1	Original Research Article
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3	<u>Factors Affecting Farm Mechanization – A Case Study in Assam, India</u>
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0	Abstract
, 8	Abstract
9	The study was conducted in Central Brahmanutra Valley and Upper Brahmanutra Valley
10	Zone of Assam in India Primary data of 240 sample farms by personal interview
11	schedule method and Logit Regression Analysis was used for examining the factors
12	affecting farm mechanization. adoption . All data collected from sample farms pertains
13	to the year 2014-15. With the help of logit regression different factors affecting the
14	mechanization adoption was examined in the sample households where seven
15	explanatory variable to explain mechanization adoption viz., age of the head of household
16	i.e. AGE, education level of the household i.e. EDU, size of land holdings i.e. LHD,
17	access to irrigation i.e. IRA, access to extension agents i. e. EXT, area under high
18	yielding varieties i.e. HYA and the access to institutional credit i.e. BLN were included
19	and the negative value of the coefficient of AGE showed that the younger generation of
20	farmers favoured the mechanization of farm much more compared to the old block. The
21	coefficient of EDU (4.325) was positive and highly significant level confirming that the
22	adoption of farm mechanization was more prevalent among the farms having relatively
23	literate in the study area. It was found from the above analysis that there were different
24	factors which affect the farm mechanization. Linkage of extension functionaries with the
25	grassroots level by creating awareness about the use of farm machineries amongst the
26	rarmers
27 20	Kon words. Machanization adoption linkage profitability credit access to irrigation
20 29	Key words. Mechanization adoption, unkage, projudbinity, crean, access to irrigation
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31	INTRODUCTION
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33	Farm mechanization in India is about 40-45 percent which is comparatively very low as
34	compared to countries like US, Barzil and China according to International Exhibition &
35	Conference on Agri- Machinery and Equipments, 2015. Mechanization encourages the
36	improvement of efficiency of production, encourages large scale production and ultimately leads
37	to urbanization and commercialization in agricultural sector. Olaoye (2010) reported that the key
38	factors for successful mechanization include socio-economic factors, supporting infrastructure,
39	land situation, and technical skills and service of people [1]. Important agricultural equipment
40	demand like tractors, power tillers, combine harvesters, irrigation pump sets, diesel engines, has
41	shown an increasing trend. Introduction and adoption of agricultural machinery in the recent past
42	has mainly been confined to the northern states of India. However, with the increase in the
43	irrigation facilities and modernization of the cropping practices, the demand for agricultural
44	machinery has shown an increasing trend in the southern and western parts of the country. The
45	eastern and the north-eastern states have been less responsive to adaption of agricultural
40	machinery. [2] The shift from conventional flood infigation to sprinkler, micro sprinkler of 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 as a catalyst to compensate for the high initial cost of the system. Further, new equipment such 49 as precision planter, zero-till drill, seed cum fertilizer drill, raised bed planter, improved weeders, 50 plant protection equipment, harvesting and threshing machines, drip, micro sprinkler and 51 sprinkler irrigation equipment have been made available to the farmers. Mechanization performs 52 several activities on the farm, there is reduction in money spent on hiring of labour and time of 53 54 operation, and increase in productivity to meet demand for day to day growing population. Farm Mechanization in enhancing farm efficiency and making farming more profitable, and i.e. why 55 56 Government of India has given highest priority to enhance farm mechanization. In this context ICFA hosted a National Round Table Conference on Farm Mechanization on January 31, 2017 at 57 India International Centre, Lodi Estate, New Delhi. Again, average farm size in European Union 58 (14 hectare) and the US (170 hectare) but in India it is less than 2 hectares, which is far lower. 59 So, farm machineries are difficult to operate on such land holdings, which in some cases are 60 completely unsuitable because of soil condition also. Therefore, mechanization is impossible 61 unless machines appropriate for small holdings are made available or substantial farm 62 amalgamation takes place. It is difficult for the farmers to own machinery because of small size 63 of land holdings. Therefore, the mechanization adoption are prevail by only a section of the 64 farmers who have large farm holdings. In the study area extent of mechanization adoption was 65 found moderate. In this section different factors which influence the mechanization adoption in 66 the study area are discussed. Rasouli et al. (2006) conducted a study to determine the factor 67 affecting the implementation of national agricultural mechanization programs in Iran and found 68 69 that the mean agricultural mechanization level practiced on the sunflower producing farms was about 0.5 KW per ha of cultivated land and the amount of energy input varied between 0.0149 to 70 3.4973 KW. Using Multivariate linear regression .46.9 per cent ($R^2 = 0.469$) of the variance in the 71 level of agricultural mechanization practiced could be explained by variables such as income, 72 total farming land, and land holdings under sunflower seed cultivation [3]. Avandiji and 73 Olofinsao (2015) studied the socio economic factors affecting farm mechanization by cassava 74 farmers in Ondostate, Nigeria and logistic regression analysis model to examine the factors. 75 They found that access to extension workers and access to farm machines had a positive 76 relationship with adoption and problems faced included were access to spare parts, access to 77 78 skilled man power, maintenance of farm machines, availability of machines in time required.[4]. Mwangi and Kariuki [4] studied the factors affecting adoption of new agricultural technology by 79 smallholder farmers in developing countries and concluded that perception of farmers towards a 80 new technology was a key precondition for adoption to occur. Other factors included were 81 human specific factors, economic factors, technological and institutional factors. They reported 82 that the determinant of agricultural technology adoption did not always have the same effect on 83 adoption rather the effect varies depending on the type of technology being introduced [5]. In 84 the context of farm mechanization impact and factors on agricultural production, there has hardly 85 been any study so far in the state of Assam and therefore the present study was an attempt to 86 answer the aspects of farm mechanization in Assam with following specific objectives. 87 88 **Objectives :** Examine the various factors affecting mechanization adoption of the sample farms 89

- 90 in the study area
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94	MATERIALS AND METHODS
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96	Study area: The present study is an attempt to study the factors affecting farm
97	mechanization in the sample households. The study was conducted in Upper Brahmaputra and
98	Central Brahmaputra Valley Zone of Assam
99	Sampling procedure: The sampling design followed for the study was four stage random
100	sampling design. Districts from the first stage unit, blocks were the second stage unit, villages
101	were the third and the sample farmers were the fourth ultimate stage of units of sampling. For
102	Central Brahmaputra Valley Zone, Nagoan district had been selected as Nagaon district is ahead
103	of mechanization compared to other districts According the Department of Agriculture, Govt of
104	Assam . Dibrugarh and Jorhat districts represented the Upper Brahmaputra Valley Zone. In
105	consultation with Agricultural Development Officer (ADO) and Agricultural Engineering
106	Department, Government of Assam in the selected districts, the blocks having higher
107	concentration of farm implements were selected.
108	Data collection: Primary data pertaining to the year 2014-15 were collected from 240 numbers
109	of sample farms by personal interview method and with the help of specially designed pretested
110	schedule were used for examining the factors affecting farm mechanization.
111	Analytical technique: In this study tabular method of analysis is used to present the result of
112	field survey and Logit regression analysis was done order to study the factors affecting farm
113	mechanization across different ample households. Logit regression is a kind of regression
114	analysis when dependent variable is binary. Logistic regression explained the relationship
115	between one dependent binary variable and one or more nominal, ordinal, interval or ratio level
116	independent variable. Advantages of Logit Regression are :
117	i)It is more robust: the independent variables don't have to be normally distributed, or have equal
118	variance in each group. It does not assume a linear relationship between the IV and DV.
119	ii) It may also handle nonlinear effects.
120	Disadvantages of Logit Regression are:
121	i) requires much more data to achieve stable and meaningful outcome.
122	11) With standard regression typically 20 data points per predictor is considered the lower bound
123	whereas in Logit regression, at least 50 data points per predictor is necessary to achieve stable
124	results.
125	Ualene and Rafael [6] reported the agricultural technology adoption by rural households in
126	Mozambique and probit and logit models based on normal and logistic cumulative distribution
127	to technology adoption. Aslan at al. [7] analyzed nervonal inhysical and social accompanie factors
128	offecting formers and consolidation adoption with the help of dymmy variable constructed
129	anecting farmers fand consolidation adoption with the help of duffinity variable constructed
121	is very difficult to achieve the mechanization level of the formers, here index of mechanization
127	was used based on farmers' used and ownership of modern implements such as tractors (owned
122	or hired) power tiller (owned or hired) spraver harvester thresher etc. Farmers' responses of
137	these parameters are codified as scores. Total scoring of these codification ranges from 1 to 7 on
135	the level of farm mechanization achieved by the respective farmer. Finally if the score of the
136	farmer exceed 50 per cent of the total attainable score we considered the farm as mechanized and
137	assign a value 1 to that farm and 0, otherwise. Logit analysis was with the help of following
138	formula:

139	$P = 1/(1 + e^{-FM})$
140	Where, P is the probability that household achieved farm mechanization
141	$FM=a_0+a_1*AGE+a_2*EDU+a_3*LHD+a_4*EXT+a_5*IRA+a_6*HYA+a_7*BLN$
142	Where,
143	i) AGE is the age of head of the household(proxy for experience) in years
144	ii) EDU is the education level of the household;
145	Where,
146	0=illiterate
147	1= up to class IV
148	2=from class V to X
149	3=from class X to graduate level
150	4=more than graduate
151	iii) LHD is the farm size in ha.
152	iv) EXT is the level of contact with the extension functionaries;
153	Where,
154	0 = no contact
155	I = contact once in a month
150	2 = contact twice in a month
157	S = Contact more than twice in a monthw) IP A is access to irrigation 1 if yes 0 otherwise
150	v) HVA is area grown under high vielding variety grops in ha
160	vii) BLN is access to institutional credit ves-1.0 otherwise
161	vir) BEA is access to institutional credit yes=1,0 otherwise
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163	Result & Discussion
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165	Result of Logit Regression in order to analyze different factors affecting the
166	mechanization adoption with help of Logit regression in the sample household is presented in
167	Table 1. To examine the the specific objective we look into the ven important agrian
168	characteristics of the sample households maximum education level of the household, age of the
169	head of household, size of land holdings, access to irrigation, level of contact with extension
170	functionaries area under high vielding varieties and the access to institutional credit were used
171	for the analysis to examine the factors affecting farm mechanization which ultimately very
172	important in economic system These variable to explain mechanization adoption viz maximum
172	aducation level of the household are of the head of household size of land holdings access to
171	irrigation level of antact with extension functionaries, area under high violding variatios and
174	the access to institutional andit were used for the analysis to avaming the factors offecting form
175	the access to institutional credit were used for the analysis to examine the factors affecting farm
1/6	mechanization. Four explanatory variables <i>viz.</i> , EDU (education level), LHD (landholding size),
177	HYA (area under high yielding varieties) and EXT (level of contact with extension functionaries)
178	out of six was found to be positively significant. The coefficient of EDU (4.32) was positive and
179	highly significant at per cent probability level confirming that the adoption of farm
180	mechanization was more prevalent among the farms having relatively literate respondents in the
181	study area. This implies that the higher the education level of the farmers, the higher the level of
182	adoption of mechanization for performing various agricultural operations. This result is in

183 conformity with the findings of positive correlation found between education and adoption of new technologies reported by Uddin et al. (2015) reported the various factors affecting farmers 184 adaptation strategies to environmental degradation and climate change effects in Bangladesh and 185 found that age, education, family size, farm size, family income, and involvement in 186 187 cooperatives were significantly related to self-reported mechanization adaptation [8]. The coefficient of LHD i.e. size of land holding (1.773) with positive and significant at 10 per cent 188 probability level indicated that farmers having greater farm size had relatively high 189 mechanization adoption and small farmers had low adoption of mechanization. This was mainly 190 due to larger farmers were financially sound as compared to farmers with small landholding and 191 tend to have modern machineries easily. Again, coefficient of EXT i.e. level of contact with 192 extension functionaries (1.854) and HYA i.e. area under high vielding varieties (1.966) were 193 found to be significant and positive indicating that level of contact with extension functionaries 194 195 and area under high yielding varieties played an important role in mechanization adoption. 196 Therefore, more emphasized should be given to increasing the level of access to extension agents to increase the level of mechanization adoption which ultimately uplift the rural community. 197 Hence, farm size, area under high yielding varieties and level of contact with extension 198 functionaries were considered as important explanatory variable of agricultural mechanization 199 because it showed a positive significant relationship with mechanization adoption. Contrary to 200 expectation, the coefficient of the variable IRA (1.49) i.e., access to irrigation and coefficient of 201 BLN (0.32) i.e. access to intuitional credit had found positive but insignificant relationship with 202 adoption of farm mechanization. Insignificant result IRA indicated that area under irrigated area 203 needs more farm mechanization and similar is in case of institutional credit also means that 204 205 farmers which had access to credit should be more mechanized. Lastly, the negative value of the coefficient of AGE (-2.63) showed that the younger generation of farmers favours the 206 mechanization of farm much more compared to the old block. This result is in consistence with 207 the findings reported by Ghosh [9] carried out a study on determinants of farm mechanization in 208 209 Burdwan district of West Bengal in India.and revealed that younger generation were more opt for farm mechanization than the older block, i.e., age-old custom acted as a hindrance to 210 mechanize the farm practices. This results is in conformity with the findings of Berg (2013) who 211 revealed that the main factors were the high age of farmers, high incidence of tractor use, access 212 213 to land, high off-farm income and poor extension services and found no significant relationships between adoption of mechanization [10]. Similarly, Bac et al. [11] studied the determinants 214 affecting farmers' adoption of Vietnamese Good Agricultural Practices (VietGAP) for tea 215 production in Northern Vietnam. With the help of binary logit model and tobit model and found 216 significant and positive impacts of family laborers, tea farm size, tea price, access to irrigation 217 systems, ratio of tea income and farming experience and age of the tea farm negatively affected 218 the conversion decision and farmland allocation [11] and Owombo et al. (2012) reported 219 economic impact of agricultural mechanization adoption in Ondo State, Nigeria and found that 220 221 adopted farmers in the area were middle-aged and were relatively educated and non-adopters 222 agreed that mechanization destroys soil quality and as a result of the logistic regression revealed

- that education, extension visit and machine access were significant determinants of adoption of
- mechanization practices [12]. On the contrary Kehinde *et al.* [13] reported factors affecting
- 225 improved technologies dis-adoption in cocoa-based farming systems of Southwestern Nigeria
- and revealed that education was the factors affecting dis-adoption of improved. The results
- showed that the overall results fit moderately as Mc Fadden R squared is 0.412349.
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Table 1. Logit analysis of factors affecting farm mechanization of sample farm 231

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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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Conclusion

Mechanization is need based process which provides sufficient time gap for self adjustment of various inputs which ultimately gives positive impact on agricultural production. The present 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 242 243 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 244 the coefficient of AGE showed that the younger generation of farmers favoured the 245 mechanization of farm much more compared to the old block. The coefficient of EDU (4.325) 246 was positive and highly significant at confirming that the adoption of farm mechanization was 247 more prevalent among the farms having relatively literate in the study area. The study revealed 248 that age was the hindrance of mechanization adoption and found positive correlation between 249 land holding size and mechanization adoption. 250

251 252

253 **Recommendation:**

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The following recommendations had been emerged from the above findings for appropriate 255 policy measure for increasing the benefits of farm mechanization: 256

1.Development of adequate irrigation and short duration photo-insensitive varieties which would 257

help to increase the cropping intensity which in turn will neutralize labour displacement affect in 258 the study area. 259

- 2.Advancing credit for the purpose of purchasing of machineries should be strengthened with 260 simplified forms of norms. 261
- 3.Increasing the uptake of improved technologies could be achieved through enlightenment 262
- program by linkage of extension functionaries with the grassroots level by creating awareness 263
- about the use of farm machineries amongst the farmers. 264
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