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Problems of smallholder farmers in mechanisation of farms: A study in Assam

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Abstract

Farm mechanisation plays an important role in improving agricultural productivity, reducing dependence on human labour and ensuring timely completion of farm operations. However, smallholder farmers often face several constraints in accessing, adopting and effectively utilising farm machineries. The present study was undertaken to identify and analyse the major problems faced by smallholder farmers in farm mechanisation in Assam. The study examined the problems reported by the respondents which were systematically classified into five major categories, namely personal, social, economic, family and institutional. Data were collected from selected smallholder farmers using a structured interview schedule and the identified problems were analysed and prioritised using appropriate statistical techniques, including Pareto analysis. The findings revealed that the respondents experienced problems of varying magnitude across all the identified categories. Social and personal problems emerged as the most prominent categories, each accounts for twenty six per cent of the total problems reported. Economic problems constituted 19.00 per cent, while family and institutional problems accounted for 15.00 and 14.00 per cent, respectively. The results indicated that the difficulties associated with farm mechanisation were multidimensional and various factors related to individual circumstances, social environment, economic capacity, family conditions and institutional support collectively influenced the respondents' ability to effectively utilise mechanisation services. Moreover, Pareto analysis was employed to prioritise the major problem categories.

Keywords: Farm mechanisation, Assam, problems, pareto analysis, smallholder farmers

Introduction

Farm mechanisation is an important component of agricultural development as it facilitates timely farm operations, reduces dependence on human and animal labour, minimises drudgery and improves the efficiency and productivity of agricultural production. Mechanisation enables farmers to undertake various farm operations within the optimum time, which is important alternative for changing labour availability and rising agricultural wages. Mechanisation has considerable potential to improve agricultural productivity and reduce the dependence on manual labour, even though through mechanisation the farmers face several challenges in India (Mehta *et al.*, 2014) ^[4]. Similarly, Tiwari *et al.* (2019) ^[8] emphasised that appropriate mechanisation improves the timeliness and efficiency of farm operations and contribute to increased cropping intensity and productivity. Despite its importance, the level of mechanisation among smallholder farmers remains constrained by several interrelated factors. Small and fragmented landholdings are one of the major structural constraints as many conventional machines are designed for relatively larger and consolidated farms. The size and structure of agricultural holdings have an important bearing on the economic viability of mechanisation (Singh 2006) ^[7]. Various small and fragmented holdings, inadequate availability of appropriate machinery and limited economic capacity also acts as important challenges to farm mechanisation in India. Thus, the adoption of machineries may not always be economically feasible for farmers operating on a small scale. (Mehta *et al.* 2014) ^[4].

The economic capacity of farmers is another major determinant of access to mechanisation. The high cost of machinery, fuel, repair and maintenance, together with limited access to institutional

credit, can restrict farmers' ability to adopt and continuously use mechanised technologies. Pingali (2007) ^[6] observed that the economics of mechanisation is closely associated with farm size, labour costs and the expected returns from investment in machinery. According to Mottaleb *et al.* (2016) ^[5] rising machinery costs and farmers limited financial capacity influence their access to mechanisation services and technologies. Mechanisation among smallholders is influenced not only by the availability of machinery but also by farmers' access to finance, information, infrastructure and complementary services (Daum *et al.*, 2020) ^[3]. Technological and knowledge-related constraints influence the effective utilisation of farm machineries. Farmers experience difficulties in selecting machineries which are appropriate to their farm conditions, operating equipment, carrying out routine maintenance and obtaining technical assistance when machinery breaks down. Tiwari *et al.* (2019) ^[8] stressed the importance of developing and promoting machinery suited to the diverse farm sizes and agro-ecological conditions prevailing in India. Lack of technical knowledge and inadequate training can consequently limit farmers' confidence and ability to use mechanised technologies effectively. Institutional and infrastructural limitations further influence the process of farm mechanisation. Inadequate access to credit, limited extension support, insufficient awareness of government assistance and lack of adequate repair and maintenance facilities can create additional barriers. Likewise, identified high machinery costs, inadequate financial resources, limited technical knowledge, infrastructure-related difficulties and gaps in institutional support as important challenges to farm mechanisation among smallholder farmers in India. (Burman *et al.* (2025) ^[2].

The suitability and affordability of various machineries, availability of farm power, access to financial and technical support and farmers' knowledge and training are important contemplations for promoting mechanisation in the state. Factors such as farm size, credit availability, extension contact, training exposure and farmers' preferences were associated with the extent of mechanisation indicates that mechanisation is influenced by a combination of farmers' resource conditions and institutional factors rather than by machinery availability alone (Baruah *et al.*, 2025) ^[1]. As various agricultural machines and tools are not adequately designed according to the requirement of women due to which various problems arises in handling, operating and transporting. Moreover, lack of training and limited access to appropriate machineries also restrict their participation in mechanised agriculture.

Therefore, the problems faced by smallholder farmers in farm mechanisation are multidimensional which also encompass economic, technological, infrastructural, institutional and human factors. High investment and operating costs, small and fragmented holdings, inadequate access to suitable machinery, limited financial resources, lack of technical knowledge and training, insufficient extension support, maintenance difficulties and inadequate institutional assistance may collectively restrict the effective adoption and utilisation of farm machinery. Hence, it is important to understand the nature and magnitude of the problems experienced by smallholder farmers as it is essential for formulating appropriate strategies to promote inclusive and sustainable farm mechanisation. Against this background, the present study was undertaken to assess the problems faced by smallholder farmers in the mechanisation of farms in Assam.

Methodology

The present study was conducted in 7 districts of Assam selected among the four agro-climatic zones which include: Jorhat from

Upper Brahmaputra Valley Zone, Sonitpur and Darrang from North Bank Plain Zone, Bongaigaon, Barpeta and Goalpara under Lower Brahmaputra Valley Zone and Morigaon from Central Brahmaputra valley zone. Subsequently, 60 smallholder farmers from each district who are engaged in cultivation of various crops like paddy, toria and various tuber crops were selected which comprised a total of 420 respondents as a final sample for the study. Thus, a multistage random sampling design was followed for the selection of respondents in the present study.

The problems faced by the respondents in farm mechanisation were identified in terms of personal, social, economic, family and institutional. The respondents were asked to give their response against each problem by choosing a given option i.e very serious, serious and not so serious with a score of 3, 2, 1 respectively. The variable was measured using frequency and percentage distribution.

Further, the Pareto Principle (80/20 rule), was used to find out the problems faced by the respondents. The issues faced by the farmers were grouped under five categories from where the frequency of responses within each category was determined and the total was presented in decreasing order. Moreover, the cumulative frequencies and cumulative percentages were computed accordingly. These values were used to design the pareto chart in which the bars indicate the frequency of issues and the line graph indicates the cumulative percentage.

Steps followed in identification of problems through pareto analysis:

Step 1: Identification of problems

The problems faced by the respondents in farm mechanisation were identified through the structured interview schedule.

Step 2: Classification of problems

The identified problems were grouped into relevant categories, such as:

- Personal problems
- Social problems
- Economic problems
- Family problems
- Institutional problems

Step 3: Frequency calculation

For each individual problem, the number of respondents reporting that problem was counted.

Step 4: Ranking of problems

The problems were arranged in descending order according to their frequency, with the most frequently reported problem placed first.

Step 5: Calculation of percentage

The percentage contribution of each problem was calculated using:

The percentage contribution of each problem was calculated by using the following formula

$$\text{Percentage} = \frac{\text{Frequency of a problem}}{\text{Total frequency of all the problems}} \times 100$$

Step 6: Calculation of cumulative percentage

The percentage values were successively added to obtain the cumulative percentage.

The cumulative percentage was calculated by adding the

percentage contribution of each problem sequentially from the highest to the lowest frequency:

CP_i = Cumulative percentage up to i^{th} problem

Results and Discussion

Table 1 shows the problems faced by the respondents which are divided into 5 categories namely: personal, social, economic, family and institutional

Table 1: Problems faced by the respondents in farm mechanisation

SI. No.	Problems faced by the respondents	Very serious	Serious	Not serious at all
		Frequency (%)	Frequency (%)	Frequency (%)
Personal problems				
1	Inadequate technical skills in operating modern farm machineries	353(84.04)	67(15.95)	0(0.00)
2	Lack of interest to learn about new agricultural machineries	0(0.00)	397(94.52)	23(5.47)
3	Lack of confidence to adopt new mechanisation practices	31(7.38)	375(89.04)	13(3.09)
4	Low self-confidence in operating modern farm machinery	96(22.85)	296(70.47)	28(6.66)
5	Fear of failure and financial loss from adopting new technologies	324(77.14)	87(20.71)	9(2.14)
Social problems				
6	Lack of awareness about modern farm machinery and implements	225(53.57)	157(37.38)	38(9.04)
7	Inadequate knowledge about farm machinery	159(37.85)	261(62.14)	0(0.00)
8	Limited interaction with farmers using mechanised tools and implements	152(36.19)	193(45.95)	75(17.85)
9	Lack of training on proper operation of farm machinery	380(90.47)	40(9.52)	0(0.00)
10	Unfair attention during hiring of farm machinery	54(12.85)	260(61.90)	106(25.23)
Family problems				
11	Strong preference towards traditional farming practices	134(31.90)	222(52.85)	64(15.23)
12	Reluctance to hire or purchase modern farm machineries	215(51.19)	205(48.80)	0(0.00)
13	Limited interest in the adoption of farm machinery	28(6.66)	392(93.33)	0(0.00)
Economic problems				
14	High machinery hiring charges	0(0.00)	0(0.00)	420(100)
15	Difficulty in obtaining credit to purchase farm machineries	293(69.76)	127(30.23)	0(0.00)
16	High interest rates on machinery loans	273(65.00)	147(35.00)	0(0.00)
17	Lack of skilled labour for operating farm machinery	207(49.28)	213(50.71)	0(0.00)
Institutional problems				
18	Limited availability of farm machinery	255(60.71)	165(39.28)	0(0.00)
19	Time-consuming procedures for hiring farm machinery	0(0.00)	0(0.00)	420(100)
20	Inadequate government support and subsidies for farm mechanisation	375(89.28)	45(10.71)	0(0.00)

Table 1 reveals that among the personal problems inadequate technical skills in operating modern farm machineries is the 'most serious' problems faced by the respondent in which 84.04% of the respondent declared it as a 'very serious' problem, followed by (15.95%) as a 'serious' problem to some extent. Lack of interest to learn about the new agricultural machineries is another problem faced by the respondent in which 94.52% revealed it as a 'serious' problem and 5.47% as 'not serious' at all. Lack of confidence to adopt new mechanisation practices is another important problem, according to 89.04% of the respondents it is a 'serious' problem faced followed by 7.38% who declared it as a 'very serious' problem and 3.09% of the respondents declared it as a problem which is 'not serious' at all. Low self-confidence in operating modern farm machinery is another important problem faced by the respondents. According to 70.47% respondents it is a very 'serious' problem, followed by 22.85% respondents it is 'serious' to some extent. Approximately six percent declared it as 'not serious' at all. Fear of failure and financial loss from adopting new technologies was the least important one among the personal problems where 77.14% of the respondents declared it as a 'very serious' problem, followed by 20.17% of the respondents who considered it as a 'serious' problem and only according to 2.14% of the respondent it is 'not serious' problem at all.

In regard to social problems, Lack of awareness about modern farm machinery and implements is another important problem faced by the respondents in which 53.57% of the respondents considered it as a 'most serious' problem faced by the respondent followed by 37.38% of the respondent who considered it as a 'serious' problem to some extent. Nine percent

of the respondents considered it as a problem which was 'not serious' at all. Inadequate knowledge about farm machinery is another important problem faced by the respondent in which 62.14% of the respondent considered it as a 'serious' problem to some extent followed by 37.85% of the respondent who considered it as a 'very serious' problem and none of the respondents considered it as 'not serious' at all. Limited interaction with farmers using mechanised tools and implements is another important problem faced by the respondent in which 45.95% of the respondent considered it as a 'serious' problem to some extent followed by 36.19% of the respondent who considered it as a 'very serious' problem. Only 17.85% of the respondent considered it as a problem which is 'not serious' at all.

Lack of training on proper operation of farm machineries was another problem faced by the respondents in which 90.47% of the respondents considered it as a 'very serious' problem, followed by 9.52% of the respondent who considered it as a problem which is 'serious' to some extent. Unfair attention during hiring of farm machinery was considered as 'serious' to some extent by 61.90% of the respondent, followed by 25.23% of the respondent who considered it as 'not serious' at all and only 12.85% of the respondent considered it as a 'very serious' problem.

With regard to family problem it was seen that Strong preference towards traditional farming practices is considered as a 'serious' problem to some extent by 52.85% of the respondent, followed by 31.90% of the respondent who considered it as 'very serious' problem. According to 15.23% of the respondent it is 'not a serious' problem at all. Reluctance to hire or purchase modern farm machineries is another important problem in which

48.40% of the respondent considered it as a 'serious' problem to some extent. 93.33% of the respondents face 'serious' problem to some extent followed by 6.66% of the respondents who considered it as a 'very serious' problem.

In context to economic problem it was seen that high machinery hiring charges was not at all a serious issue as reported by hundred percent of the respondents. Difficulty in availing credit to purchase farm machineries was a serious problem as considered by 69.76% of the respondents, followed by 30.23% of the respondents who considered it as a serious problem to some extent. High interest rates on machinery loans is another problem which is considered as 'very serious' by 65.00% of the respondents. 35.00% of the respondents considered it as 'serious' to some extent. Lack of skilled labour for operating farm machinery is another important problem as faced by the respondents in which 50.71% considered it as serious to some extent, followed by 49.28% of the respondent who considered it as a very serious problem. None of the respondents considered it as a problem which is not serious at all. These reveals that financial limitations and inadequate availability of trained machine operators continue to hinder the widespread of the farm machinery usage.

Regarding institutional problems, 60.71 percent respondents identified limited availability of farm machinery as 'very serious' problem which was followed by 39.28% who considered it as 'serious problem'. Time-consuming procedures for hiring farm machinery was not at all a serious as considered by hundred percent of respondents. Inadequate government support and subsidies for farm mechanisation was considered as

serious by 89.28 per cent of the respondents, followed by 10.71% of the respondents who considered as serious to some extent and none of the respondents considered it as a problem which is not serious at all. These problems affected the These problems adversely affected the affordability of the machineries particularly during the tough agricultural operations.

Furthermore, Pareto analysis was employed to prioritize the major problem categories and identify the most critical problems encountered by the respondents. The technique is based on the principle that a relatively small number of factors contribute to a substantial proportion of the total problems. By ranking the identified problems in descending order according to their contribution and calculating the corresponding cumulative percentages, Pareto analysis helps in distinguishing the most significant problem areas and determining those that require greater attention and intervention.

Table 2 highlights the results of the pareto analysis, where the problems a arranged in descending order of importance along with their cumulative percentage.

Table 2: Pareto chart showing the problems faced by the respondents

SI. No.	Problems	Total average	Percentage	Cumulative percentage
1	Social problems	11.78	26	26
2	Personal problems	11.73	26	52
3	Economic problems	8.84	19	71
4	Family problems	6.75	15	86
5	Institutional problems	6.50	14	100

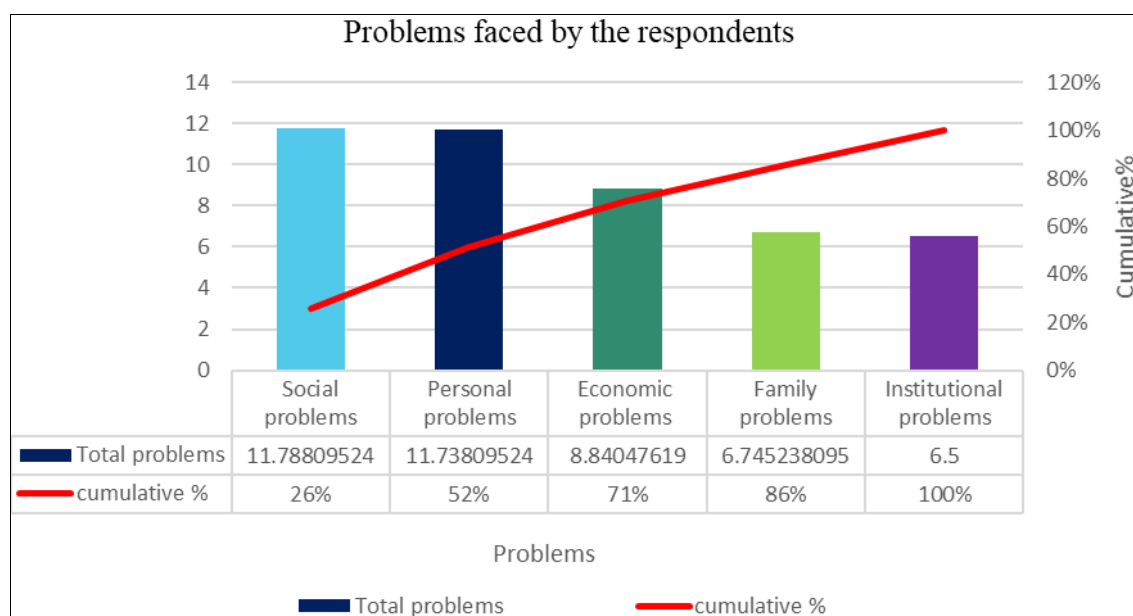


Fig 1: Pareto chart showing the problems faced by the respondents

The Pareto analysis presented above depicts the various problems reported by the respondents, which were classified into five broad categories, namely social, personal, economic, family and institutional problems. The analysis provides a systematic representation of the relative contribution of each problem category to the overall constraints experienced by the respondents. The bar diagram illustrates the proportion of problems under each category, while the cumulative percentage curve indicates the progressive contribution of the categories to the total problem burden. The results indicate that social and personal problems constituted the most prominent categories among the problems reported by the respondents. Together,

these two categories represented a substantial proportion of the total problems and therefore emerged as the major areas of concern. As presented in Table 4.5.2, social problems accounted for 26.00 per cent of the total problems and occupied the highest rank, while personal problems also contributed 26.00 per cent. Economic problems constituted 19.00 per cent, followed by family problems with 15.00 per cent and institutional problems with 14.00 per cent. The cumulative contribution of the problem categories increased progressively from 26.00 per cent for the first category to 52.00 per cent after the inclusion of the second category. It further increased to 71.00 per cent, 86.00 per cent and ultimately 100.00 per cent with the successive inclusion of

the remaining categories. The cumulative percentage curve therefore demonstrates how the overall problem burden accumulated across the different categories. The combined contribution of social, personal and economic problems amounted to 71.00 per cent, indicating that these three categories constituted more than two-thirds of the total problems reported by the respondents.

When the problem categories were arranged in descending order according to their respective contributions, social problems, personal problems and economic problems occupied the first three positions, followed by family and institutional problems. The cumulative percentage corresponding to the first three categories reached approximately 71.00 per cent. Thus, these three categories together represented the major share of the problems experienced by the respondents, whereas family and institutional problems accounted for comparatively smaller proportions of the overall problem burden.

The results suggest that interventions, development programmes and support measures intended to reduce the difficulties faced by the respondents should give greater emphasis to social, personal and economic constraints. Addressing these three major areas could potentially bring about a substantial reduction in the overall problem burden, as they collectively accounted for 71.00 per cent of the problems reported by the respondents. The findings therefore provide useful direction for prioritising resources and designing need-based interventions aimed at alleviating the major constraints experienced by the respondents.

Conclusion

The study revealed that the respondents encountered a range of constraints in the adoption and utilisation of farm mechanisation. These constraints were broadly grouped into social, personal, economic, family and institutional categories, indicating that the difficulties associated with farm mechanisation were not limited to the availability or use of machinery alone but were influenced by several interrelated factors. Among the identified categories, social and personal problems emerged as the most prominent concerns, followed by economic, family and institutional problems. The Pareto analysis further indicated that social, personal and economic problems constituted the major share of the total problems reported by the respondents, collectively accounting for 71.00 per cent of the overall problem burden. This highlights the need to give priority to these three areas while formulating interventions for promoting effective farm mechanisation. Although family and institutional problems contributed comparatively less, they should not be overlooked, as these constraints may also influence the respondents' ability to access, hire and efficiently utilise farm machinery.

Overall, the findings suggest that improving farm mechanisation for crop cultivation practices often requires a comprehensive approach rather than focusing solely on the provision of machinery. Greater attention should be given to reducing economic barriers, strengthening farmers' knowledge and confidence regarding machinery use, improving access to timely custom hiring services and enhancing institutional support. Appropriate training, awareness programmes, affordable hiring facilities, timely availability of machinery and better coordination among concerned agricultural institutions could help reduce the major constraints faced by farmers. Addressing these priority areas would contribute towards greater acceptance, efficient utilisation and sustainable adoption of farm mechanisation.

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