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Research Article

Present Status and Intervention of New Technology to the Existing Rice Cultivation System in South Garo Hills District of Meghalaya, India

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ABSTRACT

The farm power availability has been increased in some parts of India; however, traditional methods of cultivation practices are prevalent over NER due to highly exclusive in nature, location peculiarities, terrain, climatic patterns, etc. In South Garo Hills, district of Meghalaya, farmers still depend upon traditional methods using animals and sometimes power tiller for threshing in rice cultivation. Animal threshing has its limitation due to time consuming and unavailability during the peak season and the farmers still depend upon human labour for winnowing practices. This method is facing some of the constraints in terms of production, labour availability, drudgery and economic return. This study deals with the intervention of pedal operated paddy thresher and hand operated winnower in rice cultivation system at South Garo Hills, district of Meghalaya as a part of OFT and FLD programme. It was found that the average threshing capacity of thresher was 49.80 (kg/hr) against the traditional methods of 74.36 (kg/hr) and winnowing capacity of 240 kg/hr against 130 kg/hr in traditional method. It also found that the Benefit-Cost (B: C) ratio was increased from 1.4:1 to 2.00:1 using the combine technology; thereby increase the farmers' income. The cost of cultivation was also found to be reduced from 41,437 Rs/ha to 29,137 Rs/ha after the intervention of technology.

Keywords: *(B: C) Ratio, Field Capacity, Efficiency, OFT, FLD, Thresher, Winnower.*

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important cereal crop after wheat in the world. It is a staple food of the people of South-east Asia and at present more than half of the world population subsists on this crop (Manzoor et al., 2006) Rice is the most important grain with regard to human nutrition and calorie intake providing more than one-fifth of the calories consumed worldwide by humans. India has moved from food scarcity to food surpluses in the last four decades due to the growth of science coupled with quick adoption of technology by the farmers.

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Out of the total cultivated area of 193 million hectare in India paddy is grown in 42.41 million ha. This amongst to 28 percent of the world's total area of 151 million ha under paddy cultivation. India shares about 22.3 percent of paddy cultivation with an annual production of 132 million tonnes. About 95 per cent of the world's rice is produced in developing countries primarily in Asia which is home to 59 per cent of the world's population. The Asian farmers harvest nearly 92 percent of global rice produce (Chakraborty, 2001). Among rice growing countries India ranks second with a production of rice about 20.40 per cent of the total world's production. It is estimated that rice demand in the country will be about 100 million tonnes by the year 2010 and by the year 2025, it would be about 140 million tones (Anon., 2004 a). Although productivity of rice in India has shown an increasing trend in the last few years, it is still among the lowest in the world. Thus, the future increase in rice production requires improvement in productivity and efficiency (Paroda, 1998).

The North Eastern Region (NER) is considered to be one of the hot pockets of rice genetic resources in the world and a potential rice-growing region with extremely diverse rice growing conditions as compared to other parts of the country. Being the secondary centre of origin of rice, the NER is rich in diverse germplasm that shows the distinctness amongst the germplasm which have been collected so far. Selection made unknowingly by various ethnic groups inhabiting at different altitudes and climatic situations, practising different forms of cultivation might have also contributed to some extent towards the diversity of rice crop in this region (Sarma et al., 2002). The NER is also home to a large number of aromatic and quality rice varieties. In fact, the whole region is considered as a veritable treasure trove of rice germplasm with wide genetic resource of rice. The increase in rice production and productivity over the past 30 years is marginal and much below the national average; most part of which are attributed to expansion of rice area mainly in the summer season in 90's. Rice self-sufficiency is only about 80 percent in North-Eastern India. States like Assam, Manipur and Tripura can easily produce surplus rice. During the post-green revolution period due to introduction of improved varieties, the rice yield in NEH region has been enhanced up to 40% that plays a pivotal role in increasing the productivity (Borthakur, 1993 & Dhillon et al., 2001).

Rice is one of the main crops of the North-eastern region of India accounting for about 89% of the area and 92% of the total food grains production (Misra & Misra, 2006) followed by maize with an area of around one million hectare giving an average productivity of 14.5 q/ha (Anonymous, 1999). The NER of India accounts for 7.8 percent of the total rice area in India while its share in rice production is only 5.9 percent. The average rice productivity of 1.4 t/ha is below the national average of 1.9 t / ha (Anon., 2000).

Threshing is the process of separating the grain from the straw. South Garo Hills District of Meghalaya still practiced traditional methods using bullock and sometimes using power tiller. There is a high rate of grain loss and breakage using the power tiller method of threshing rendering it inefficient. The pedal operated rice threshing and winnower machines were tested with the aim of assessing the threshing performance, winnowing speed, time consume, cost of cultivation and mostly gathering feedback from local rice farmers to evaluate the efficiencies of the pedal operated rice threshers and winnower to determine which will be suitable for local rice farmers in South Garo Hills, District, Meghalaya.

Keeping in view of the problems arising in threshing and winnowing of paddy and moreover high cost of cultivation, the study was conducted with the following objectives:

i. To determine the threshing capacity, threshing efficiencies and winnowing capacity of both the traditional method, pedal operated threshers and hand operated winnower.
ii. To reduced the cultivation cost in paddy.
iii. To determined the Benefit-Cost (B: C) ratio of both practices.

MATERIALS AND METHODS

The state of Meghalaya is situated in the northeast region of India, and it extends from latitude 20°1′ N - 26°5′ N and longitude 85°49′ E - 92°52′ E. It is bounded on the North and East by the state of Assam and on the South and West by Bangladesh. A compact and isolated state in the north-eastern region of India, Meghalaya extends to 22,429 sq km of land. The landscape of Meghalaya is mostly rolling plateau with south-facing slopes being extremely steep.

The South Garo Hills district lies in the southern part of Meghalaya, and was created on 18th June, 1992. The district is situated between 25˚10′ and 25˚35′ N latitudes and 90˚15 and 91˚0′ E longitude. It covers an area of 1887 sq. Km. It is bounded in the North by East Garo Hills, in the East by the West Khasi Hills district, in the West by West Garo Hills district and in the South by Bangladesh**.** Table 1 shows the area production and yield of agricultural crop during the year 2016-17 for Meghalaya.

Table 1: Area Production and Yield of Agricultural crops for the year 2016-17

Sl. No.	Name of Agricultural crops	South Garo Hills			Total Meghalaya		
		Area (ha)	Production (MT)	Yield (kg/ha)	Area (ha)	Production (MT)	Yield (kg/ha)
1.	Autumn rice	4940	12296	2489	33310	88818	2666
2.	Winter Rice	3375	8957	2654	63834	175689	2752
3.	Spring Rice	300	450	1500	13747	65885	4793

2.1 Description of Study and Demonstration Site

The demonstration was conducted in Dec, 2018 as a part of On-Farm Testing (OFT) & Front Line Demonstration (FLD) in Chokpot i.e a Block situated in South Garo Hills district in Meghalaya. The demonstration sites and farmers were selected purposively in area. Under this three different villages under Chokpot Sub-Division namely, Bibragre, Chokpotgre and Dobogre were selectted. For the trial purpose five (5) numbers of farmers from each village considering 15 numbers of trials were conducted each on pedal operated thresher and hand operated winnowers. Location map of study area is shown below.

Location map of study area

2.2. Methods of Threshing and Winnowing

2.2.1. Farmers Practice

Threshing of paddy in Chokpot sub-division was done by traditional methods using bullocks and sometimes using power tillers. In traditional methods using bullocks the harvested dried paddy were spread uniformy over the hard surface forming a layer of 15 to 20 cm thick prepared mainly for threshing. Two to Three bullocks were allowed to trampling in circular pattern over the spread harvested dried paddy followed by manual refining, depending upon capacity, lot size and situation. During the trampling by animals mutual rubbing and shearing of paddy takes place, resulting in threshing (Amare et. al, 2015). Threshing by animal treading is still practiced on large scale in the country where mechanization is still a limiting factor, but it is also time consuming and involves drudgery. Absence of sufficient livestock for trampling forces prolonging threshing period thereby increasing loss due to shattering, pests and rotting of grains. To complete threshing of 1 Bigha (0.13387 hectares) took around 6 to 7 hr using 2 to 3 bullocks.

Apart from traditional practices of threshing using bullocks, some farmers prefers of using power tillers for threshing. Same as in methods using bullocks, here also the dried paddy were spread uniformy over the hard surface forming a layer of 15 to 20 cm thick and power tillers were allowed to run over the layer shown in Figure 1. To complete threshing of 1 Bigha (0.13387 hectares) took around 1.5 to 2 hr using a single power tiller. The timeliness of operation is greatly reduced, however a costly methods of threshing. Therefore, majority of the farmers in the region were not able to adopt.

Fig. 1: Existing traditional practice of threshing

Winnowing is the process of removing lighter contaminants like straw, chaff, dust etc either by dropping the materials from a height against natural wind then fanning manually or by using a mechanical blower. Winnowing of threshed grain is still carried out in traditional method using human labour. Here the farmers had thrown away the unthreshed grain using a bamboo tray from a certain height into the air and allowed to fall freely on the ground shown in Figure 2. During the process, the lighter contaminants like straw, chaff, dust etc were blown away by providing maximum wind velocity using bamboo made tray like structure. To complete winnowing of 1 Bigha (0.13387 hectares) took around 3 to 4 hr by 5 to 6 labour.

Fig. 2: Traditional method of winnowing

2.2.2. Intervention of New Technology

Pedal operated paddy thresher was introduced for threshing a harvested paddy. It is simple in design and consists of an open rotating drum with wire loops (Khadatkar et. al, 2018). The drum strips the grains from the panicles when fed by hand. It is simple to operate with leg muscle, doesn't consume fuel and it is used for threshing paddy rice easily. It can also be operated by women and can be used in hilly or terraced areas because of its portability (Khan & Salin, 2005). During threshing with thresher, one person was engaged in supplying the paddy bundle to the operator and another person was engaged for manual moving the bundle over the thresher and pedaling the thresher shown in Figure 3.

During threshing with pedal operated thresher, one person was engaged in supplying the paddy bundle to the operator and other person was engaged for manually moving the bundle over thresher and pedalling the thresher.

Apart from thresher hand operated winnower was also introduced for cleaning of threshed paddy grains and separation of husk, dust and other light weight foreign materials from paddy and other cereals and pulses (Singh & Gite, 2007). It has a pair of sprocket and chain for increasing the speed of the fan blades to a ratio of 1:3. The use of chain and sprocket arrangement makes the operation of fan easier with less effort. Four blades each having a length of 610 mm are fitted to the fan shown Figure 4. A fan guard is provided to prevent any accident. One person is required for the operation of this equipment while another person releases grains from height to enable the separation of dust and other unwanted light weight materials from the grain.

Fig. 3: Demostration of pedal operated thresher

Fig. 4: Demostration of hand operated winnower

2.3. Cost analysis

The cost of cultivation is divided into two parts, namely, variable and fixed cost. The variable cost is more sensitive to changes in the agricultural sector i.e input and output prices etc. The fixed cost is not based on the size of operational unit while the variable cost depends on the size of unit. It is the variable cost which mostly enters into the decision making process regarding the allocation of resources.

3.3.1 Variable cost

The major items coming under variable cost are human labour, machine/bullock labour, seed, irrigation, lime, manures, fertilizers, pesticides, transportation and interest on working capital. Here, we considered cost of seedling, weeding cost, labour cost and land preparation cost.

3.3.2 Fixed Cost

Items normally included under the category of fixed costs are, land revenue/ tax, rent and depreciation on farm buildings, machinery, equipments and implements. For our purpose the fixed cost is not considered for the evaluation.

RESULTS AND DISCUSSION

3.1 Threshing Capacity (kg/hr) & Threshing Efficiency (%)

The threshing capacity of the thresher depends on Paddy holding capacity of the operator at once with hand, feeding rate of the operator, threshing unit /drum rpm (Selco Foundation, 2013) and the variety of the rice and other factors. In addition, driving mechanism may influence the threshing capacity. The threshing capacity of the thresher ranges from minimum 45.60 (kg/hr) to the maximum 53.80 (kg/hr) with the average threshing capacity of 49.80 (kg/hr) while that of traditional method ranges from minimum 69.40 (kg/hr) to the maximum 82.60 (kg/hr) with the average threshing capacity of 74.36 (kg/hr) is shown in Table 2 and graphical representation is shown in Figure 5 below.

Table 2: Data of threshing capacity (kg/hr) between traditional method and thresher

Traditional methods using animal			
Trials	**Dobogre Village**	**Chokpotgre Village**	**Bibragre Village**
F1	70.10	76.90	70.80
F2	76.20	72.50	73.20
F3	74.20	82.60	78.20
F4	78.10	80.59	69.40
F5	70.20	70.28	72.20
Average	**73.76 (kg/hr)**	**76.57 (kg/hr)**	**72.76 (kg/hr)**
Pedal operated thresher			
F1	45.60	48.10	50.60
F2	48.80	46.30	47.80
F3	50.10	48.50	51.80
F4	50.80	50.30	53.80
F5	53.74	51.30	50.30
Average	**49.80 (kg/hr)**	**48.90 (kg/hr)**	**50.86 (kg/hr)**

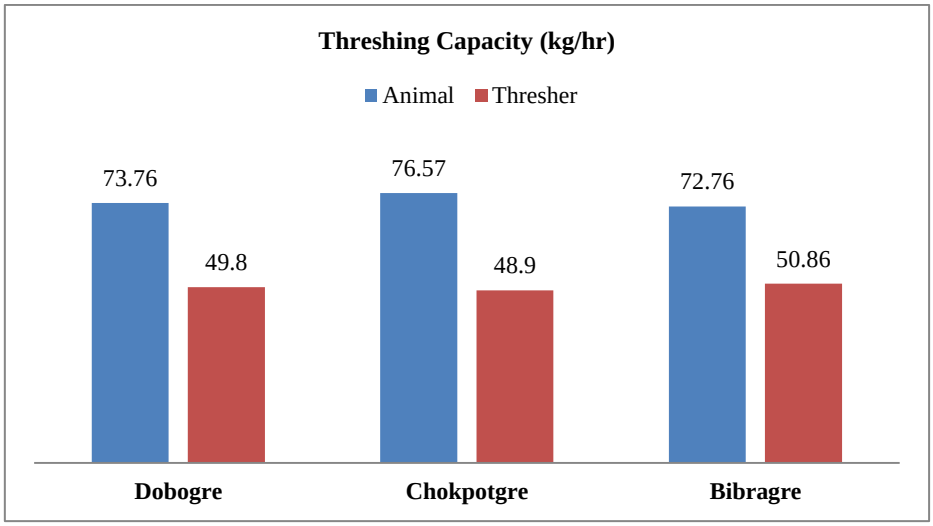

Fig. 5: Graphical reprentation of two threshing practices

Spread of paddy uniformy over the hard surface to form a layer of 15 to 20 cm thick is essential for maximum threshing efficiency. Using thresher, person should seize a manageable size for accessing the beaters or else should turn the sides of the panicles and rotate to thresh. The threshing efficiency of the thresher ranges from minimum 93.10 (%) to the maximum 95.48 (%) with the average threshing efficiency of 94 (%) while that of traditional method ranges from minimum 96.17 (%) to the maximum 98.10 (%) with the average threshing efficiency of 97.38 (%) is shown in Table 3 and graphical representation is shown in Figure 6 below.

Table 3: Data of threshing efficiency (%) between traditional method and thresher

Traditional methods using animal (%)			
Trials	**Dobogre Village**	**Chokpotgre Village**	**Bibragre Village**
F1	97.62	97.12	96.80
F2	96.29	96.90	97.90
F3	98.10	97.27	98.23
F4	96.17	97.90	97.24
F5	97.13	98.10	97.18
Average	**97.24 (%)**	**97.45 (%)**	**97.47 (%)**
Pedal operated thresher (%)			
F1	93.58	94.47	94.78
F2	94.27	95.48	95.22
F3	93.10	93.40	94.17
F4	93.20	93.32	94.58
F5	93.80	94.31	95.10
Average	**93.58 (%)**	**94.19 (%)**	**94.78 (%)**

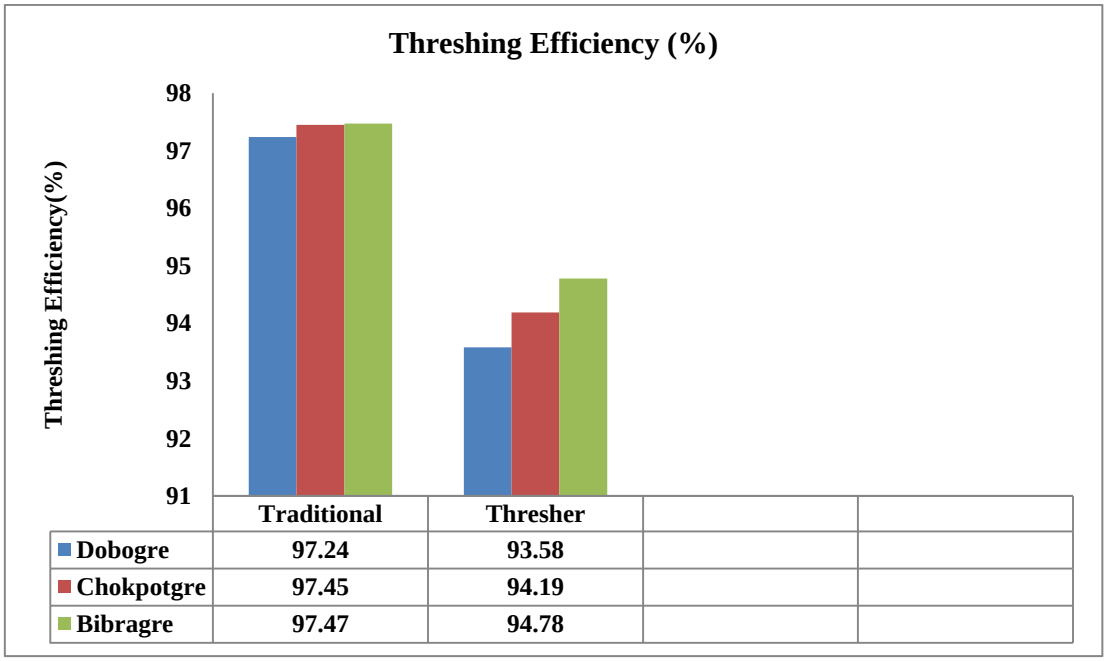

Fig. 6: Graphical reprentation of two threshing practices

3.2 Winnowing Capacity (kg/hr) & Cleaning Efficiency (%)

From the Table 4 it is found that the winnowing capacity of the winnower ranges from minimum 210 (kg/hr) to the maximum 262 (kg/hr) with the average winnowing capacity of 240 (kg/hr) while that of traditional method ranges from minimum 114 (kg/hr) to the maximum 145 (kg/hr) with the average winnowing capacity of 130 (kg/hr) and graphical representation is shown in Figure 7 below. The average cleaning efficiency of the winnower was found to be 97% while that of traditional method was found to be 98.9%.

Table 4: Data of winnowing capacity (kg/hr) between traditional method and winnower

Traditional manual method			
Trials	**Dobogre Village**	**Chokpotgre Village**	**Bibragre Village**
F1	134	132	138
F2	128	114	145
F3	125	128	122
F4	138	132	132
F5	115	124	153
Average	**128 (kg/hr)**	**124 (kg/hr)**	**138 (kg/hr)**
Winnower			
F1	240	239	235
F2	245	246	252
F3	230	262	258
F4	255	235	220
F5	210	248	235
Average	**236 (kg/hr)**	**246 (kg/hr)**	**240 (kg/hr)**

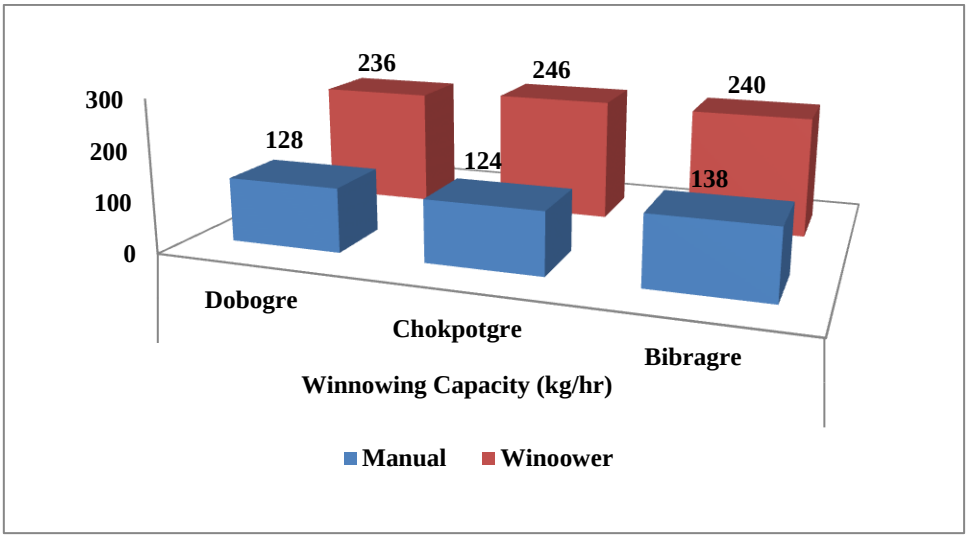

Fig. 7: Graphical reprentation of two winnowing practices

3.3 Total cost of cultivation (Rs/ha)

The cost of cultivation include land preparation cost, cost of seed for seedlings preparation, Transplanting cost, Harvesting cost, Threshing cost, Winnowing cost in (Rs/ha). It was found that the farmers in the study area where not using any fertilizers, and cost of irrigation is also neglected as the cultivation system is totally a rain fed no weeding practices were used. Therefore, it was found that the Gross cost of cultivation in traditional methods was found to be 41,437 Rs/ha while that of using Thresher and Winnower independently was found to be 33,937 Rs/ha & 36, 637 Rs/ha respectively. The graphical representation of cultivation cost between traditional methods and new technology is shown in Figure 8 below. From the graph it was seen that the cost of cultivation differ abruptly from the point of harvesting cost, as the intervention of new technology takes place after harvesting of paddy.

3.4 Cost - Benefit Ratio (B: C)

From the study it was found the Cost-Benefit (B:C) Ratio obtained from traditional methods was found to be 1.4:1 while that of using thresher the B:C ratio uplifted to 1.72:1and 1.5:1 using winnower. However, if the thresher and winnower were used in combine, the Cost-Benefit Ratio obtained was found to be 2.00:1.

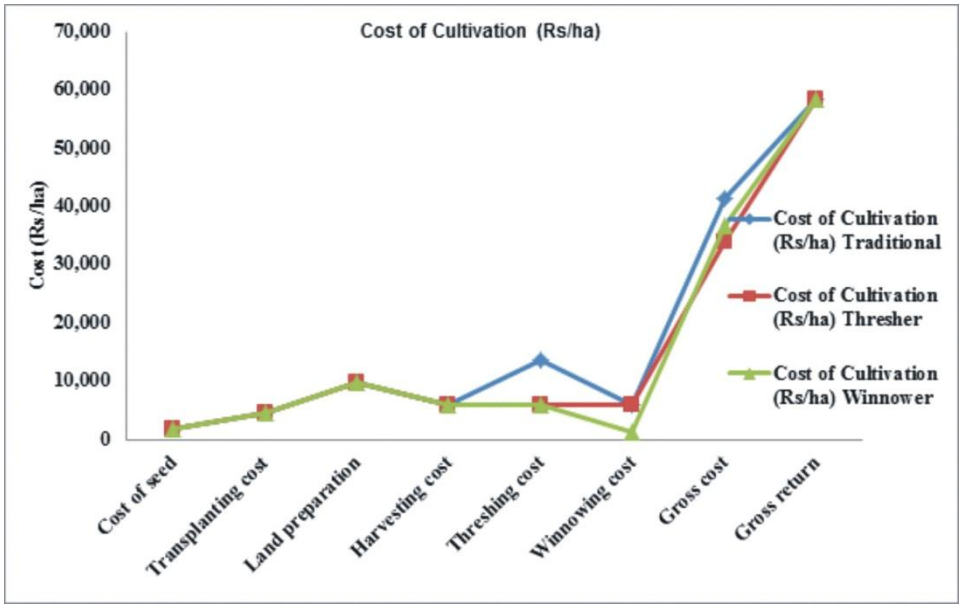

Fig. 8: Graphical reprentation of cultivation cost between two practices

CONCLUSIONS

From the study it was found that the average threshing capacity of the thresher was 49.80 (kg/hr) against the traditional methods 74.36 (kg/hr) using bullocks. Inspite of less threshing capacity, women farmers having a small farm land prefers to use this technology as majority of the farmers are farm women. The threshing efficiency was less in new technology due to short stalk length of harvested paddy which leads to difficulty in feeding. The average winnowing capacity was found to be higher in the new technology with 240 kg/hr against 130 kg/hr in traditional method. It was also found that the Gross cost of cultivation in traditional methods was found to be 41,437 Rs/ha while that of using thresher and winnower independently was found to be 33,937 Rs/ha & 36, 637 Rs/ha respectively. This shows an increase in B:C ratio from 1.4:1 to 2.00:1 and also reduced the cost of cultivation by 12,300 Rs/ha using the combine technology. The drudgery involve during traditional method of winnowing is minnimized by using the new technology. The technology of utilizing pedal operated paddy thresher and winnower for production of rice needs to be popularized among the tribal farming community of the South Garo Hills District, Meghalaya, India.

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