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Adoption of Farm Mechanization in Rice Cultivation in Villupuram District

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Authors' contributions

The work was carried out collaboration among all authors. Author MD carried out the collection of data, performed statistical analysis and wrote the first draft of the manuscript. Author TD guided read and made corrections of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Rice is a predominant food crop that was extensively cultivated and consumed in India. Recently, small and fragmented land holdings and labour scarcity during the peak season are driving farmers toward farm mechanization. Villupuram is one of the prominent districts with the maximum area under rice cultivation. The study was conducted to examine the adoption level of various recommended implements and machinery by rice farmers in the Villupuram district. Of the 13 blocks of Villupuram district three blocks were selected for this study. A total of 120 farmers were selected for the study using a proportionate random sampling method. This study was conducted during April and May 2022. Ex-post facto research design was used for the study. Data were collected using a well-structured and pre-tested interview schedule. The findings of the study revealed that most respondents had a medium level of adoption of farm implements and machinery in rice cultivation. Most respondents adopted a combined harvester, tractor, power tiller, rotavator and power sprayer. None of the respondents adopted bund maker, seed cum fertilizer drill, rice cum Daincha seeder,

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rotary weeder, power weeder, drone operated sprayer, reaper and thresher. Custom hiring facilities are required to rent the equipment on a payment basis and awareness should be made on specific equipment like, seed cum fertilizer drill, power weeder, Conoweeder and rotary weeder.

Keywords: Farm mechanization; rice cultivation and adoption.

1. INTRODUCTION

Rice is a primary food crop for more than half of the world's population. In the world scenario, rice is the third leading crop that is widely cultivated preceded by wheat and maize. Rice is widely consumed in many regions of the world, including Southern and Eastern Asia. According to annual report 2021-22 released by Department of Agriculture and Farmer Welfare, In India, the rice cultivated area during 2020-21 was 45.1 million hectares and total rice production was 112.4 million tonnes. Rice is the predominant crop in Tamil Nadu, which is widely grown in all the districts with an area of 18.50 lakhs ha as well as an average production of 70.72 lakh MT per year. In Tamil Nadu, the Villupuram district is ranked as one the most important rice cultivating districts preceded by the Cauveri Delta and Thamirabarani command area, because of the Thenpennai river in its vicinity. Nevertheless, High labour costs, a labour scarcity, a lack of suitable farming equipment, unfavourable socioeconomic conditions, poor crop management with other sources of income and a very low market price for rice are some of the factors ascribed to the decrease of rice cultivation. The cost of cultivation is significantly rising as a result of rising labour costs and higher hiring charges [1]. At the same time, non-availability of water, climate change and low prices for the produce affect rice cultivation, forced to migration of farmers and agricultural labours to their nearby cities for employment opportunities [2]. Besides, the landless labours and marginal farmers switch over to Rural Employment Guarantee Scheme considering the daily wage to be a better source of income. This situation leads to a labour shortage and high cost of labour during peak season. Farm mechanization is the ideal alternative to this nuisance. The term "Farm mechanization" refers to the use of suitable tools, implements and machinery in agricultural activities with the aim of improving the productivity of farm labour and land. The tools, implements and machinery may need either human, animal, mechanical or electrical power, or a combination of these as the source of power. Farm mechanization is the process of transferring energy in the farm production system using engines and motorized equipment. It simplifies and eliminates labour intensive tasks, compensates for labour shortage and improve productivity. The key operations in which farm mechanization is involved are land preparation, planting, plant protection, and harvesting. Adoption of farm implements and mechanization can ensure farm operation in time, reduce wastage and deal with the labour shortage. Tractors are used on 22.78 per cent of the total area, power tillers on 72.22 per cent and bullocks on 2.00 per cent. The term "Adoption" refers to decision to make full use of an innovation as the best course of action available. Adoption level of the respondents about farm mechanization was divided into fully adopted, partially adopted and never adopted category to produce insightful results [3]. Hence, this study attempts to analyze the adoption of farm mechanization by rice growers [4] revealed that 67.50 per cent of the farmers had a medium level of adoption, 22.5 per cent of the farmer had a low level of adoption and the remaining 10 per cent of the farmers belong to high level of adoption. Likewise, Teja et al. [1] concluded that 44 farmers (36.67 %) had a medium level of adoption, 40 farmers (33.34 %) fell under the low adoption group and 36 farmers (30.00 %) belongs to the high adoption category. According to Shoba et al. [5] nearly half of the respondents (45.33 %) had a medium level of adoption followed by a low level of adoption (38.00 %) and the remaining had high adoption (28.00 %) of tractor drawn implements. Machinery cost, Fuel cost, availability of credit facilities, Size and location of land holdings, availability of hiring agencies, hiring charge, labour's skill to operate machinery and level of training on use of farm machinery, implements and tools are some of the factors affecting the adoption level of farm mechanization in rice cultivation.

2. METHODOLOGY

Villupuram district was chosen for this study since it is one of the districts with the large proportion of rice area under cultivation. Three blocks namely Koliyanur, Kanai and Tiruvennainallur, were sorted out from a total of

13 blocks based on the largest area of rice cultivation. In each block, two revenue villages with the most rice area were selected. The respondents were selected as four per cent from the total rice farmers from each village by using Proportionate Random Sampling method [6]. The list of rice cultivating farmers is obtained from State Department of Agriculture and it was used for selecting the respondents. Based on number of rice farmers, 33, 44, and 43 respondents were selected from Thiruvennai Nallur, Kanai and Koliyanur blocks respectively to obtain a total of 120 farmers. The research design acquired for this study was non-experimental *Ex-post-facto* technique, since the phenomenon has already started and is continuing. Ex-post-facto research is the most systematic empirical investigation in which the researcher has no direct control over independent variables because they have already manifested themselves or because they are intrinsic and unmanipulatable [7]. A well-structured and pre-tested interview schedule was employed to collect the primary data. Descriptive statistics, cumulative frequency method, correlation analysis and regression analysis were used to analyze the data.

3. RESULTS AND DISCUSSION

Adoption level of recommended farm machinery in rice cultivation, both overall adoption and machinery-specific adoption are explored.

3.1 Overall Adoption of Rice Machinery

Table 1 disclosed that more than half of the respondents (54.17 %) had a medium level of overall adoption followed by a low (24.17 %) and high (21.66 %) level of overall adoption of farm implements and machinery in rice cultivation.

The cause might be the high cost of machinery, high fuel cost, lack of availability of custom hiring centers and lack of awareness and knowledge about the machinery [5], Reasons could be the majority of the respondents were middle aged (54.17 %) and had medium level of education (63.33 %). Most of the respondents had fragmented marginal and small land holding (84.90 %), Raina, A. [8] found that major problems were scattered holdings, small size of fragments, small and terraced fields and non-uniform shape of fields by the respondents. More than fifty per cent of the respondents had low level of social participation (69.17 %), high information seeking behaviour (53.33 %), Farmers had a neutral attitude (51.60 %) towards farm mechanization. Hasan. [9] reported that among the farmers, 63.4 percent belonged to neutral attitude category while 23.7 per cent belonged to unfavorable and 12.9 per cent to the favorable attitude category. The other reason could be most of the respondents had moderate possession (64.17 %) of farm machinery and implements. Ravi Shankar Chand Reddy [10] depicts that 45.00 per cent of the respondents had medium level of material possession whereas, 29.17 per cent and 25.83 per cent of them had high and low material possession respectively. It could be concluded that the majority of the respondents had a medium level of adoption of farm implements and machinery in rice cultivation. The results are similar to that of Teja et al. [1]. Teja et al. [11] concluded that 44 farmers (36.67 %) had a medium level of adoption, 40 farmers (33.34 %) fell under the low adoption group and 36 farmers (30.00 %) belongs to the high adoption category.

It is clear from the findings that the positive and significant relationship of the personal characteristics like Age, Information seeking behaviour, social participation, training undergone and attitude towards farm mechanization might have influenced the adoption level of the farmers.

3.2 Machinery wise Adoption Level of Farm Mechanization in Rice Cultivation

To conduct a thorough investigation and produce insightful results, the adoption level of each recommended machinery and implement were also investigated**.** The recommended farm implements and machinery in rice cultivation were explored under six dimensions viz., field preparation, sowing and transplanting, weeding, plant protection, harvesting and post-harvest.

3.2.1 Adoption level of farm mechanization in field preparation

It was concluded from Table 2 that more than 60 per cent of the respondents fully adopted a power tiller (68.33 %), tractor (67.00 %) and tractor operated rotavator (67.50 %) followed by a tractor drawn leveller (55.83 %). Tractor drawn cage wheel and bullock drawn leveller were fully adopted by 46.67 per cent and 41.67 per cent respectively. Only 8.33 per cent and 5.83 per cent of the respondents fully adopted mould board plough and disc plough respectively. Bund maker was not adopted by any of the respondents area.

Table 1. Distribution of respondents based on overall adoption of rice farm machinery and implements

(n=120)

S. No.	Category	Number	Per cent
1.	Low	29	24.17
2.	Medium	65	54.17
3.	High	26	21.66
Total		120	100.00

Table 2. Distribution of respondents based on Adoption of farm machineries in field preparation

(n=120)

S. No.	Item	Fully Adopted		Partially adopted		Not adopted	
		Number	Per cent	Number	Per cent	Number	Per cent
1.	Tractor	81	67.50	24	20.00	15	12.33
2.	Power tiller	82	68.33	22	18.33	16	13.33
3.	Mould board plough	10	8.33	14	11.67	96	80.00
4.	Tractor drawn Disc plough	7	5.83	18	15.00	95	79.17
5.	Tractor drawn Cage wheel	56	46.67	5	4.17	59	49.17
6.	Tractor operated Rotavator	81	67.50	24	20.00	15	12.33
7.	Bullock drawn leveller	50	41.67	4	3.33	66	55.00
8.	Tractor drawn leveller	67	55.83	1	0.83	52	43.33
9.	Bund maker	00	00	00	00	120	100.00

The reason for the above result may be that while disc plough and mould board plough could only be used for deep ploughing operations and not for ploughing, tractor operated rotavator and power tiller might be utilized for both shallow ploughing (stagnate water and is more desirable for rice cultivation) and puddling. The findings were comparable with that of Kavinya et al. [6].

3.2.2 Adoption level of farm mechanization in sowing and transplanting

Table 3 showed that one-fourth of the respondents (25.00 %) fully adopted rice drum seeder followed by rice transplanter (23.33 %). None of the respondents adopted seed cum fertilizer drill and rice cum Daincha seeder. This might be due to medium availability of labour for transplanting operation in the study area and also there was less availability of rice transplanters in nearby hiring centres of the study area. None of the respondents adopted seed cum fertilizer drill and rice cum Daincha seeder for sowing operation. Most of the cultivators are poor, unable to afford expensive machinery [12].

3.2.3 Adoption level of weeding implements

Only 7.50 per cent of the respondents adopted Conoweeder. Cent per cent (100 %) of the respondents adopted neither rotary weeder nor power weeder. Possible causes include lack of awareness, and rapid effects of herbicide application.

3.2.4 Adoption level of plant protection equipment

Table 5 reported that 62.50 per cent of the respondents fully adopted power sprayers followed by battery sprayers (24.17 %). Only 8.33 per cent of the respondents fully adopted a knapsack sprayer. None of the respondents adopted drone operated sprayer. The reason might be that availability of power sprayers in the farming community is high at the same time it had high pressure, low drudgery and more area coverage than other sprayers. Low capacity and high cost do not encourage farmers' adoption behaviour towards battery sprayers. Kavinya et al. [6]

Table 3. Distribution of respondents based on Adoption of implements and machinery in sowing and transplanting

(n=120)

S. No.	Item	Fully Adopted		Partially adopted		Not adopted	
		Number	Per cent	Number	Per cent	Number	Per cent
1.	drum seeder	30	25.00	00	00	90	75.00
2.	Rice transplanter	28	23.33	00	00	92	76.67
3.	Seed cum fertilizer drill for paddy	00	00	00	00	120	100.00
4.	Rice cum Daincha seeder	00	00	00	00	120	100.00

Table 4. Distribution of respondents based on Adoption of Weeding implements

(n=120)

S. No.	Item	Fully Adopted		Partially adopted		Not adopted	
		Number	Per cent	Number	Per cent	Number	Per cent
1.	Conoweeder	9	7.50	00	00	111	92.50
2.	Rotary weeder	00	00	00	00	120	100.00
3.	Power weeder	00	00	00	00	120	100.00

Table 5. Distribution of respondents based on Adoption of plant protection equipment

(n=120)

S. No	Item	Fully Adopted		Partially adopted		Not adopted	
		Number	Per cent	Number	Per cent	Number	Per cent
1.	Knapsack sprayer	10	8.33	3	2.50	107	89.17
2.	Battery operated sprayer	29	24.17	54	45.00	37	30.83
3.	Power sprayer	75	62.50	31	25.83	14	11.67
4.	Drone operated sprayer	00	00	00	00	120	100.00

Table 6. Distribution of respondents based on Adoption of harvesting equipment

(n=120)

S. No	Item	Fully Adopted		Partially adopted		Not adopted	
		Number	Per cent	Number	Per cent	Number	Per cent
1.	Combined harvester	120	100.00	00	00	00	00
2.	Paddy reaper	00	00	00	00	120	100.00
3.	Paddy thresher	00	00	00	00	120	100.00

Table 7. Distribution of respondents based on Adoption of straw handling equipment

(n=120)

S. No.	Item	Fully Adopted		Partially adopted		Not adopted	
		Number	Per cent	Number	Per cent	Number	Per cent
1.	Baler	58	48.33	14	11.67	48	40.00

3.2.5 Adoption level of harvesting equipment

It could be identified that a cent per cent of respondents adopted a combined harvester. On the other hand, none of the respondents adopted paddy reaper and paddy thresher. The reason might be that combined harvester minimizes harvesting cost and time. It requires only one labour to operate and it can be used directly at the field level. Kavinya et al. [6].

3.2.6 Adoption level of straw handling equipment

It was found in Table 7 that 48.30 per cent of the respondents adopted baler. Reasons were that

Small and marginal farmers don't want to store the paddy straw for an extended period. When long-term storage and long-distance transportation are required, farmers adopt balers.

4. CONCLUSION

The study indicates, that there was a considerable disparity in the level of adoption of farm mechanization in the sampled area. The Majority of the respondents (54.17 %) had a medium level of overall adoption of farm mechanization in rice cultivation. All the respondents adopted a combined harvester. More than 50 per cent of the respondents fully adopted power tiller (68.33 %), tractor (67.67 %), rotavator (67.67 %), power sprayer (62.50 %) and tractor-drawn leveller (55.83 %). None of the respondents adopted bund maker, seed cum fertilizer drill, rice cum Daincha seeder, rotary weeder, power weeder, drone operated sprayer, reaper and thresher. This is due to less awareness and knowledge about the machinery. The findings of the study suggested that responsible institutions and government agencies should work more to hasten farmers' adoption of farm mechanization for sustainable rice production. Custom hiring facilities are required to rent the equipment on a payment basis. The size and price of some equipment, such combine harvesters and paddy transplanters, should be decreased. Frequent awareness camp should be conducted in the study area. Most farmers are longing to know about improved machinery and adoption but they need assistance. The findings of the study will assist the policy maker in determining the best course of action for the adoption of mechanization among the farmers of the Villupuram district, which will strengthen the rice production in Villupuram district as a whole.

5. RECOMMENDATION

1. Training and workshop are required to increase awareness about improved machineries
2. Decentralized custom hiring centers
3. Established service centers are needed for repair and service

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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