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Use of paddy drum seeder to sow pre-germinated seed as an alternative to mechanized paddy transplanter in valley area of Manipur

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Abstract
Rice is the main food of Manipur and it is still insufficiency in production. The cost of producing rice crops is increasing significantly due to higher fertilizer rates and wages due to the increased demand for work at the time of the transplant. Human labours continue to be the primary source of energy for agricultural production on small and marginal land and in both valley and hilly areas of Manipur, which indicates a very low level of mechanization. The paddy drum seeder is one of the tools with which human labour can be reduced and tools can be used successfully in the farmer's field. During the study of rice production activities, using paddy drum seeder can enhanced crop yield by 22%. In comparison, financial input can be reduced by 52% and further drudgery requirements can be reduced by 93% compared to the traditional farming system. By using paddy drum seeder, rice cultivation could be reduced significantly and makes it possible for other agricultural mechanizing activities involved in rice cultivation.

Keywords: paddy drum seeder, traditional farming system, yield, man-days

1. Introduction
Rice (*Oryza Sativa*) is the main food crop grown in valley areas of Manipur covering six districts with an area of 128600 ha (Anonymous, 2013) [3]. Rice is better suited to regions with high rainfall because it needs plenty of moisture through rain or irrigation to keep the soil saturated. The cost of producing rice crops is increasing significantly due to higher fertilizer rates and wages due to the increased demand for work at the time of the transplant. Climate change, uncertainty water availability and the lack of water storage structures lead to very irregular and premature seasonal monsoon conditions. Under such circumstances, seedling gets age and transplantation is delayed, limiting the farmer's net income and increasing harvest time. The raising of nursery, transplantation, weed control and harvesting are the most substantial part of the labour requirement in rice cultivation. Therefore, the mechanization of these processes should be emphasized to reduce labour needs in rice cultivation.
Human labours continue to be the main source of energy for agricultural production on small and marginal land and in hilly areas in Manipur, which indicates a deficient level of mechanization. Human energy is mainly used in agriculture for from seedling raising, weeding, harvesting and cleaning. In order to improve the efficiency of human work, simple, adequate and efficient machines or tools must be available to increase agricultural production in Manipur. Transplanting rice seedlings, a very tedious and pricey process, can be restored by direct sowing, which can lessen the workload by more than 30%. The paddy drum seeder is one of the tools with which human labour can be reduced and tools can be used successfully in the farmer's field. Transplantation through human energy necessitates approximately 25% of the total labour involved in rice production (Singh *et al*. 1983) [4]. The paddy transplant usually requires about 40 man-days/ha (Singh and Devi, 2016) [5]. The human hassle and drudgery implicated in transplanting action are also incredibly high. Paddy drum seeder can enhance rice production by 5-10% (Alam *et al*., 2006; Alam *et al*., 2007) [1, 2]. The paddy drum seeder has a high scope to be established by the farmers due to its lesser energy consumption, low cost, effortless to operate, and improved rice production.

2. Material and Methods
2.1 Study area
Valley areas of Manipur state were chosen for this study. The state having geographical area of 22,347 km² and lies at latitude of 23º 83′ N - 25º 68′ N and a longitude of 93º 03′ E - 94º 78′ E and. Manipur is one of the smallest states of India, located in the northeastern part of the country (Fig.1). Imphal is the capital of Manipur in the hub portion of the state enclosed by several hill ranges. The state is border flanked by Mizoram in the south, Nagaland in the north, Assam in the west, and has an international boundary with Myanmar in the east as well as in the south. The state has ten hill districts, and the valley area encompasses six districts with about 2,000 km^2 area of oval-shaped located in the innermost part of the state.

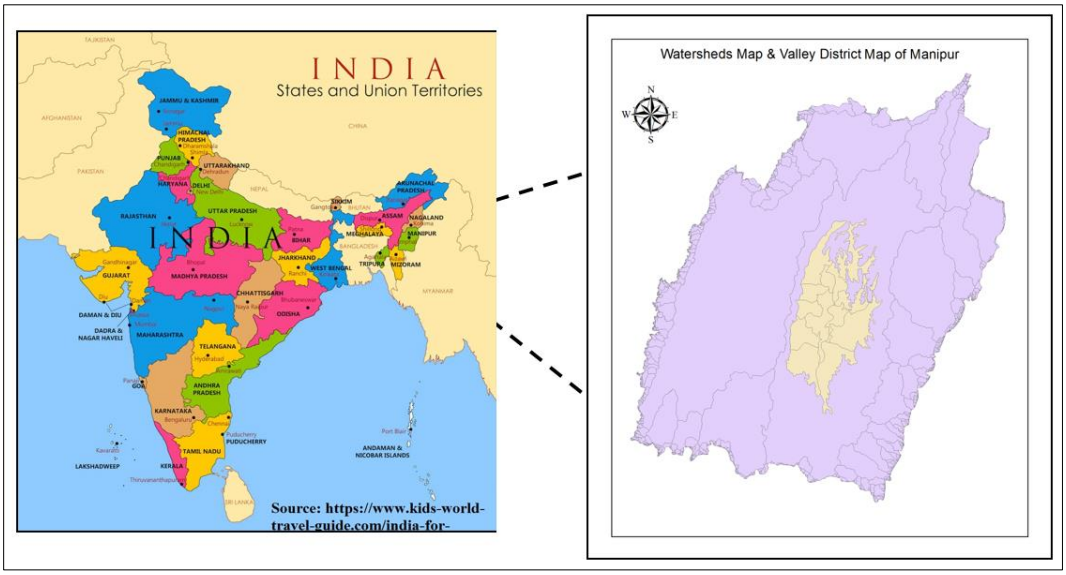

Fig 1: Study area map

2.2 Paddy drum seeder

The paddy drum seeder is used for sowing sprouted rice seeds directly in the wetland. A transplant is not necessary. It is a manually pulled device. It consists of 8 lines with a distance of 20 cm between the lines. It is made of plastic. The seeder consists of a seed drum, the main shaft, a plastic wheel, and a crank. By uniting the smaller ends of the stem, the seed falls off the drum. "The seed drum is hyperboloid shaped with 200 mm diameter. There are 4/8 numbers of seeding metering holes of 9 mm diameter. Baffles are provided inside the seed drum between the seed holes to ensure the uniform seed rate in operation and to ensure the hill dropping of the seeds. Each seed drum has two rows of planting, and four drums are assembled to form eight rows of planting at a single stretch. One square shaft, handle base and handle and four seed drums are assembled with the square shaft. The handle is meant to pull along" (https://www.ksnmdrip.com/direct-paddy-seeder). Wheels of two feet diameter are provided at both ends. These wheels are made up of plastic material to provide floating features. The direct seeding of paddy at Sangaithel Village and Heigrujam Village of Imphal West district, Manipur, are given in Fig. 2(a) and Fig. 2(b).

Fig 2(a): Direct seeding of paddy at Sangaithel Village, Imphal West district, Manipur on 4th July, 2016

Fig 2(b): Direct seeding of paddy at Heigrujam Village, Imphal West district, Manipur on 5th July, 2016

2.3 Preparation of pre-germination seed

Paddy seeds were soaked in the salted water, and after one hour, the floated seed on the water was removed. The selected seeds were put into gunny bags and soaked in the water for 24 hours, followed by drained out of the water from the seed gunny bag for another 24 hours. The period during the drained of water from the gunny bag let to incubate of paddy seed, which provides the sprout of the seed. The optimum length of the sprout of the seed maintains at 1-2 mm. Otherwise, the more considerable sprout lengths prevent the free flow of seeds through the drums' holes.

2.4 Economic evaluation of paddy drum seeder

The economic estimation of paddy drum seeder was compared with tradition practiced. Different levels of benefits were compared in terms of labour requirement, production and drudgery reduction.

2.5 Depreciation methods

The depreciation value of the farm implement (Paddy Drum Seeder) was calculated using straight-line depreciation method (http://www.fao.org/3/t0579e/t0579e05.htm). It is a simple and efficient technique to assess to depreciation value of farm implements.

3. Results and Discussions

3.1 Cost of paddy seedling preparation and transplantation in the traditional farming system

The cost of paddy seedling preparation and transplantation for the one-hectare area under the traditional farming system in Manipur is evaluated at Rs. 28470.00 and details are given in Table 1. The land preparation for paddy nursery is calculated at Rs. 800.00, while seed sowing, fertilizer, and chemicals are estimated at Rs. 350.00 and Rs, 400.00, respectively. Besides, irrigation and plant protection, seedling removal and transplanting, and land preparation for paddy seedling transplants are also evaluated at Rs. 1400.00, 14000.00, and 9600.00, respectively.

3.2 Cost of planting paddy seed using paddy drum seeder

The cost of planting paddy seed using paddy drum seeder for the one-hectare area in Manipur is calculated at Rs. 13180.00, and details are provided in Table 2. The cost of paddy drum seeder is estimated for one year at Rs. 960.00. Further, seed planting using paddy drum seeder and land preparation for paddy seed planting are also evaluated at Rs. 700.00 and Rs. 9600.00 respectively.

Table 1: Cost of paddy seedling preparation and transplantation for one-hectare area under traditional farming system

Sl. No.	Particulars	Requirements	Unit Cost (Rs.)	Total expenditure (Rs.)
1.	Seed	40 kg	48.00	1920.00
2.	Land preparation for nursery	1 hour	800.00	800.00
3.	Seed sowing	1 man-day	350.00	350.00
4.	Fertilizer and chemicals	20 kg	20.00	400.00
5.	Irrigation and plant protection	4 man-days	350.00	1400.00
6.	Seedling removal and Transplanting	40 man-days	350.00	14000.00
7.	Land preparation for paddy seedling transplant	12 hours	800.00	9600.00
			Total	28470.00

Table 2: Cost of planting paddy seed using paddy drum seeder for one-hectare area

Sl. No.	Particulars	Requirements	Unit Cost (Rs.)	Total expenditure (Rs.)
1.	Seed	40 kg	48.00	1920.00
2.	Cost of paddy drum seeder	1 year	960.00	960.00
3.	Preparation of Pre-germination Seed	1 man-day	350.00	350.00
4.	Seed planting using paddy drum seeder	2 man-days	350.00	700.00
5.	Land preparation for paddy seed planting	12 hours	800.00	9600.00
			Total	13530.00

3.3 Comparison study of both paddy drum seeder and traditional system

Comparison of cost of paddy plantation, yield and man-days required in paddy drum seeder and traditional agriculture system is presented in Fig.3. By using paddy drum seeder cost of cultivation can be decreased by 52%, while the yield of production can be increased by 22% and man-days can be reduced by 93% as compared to the traditional agricultural practices.

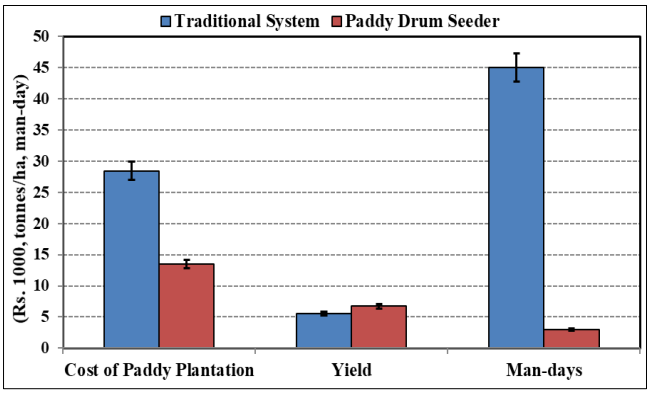

Fig 3: Comparison of cost paddy plantation, yield and man-days required in paddy drum seeder and traditional system

4. Conclusions

Rice is the main food of Manipur and it is still insufficiency in production. The deficient amount of rice has to come from outside the state. Manipur has rich resources of water and rainfall in the state is more than adequate. The production of farms depends significantly on the accessibility and cautious use of farm power by the farmers. Farm implements and tools facilitate the farmers to utilize the power judiciously for production reasons. Agricultural implements augment the efficiency of land and labour by gathering appropriateness of agricultural operations and amplify work productivity per unit time. Besides its dominant input to the numerous cropping and diversification of crops, mechanization also allows resourceful consumption of inputs such as seeds, fertilizers and irrigation water. Rice cultivation planning at higher production would necessitate mechanization and provide of adequate energy is a precondition for mechanized agriculture. During the study of rice production activities, using paddy drum seeder can enhanced crop yield by 22%. In comparison, financial input can be reduced by 52%, and drudgery requirement can be reduced by 93% as compared to the traditional farm system. By using paddy drum seeder, the cost of cultivation of rice could be reduced significantly and makes it possible for other activities of agricultural mechanizing involved in rice cultivation.

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