



Economic Evaluation for different Level of Agricultural Mechanization in Manipur

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ABSTRACT

Agriculture is the mainstay of the state's economy with about 76 % of the working population in the state directly or indirectly depending on agriculture for employment and livelihood. Improved tools and equipments namely, paddy drum seeder, cono weeder and pedal operated paddy thresher were used in this study for different level of agricultural mechanisation. Improved mechanised farming could save more than 50% of the total cost involved in traditional farming. By using cono weeder for weeding of paddy cultivation could save Rs. 6560.00 per hectare over the manual weeding. Seed requirement using paddy drum seeder could reduce 50% over the traditional farming and also save Rs. 10830.00 per hectare in paddy nursery raising and transplantation over the traditional farming. Using pedal operated paddy thresher for threshing of paddy could save Rs. 3200.00 per hectare over the traditional farming and which are the major significant of mechanisation. The cost of cultivation of rice could be further reduced by mechanizing various activities involved in rice cultivation.

1. Introduction

Farm mechanization is an important component in modern agriculture. Farm Productivity is dependent on availability of farm power with efficient farm implements and their economically utilization. Agricultural mechanization enables efficient utilization of various inputs such as seeds, fertilizers, plant protection measures and efficient irrigation system and also it helps in improving agricultural production, which improves economy of many farmers by making farming an attractive enterprise. Power availability in India for various agricultural operations has been increased from 0.3 kW ha⁻¹ in 1971-72 to 1.4 kW ha⁻¹ in 2003-04. The increased in power availability was due to the increased in tractor, power tiller, and combine harvesters, irrigation pumps and other power-operated machines. The share of mechanical and electrical power has increased from 84 % in 2003-04 from 1971-72 (<http://indiabudget.nic.in>). The country's agricultural growth has stagnated when other sectors of the economy have grown.

India's contribution to the GDP through agricultural sector is declining, though our country has achieved self-sufficiency in food grain production and still growth rate of food grain production lag behind that of population growth rate. Growing demand for food has brought the need for building efficiencies in agricultural sectors. In order to achieved such food demand it is imperative to focus on improving the intensity of farm mechanization in our country. Manipur is essentially an agricultural state and agriculture is the mainstay of the state's economy with about 76 % of the working population in the state directly or indirectly depending on agriculture for employment and livelihood. About 22% of the populations are engaged in agriculture. The size of the cultivated area is, however, only 7.24% of the total geographical area of the state and of this total cultivated area, 56.88% is confined to the valley. The average percent of female cultivator /farm labourer to male cultivator /farm labourer in Manipur is 44.43% (Anonymous, 2014). The state produces sizeable quantity of paddy, wheat, maize, pulses, oilseeds such as mustard, groundnut, soybeans, sunflower, ginger, turmeric and fruits like pineapple, lime/lemon,

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banana, orange, papaya, plum and vegetables like, cauliflower, cabbage, tomato, peas, carrot, pumpkin. Growing demand for food has brought the need for building efficiencies in agricultural sectors. In order to achieved such food demand it is imperative to focus on improving the intensity of farm mechanization in the state.

2. Materials and Methods

Study area

Manipur state was chosen for study area. Manipur is one of the smallest states of northeast India (Fig.1). The state capital of Manipur is Imphal. The state lies at a latitude of 23°83'N – 25°68'N and a longitude of 93°03'E – 94°78'E and having geographical area of 22,347 km². To the north of Manipur lies Nagaland, to the west is Assam, to the south lies Mizoram, and to the east it has the long international boundary with Myanmar. Out of the total geographical area of about nine-tenths constitute the hills which surround the remaining one-tenth valley. The valley comprises of four districts having about 2,000 km² area of oval-shaped located in central part of the state surrounded by several mountain ranges. The Barak River, the largest river in Manipur, originates from Manipur hills. Manipur has four major river basins namely; the Barak River Basin to the west, the Manipur River Basin in central Manipur, the Yu River Basin in the east, and a portion of the Lanye River Basin in the north. The state is blessed with lush green beauty and is surrounded by blue hills with an oval shaped valley. Manipur enjoys moderate climatic condition.

Manipur contributes about 0.7236 Mham (million hectare metre) of water resources to country's total water budget of 400 Mham.

Equipment used for farm mechanization

Some of improved farm tools and equipments were used in this study to compare with traditional farming system of Manipur. The improved tools and equipments were used as a part of on farm trial (OFT) and front line demonstration (FLD) under activities of Krishi Vigyan Kendra, Imphal West, Manipur. Paddy drum seeder was used for sowing of pre-germinated paddy seeds directly on puddle fields. The cono weeder was used for removing weeds between rows of paddy crop. Cono weeder can smoothly in the paddy fields and it is easy to operate. Peddle operated thresher was used for threshing of paddy in the study area (Pandey *et al.*, 2006).

Rice cultivation area of Manipur and cost of cultivation of rice

Rice is the main and staple crop of Manipur. District-wise wet rice cultivation (WRC) area were collected from Statistical Year Book Manipur (2013). Data for the entire nine districts were collected. The available data were from 2004-05 to 2010-11. Largest area under wet rice cultivation in Manipur was found to be in the year 2004-05 with area of 130970 ha. Average area cover under wet rice cultivation was estimated at 127407 ha from the year 2004-05 to 2010-11. Cost of cultivation of rice in Imphal West district of Manipur was obtained from Krishi Vigyan Kendra, Imphal West, Manipur. The details of district-wise rice cultivation in Manipur is given in Table 1.

Table1. District-wise wet rice cultivation area of Manipur during 2004-05 to 2010-11

District	Year-wise wet rice cultivation area (ha)						
	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11
Hill Districts							
Senapati	24110	29810	25200	20810	23600	16720	15000
Tamenglong	460	3640	2730	--	190	--	--
Churachandpur	3500	1580	--	--	160	1190	2110
Chandel	1600	2040	3850	3410	3080	3150	3550
Ukhrul	1110		13400	9960	7740	6890	11940
Hills Total	30780	37070	45180	34180	34770	27950	32600
Valley Districts							
Imphal East	29570	25750	24290	26710	26440	26600	25110
Imphal West	23130	19170	18890	22540	22580	22870	22910
Bishnupur	21740	16030	15210	17200	17080	18430	19130
Thoubal	25750	22640	27150	27330	27580	28640	28850
Valley Total	100190	83590	85540	93780	93680	96540	96000
Totals	130970	120660	130720	127960	128450	124490	128600

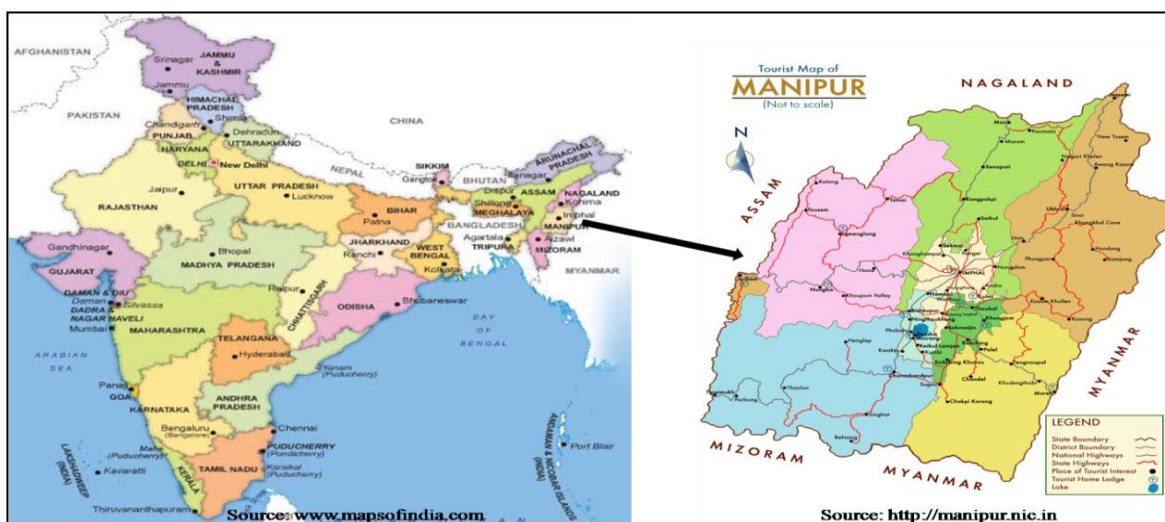


Figure 1. Study area location

Depreciation methods

Straight line depreciation method was adopted for calculation depreciation cost of the farm implements (<http://www.ffc.agnet.org/>). It is a simple and effective method to estimate to depreciation cost of farm implements.

3. Results and Discussions

Cost of cultivation of rice in traditional farming system

The cost of cultivation of rice for one hectare area was estimated at Rs. 62630.00 under the traditional farming

system in Manipur. The cost for raising of nursery was calculated at Rs. 4450.00 per hectare and the total cost of cultivation excluding nursery raising of one hectare area of paddy was estimated at Rs. 58180.00. Various agricultural operations like land preparation, nursery raising, uprooting, transplanting, weeding, threshing and winnowing were involved in the paddy cultivation. Details of various cost involved in agricultural activities in paddy cultivation of one hectare area under traditional farming system is given in Table 2.

Cost of operation for farm implements

Depreciation cost is an invisible cost which farmers often neglect. It is, however, a important expense item in

Table 2. Cost of cultivation of rice for one hectare area under traditional farming system

Sl. No.	Particulars	Man-days	Rate (Rs.)	Amount (Rs.)
Nursery				
1.	Land preparation			800.00
2.	Seed cost (60 kg)		25.00	1500.00
3.	Fertilizer			400.00
4.	Sowing	2	250.00Man-days (Male Labour)	500.00
5.	Miscellaneous (irrigation and plant protection)	5	250.00Man-days (Male Labour)	1250.00
			Sub-total	4450.00
Cultivation				
6.	Land preparation			6000.00
7.	Fertilizer			6330.00
8.	Uprooting	6	250.00Man-days (Male Labour)	1500.00
9.	Transplanting	40	230.00Man-days (Female Labour)	9200.00
10.	Weeding (for hand weeding)	40	230.00Man-days (Female Labour)	9200.00
11.	Plant protection chemicals			2000.00
12.	Plant protection	3	250.00Man-days (Male Labour)	750.00
13.	Reaping	40	230.00Man-days (Female Labour)	9200.00
14.	Threshing and winnowing	56	250.00Man-days (Male Labour)	14000.00
	Sub-total	192		58180.00
	Total			62630.00

assessing the farming performance. The life spans of the implements were taken five years. The maintenance cost and interest on investment of implements were also considered for calculation of cost of operation for farm implements. The total annual cost of operation of implement for paddy drum seeder, cono weeder and peddle operated paddy thresher were calculated as Rs. 1600.00, Rs. 800.00 and Rs. 2800 respectively. The detailed costs involved in calculation for operation of farm implements are given in Table 3.

Different scenarios using improved implements in traditional farming system

Three different improved tools and equipments namely paddy drum seeder, cono weeder and paddy threshers were used in various agricultural operations to compared with

traditional farming system and improved mechanised farming system. Most of tools and equipments used in this study were women friendly. The study was carried out on five different scenarios.

Using paddy drum seeder in traditional farming system (Scenario 1)

In the first scenario traditional farming system was improved by using paddy drum seeder. It helps in reducing various operations like nursery raising, uprooting and transplanting. By reducing such activities cost of cultivation in traditional farming can be reduced by 18.57% and labour requirement was reduced by 25.52%. Detail cost of cultivation using paddy drum seeder is given in Table 4.

Table 3. Annual cost of operation for farm implements

Sl. No.	Name of implements	Cost of implement (Rs.)	Life span of implement	Depreciation cost of implement (Rs.)	10% maintenance cost (Rs.)	12% interest on investment (Rs.)	Total annual cost of operation of implement (Rs.)
1.	Paddy Drum Seeder	4000.00	5	720.00	400.00	480.00	1600.00
2.	Cono Weeder	2000.00	5	360.00	200.00	240.00	800.00
3.	Peddle Operated Paddy Thresher	7000.00	5	1260.00	700.00	840.00	2800.00

Table 4. Cost of cultivation of paddy for one hectare area by improving using paddy drum seeder in traditional farming system

Sl. No.	Particulars	Rate (Rs.)	Man-days requirement under traditional farming	Total expenditure after using paddy drum seeder in traditional farming system (Rs.)
1.	Seed cost	25.00		1000.00
2.	Land preparation			6000.00
3.	Fertilizer			6330.00
4.	Transplanting /Seeding	230.00Man-days (Female Labour)	4	920.00
5.	Paddy drum seeder annual operation cost			1600.00
6.	Weeding	230.00Man-days (Female Labour)	40	9200.00
7.	Plant protection chemicals			2000.00
8.	Plant protection	250.00Man-days (Male Labour)	3	750.00
9.	Reaping	230.00Man-days (Female Labour)	40	9200.00
10.	Threshing and winnowing	250.00Man-days (Male Labour)	56	14000.00
		Total	143	51000.00

Using cono weeder in traditional farming system (Scenario 2)

In the second scenario traditional farming system was improved by using cono weeder. Using cono weeder it can replaced manual weeding and it also save time in weeding. Traditional farming system using cono weeder can save 10.47% of total cost of cultivation and labour requirement could be reduced by 16.67%. Detail cost of cultivation using cono weeder is given in Table 5.

Using peddle operated paddy thresher in traditional farming system (Scenario 3)

In the third scenario traditional farming system was improved by using peddle operated paddy thresher. Peddle operated paddy thresher could reduced 5.11% cost of cultivation of rice in traditional farming by replacing the manual threshing and could reduced labour requirement by 12.50%. Detail cost of cultivation using peddle operated paddy thresher is given in Table 6.

Table 5. Cost of cultivation of paddy for one hectare area by improving using cono weeder in traditional farming system

Sl. No.	Particulars	Rate (Rs.)	Man-days requirement under traditional farming	Total expenditure after using cono weeder in traditional farming system (Rs.)
Nursery				
1.	Land preparation			800.00
2.	Seed cost	25.00		1500.00
3.	Fertilizer			400.00
4.	Sowing	250.00Man-days (Male Labour)	2	500.00
5.	Miscellaneous (irrigation and plant protection)	250.00Man-days (Male Labour)	5	1250.00
Cultivation				
6.	Land preparation			6000.00
7.	Fertilizer			6330.00
8.	Uprooting	250.00Man-days (Male Labour)	6	1500.00
9.	Transplanting /Seeding	230.00Man-days (Female Labour)	40	9200.00
10.	Weeding	230.00Man-days (Female Labour)	8	1840.00
11.	Cono weeder annual operation cost			800.00
12.	Plant protection chemicals			2000.00
13.	Plant protection	250.00Man-days (Male Labour)	3	750.00
14.	Reaping	230.00Man-days (Female Labour)	40	9200.00
15.	Threshing and winnowing	250.00Man-days (Male Labour)	56	14000.00
		Total	160	56070.00

Table 6. Cost of cultivation of paddy for one hectare area by improving using peddle operated paddy thresher in traditional farming system

Sl. No.	Particulars	Rate (Rs.)	Man-days requirement under traditional farming	Total expenditure after using peddle paddy thresher in traditional farming system (Rs.)
Nursery				
1.	Land preparation			800.00
2.	Seed cost	25.00		1500.00
3.	Fertilizer			400.00
4.	Sowing	250.00Man-days (Male Labour)	2	500.00
5.	Miscellaneous (irrigation and plant protection)	250.00Man-days (Male Labour)	5	1250.00
Cultivation				
6.	Land preparation			6000.00
7.	Fertilizer			6330.00
8.	Uprooting	250.00Man-days (Male Labour)	6	1500.00
9.	Transplanting /Seeding	230.00Man-days (Female Labour)	40	9200.00
10.	Weeding	230.00Man-days (Female Labour)	40	9200.00
11.	Plant protection chemicals			2000.00
12.	Plant protection	250.00Man-days (Male Labour)	3	750.00
13.	Reaping	230.00Man-days (Female Labour)	40	9200.00
14.	Threshing and winnowing	250.00Man-days (Male Labour)	32	8000.00
15.	Peddle operated paddy thresher annual operation cost			2800.00
		Total	168	59430.00

Using paddy drum seeder and cono weeder in traditional farming system (Scenario 4)

In the forth scenario traditional farming system was improved by using paddy drum seeder and cono-weeder. By using both paddy drum seeder and cono-weeder in traditional farming system could reduced 27.45% cost of cultivation of rice and labour requirement was reduced by 35.42%. Detail cost of cultivation using paddy drum seeder and cono weeder in traditional farming system is given in Table 7.

Comparing between improved mechanised farming system and traditional farming system (Scenario 5)

Details comparison of traditional and improved mechanised farming of different agricultural activities are given in Table 8 and Figure 2. The seed requirement in traditional farming was 50% more than improved mechanised farming system by using paddy drum seeder, where about Rs. 500.00 per hectare could be saved in seed material. The sowing cost in case of traditional farming for nursery raising was Rs. 500.00 where as in improved mechanised farming system nursery raising activity does not involved.

Table 7. Cost of cultivation of paddy for one hectare area by improving using paddy seeder and cono weeder in traditional farming system

Sl. No.	Particulars	Rate (Rs.)	Man-days requirement under traditional farming	Total expenditure after using paddy seeder and cono weeder in traditional farming system (Rs.)
Nursery				
1.	Land preparation			Nil
2.	Seed cost	25.00		1000.00
3.	Fertilizer			Nil
4.	Sowing	250.00Man-days (Male Labour)	2	Nil
5.	Miscellaneous (irrigation and plant protection)	250.00Man-days (Male Labour)	5	Nil
		Sub-total		1000.00
Cultivation				
6.	Land preparation			6000.00
7.	Fertilizer			6330.00
8.	Uprooting	250.00Man-days (Male Labour)	6	Nil
9.	Transplanting /Seeding	230.00Man-days (Female Labour)	4	920.00
10.	Paddy drum seeder annual operation cost			1600.00
11.	Weeding	230.00Man-days (Female Labour)	8	1840.00
12.	Cono weeder annual operation cost			800.00
13.	Plant protection chemicals			2000.00
14.	Plant protection	250.00Man-days (Male Labour)	3	750.00
15.	Reaping	230.00Man-days (Female Labour)	40	9200.00
16.	Threshing and winnowing	250.00Man-days (Male Labour)	56	14000.00
		Total	124	45440.00

The amount spend on land preparation in traditional farming cost Rs. 800 per hectare more than improved mechanised farming system and in case of fertigation, traditional farming cost Rs. 400.00 per hectare more than the improved mechanised farming. Uprooting of seedling cost Rs. 1500.00 per hectare in traditional farming whereas the activity in improved mechanised farming does not involve. Transplantation cost in traditional farming was estimated as Rs. 9200.00 per hectare, but the activity of transplantation is replaced by seeding using paddy drum seeder in case of improved mechanised farming with only cost of Rs. 920.00 per hectare. Weeding cost in traditional farming was calculated at Rs. 9200.00 per hectare using 40 man-days whereas only 8 man-days per hectare was required for weeding in improved mechanised farming

system spending only Rs. 1840.00 per hectare. In traditional farming system plant protection measures cost Rs 1250.00 per hectare more than improved mechanised farming. The most laboured intensive in all agricultural activities of rice cultivation was found in threshing of paddy. Using pedal operated paddy thresher for threshing of paddy could save Rs. 3200.00 per hectare over the traditional farming system and which is one the major significant in mechanisation. By mechanising using improved tools and equipments namely, paddy drum seeder, cono weeder and pedal operated paddy thresher could over all save of Rs. 21390.00 per hectare comparison to the traditional farming system and labour requirement is lesser by 54.69% as compare to the traditional farming system. The amount saved by using improved mechanised farming is more than the 50% of the total cost spend in traditional farming system.

Table 8. Comparison between traditional and improved mechanised farming system using paddy seeder, cono weeder and peddle thresher for the cost cultivation of paddy for one hectare area

Sl. No.	Particulars	Rate (Rs.)	Man-days requirement under traditional farming	Total Expenditure requirement under traditional farming (Rs.)	Man-days requirement under improved mechanised farming	Expenditure requirement under improved mechanised farming (Rs.)
Nursery						
1.	Land preparation			800.00		Nil
2.	Seed cost	25.00		1500.00		1000.00
3.	Fertilizer			400.00		Nil
4.	Sowing	250.00Man-days (Male Labour)	2	500.00		Nil
5.	Miscellaneous (irrigation and plant protection)	250.00Man-days (Male Labour)	5	1250.00		Nil
Cultivation						
6.	Land preparation			6000.00		6000.00
7.	Fertilizer			6330.00		6330.00
8.	Uprooting	250.00Man-days (Male Labour)	6	1500.00		Nil
9.	Transplanting /Seeding	230.00Man-days (Female Labour)	40	9200.00	4	920.00
10.	Paddy drum seeder annual operation cost					1600.00
11.	Weeding	230.00Man-days (Female Labour)	40	9200.00	8	1840.00
12.	Cono weeder annual operation cost					800.00
13.	Plant protection chemicals			2000.00		2000.00
14.	Plant protection	250.00Man-days (Male Labour)	3	750.00	3	750.00
15.	Reaping	230.00Man-days (Female Labour)	40	9200.00	40	9200.00
16.	Threshing and winnowing	250.00Man-days (Male Labour)	56	14000.00	32	8000.00
17.	Peddle operated paddy thresher annual operation cost					2800.00
		Total	192	62630.00	87	41240.00

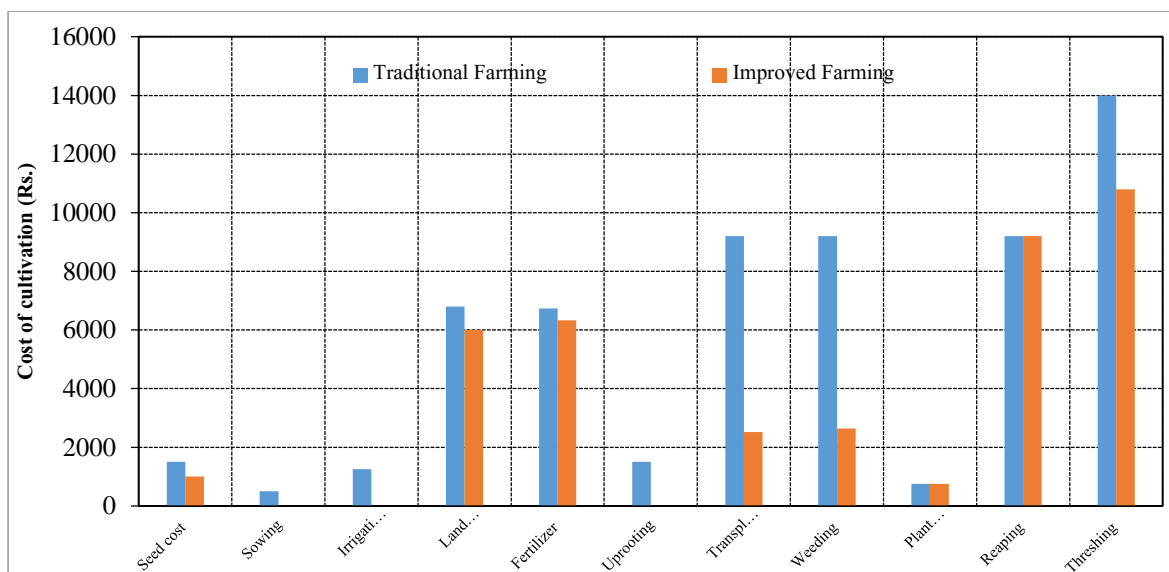


Figure 2. Comparison between traditional and improved mechanised farming in various agricultural activities in paddy cultivation

Conclusion

Rice is the staple food of Manipur and it is still deficit in production. There is deficit in respect of cereals, pulses, vegetables and all other food items as well. The shortage commodities have to come from outside the state. Sometimes the price of the food commodities rises due to the landslide and highway blockades. Manipur has rich resources in terms of adequate land and water resources. Rainfall in the state is more than sufficient. The non-agricultural area in the state can be some kind of agricultural use. But the yield of any farm produce is phenomenally low. The farmers still use very primitive farming practices. Yields and incomes have progressively decreased. Without any secondary source of income, the farmers have become poorer.

The productivity of farms depends greatly on the availability and judicious use of farm power by the farmers. Agricultural tools, implements and machines enable the farmers to employ the power judiciously for production purposes. Agricultural machines increase productivity of land and labour by meeting timeliness of farm operations and increase work out-put per unit time. Besides its paramount contribution to the multiple cropping and diversification of agriculture, mechanization also enables efficient utilization of inputs such as seeds, fertilizers and irrigation water. Agricultural development aiming at higher production would require mechanization and supply of sufficient energy is a prerequisite for mechanized agriculture. During the study agricultural activities of improved mechanised farming using paddy drum seeder

was found to be maximum benefit with amount of Rs. 10830.00 per hectare over the traditional farming followed by weeding using cono weeder which could save Rs. 6560.00 per hectare against the manual weeding in case of traditional farming. By using peddle operated paddy thresher a total amount of Rs. 3200.00 per hectare could save over the manual threshing. By using paddy drum seeder seed requirement could reduce 50% over the traditional farming system. The cost of cultivation of rice could be further reduced by mechanizing other activities involved in rice cultivation.

Overall, the study demonstrated that the improved mechanised farming with field experience based decision criteria offer a cost-effective and helpful to integrated with improved tools and equipments with traditional farming. It is recommended that the activities of agricultural mechanization of the study area be expanding in other neighboring villages or districts of the state. The future to combat growing food demand and labour problems of the state or region could solved through agricultural mechanization. Since the methodology and the analyses demonstrated in this study have generic applicability, they are also very useful for other parts of India, particularly for the north eastern states.

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