



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

Sinki Barman^{1*}, Nivedita Deka² and Pallavi Deka³

¹Krishi Vigyan Kendra, Nagaon, India.

²Assam Agricultural University, Jorhat, India.

³Krishi Vigyan Kendra, Udalguri, India.

Authors' contributions

This work was carried out in collaboration among all authors. Author SB designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ND and PD managed the analyses of the study. Author PD managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2019/v32i130146

Editor(s):

- (1) Dr. Rajesh Kumar Assistant Professor, Department of Veterinary & A.H. Extension Education, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), India.
- (2) Dr. Md. Abiar Rahman, Professor, Agroforestry & Environment, Additional Director, IQAC-BSMRAU, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Bangladesh.
- (3) Dr. Golubkina Nadezhda Alexandrovna, Agrochemical research center, All-Russian Institute of vegetable breeding and seeds production, Moscow Region, Russia.

Reviewers:

- (1) Dr. Virendra Singh, IFTM University, India.
 - (2) Luana Oliveira Leite, State University of Ceará, Brazil.
 - (3) Natson Eyram Amengor, CSIR-Crops Research Institute, Ghana.
- Complete Peer review History: <http://www.sdiarticle3.com/review-history/48079>

Received 03 February 2019

Accepted 17 April 2019

Published 22 April 2019

Original Research Article

ABSTRACT

The study was conducted in Central Brahmaputra Valley and Upper Brahmaputra Valley Zone of Assam in India. Primary 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

*Corresponding author: E-mail: sinkutes@gmail.com;

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.

Keywords: Mechanization adoption; linkage; profitability; credit; access to irrigation.

1. INTRODUCTION

Farm mechanization in India is about 40-45 percent which is comparatively very low as compared to countries like US, Brazil and China according to International Exhibition & Conference on Agri- Machinery and Equipment, 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 irrigation systems is apparently visible indicating the importance of water use efficiency for 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 as precision planter, zero-till drill, seed cum fertilizer drill, raised bed planter, improved weeders, plant protection equipment, harvesting and threshing machines, drip, micro sprinkler and sprinkler irrigation equipment have been made available to the farmers. Mechanization performs several activities on the farm, there is reduction in money spent on hiring of labour and time of 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 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 India International Centre, Lodi Estate, New Delhi. Again, average farm size in European Union (14 hectare) and the US (170 hectare) but in India it is less than 2 hectares, which is far lower. So, farm machineries are difficult to operate on such land holdings, which in some cases are completely unsuitable because of soil condition also. Therefore, mechanization is impossible unless machines appropriate for small holdings are made available or substantial farm amalgamation takes place. It is difficult for the farmers to own machinery because of small size of land holdings. Therefore, the mechanization adoption is prevailing by only a section of the farmers who have large farm holdings. In the study area extent of mechanization adoption was found moderate. In this section different factors which influence the mechanization adoption in the study area are discussed. Rasouli et al. (2006) conducted a study to determine the factor affecting the implementation of national agricultural mechanization programs in Iran and found 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 3.4973 KW. Using Multivariate linear regression, 46.9 per cent ($R^2 = 0.469$) of the variance in the level of agricultural mechanization practiced could be explained by variables such as income, total farming land, and land holdings under sunflower seed cultivation [3]. Ayandiji and Olofinsao studied the socio economic factors affecting farm mechanization by cassava farmers in Ondo state, Nigeria and logistic regression analysis model to examine the factors. They found that access to extension workers and access to farm machines had a positive relationship with adoption and problems faced included were access to spare parts, access to 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 smallholder farmers in developing countries and concluded that perception of farmers towards a new technology was a key precondition for adoption to occur. Other factors included were human specific factors, economic factors, technological and institutional factors. They reported that the determinant of agricultural technology adoption did not always have the same effect on adoption rather the effect varies depending on the type of technology being introduced [5]. In the context of farm mechanization impact and factors on agricultural production, there has hardly been any study so far in the state of Assam and therefore the present study was an attempt to answer the aspects of farm mechanization in Assam with following specific objectives.

1.1 Objectives

Examine the various factors affecting mechanization adoption of the sample farms in the study area.

2. MATERIALS AND METHODS

2.1 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.

2.2 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 Nagoan 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.

2.3 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.

2.4 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 [6] 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. Aslan et al. [7] 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. 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 mechanized and assign a value 1 to that farm and 0, otherwise. Logit analysis was with the help of following formula:

$$P = 1/(1+e^{-FM})$$

Where, P is the probability that household achieved farm mechanization

$$FM = a_0 + a_1*AGE + a_2*EDU + a_3*LHD + a_4*EXT + a_5*IRA + a_6*HYA + a_7*BLN$$

Where,

- i) AGE is the age of head of the household(proxy for experience) in years
- ii) EDU is the education level of the household ;

Where,

- 0=illiterate
- 1= up to class IV
- 2=from class V to X
- 3=from class X to graduate level
- 4=more than graduate

- iii) LHD is the farm size in ha.
- iv) EXT is the level of contact with the extension functionaries;

Where,

- 0= no contact
- 1= contact once in a month
- 2= contact twice in a month
- 3= contact more than twice in a month

- v) IRA is access to irrigation, 1 if yes 0, otherwise
- vi) HYA is area grown under high yielding variety crops in ha
- vii) BLN is access to institutional credit yes=1,0 otherwise

3. RESULTS AND DISCUSSION

Result of Logit Regression in order to analyze different factors affecting the mechanization adoption with help of Logit regression in the

sample household is presented in Table 1. To examine the the specific objective we look into the ven important agrarian characteristics of the sample households maximum education level of the household, age of the head of household, size of land holdings, access to irrigation, level of contact with extension functionaries, area under high yielding varieties and the access to institutional credit were used for the analysis to examine the factors affecting farm mechanization which ultimately very important in economic system These variable to explain mechanization adoption viz., maximum education level of the household, age of the head of household, size of land holdings, access to irrigation, level of contact with extension functionaries, area under high yielding varieties and the access to institutional credit were used for the analysis to examine the factors affecting farm mechanization. Four explanatory variables viz., EDU (education level), LHD (landholding size), HYA (area under high yielding varieties) and EXT (level of contact with extension functionaries) out of six was found to be positively significant. The coefficient of EDU (4.32) was positive and highly significant at per cent probability level confirming that the adoption of farm mechanization was more prevalent among the farms having relatively literate respondents in the study area. This implies that the higher the education levels of the farmers, the higher the level of adoption of mechanization for performing various agricultural operations. This result is in 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 adaptation strategies to environmental degradation and climate change effects in Bangladesh and found that age, education, family size, farm size, family income, and involvement in 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 probability level indicated that farmers having greater farm size had relatively high mechanization adoption and small farmers had low adoption of mechanization. This was mainly due to larger farmers were financially sound as compared to farmers with small landholding and tend to have modern machineries easily. Again, coefficient of EXT i.e. level of contact with extension functionaries (1.854) and HYA i.e. area under high yielding varieties (1.966) were found to be significant and positive indicating that level of contact with extension functionaries and area

under high yielding varieties played an important role in mechanization adoption. 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. Hence, farm size, area under high yielding varieties and level of contact with extension functionaries were considered as important explanatory variable of agricultural mechanization because it showed a positive significant relationship with mechanization adoption. Contrary to expectation, the coefficient of the variable IRA (1.49) i.e., access to irrigation and coefficient of BLN (0.32) i.e. access to intuitional credit had found positive but insignificant relationship with adoption of farm mechanization. Insignificant result IRA indicated that area under irrigated area needs more farm mechanization and similar is in case of institutional credit also means that 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 mechanization of farm much more compared to the old block. This result is in consistence with the findings reported by Ghosh [9] carried out a study on determinants of farm mechanization in 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 mechanize the farm practices. This results is in conformity with the findings of Berg (2013) who

revealed that the main factors were the high age of farmers, high incidence of tractor use, access 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 affecting farmers' adoption of Vietnamese Good Agricultural Practices (VietGAP) for tea production in Northern Vietnam. With the help of binary logit model and tobit model and found significant and positive impacts of family laborers, tea farm size, tea price, access to irrigation systems, ratio of tea income and farming experience and age of the tea farm negatively affected the conversion decision and farmland allocation [11] and Owombo et al. (2012) reported economic impact of agricultural mechanization adoption in Ondo State, Nigeria and found that adopted farmers in the area were middle-aged and were relatively educated and non-adopters 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 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.

Table 1. Logit analysis of factors affecting farm mechanization of sample farm

| 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 | |

4. 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 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 program by linkage of extension functionaries with the grassroots level by creating awareness about the use of farm machineries amongst the farmers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Olaoye JO, Rotimi AO. Measurement of agricultural mechanization index and analysis of agricultural productivity of some farm settlements in South West, Nigeria. *Agricultural Engineering International: The CIGR E journal*. Manuscript 1372. 2010;11.
2. International Exhibition & Conference on Agri-Machinery and Equipment. *Transferring Agriculture Through Mechanization*; 2015, IARI, PUSA, New Delhi; 2015.
3. Rasouli et al. Factor affecting agricultural mechanization: A case study on sunflower seed farms in Iran. *Journal of Agricultural Science Technology*. 2006;11:39-48.
4. Mwangi M, Kariuki S. Factor's determining adoption of new agricultural technology by small holder farmers in developing countries. *Journal of Economics and Sustainable Development*. 2015;6(5).
5. Ayandiji A, Olofinsao OT. Socio economic factors affecting adoption of farm mechanization by cassava farmers in Ondo State, Nigeria. *IOSR Journal of Environmental Science, Toxicology and Food Technology*. 2014;9(3):39-45.
6. Uaiene, Rafael N. Determinants of agricultural technology adoption in Mozambique. *International Food Policy Research Institute, Maputo, Mozambique*; 200.
7. Aslan STA, Gundogdu KS, Yaslioglu E, Kirmikil M, Arici I. *Spanish Journal of Agricultural Research*. 2007;5(2):204-213.
8. Uddin MN, Bokelmann W, Entsminger JS. Factors affecting farmers' adaptation strategies to environmental degradation and climate change effects: A farm level study in Bangladesh. *Climate*. 2012;223-241.
9. Ghosh BK. Determinants of farm mechanization in modern agriculture: A case study of Burdwan districts of West Bengal. *International Journal of Agricultural Research*. 2007;5(2):1107-1115.
10. Berg JV. Socio-economic factors affecting adoption of improved agricultural practices by small scale farmers in South Africa. *African Journal Agricultural Research*. 2013;8(35):4490-4500.
11. Bac HV, Nanseki T, Chomei Y. Factors influencing tea farmers' decision to adopt Vietnamese good agricultural practices in Northern Vietnam. *Journal of Agricultural Economics and Development*. 2016;6(2): 012-020.

12. Owombo, et al. Economic impact of agricultural mechanization adoption: Evidence from Maize farmers in Ondo State, Nigeria. *Journal of Agriculture and Biodiversity Research*. 2012;1:25-32.
13. Kehinde AD, Adeyemo R. A probity analysis of factors affecting improved technologies dis-adoption in cocoa-based farming systems of southwestern Nigeria. *International Journal of Agricultural Economics*. 2016;2(2):35-41.

© 2019 Barman and Deka; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle3.com/review-history/48079>