



Farm Mechanization and Farmers' Preferences: Evidence from North Bank Plain Zone of Assam

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HIGHLIGHTS

- The average mechanized farm area among the sample farmers was 27.52 per cent. High degree of mechanization was found for post-harvest operation like milling and threshing followed by land preparation.
- Knapsack or power sprayer, portable milling machines, tractor mounted thresher and tractor with rotavator were the most preferred farm machineries among the farmers
- Farmers' most preferred farm operation for mechanization were irrigation, milling, plant protection, threshing and land preparation.

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ABSTRACT

The study was conducted during 2022 in the North Bank Plain Zone of Assam to assess the degree of farm mechanization, preferences toward farm machinery and farm operations, as well as factors influencing the extent of farm mechanization. Descriptive research design was followed and a purposive cum stratified random sampling technique was used for selection of 120 farmers as respondents for study. The degree of farm mechanization was recorded from medium to high for the majority of farmers, with an average farm mechanization area of 27.52 per cent. The majority of farmers showed a medium level of preference towards farm mechanization, but knapsack or power sprayer, portable milling machines, tractor-mounted thresher, tractor with rotavators or cultivator were the most preferred farm machineries. Irrigation, milling, plant protection, threshing, and land preparation were the most preferred farm operations for mechanization. Six socio-economic factors, viz. farm size, innovativeness, extension contact, credit availability, training exposures, and preferences for mechanization were positively and significantly contributed around 46 per cent variation of farm mechanization. Governments and non-government organizations should put efforts into promoting farm mechanization through the establishment of a custom hiring center for preferred farm machinery, easy access to government assistance, and strategic mobilization of resource-poor farmers.

INTRODUCTION

Mechanization is regarded as a key solution to the challenges of food insecurity and malnutrition in India, primarily by enhancing agricultural efficiency in the context of a growing population. Farm mechanization, a crucial component of the Green Revolution, marks a significant transition from traditional agricultural practices reliant

on human and animal labor to the use of machines for various farming operations. The adoption of mechanization not only improves the timeliness and efficiency of agricultural tasks but also holds the potential to reduce production costs and enhance overall farm profitability. Research conducted in the past has indicated that effective mechanization can result in substantial savings of seeds (15-20%), fertilizer (20-30%), time (20-30%), and labor (5-20%),

leading to an increase in cropping intensity (10-15%) and overall productivity (15-20%) (Singh, 2008; Tiwari et al., 2017; Tiwari et al., 2019; Mehta et al., 2023). Despite the potential benefits, the level of farm mechanization in India remains relatively low, standing at around 40-45 per cent, in stark contrast to nations like the US and Western Europe with rates as high as 95 per cent, as well as Russia (80%), Brazil (75%), and China (48%) (Mehta et al., 2023). The evolution of power availability per hectare over the years is remarkable, rising from a mere 0.32 KW in 1961-62 to an estimated 5.17 KW/ha in 2032-33 (Tiwari et al., 2017; Tyagi et al., 2010; Singh et al., 2021; Mehta et al., 2023). This transition is reflected in the shift from animate power sources (human and animal labor) contributing 91.35 per cent in 1960-61 to a mere 6 per cent in 2020-21. In contrast, mechanical power sources have surged from 37.80 per cent to 81.15 per cent, while electrical power's share has increased from 2.36 per cent to 19.58 per cent during the same period (Singh et al., 2021). Amidst this context, the state of Assam presents a unique scenario, with mechanization levels lagging behind despite consistent efforts by the government. The farm power availability in 2024 is about 3.126 kW/ha as estimated by the Indian Council of Agricultural Research (ICAR). However, significant disparities exist across the states -Punjab has a farm power availability of 6 kW/ha, whereas northeastern states like Assam and Mizoram have only 1.2 kW/ha and 0.7 kW/ha, respectively (Mehta et al., 2023). The government of Assam has taken proactive steps by implementing central sector schemes aimed at promoting farm mechanization. Nevertheless, the success of these initiatives hinges on the attitudes and preferences of farmers towards adopting new technologies. The adoption or rejection of a technology is significantly influenced by farmer perceptions, attitude, and requirements (Mwangi & Kariuki, 2015). Therefore, to expedite agricultural modernization, understanding farmer preferences towards mechanization and machinery becomes vital for consideration. In light of these considerations, this study was carried out to assess the farmers' level of farm mechanization, preference of mechanization and factors influencing farm mechanization.

METHODOLOGY

The study was conducted in Biswanath and Sonitpur district of Assam during 2022. A descriptive research design was followed to conduct the study. Purposive cum stratified random sampling techniques was followed for selection of districts, sub-divisions, Agriculture Development Officer (ADO) circles, Agriculture Extension Assistant (AEA) Elekas and villages for the study. A total of eight villages- Pormaigauli, Rupkuria, Bakchung, Punioni, Kuwari, Japoubari, Borpothar-1 and Borpothar-4 were randomly selected from eight designated AEA elekas for the study. From each village, 15 farmers were selected using simple random sampling, resulting in a total sample size of 120 farmers for the study. Data for the study were collected through pretested interview schedule with the help of personal interview method.

In order to measure farm mechanization, the following formula was used;

$$FMi = \frac{AMi}{Tai} \times 100$$

Where, FMi is the mechanization index, AMi is the mechanized area and T_{Ai} is the total farm area

In order to assess preferences of farmers towards farm mechanization a total of 24 statements were prepared based on review of literature and consultation with experts. The responses of farmers were collected against each statement by following 5-point responses continuum i.e., strongly agree, agree, undecided, disagree and strongly disagree with respective scores of 5, 4, 3, 2 and 1. Subsequently, based on the responses obtained from the respondents, frequencies and percentages were calculated. The scale value of Farmers' preference towards mechanization and farm operation were calculated by following formula

$$SVP = fx_1 \times 5 + fx_2 \times 4 + fx_3 \times 3 + fx_4 \times 2 + fx_5 \times 1.$$

In order to assess the level of farmers preferences towards farm machinery, a comprehensive list of farm machinery was prepared in consultation with agriculture development officers and Agriculture engineers. Respondents were asked about which machinery they 'owned', 'hired' and 'not used' accordingly score was assigned as 2, 1 and 0 respectively. Thus, in order to rank the machinery, Total Weighted Score and Mean Weighted Scores was calculated by using the following formula:

$$TWS = f_{xi} \times 2 + f_{xi} \times 1 + f_{xi} \times 0$$

Where, TWS = Total weightage score for a machinery, f_{xi} = frequency of respondents

$$MWS = \frac{TWS}{N}$$

Where, MWS = Mean weightage score for a machinery, TWS= Mean weightage score for a machinery, N= Total number of respondents. Multiple linear regression analysis was conducted using SPSS to identify the factors influencing farm mechanization. Appropriate statistical techniques were applied for interpretation of data.

RESULTS

Farm mechanization status in study area

The data from Table 1 illustrates that a significant proportion (60.83%) falls within the medium level of farm mechanization followed by high level of farm mechanization among 25 per cent of respondents.

Mechanization of farm operations

From Table 2 it is clear that among the various farm operations, milling was the almost fully mechanized, with mean mechanization value 97.9 followed by threshing (71.5). Field preparation and plant protection were found to be with mechanization index of 48.7 and

Table 1. Distribution of farmers according to the extent of farm mechanization

Mechanization level	Score ranges	Respondents (%)	Mean	SD	CV
Low	21.15-23.60	14.16			
Medium	23.61-29.99	60.83	27.52	03.01	10.93
High	30.00-40.64	25.00			

Table 2. Extent of farm mechanization adopted by farmers

Farm operation	Mean Farm Mechanization Index	SD
Field preparation	48.7	12.4
Transplanting/sowing of seed	3.39	9.8
Irrigation	23.34	39.5
Weeding	2.1	10.8
Plant protection	42.27	29.0
Harvesting	9.8	77.0
Threshing	71.5	29.8
Winnowing	9.2	29.0
Milling	97.9	0.7

42.27, respectively. Irrigation operations display a lower mechanization index of 23.34 per cent. The rest of the farm operation namely transplanting/sowing of seed, weeding, harvesting and winnowing had less than 10 per cent of farm mechanization.

Farmer's preference towards farm mechanization and farm machinery

The degree of preference towards farm mechanization was recorded at a medium level for most farmers (72.50%), followed by a high level of preference for 15.83 per cent of farmers (Table 3). The mean score of 85.67 indicates a medium level of preference towards farm mechanization. The majority of farmers preferred mechanization, which might be due to high labour costs, migration from the agricultural sector to the non-agricultural sector, and also to have less drudgery-prone agricultural practices.

Table 3. Distribution of respondents according to level of preference of farm mechanization

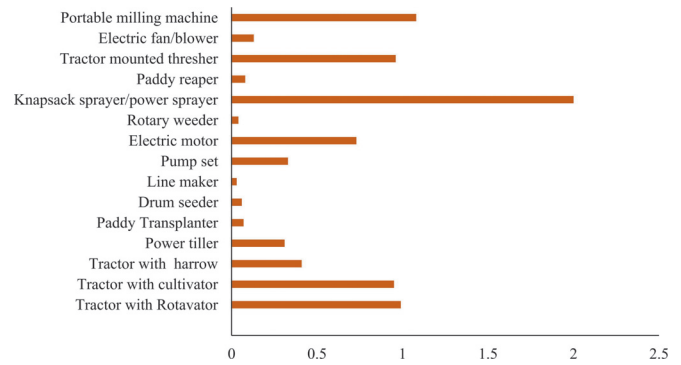
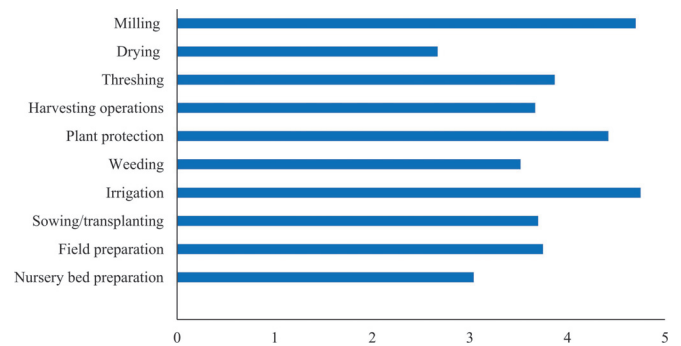
Level of preference	Score ranges	Respondents (%)	Mean score	SD	CV
Low	76.00-79.96	11.67			
Medium	79.97-91.43	72.50	85.67	5.72	6.69
High	91.44-102.00	15.83			

It is observed from Figure 1 that the knapsack or power sprayer had the highest preferences among all the farm machinery and implements. The portable rice milling machine was the farmer's next preferred machinery for milling operation.

Farmers' preference towards tractor-mounted thresher is in fourth position, followed by tractor with rotavator and cultivator. For the rest of the farm machinery, the low level of preference was recorded (Figure 1).

Choices of farm practices for farm mechanization

It is observed from Figure 2 that among all the farm practices majority of farmers preferred that irrigation operations be mechanized, which occupied the first rank, followed by milling. The next preferred farm operation was plant protection. Threshing and land preparations ranked fifth and sixth, respectively, in the preference for mechanization, whereas other operations like transplanting, harvesting, weeding, and nursery bed preparation had less farmers' preference for mechanization.

**Figure 1.** Farmers' preferences towards farm machinery**Figure 2.** Ranking of farm practices based on the choices of farmers

Factors influencing the extent of farm mechanization

Out of 16 independent variables, only six variables (Table 4) were found to contribute significantly towards the extent of farm mechanization. The variables, viz. farm size (x_3), innovativeness (x_8), extension contact (x_9), credit availability (x_{10}), training exposures (x_{14}), and preferences for mechanization (x_{16}) were positively and significantly contributed towards the extent of farm mechanization at the 0.05 level. The value of R^2 (0.46) indicated that six independent variables were found significant in the prediction of the extent of farm mechanization. Similar findings were reported by Abdullah & Samah (2013); Ayandiji & Olofinsao (2015); Mottaleb et al., (2016); Yassing et al., (2016); Kehinde & Adeyemo (2017); Rajkhowa et al., (2020).

DISCUSSION

The level of farm mechanization among the majority of farmers was concentrated in the medium level within the range of 23.61-29.99 per cent, and the average level of farm mechanization among the farmers was recorded at 27.52 per cent. This may be due to fragmented land holdings, lack of availability of farm machinery in their locality, higher hiring charges, and low penetration of government schemes (Rajkhowa et al., 2020; Teja et al., 2021).

Among the various farm operations, more mechanized farm operations were milling and threshing, followed by field preparation and plant protection. Similar findings were also reported from Bangladesh by Adu et al., (2012) & Rahman et al., (2021). The threshing operations trend can be linked to the limited availability of labor, coupled with higher labor wages, encouraging farmers to

Table 4. Influences of selected socio-economic factors on the extent of farm mechanization

	Coefficients	Standard Error	t Stat	P-value
Intercept	1.44	6.32	0.23 ^{NS}	0.820
Age (x_1)	0.02	0.03	0.43 ^{NS}	0.668
Educational status (x_2)	-0.04	0.15	-0.24 ^{NS}	0.811
Farm size (x_3)	0.41	0.20	2.09*	0.039
Land type (x_4)	0.48	0.34	1.41 ^{NS}	0.162
Occupation (x_5)	0.06	0.22	0.26 ^{NS}	0.798
Annual Income (x_6)	-0.39	0.22	-1.75 ^{NS}	0.084
Farming experience (x_7)	0.01	0.04	0.19 ^{NS}	0.853
Innovativeness (x_8)	0.36	0.16	2.23*	0.028
Extension contact (x_9)	0.37	0.13	2.91*	0.004
Credit availability (x_{10})	0.75	0.15	3.08*	0.003
Mass media exposure (x_{11})	0.15	0.12	1.22 ^{NS}	0.224
Labour availability (x_{12})	-0.01	0.01	-0.75 ^{NS}	0.454
Availability of service centre (x_{13})	-0.88	0.61	-1.44 ^{NS}	0.152
Training exposures (x_{14})	0.85	0.43	2.01*	0.048
Avail of Government scheme (x_{15})	0.30	0.19	1.61 ^{NS}	0.111
Preferences for mechanization (x_{16})	0.25	0.07	3.47*	0.001

* Significant at 0.05 level of probability, NS=Not significant, $R^2=0.46$

opt for tractor-mounted threshers. These machines are not only cost-effective but also reduce drudgery and save time compared to manual threshing or the use of draught animals (Raina et al., 2021; Hasan et al., 2020; Adu et al., 2012). Transplanting, harvesting, and winnowing operations reported the lowest mechanization rate because of low availability of compatible machinery and lack of skills (Vemireddy & Choudhary, 2023). Some farmers use electric fans or blowers while others opt for threshers, which eliminate the need for winnowing. Low mechanization of harvesting operations was observed which might be due to the unavailability of harvesting machinery, farmers' limited awareness of paddy harvesters, and the high cost associated with such machines (Kavya & Shobharani, 2019; Hasan et al., 2020). Weeding operations exhibit the lowest mechanization rate, because of non-adoption of line transplanting methods.

Majority of farmers preferred farm mechanization because of high labour cost (Buttar et al., 2023; Raina et al., 2021; Tiwari et al., 2017 & Mehta et al., 2023), migration from agricultural sector to the non-agricultural sector, making agricultural practices less drudgery prone (Kavya & Shobharani, 2019; Medeksa, 2018). Farmers preferred farm machinery due to less cost and higher efficiency, lower labour requirements, and the necessity of using quality processed products. (Workneh et al., 2021; Singh et al., 2011). Farmers preferred tractor-mounted thresher as it is less time-consuming, less drudgery prone as compared to manual threshing (Hasan et al., 2020). Reasonable hiring charge for tractor tractor-mounted thresher is another reason for preference. Tractor with cultivator preferred as because of good working efficiency with less hiring cost (Workneh et al., 2021). Machinery in case of irrigation operation like pump set, solar pump, electric motor etc. are preferred by the respondents because of its efficiency and easy availability in time for irrigation (Sarkar et al., 2013; Vemireddy & Choudhary, 2023). Among all the farm practices majority of the respondents prefer, irrigation operation to be mechanized. It's because irrigation is much essential for farming, without irrigation it's not possible to do farming in all season, followed by milling,

as milling process is as important as irrigation. Plant protection practices are to be mechanized as spraying of chemicals or pesticide manually in a large field is a laborious and time-consuming work. Threshing operation and land preparation are considered as more drudgery-prone and time-consuming, so there is a need for mechanization. Farmers had the least preference for mechanization of transplanting, harvesting, weeding, and nursery bed preparation, as these operations can be done manually and not much aware about farm machinery related to these operations are the reasons (Vemireddy & Choudhary, 2023).

The linear regression analysis could predict 46 per cent of the variation in the extent of farm mechanization. Variation of farm mechanization among farmers is influenced by the socio-economic characteristics, viz., farm size, innovativeness, extension contact, credit availability, training exposures, and preferences to mechanization of farmers (Yassing et al., 2016; Kisku et al., 2022).

CONCLUSION

The study highlights a considerable variation in the level of farm mechanization among the sample farmers. Results indicate that the majority of respondents fall within the medium mechanization category. This underscores the necessity for greater involvement from both government and non-government organizations to encourage mechanized farming practices among farming communities to ensure sustainable agricultural production. The study's current insights serve as a valuable resource for policymakers, enabling them to formulate targeted strategies to enhance mechanization adoption among farmers. Such initiatives have the potential to revitalize the agricultural sector not only within the study area but also throughout the entire state of Assam.

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