranks first in area of production (Anon., 2018; Singh., 1983) [2, 10]. Rice is cultivated in almost all states of India. Uttar Pradesh, West Bengal, Andhra Pradesh, Odisha, Chhattisgarh and Bihar are the leading state in area. West Bengal and Uttar Pradesh lead in production. Rice is a primary staple food of Jharkhand. In Jharkhand, total rice production amounts to 2.88 million tonnes from about 1.59 million hectare with average production of 1.81 tonne per hectare (Anon., 2018) [2]. Generally Indian rice cultivation is performed by manual labour from the time of seeding to harvest. Rice threshing is a strenuous labour intensive post-harvest activity. It demands great physical strength and energy (Singh. *et al*, 2011) [9]. (Trend Earth, 2018) [6] Manual threshing is tedious, injurious, time consuming and above all results in too much post-harvest losses which can be in the range of 1-15%. Post-harvest food loss translates not only to human hunger and financial losses to farmers but also results in tremendous environmental wastes.
Majority of farmers in Jharkhand grow rice in small scale due to small holding capacity of land, they are economically poor, lack enough capacity to acquire appropriate equipment for harvesting & threshing. Thus, threshing is still performed by traditional methods using manual labour. They perform different harvested actions on paddy plant/bundles to separate the grain from straw like: smashing ears of rice with hard objects to separate the paddies from the ears or straws, uses of livestock's for rubbing action due to animal heavy weight, sometimes pedal operated threshing drums are employed in fairly big farms, or even driving trucks or tractors on the un-threshed harvested paddy plants. According to (Hopfen., 1969) [7] the use of draft animals to thresh is one of the oldest improvements over the manual process, dating back over three millennia. In this method, a team of heavy weight animals is allowed to tread on the piled plants, and due to the stomping action removes the grain from the stalk. On another hand, a team of animals drags a weighted wooden sled or stone cylinder over the grain to remove it. While the use of animals is faster and less burdensome than performing manual threshing, it

allows for contamination from the animals, as well as losses from the animals eating the grain. (Singh and Devi., 2016) [8] found that the use of compatible technology at various stages of cultivation practice reduces total farming cost.

Testing and evaluation an important part of machine development. Evaluation of the machines helps in the design and development of better quality farm machinery. Evaluation of any machine indicates the deficiencies which remain present in the performance, safety and components durability of the machine (Yasin and Ansari, 1981) [11]. Several designs of rice thresher both manual pedal operated and motorized threshers are in use in different rice producing areas (Azouma *et al.*, 2009) [3]. But suitability of design may differ depending on the farm location, farm infrastructure, transportation and cost of the machine. Often, there is no electric connectivity in farms and the cost of fuel and motor operated design can be unmanageable for farmers (Baruah and Bora., 2008) [4]. Moreover, the fields are usually located far away from the core of the villages and most of the fields do not have proper road connectivity, therefore transport of heavy machine creates inconvenience which reduces application of such machineries. Therefore, mechanization using compatible technology such as manually operable tools with multiple detachable parts that can be easily assembled for ease of transport is more suitable for such places. The present study was conducted to determine the comparative performance of different threshing methods as well as performance of traditional threshing, manual pedal operated thresher and low weight power operated paddy thresher. In order to recommended suitable threshing method & equipment for paddy threshing for farmer in Jharkhand.

## 2. Materials and Methods

### 2.1 Study Site Description

This study was conducted in Khunti district of Jharkhand, India. The district is situated between 23.0140203°N North latitude and 85.2724457°E East longitude. The northern most and southern most parts of the district are covered with hillocks and forests. It consists of 19 plateaus of having different heights. Altitude of the area varies from 500 m to 700 m above mean sea level in general. There are many hillocks in the district having altitude 700 m above mean sea level. (Anon., 2022) [1].

### 2.2 Demonstration Sites

Demonstration sites were selected purposively in the on field trail (OFT) area in consultation with Krishi vigyan Kendra, Khunti. The technologies were evaluated at Sarna toil, Banai toli and kenvendtoli, Khunti district. Nine farmers were associated in evaluation and helped in promotion of the technologies though lateral extension system and providing feed backs. The foot (pedal) operated paddy thresher and motor operated paddy thresher were evaluated for two years

### 2.3 Treatments

#### 2.3.1 Traditional Paddy Threshing

Generally threshing of paddy in Jharkhand is done traditionally by feet trampling and animal trampling. Animal trampling is treading a layer of 15 to 20 cm thick harvested crop by a team of animals followed by manual refining, depending upon capacity, lot size and situation. Threshing by animal treading is practiced on large scale in the region but it is time consuming and involves drudgery. Animal trampling (hereafter referred as traditional) on average takes two human labors and 5 oxen for 10 hrs to produce 1 tone output of fairly dried rice (Dagninet *et al*., 2015) [5] However, it incurs huge loss due to spreading, fracture and mix up with soil impurities. Absence of sufficient livestock for trampling forces prolonging threshing period thereby increasing loss due to shattering, pests and rotting of grains. If threshing animals are not available, the farmers thresh by feet trampling.

**Fig 1:** Traditional Methods of Paddy Threshing - a), Feet trampling and b), Animal trampling

#### 2.3.2 Foot (Pedal) Paddy Thresher

The pedal thresher (Fig. 2) consists of an open rotating drum with wire loops fixed on wooden slates. The drum strips the grains from the panicles when fed by hand. The Pedal Rice thresher is simple to operate with leg. It has gear drive mechanism to transmit power. While cylinder is kept in rotary motion at high speed, the paddy bundle of suitable sizes are applied to the teeth. Holding the bundle against the loops of revolving cylinder, the grains are separated by combing as well as by hammering action of threshing loops. Paddy is threshed due to impact and rubbing action between threshing drawn loops and concave screen. Detailed specification of this machine is mentioned in table 1 and shown in fig 2.

#### 2.3.3 Motor Paddy Thresher

Motor operated paddy thresher was fabricated and tested. It consisted of main frame, threshing unit and power transmission unit. The thresher was gear driven by using electric motor 0.5 hp while the threshing drum of thresher was hallow cylinder fitted with wire loops. All the other specifications were similar to the pedal type except the weight, which is slightly heavier. The specifications of available thresher have been shown in the Table 1. The test date are presented in table 2 in term of threshing efficiency and grain output capacity of the machines.

**Fig 2:** Foot operated paddy thresher

**Fig 3:** Motor operated paddy thresher

**Table 1:** Detailed of treatment with specification of thresher

| S. no. | Parameters | Mode of paddy threshing | | |
|---|---|---|---|---|
| | | Traditional (Manual) | Foot (pedal) operated paddy thresher | Motor operated paddy thresher |
| | Overall dimension (length, width and height), mm | - | 1050 x 800 x 810 | 1145 x 730 x 920 |
| | Weight, kg | - | 40 | 60 |
| | Number of slats | - | 15 | 12 |
| | No. of wire loops/slat | - | 17 | 21-22 |
| | Speed of operation, rpm | - | 250 | 330 |
| | Power source | - | Manual | 0.5 hp electric motor |
| | Type of threshing cylinder | - | Wire loop type | Wire loop type |

### 2.4 Data Collection and Analysis

Data were recorded for evaluation of threshing efficiency and capacity. Opinions, views and response of the participants about the technology as compared with the traditional practice were collected. Threshing by foot (pedal) operated paddy thresher and motor operated paddy thresher and traditional methods were conducted using Sahbhagi rice variety. The threshing was done for 10 minutes on each practice with 3 replicates for both year. Data were recorded from 9 farmers for traditional method of threshing, foot (pedal) operated paddy thresher and motor operated paddy thresher were carried out at farmers threshing yard. Before testing in the field, the laboratory testing of machines was carried out. The observations such as threshing cylinder speed under load and no load, of operator required for operations were recorded. Power requirement performances were evaluated in term of feed rate, threshing efficiency and un-threshed grain percentage. The grain straw ratio and moisture content of the grain were also determined & recorded (Table 2, 3).

## 3. Results and Discussion

This study had aim to evaluate the threshing performance of pedal operated paddy thresher and power operated paddy thresher compared with traditional threshing methods used in Jharkhand. The mean value of different crop parameters for 3 replicates and field parameter for each treatment of paddy threshing were recorded (Table 2, 3).

**Table 2:** Mean value of Crop Parameters

| S. No. | Crop Parameters | For different mode of paddy threshing |
|---|---|---|
| 1. | Location | Diyankel, Khunti Jharkhand |
| 2. | Geographical location | latitude; 22.93453/N $22^0$ 56’4.302’’ and longitude; 85.10518/E $85^0$6’18.648’’ |
| 3. | Crop | Paddy |
| 4. | Variety | Sahbhagi |
| 5. | Length of ear head, mm | 230 |
| 6. | Length of straw, mm | 960 |
| 7. | No of grain per ear head | 183 |
| 8. | No of 1000 grain weight, g | 24.8 |
| 9. | Moisture content, (d.b.) % | Grain -11.0, Straw-24 |

**Table 3:** Mean value of field performance parameters

| S. No. | Parameters | Mode of paddy threshing | | |
|---|---|---|---|---|
| | | Traditional (Manual) | Foot (pedal) operated paddy thresher | Motor operated paddy thresher |
| | | Year: 2020-2021 | | |
| 1. | Grain straw ratio | 5.1:5.3 | 5.0:5.2 | 4.7:4.8 |
| 2. | Threshing efficiency, % | 96.36 | 96.64 | 96.85 |
| 3. | Un-threshed grain, % | 3.63 | 3.30 | 3.64 |
| 4. | Capacity, kg/hr | 52.27 | 80.62 | 238.00 |
| 5. | Capacity, kg/day | 418.16 | 644.96 | 1904.00 |
| 6. | Time requirement (threshing paddy crop per hectare), hr* | 50.05 | 33.35 | 10.31 |
| 7. | Manpower requirement (threshing paddy crop per hectare) | 14 | 10 | 4 |
| 8. | Cost of threshing, Rs/ha ** | 4900 (very high) | 3500 (High) | 1400 (lowest) |

**Note:** *Considering paddy yield 5.84 tonne/ha with paddy straw, **Semi skilled Labour charge: Rs. 350 per day, source the Jharkhand minimum wages notification 1st april. 2022 pdf

The average threshing capacity was observed highest for motor operated paddy thresher (1904 kg/day) followed by foot operated paddy thresher (645 kg/day) and traditional threshing (418.16 kg/day), respectively with threshing efficiency of 96.85%, 96.64% and 96.36 respectively. The threshing capacity of the thresher depends on Paddy bundle holding capacity of the operator with hand, feeding weight by the operator and threshing drum rpm.

The average un-threshed grain percentage was found to be higher for motor operated paddy thresher (3.64%) followed by traditional threshing (3.63%) and foot operated paddy thresher (3.30%), respectively.

The time requirement for threshing paddy harvested from a 1 hectare of land was higher for traditional threshing (50.05 hr) followed by pedal operated paddy thresher (33.35 hr) and motor operated paddy thresher (10.31 hr) and, respectively.

The cost of threshing was lowest for motor operated paddy threshing (Rs 1400/ha) followed by Foot (pedal) operated paddy thresher (Rs. 3500/ha) and traditional method of threshing (Rs. 4900/ha). Similarly man power requirement for threshing paddy crop from 1 ha was lowest (4 person) in case of threshing by Motor operated paddy thresher followed by Foot (pedal) operated paddy thresher (10 Person) and traditional threshing (14 Person).

Based on threshing capacity, man power requirement and time taken for threshing, motor operated paddy thresher for region where electricity is available and pedal operated paddy thresher where electricity is not there may be recommended for threshing paddy in Jharkhand.

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