Factors Affecting Farm Mechanization – A Case Study in Assam, India

Abstract

The study was conducted in Central Brahmaputra Valley and Upper Brahmaputra Valley Zone of Assam in India . **P**rimary data of 240 sample farms by personal interview schedule method and Logit Regression Analysis was used for examining the factors affecting farm mechanization. adoption . All data collected from sample farms pertains to the year 2014-15.With the help of logit regression different factors affecting the mechanization adoption was examined in the sample households where seven explanatory variable to explain mechanization adoption *viz.*, age of the head of household i.e. AGE, education level of the household i.e. EDU ,size of land holdings i.e. LHD, access to irrigation i.e. IRA , access to extension agents i. e. EXT , area under high yielding varieties i.e. HYA and the access to institutional credit i.e. BLN were included and the negative value of the coefficient of AGE showed that the younger generation of farmers favoured the mechanization of farm much more compared to the old block. The coefficient of EDU (4.325) was positive and highly significant level confirming that the adoption of farm mechanization was more prevalent among the farms having relatively literate in the study area. It was found from the above analysis that there were different factors which affect the farm mechanization. Linkage of extension functionaries with the grassroots level by creating awareness about the use of farm machineries amongst the farmers

Key words: Mechanization adoption, linkage, profitability, credit, access to irrigation

INTRODUCTION

Farm mechanization in India is about 40-45 percent which is comparatively very low as compared to countries like US, Barzil and China according to International Exhibition & Conference on Agri- Machinery and Equipments , 2015.Mechanization encourages the improvement of efficiency of production, encourages large scale production and ultimately leads to urbanization and commercialization in agricultural sector. Olaoye (2010) reported that the key factors for successful mechanization include socio-economic factors, supporting infrastructure, land situation, and technical skills and service of people [1]. Important agricultural equipment demand like tractors, power tillers, combine harvesters, irrigation pump sets, diesel engines, has shown an increasing trend. Introduction and adoption of agricultural machinery in the recent past has mainly been confined to the northern states of India. However, with the increase in the irrigation facilities and modernization of the cropping practices, the demand for agricultural machinery has shown an increasing trend in the southern and western parts of the country. The eastern and the north-eastern states have been less responsive to adaption of agricultural machinery. [2] The shift from conventional flood irrigation to sprinkler, micro sprinkler or drip

47 irrigation systems is apparently visible indicating the importance of water use efficiency for
48 covering more area under irrigation. The Government support in the form of subsidy is serving
49 as a catalyst to compensate for the high initial cost of the system. Further, new equipment such
50 as precision planter, zero-till drill, seed cum fertilizer drill, raised bed planter, improved weeders,
51 plant protection equipment, harvesting and threshing machines, drip, micro sprinkler and
52 sprinkler irrigation equipment have been made available to the farmers. Mechanization performs
53 several activities on the farm, there is reduction in money spent on hiring of labour and time of
54 operation, and increase in productivity to meet demand for day to day growing population. Farm
55 Mechanization in enhancing farm efficiency and making farming more profitable, and i.e. why
56 Government of India has given highest priority to enhance farm mechanization . In this context
57 ICFA hosted a National Round Table Conference on Farm Mechanization on January 31, 2017 at
58 India International Centre, Lodi Estate, New Delhi. Again , average farm size in European Union
59 (14 hectare) and the US (170 hectare) but in India it is less than 2 hectares, which is far lower .
60 So, farm machineries are difficult to operate on such land holdings, which in some cases are
61 completely unsuitable because of soil condition also. Therefore, mechanization is impossible e
62 unless machines appropriate for small holdings are made available or substantial farm
63 amalgamation takes place. It is difficult for the farmers to own machinery because of small size
64 of land holdings. therefore Therefore , the mechanization adoption are prevail by only a section
65 of the farmers who have large farm holdings. . In the study area extent of mechanization adoption
66 was found moderate. In this section different factors which influence the mechanization adoption
67 in the study area are discussed. Rasouli *et al.* (2006) conducted a study to determine the factor
68 affecting the implementation of national agricultural mechanization programs in Iran and found
69 that the mean agricultural mechanization level practiced on the sunflower producing farms was
70 about 0.5 KW per ha of cultivated land and the amount of energy input varied between 0.0149 to
71 3.4973 KW. Using Multivariate linear regression ,46.9 per cent (R^2= 0.469) of the variance in the
72 level of agricultural mechanization practiced could be explained by variables such as income,
73 total farming land, and land holdings under sunflower seed cultivation [3].Ayandiji and
74 Olofinsao (2015) studied the socio economic factors affecting farm mechanization by cassava
75 farmers in Ondostate, Nigeria and logistic regression analysis model to examine the factors.
76 They found that access to extension workers and access to farm machines had a positive
77 relationship with adoption and problems faced included were access to spare parts, access to
78 skilled man power, maintenance of farm machines, availability of machines in time required.[4].
79 Mwangi and Kariuki (2015) studied the factors affecting adoption of new agricultural technology
80 by smallholder farmers in developing countries and concluded that perception of farmers towards
81 a new technology was a key precondition for adoption to occur. Other factors included were
82 human specific factors, economic factors, technological and institutional factors. They reported
83 that the determinant of agricultural technology adoption did not always have the same effect on
84 adoption rather the effect varies depending on the type of technology being introduced [5]. In
85 the context of farm mechanization impact and factors on agricultural production, , there has
86 hardly been any study so far in the state of Assam and therefore the present study was an
87 attempt to answer the aspects of farm mechanization in Assam with following specific
88 objectives.
89
90 **Objectives :** Examine the various factors affecting mechanization adoption of the sample farms
91 in the study area
92

MATERIALS AND METHODS

Study area: The present study is an attempt to study the factors affecting farm mechanization in the sample households. The study was conducted in Upper Brahmaputra and Central Brahmaputra Valley Zone of Assam

Sampling procedure: The sampling design followed for the study was four stage random sampling design. Districts from the first stage unit, blocks were the second stage unit, villages were the third and the sample farmers were the fourth ultimate stage of units of sampling. For Central Brahmaputra Valley Zone, Nagoan district had been selected as Nagaon district is ahead of mechanization compared to other districts According the Department of Agriculture, Govt of Assam . Dibrugarh and Jorhat districts represented the Upper Brahmaputra Valley Zone. In consultation with Agricultural Development Officer (ADO) and Agricultural Engineering Department, Government of Assam in the selected districts, the blocks having higher concentration of farm implements were selected.

Data collection: Primary data pertaining to the year 2014-15 were collected from 240 numbers of sample farms by personal interview method and with the help of specially designed pretested schedule were used for examining the factors affecting farm mechanization.

Analytical technique: In this study tabular method of analysis is used to present the result of field survey and Logit regression analysis was done order to study the factors affecting farm mechanization across different ample households. Logit regression is a kind of regression analysis when dependent variable is binary. Logistic regression explained the relationship between one dependent binary variable and one or more nominal , ordinal , interval or ratio level independent variable. Advantages of Logit Regression are **:**

i)It is more robust: the independent variables don't have to be normally distributed, or have equal variance in each group. It does not assume a linear relationship between the IV and DV.

ii) It may also handle nonlinear effects.

Disadvantages of Logit Regression are:

i) requires much more data to achieve stable and meaningful outcome.

ii) With standard regression typically 20 data points per predictor is considered the lower bound whereas in Logit regression, at least 50 data points per predictor is necessary to achieve stable results.

Uaiene and Rafael (2005) reported the agricultural technology adoption by rural households in Mozambique and probit and logit models based on normal and logistic cumulative distribution functions were used and difficulty in accessing credit appeared to be one of the major constraints to technology adoption [6]. Aslan *et al.* (2007) analyzed personal, physical and socio-economic factors affecting farmers land consolidation adoption with the help of dummy variable constructed against dependent and different independent variable by using logit regression model [7]. Though it is very difficult to achieve the mechanization level of the farmers, here index of mechanization was used based on farmers' used and ownership of modern implements such as tractors (owned or hired), power tiller (owned or hired), sprayer, harvester, thresher etc. Farmers' responses of these parameters are codified as scores. Total scoring of these codification ranges from 1 to 7 on the level of farm mechanization achieved by the respective farmer. Finally if the score of the farmer exceed 50 per cent of the total attainable score we considered the farm as

138 mechanized and assign a value 1to that farm and 0, otherwise. Logit analysis was with the help
139 of following formula:
140       $P = 1/(1+e^{-FM})$
141 Where, P is the probability that household achieved farm mechanization
142       $FM = a_0 + a_1*AGE + a_2*EDU + a_3*LHD + a_4*EXT + a_5*IRA + a_6*HYA + a_7*BLN$
143 Where,
144   i)   AGE is the age of head of the household(proxy for experience) in years
145   ii)   EDU is the education level of the household ;
146 Where,
147   0=illiterate
148   1= up to class IV
149   2=from class V to X
150   3=from class X to graduate level
151   4=more than graduate
152   iii) LHD is the farm size in ha.
153   iv) EXT is the level of contact with the extension functionaries;
154 Where,
155   0= no contact
156   1= contact once in a month
157   2= contact twice in a month
158   3= contact more than twice in a month
159   v) IRA is access to irrigation, 1 if yes 0,otherwise
160   vi) HYA is area grown under high yielding variety crops in ha
161   vii) BLN is access to institutional credit yes=1,0 otherwise
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164   **Result & Discussion**
165
166   Result of Logit Regression in order to analyzed different factors affecting the
167 mechanization adoption with help of Logit regression in the sample household is presented in
168 Table 1. To examine the the specific objective we look into thes ven important agrian
169 characteristics of the sample households maximum education level of the household, age of the
170 head of household, size of land holdings, access to irrigation, level of contact with extension
171 functionaries, area under high yielding varieties and the access to institutional credit were used
172 for the analysis to examine the factors affecting farm mechanization which ultimately very
173 important in economic system These variable to explain mechanization adoption *viz.*, maximum
174 education level of the household, age of the head of household, size of land holdings, access to
175 irrigation, level of contact with extension functionaries, area under high yielding varieties and
176 the access to institutional credit were used for the analysis to examine the factors affecting farm
177 mechanization. Four explanatory variables *viz.,* EDU (education level), LHD (landholding size),
178 HYA (area under high yielding varieties) and EXT (level of contact with extension functionaries)
179 out of six was found to be positively significant. The coefficient of EDU (4.32) was positive and
180 highly significant at per cent probability level confirming that the adoption of farm
181 mechanization was more prevalent among the farms having relatively literate respondents in the

182 study area. This implies that the higher the education level of the farmers, the higher the level of
183 adoption of mechanization for performing various agricultural operations. This result is in
184 conformity with the findings of positive correlation found between education and adoption of
185 new technologies reported by Uddin *et al.*(2015) reported the various factors affecting farmers
186 adaptation strategies to environmental degradation and climate change effects in Bangladesh and
187 found that age, education, family size, farm size, family income, and involvement in
188 cooperatives were significantly related to self-reported mechanization adaptation [8].The
189 coefficient of LHD i.e. size of land holding (1.773) with positive and significant at 10 per cent
190 probability level indicated that farmers having greater farm size had relatively high
191 mechanization adoption and small farmers had low adoption of mechanization. This was mainly
192 due to larger farmers were financially sound as compared to farmers with small landholding and
193 tend to have modern machineries easily. Again, coefficient of EXT i.e. level of contact with
194 extension functionaries (1.854) and HYA i.e. area under high yielding varieties (1.966) were
195 found to be significant and positive indicating that level of contact with extension functionaries
196 and area under high yielding varieties played an important role in mechanization adoption.
197 Therefore, more emphasized should be given to increasing the level of access to extension agents
198 to increase the level of mechanization adoption which ultimately uplift the rural community.
199 Hence, farm size, area under high yielding varieties and level of contact with extension
200 functionaries were considered as important explanatory variable of agricultural mechanization
201 because it showed a positive significant relationship with mechanization adoption. Contrary to
202 expectation, the coefficient of the variable IRA (1.49) i.e., access to irrigation and coefficient of
203 BLN (0.32) i.e. access to intuitional credit had found positive but insignificant relationship with
204 adoption of farm mechanization. Insignificant result IRA indicated that area under irrigated area
205 needs more farm mechanization and similar is in case of institutional credit also means that
206 farmers which ~~were~~ had access to credit should be more mechanized. Lastly, the negative value
207 of the coefficient of AGE (-2.63) showed that the younger generation of farmers favours the
208 mechanization of farm much more compared to the old block. This result is in consistence with
209 the findings reported by Ghosh (2007) carried out a study on determinants of farm mechanization
210 in Burdwan district of West Bengal in India. and revealed that younger generation were more opt
211 for farm mechanization than the older block, i.e., age-old custom acted as a hindrance to
212 mechanize the farm practices [9]. This results is in conformity with the findings of Berg (2013)
213 who revealed that the main factors were the high age of farmers, high incidence of tractor use,
214 access to land, high off-farm income and poor extension services and found no significant
215 relationships between adoption of mechanization [10]. Similarly, Bac *et al.*(2010) studied the
216 determinants affecting farmers' adoption of Vietnamese Good Agricultural Practices (VietGAP)
217 for tea production in Northern Vietnam. With the help of binary logit model and tobit model and
218 found significant and positive impacts of family laborers, tea farm size, tea price, access to
219 irrigation systems, ratio of tea income and farming experience and age of the tea farm negatively
220 affected the conversion decision and farmland allocation [11] and Owombo *et al.* (2012) reported
221 economic impact of agricultural mechanization adoption in Ondo State, Nigeria and found that

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222 adopted farmers in the area were middle-aged and were relatively educated and non-adopters
223 agreed that mechanization destroys soil quality and as a result of the logistic regression revealed
224 that education, extension visit and machine access were significant determinants of adoption of
225 mechanization practices [12]. On the contrary Kehinde *et al.* (2017) reported factors affecting
226 improved technologies dis-adoption in cocoa-based farming systems of Southwestern Nigeria
227 and revealed that education was the factors affecting dis-adoption of improved [13] .The results
228 showed that the overall results fit moderately as Mc Fadden R squared is 0.412349.

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230
231 **Table 1. Logit analysis of factors affecting farm mechanization of sample farm**
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Variable	B coefficient	Standard error	Z Statistics	Prob
AGE	-2.63	1.24	-0.985	0.0132
EDU	4.32	1.68	2.396	0.0001
LHD	1.77	1.03	0.383	0.0652
EXT	1.85	1.11	0.391	0.0789
IRA	1.49	0.17	0.312	0.8523
HYA	1.96	1.19	0.398	0.0103
BLN	0.32	0.09	5.212	0.9123

Statistical Analysis	Value
Mean dependent variable	0.198743
SE of regression	0.287544
Log likelihood	-49.439082
Mc Fadden R squared	0.412349
SD of dependent variable	0.389076
Prob (LR Statistic)	0.000000
* Sample size: 240	

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235
236   **Conclusion**
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238   Mechanization is need based process which provides sufficient time gap for self adjustment
239 of various inputs which ultimately gives positive impact on agricultural production. The present

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study showed various factors affecting of farm mechanization –in Upper Brahmaputra and Central Brahmaputra Valley zone of Assam. With the help of logit regression different factors affecting the mechanization adoption was examined. Logit regression in the sample household was done where seven explanatory variable to explain mechanization adoption *viz.*, age of the head of household, size of land holdings, access to irrigation, access to extension agents, area under high yielding varieties and the access to institutional credit were included and the negative value of the coefficient of AGE showed that the younger generation of farmers favoured the mechanization of farm much more compared to the old block. The coefficient of EDU (4.325) was positive and highly significant at confirming that the adoption of farm mechanization was more prevalent among the farms having relatively literate in the study area. The study revealed that age was the hindrance of mechanization adoption and found positive correlation between land holding size and mechanization adoption.

Recommendation:

   The following recommendations had been emerged from the above findings for appropriate policy measure for increasing the benefits of farm mechanization:
1.Development of adequate irrigation and short duration photo-insensitive varieties which would help to increase the cropping intensity which in turn will neutralize labour displacement affect in the study area.
2.Advancing credit for the purpose of purchasing of machineries should be strengthened with simplified forms of norms.
3.Increasing the uptake of improved technologies could be achieved through enlightenment programme by linkage of extension functionaries with the grassroots level by creating awareness about the use of farm machineries amongst the farmers.

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