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Farmers' perception and adoption behavior of Agricultural machineries – An Empirical Evidence from Cauvery Delta Tamil Nadu

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ABSTRACT

The study aimed to explore the agricultural machinery usage behavior and its direct and indirect effects on the livelihood of the delta farmers in the Cauvery River region of Tamil Nadu. Four villages namely, Pullavarayan Kudikaadu, Idamelaiyur, Vaduvoor, and Saathanur from Thiruvarur district of Tamil Nadu have been selected based on land distribution and intensive agriculture. The household survey was held in all the four villages. Based on the secondary data, the villages were identified. Around 104 voluntary farm households were surveyed. The study found that, because of the Cauvery Canal and the availability of a phase current supply, most of the households relied on agriculture for their livelihood. The farm families that earn supplementary income excluding animal rearing are above 90.00 %. About 22.50 % of the farm households are collegiate, a meager proportion (5.62 %) of the farm Households leased out their land due to aging, migrated children, and to preferentially allocate more time for their non-farm jobs. The most prominent agricultural machinery used by the samples either by ownership or through rent are Combined harvester (96.92%), Tractor (96.92%), Straw Baler (90.81%) Hand Sprayer (76.53), and Rice Transplanter (70.40%). The cost savings using agricultural machinery over the traditional cultivation method as perceived by the respondents were less than 25000 rupees (48.97%), more than 25000 to 1 lakh rupees (40.81%), and more than 1 lakh rupees (10.20%). Even though agricultural machinery has proven economic benefits on the field level, farmers are yet to be convinced fully of its adoption this might be due to several insightful field-level usage and access problems.

Keywords: *Agricultural Mechanization, Accessibility, Unemployment, Skill, Farmers' Perception, labour situation*

Introduction

The recent past is a favorable time for farm mechanization in India. Farmers felt the need for advanced agricultural technology, majorly for two reasons i.e. lowering the cost of unit production and improving the productivity per unit area. Cauvery Delta Zone (CDZ) lies in the eastern part of Tamil Nadu. It is bounded by the Bay of Bengal on the east and the Palk straight on the south, the Trichy district on the west, the Perambalur, and Ariyalur districts on the northwest, the Cuddalore district on the north and Puddukkottai district on the southwest. CDZ has a total geographic land area of 14.47 lakh ha. In this zone, rice is the principal crop. In the rice-based cropping system, it is either single or double-cropped. Pulses of black gram and green gram are the next important grown in the rice fallows throughout the delta region from January onwards.

The use of mechanical power was the highest for paddy and the lowest for cotton among other crops [1]. Since, there was a significant reduction in human labor use and bullock labor use in most of the crops and on the other hand, machinery use on the increasing trend [2].) It was commonly believed that farm mechanization enhances the production and productivity of different crops due to the timeliness of operations, better quality of operations, and precision in the application of inputs [4]. Factors such as irrigation, access to institutional credit, size of land holdings, etc., were found to have a positive significant bearing on the level of farm mechanization. A study on selective mechanization in rice cultivation for energy saving and enhancing profitability and identified that carrying out timely operation and reducing the cost of cultivation is the prerequisite for enhancing the production and productivity of rice [5]. The economic impact of mechanization in Nigeria on Maize crops and concluded logistic regression model revealed that education, extension visits, and machine access were the significant determinants of the adoption of mechanization practices [6]. Hence, in this study, an attempt has been made to understand the agricultural machinery usage behavior and its direct and indirect effects on the livelihood of the localities in the Cauvery Delta region.

Methodology

Our proposed study area is the Cauvery Delta in Tamil Nadu. For the present study, the Thiruvarur districts of Tamil Nadu have been chosen for empirical analysis as our study area. It is planned to select four villages from the Thiruvarur district based on land distribution. Intensive agriculture and census surveys were held in all four villages. Thus total sample household is around 104. Data pertaining to agriculture, rural employment, rural development intervention, agricultural technological programs promoted by the Department of Agriculture, labor statistics, type of operational holdings and area of operational holdings, population details in general and gender-wise and occupational-wise were collected from various sources before the crop season starts around

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September. Based on the secondary data, the villages were identified. Primary data was collected using a structured interview schedule covering all aspects of the research and pre-tested in a non-sample village. After the pre-testing of a questionnaire, it was modified accordingly by incorporating the lapses. The primary data collection was done around October and January. This is because 70 percent of the total labor demand for paddy cultivation is created in the two seasons. The ex-post facto research design has been implemented as the study expects the perceived impacts of agricultural machinery usage among the delta farmers. Four villages namely, Pullavarayan Kudikaadu, Idamelaiyur, Vaduvoor, and Saathanur from the Thiruvarur district of Tamil Nadu have been selected based on land distribution and intensive agriculture.

Findings

As several geographical and historical reasons clumped up with the sustained reliance on paddy cultivation in the Cauvery delta region, this research added up a few reasons such as the supply of three-phase power at no cost and guaranteed water supply through the Cauvery canal glues up the farmers with the sustained paddy production. Several findings on the socio-personal and economic characteristics have been discussed below as,

Table 1 represents the data on the age of farming household heads in the study area. It is found that a little less than two-thirds of the sample household heads belong to the age group of 36 to 59. Only in a few households, the young age people emerge as the head of their household due to several adverse conditions like the early demise of their parents and living separately from their parents once after the marriage.

Table 1: Distribution of Household Heads based on Age (n = 104)

S. No.	Classification	Number	Percentage
1.	<=35	8	7.69
2.	36-59	63	60.57
3.	>60	33	31.73

Table 2 comprises information on the educational status of both the respondents and their household members as well. It indicates that almost all the villagers are fond of engaging themselves in the formal educational setup. Limelight, more than 22 percent of them went to college which is in continuously growing trend as understood from the survey. Around 16 percent of them have finished or enrolled with a higher secondary level of education.

Table 2: Distribution of Respondents based on Educational Status (n = 447)

S. No.	Classification	Number	Percentage
1.	Uneducated/Toddler	131	29.34
2.	<=5	59	13.19
3.	6 to 10	86	19.23
4.	11-12/Diploma/ITI	70	15.66
5.	Collegiate	75	16.77
6.	Post Graduation	26	5.81

Farming always stands as the gamble game with nature as the climatic vagaries affect the yield almost every year. Hence, it urges the person who is engaged in farming for their livelihood to generate alternate income generation opportunities. From Table 3 we can say that almost all the respondent households involve themselves in supplementary income generation activities in one or another way. The relying on livestock stands first which is followed by MNREGA and private company employment respectively.

Table 3: Distribution of Respondents based on their Supplementary Income Generation (n = 104)*

S. No.	Employment	Number	Percentage
1.	Animal rearing	46	44.23
2.	Private company	19	18.27
3.	Driver	5	4.81
4.	Own business	11	10.57
5.	Govt. employee	16	15.38
6.	Daily wage earners	15	14.42
7.	Migrant work	9	8.65
8.	MNREGA	29	27.88
9.	Others	1	0.96

**multiple response*

The data presented in Table 4 indicates that respondents from the survey villages are very much interested in farming on their own rather than leasing out. It might be due to the local stigma that the households with more land were the ones valued most. The social status of the household was mostly calculated by their productive land holdings. Data figures out that around two-thirds of the respondents do farming on their own whereas a meager proportion of the respondents (5.77 %) alone completely leased out their farmland due to reasons such as aging, migrating children, and preferentially allocating more time for their non-farm jobs.

Table 4: Distribution of Respondents based on Farmland operation (n = 104)

S. No.	Classification	Number	Percentage
1.	Own land alone	66	63.46
2.	Leased in alone	5	4.81
3.	Leased out alone	6	5.77
4.	Leased in+ own land	15	14.43
5.	Leased out own land	12	11.53

As from the previous table, it is clear that only 98 respondent households were engaged in farming directly, hence, further inquiries were made only with them. Table 5 indicates that, among the respondents, only the small land-holding category is a little lesser in contribution than the other two categories.

Table 5: Distribution of Respondents based on Operated Land Size (n = 98)

S. No.	Classification	Number	Percentage
1	<=2.5 acres	38	38.77
2	2.6 - 5 acres	25	25.51
3	>5 acres	35	35.71

As understood from several reviews, the Cauvery delta region is flooded with paddy cultivation. To verify the same, the cropping pattern question has been included and it is found from Table 6 that nearly two-thirds of the respondents cultivates paddy as triennium. Only 13.27 percent of them practice pulses instead of third paddy and a meager proportion (4.08 %) of the respondents were cultivating paddy once a year rest of them go for paddy cultivation at least twice per annum.

Table 6: Distribution of Respondents based on cropping pattern followed (n = 98)

S. No.	Category	Frequency	Percentage
1	Paddy+Paddy+Paddy	63	64.28
2	Paddy+Paddy+Pulses	13	13.27
3	Paddy+Paddy+Oilseeds	11	11.22
4	Paddy+fallow+oilseeds	3	3.06
5	Paddy+Fallow+Pulses	1	1.02
6	Paddy+Paddy+Fallow	2	2.04
7	Others	5	5.10

As mentioned elsewhere, the region prominent for paddy cultivation always possesses proficient knowledge in the usage of agricultural machinery, the same has been proven in this study as well. Almost all the paddy growers in the study area use

agricultural machinery. The usage of machinery differs with respect to their land size. Table 7 represents the usage pattern among the paddy growers either they own it or use it through rent. In the owning category, around three-fourths (72.44 %) of the respondents on the hand sprayer followed by Kono weeder (33.67 %), battery-operated sprayer (28.57 %), and tractor (18.37 %) respectively. Even though 97 percent of the respondents use a combined harvester and 91 percent of them use a straw baler they are outsourcing both for their need fulfillment. It might be due to the high cost and fewer number of operational days per season.

Table 7: Distribution of Respondents based on Machineries owned (n = 98)*

S. No.	Machineries	Frequency	Percentage
1.	Tractor	18	18.37
2.	Land leveller	4	4.08
3.	Power tiller	15	15.30
4.	Rice transplanter	4	4.08
5.	Kono weeder	33	33.67
6.	Battery operated sprayer	28	28.57
7.	Combined harvester	0	0
8.	Straw baler	0	0
9.	Hand sprayer	71	72.44
	Machineries used on rent		
S. No.	**Machineries**	**Frequency**	**Percentage**
1.	Tractor	77	78.57
2.	Land leveller	0	0
3.	Power tiller	1	1.02
4.	Rice transplanter	65	66.32
5.	Kono weeder	3	3.06
6.	Power sprayer	14	14.28
7.	Combined harvester	95	96.93
8.	Straw baler	89	90.81
9.	Hand sprayer	4	4.08

**multiple response*

Any invention stays as scientific fantasies if and otherwise its usage creates a demand market and mends money out of its operation. The above-mentioned agricultural machinery does the job better, which could be evidenced from the table 8 and 9. It clearly states that irrespective of their land size category almost all the respondents get economically benefitted from using agricultural machinery. The money saved is in direct proportion to their operational land holding.

Table 8: Distribution of Respondents based on Difference in cost using Agricultural Machinery over traditional cultivation method (n = 98)

S. No.	Savings (in Rs.)	Frequency	Percentage
1.	<10000	27	27.55
2.	>10000 - 25000	21	21.42
3.	>25000 - 50000	25	25.51
4.	>50000 - 1 lakh	15	15.30
5.	>1 lakh	10	10.20

Table 9: Distribution of Respondents based on Difference in cost using Agricultural. Machinery based on land size (n = 98)

S. No.	Savings (in Rs.)	Marginal farmer		Small farmer		Medium and Big farmer	
		No.	%	No.	%	No.	%
1.	<10000	27	27.55	0	0	0	0
2.	>10000 - 25000	10	10.20	11	11.22	0	0
3.	>25000 - 50000	1	1.02	11	11.22	13	13.27
4.	>50000 - 1 lakh	0	0	3	3.06	12	12.24
5.	>1 lakh	0	0	0	0	10	10.20

Conclusion

Even though agricultural machinery has proven economic benefits on the field level, farmers are yet to be convinced fully of its adoption this might be due to several insightful field-level usage and access problems. A few notable problems documented in of study are,

- The Paddy transplanting machine leaves a one-foot gap between one set of planting and another which needs manual filling-up. Hence, again the farmer looks for the labour whose availability is short.

- At times of Flood machine transplanted field is worst affected relatively due to the transplanting age of the seedling (14 days) as compared with manual transplanting (28 days)

- Farmers also insisted that in manual harvest more than 90 % of the original produce could be retrieved whereas in machine harvest it is not more than 70 %

- Power sprayers are not preferred by them for their diesel dependency and mobility.

- Combined harvester drivers' getting wage per hour than per acre which burdens the farmers

Despite all the constraints paddy growers continuously rely on machinery due to the existing factors like increasing labor costs and timely unavailability of labor.

Future Scope of the Study

Based on the insights drawn from the current study, the following future research directions can be explored to address the challenges faced by farmers in adopting agricultural machinery:

1. Design Optimization of Machinery: Research can focus on improving the design and functionality of paddy transplanting machines to minimize gaps between planting rows, reducing the need for manual filling and labor dependency.

2. Flood-Resilient Transplanting Techniques: Investigating the impact of transplanting age on crop resilience during floods and developing machinery compatible with older seedlings could mitigate the disadvantages of machine transplanting in flood-prone areas.

3. Enhancing Machine Harvest Efficiency: Studies aimed at improving the efficiency of machine harvesting to reduce grain loss and achieve higher retrieval percentages could make mechanical harvesting more acceptable to farmers.

4. Exploring Alternative Power Sources for Sprayers: Developing battery-operated or solar-powered sprayers as alternatives to diesel-powered ones could address issues related to fuel dependency and operational mobility.

5. Revisiting Payment Models for Combined Harvesters: Conducting research on equitable wage structures for combined harvester drivers, such as shifting from hourly rates to acreage-based rates, can reduce the financial burden on farmers.

6. Farmer-Centric Machinery Customization: Engaging farmers in participatory research to understand their preferences and challenges can guide the development of machinery tailored to local needs and conditions.

7. Assessment of Socioeconomic and Environmental Impacts: Further studies can evaluate the long-term socioeconomic benefits and environmental impacts of adopting agricultural machinery, with a focus on labor dynamics, productivity, and resource sustainability.

8. Capacity Building and Awareness Programs: Research on the effectiveness of training and awareness programs in enhancing farmers' understanding of machinery operations and maintenance can help address adoption challenges.

These directions aim to bridge the gap between the economic benefits of agricultural machinery and its practical applicability, fostering wider acceptance and sustainable adoption in the agricultural sector.

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Conflict of Interest

There is no conflict of interest

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