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Impact of Extension Services Provided by ATMA (Agricultural Technology Management Agency) on Small and Marginal Farmers in Rural Assam

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ABSTRACT

Agricultural Extension Services aim at disseminating new knowledge and skill to farmers to aid them in adopting new agricultural technologies and use their resources efficiently. Agricultural knowledge improves their skill and decision-making and enhances more efficient utilization of agricultural technologies. With a sample of 160 famers collected from Golaghat district of Assam by using multi-staged random sampling method, this study attempts to understand the impact of extension services provided by ATMA (Agricultural Technology Management Agency) in rural Assam. The Propensity Score Matching (PSM) technique is employed to control for potential sample selection biases. The analysis and findings reveal that the extension services provided by ATMA in the study area positively impacts on the income and paddy production of the small and marginal farmers. Timely dissemination of extension services which meet the actual needs of the farmers can impact the farmers income and output production to larger extent.

Keywords: *ATMA; Agricultural Extension Services; Propensity Score Matching; Small and marginal farmers; Assam*

INTRODUCTION

The ATMA model, a decentralised, market driven extension model, was introduced under the National Agricultural Technology Project (NATP) as a solution to the challenges faced by Training and Visit System which was plagued by unrelenting fund requirements and inadequate quality-employees. (Anderson and Feder, 2004; Reddy and Swanson, 2006;Swanson et al., 2008; Babu et al., 2013). "Support to State Extension Programs for Extension Reforms" widely known as Agriculture Technology Management Agency (ATMA) Scheme was first implemented in 2005 and presently is functioning in 691 districts of 28 states and 5 Union Territories throughout India. Since its inception, the ATMA has been disseminating extension services to the agriculture and allied sectors of the country in the form of Farmers Training, Demonstrations, Exposure Visits, Kisan Mela, Mobilization of Farmers Groups and organizing Farm Schools at the district level. In the year 2021, 1370654 farmers benefitted from nationwide provision of

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extension services by ATMA. Of the total beneficiaries about 45 percent had participated in training programs and 13 percent in demonstrations organized by ATMA. In Assam, the number of participants in trainings programmes has shown an increasing trend since a decade and in 2021, it shared about 91 percent of the total beneficiaries of extension services provided by ATMA in the state (Ministry of Agriculture and Farmers Welfare).

International studies have generally evaluated extension system and methodology and have found mixed results (Dercon et al., 2009 ; Davis et al., 2012; Hunt et al., 2014; Läpple and Hennessy 2015; Josephat and Rose, 2015 Cawley et al., 2018; Teka and Lee, 2019).

Previous researches have also been conducted to see the impact of extension services of ATMA in India and these studies too have found mixed results (IIM, Lucknow, 2004a; 2004b; Swanson et al., 2009; Singh, et al., 2014; Babuet al. 2013;Saikia et al., 2013; Biam and Barman, 2017; Goswami and Bezbaruah, 2017; Walling et al. 2017; Deka et al. 2017; Bortamuly and Das, 2018; Shita et al., 2020). Most of these studies have focused on the implementation and institutional achievements ATMA, on the organizational performance of the agency and on the nature and effectiveness of adoption of technology, and therefore, there are limited systematic farm-level studies which have looked into the impact of extension services provided by ATMA on total output production and income of the farmers. This calls for assessing the impact of extension services on the total output production and income of the farmers.

A review of previous studies on the impact of extension interventions by Anderson and Feder (2004) warns that the mixed results obtained in the previous studies should be treated with caution because of existent econometric challenges. Assessing the impact of extension services is, indeed, a challenge (Ragasa et al. 2016) because of the vast range and diversity in the methods of extension and the outcome measures which might lead to possible inconsistent results (Läpple and Hennessy, 2015). However, viewing from the policy perspectives, the ultimate criterion is to understand the impact of these extension interventions (Birneret al., 2009). Heinrich et al.,(2010) and Duflo and Kremer (2003) point towards problems namely, establishing the counterfactual; an adequate group for comparison; sample selection bias. Unfortunately, most of the studies concerning the impact of extension interventions in the past have been assessed by looking at the pre-intervention and post intervention observations with little consideration to the counterfactual factors (Josephat and Likengaga, 2015).

Accordingly, the purpose of this study is to see the impact of the extension service provided by ATMA on farmers output production and farm-level income after controlling for potential sample selection biases.Our study attempts to understand the impact of extension services by using the Propensity Score Matching (PSM), which addresses the fundamental problems associated with impact evaluation, and also controls for possible sample selection bias.

METHODOLOGY

The present study was conducted in Golaghat district of Assam which comprises about 2.03 lakh farm families, who are engaged in paddy production. Primary data for the study were collected by conducting a field survey in which the head of the farmer household was interviewed. It is to be mentioned here that, being the main crop produced in the district, paddy crop focused in the study. The universe of the study being vast and the researcher facing resource and time constraints, four blocks in Golaghat district were selected for field survey given their level of paddy production. For the selection of farm households, in the present study, a multi-staged random sampling method was used. Initially, four blocks in the district, namely- Kathalguri, Kakodonga, Gomariguri and Morangi, were selected for the present study. From each block, four Gram Panchayat Units (GPUs) were selected randomly. From each GPU, one village was selected randomly and finally, from each village, ten farm-households were interviewed randomly. Thus, the total sample included one hundred and sixty farmers, of which fifty percent farmers were beneficiaries of ATMA, and had attended training programmes and method demonstration in line planting, nutrient management and its application and spraying of insecticides in 2019 and 2020. The remaining had never received extension service in any form from ATMA. Primary Data was collected by interviewing the head of the farmer household using an interview schedule which was prepared by consulting the existing literature. Data on various aspects of agriculture like land holding, the socio-economic profile of the farmer household, access to extension services provided by ATMA and the quality and usefulness of the technology disseminated at the district level by Agricultural Technology Management Agency were recorded with the help the interview schedule during December, 2020 and January, 2021 through field survey.

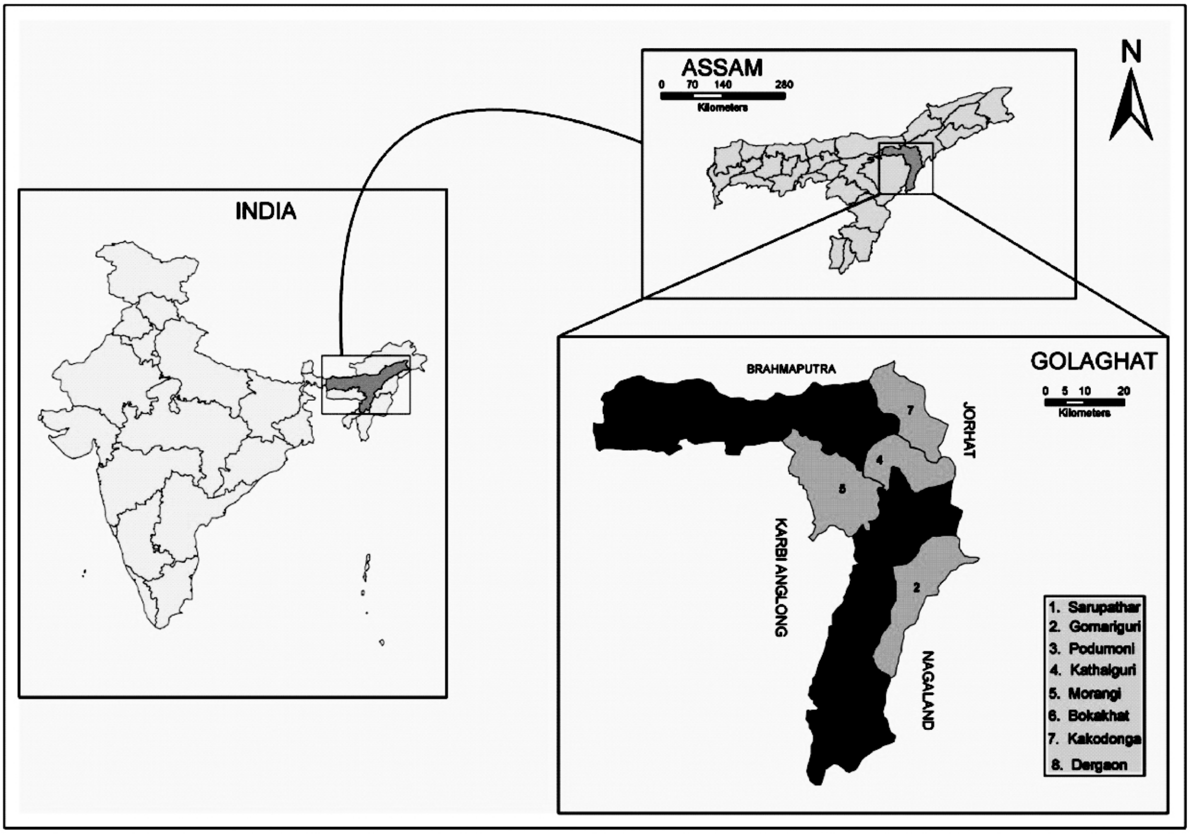

Figure 1: Map of the study area

To understand the impact of extension services provided by ATMA in the study area the Propensity Score Matching (PSM) technique, introduced by Rosenbaum and Rubin (1983) was employed. Propensity Score Matching refers to the pairing of treatment and controlled observations having similar values on their propensity scores for an individual *(i)* as the conditional probability (p) of receiving a particular treatment given a vector of observed covariates (Z) and is expressed as:

$$p(Z)i = Pr\{Di = 1|Zi\}\text{.......................}(i)$$

where, D indicates the exposure to treatment. It takes the value 1 for receiving treatment or membership in the treated group and 0 for not receiving treatment or membership in controlled group. *Zi* represents the vector of observed covariates for the i^{th} individual. The exposure to treatment within the cells defined by the values of the mono-dimensional variables $p(Z)$ is random if the exposure to treatment wihin the cells defined by *Z*is random.p(Z) is also known as the Average effect of Treatment on the Treated (ATET) is a prominent estimator as it explicitly focuses on the effects on those for whom the scheme is intended, and is expressed as

$$ATET = E\{y_{1i} - y_{0i} | D\,i = 1\}\text{..................}(ii)$$

$$= E\{E\{y_{1i} - y_{0i} | D\,i = 1, (p\,(Z_i))\}\}$$

$$= E\{E\{y_{1i} | D\,i = 1, (p(Z_i)\} - E\{y_{0i} | D\,i = 0, (p(Z_i)\} | D\,i = 1\}\text{..........}(iii)$$

Where, the outer expectation is over the distribution of $(p(Z_i)\}|D\ i=1)$ and y_{1i} and y_{0i} are the possible outcomes of the treatment and non-treatment respectively. The expected outcome of the average treatment effect for the treated is the difference between the outcomes of the treated and of the treatment, had they not been treated.

One of the major problems in estimating treatment effects is the selection biases that arise because of the differences between the treated and non-treated groups for reasons other than treatment status. The Propensity Score Matching technique is usually used in evaluation studies to correct for potential bias arising in the data due to differences between the treatment and controlled observations (Godtland et al.,2004; Mendola, 2007; Ali and Rahut, 2013; Teka and Lee, 2019; Shita et al., 2020).

FINDINGS AND DISCUSSION

General Characteristics of the Sampled Farmers

The sampled farmers' socioeconomic profile helps to understand the characteristics of the farmers' households in the study area. Table1 provides information on the general characteristics of the sampled farmers which helps to identify the broad socio-economic characteristics of both the groups of farmers in the study area. Efforts have been made to understand the level of living of the farmers through the sampled farmers' age and experience in agriculture and allied activities, years of schooling, operational land holding, production and annual income.It is evident from Table 1 that, on average, most of the farmers are adults have considerable years of experience in paddy farming. The average years of schooling of the sampled farmers is about ten years which implies that farmers in the study area have received high school education. The average size land-holding of the total sampled farmers as evident from the table indicates that most of the farmers are small and marginal land holders. The average family size of the sampled farmer household is about 5 members. It is also seen that on average the beneficiary farmers produce about 74 quintals of paddy and their average annual income is about INR 129000.The non-beneficiary farmers, on the other hand, produce on an average of about 48 quintals and their average annual income is about INR 83995.The perusal of Table 1 reveals that there is significant mean difference in production and income between the beneficiaries of ATMA and the non- beneficiary farmers who have not received any benefits from ATMA. A statistically significant difference in the production between the two categories of farmers, with a mean production difference of about 25 kilograms, is seen in the table. The observation is similar between the two groups of farmers in terms of Income.

Table 1. General Characteristics of the Sampled Farmers

Sl.No.	Variable	Mean		Mean Difference	t (SE)
		Beneficiaries	Non-Beneficiaries		
1	Age	43.52 (7.78)	43.78 (10.83)	-.5375	-0.3603 (1.491)
2	Education	10.16 (3.83)	9.52 (3.23)	.6375	1.1370 (.560)
3	Family size	4.85 (1.09)	4.68 (1.22)	.1625	0.8844 (0.183)
4	Land-Holding	1.34 (0.77)	0.84 (0.38)	.5003	1.4578 (0.146)
5	Production	73.62 (44.21)	48.33 (26.41)	25.29	(5.763)
6	Income	129000 (70277.08)	83995 (42972.73)	45272.5	4.9157*** (9209.725)

Note: *** indicate that the results are statistically significant at 1 percent level of significance

A statistically significant difference in the income between the two categories of farmers, with a mean income difference of INR.45272, is noticed from the table. However, no statistically significant differences are noticed in the other variables between the farmers who have received extension services from ATMA and the farmers who have not received any agricultural extension benefits. Therefore, it can be said that there is significant evidence that to support the fact that extension services provided by ATMA impact the farmers' production and income.

Treatment Effect

The Probit model, with extension beneficiary as the dependent variable and other demographic and socioeconomic variables as explanatory variables, is used to estimate the propensity scores. All the estimations were done using the "pscore.ado" module in the STATA software. The result of the Probit Regression, based on which the propensity scores were estimated, is presented in Table 2. The dichotomous variable extension beneficiary was treated as the dependent variable that assumed a value of "1" if the farmer household was a beneficiary and "0" if not. The explanatory variable included the farmer's age, the farmer's experience in paddy farming, size of land-holding of the farmers, and the farmer's income. The probability of the LR X^2statistic is 0.000, indicating that the estimated probit regression is significant at a 1 percent level. Table 2 shows that the farmers' participation in the extension services is significantly influenced by age, experience, land-holding and income. The variable age has a negative sign indicating that younger farmers have a greater probability of receiving extension services and the probability of participation in extension services decreases as the farmers get older. Similar finding was recorded by Suvedi*et al.* (2017). This implies that the younger farmers are the main beneficiaries of the extension services provided by ATMA. It could be due to the risk bearing nature of the young farmers than the older farmers.

Table 2. Results of Probit estimation of Propensity Scores

Explanatory Variables	Coefficients	P value
Age	- 0.105 (0.022)	0.000
Education	0.037 (0.034)	0.255
Experience	0.111 (0.019)	0.000
Family size	- 0.040 (0.105)	0.703
Land holding	0.860 (0.336)	0.000
Off Farm Income	0.000 (3.120)	0.010
Constant	1.060 (0.854)	0.214
Number of Observation	160	
LR X^2 (6)	69.41	
P > X^2	0.000	
Pseudo R ^{2}	0.312	

The coefficient of experience is positive and significant indicating that farmers with more years of experience in paddy farming had greater probability of receiving extension services delivered by ATMA. Ainembabazi and Mugisha (2014), however, suggest that experience determines the farmers' attitude and decision towards adoption, retention and rejection of a technology. The coefficient of land is positive and significant indicating that land-ownership as an important factor for receiving extension services. Similarly, farmers with higher income had greater probability of receiving extension services. The farmers with higher income also have the ability to purchase new technology and bear its depreciation cost. To proceed with the estimation of the Average Treatment Effect on the Treated (ATT), all the assumptions of propensity score matching have been achieved and the region of the "common support" is 0.005 and 0.999. Table 3 presents the description of the estimated propensity scores in the region of common support.

Table 3. Estimated Propensity Score in the Region of Common Support

Percentage	Percentiles	Smallest
1 %	0.0088	0.0054
5%	0.0303	0.0088
10%	0.0967	0.0088
25%	0.2647	0.0119
50%	0.5384	
75%	0.7745	0.9829
90%	0.9107	0.9871
95%	0.9574	0.9952
99%	0.9952	0.9989
Number of Observation		158
Mean		0.5131
Standard Deviation		0.2908
Variance		0.0845

The mean value and the standard deviation of the estimated propensity score within this region of common support are 0.513 and 0.290 respectively. The balancing property was satisfied and the estimated propensity scores are categorised into five blocks which ensured that the mean propensity score of the treated and control group in each block is not different and it facilitates matching to be done with minimum bias. The propensity score matching results for the Average Treatment Effect on the Treated (ATT) are presented in the Table 4. Different matching algorithms like Nearest Neighbour Matching (NNM), Radius Matching (RM), Kernal Matching (KM) and Stratification Matching(SM) were employed for the analysis. The outcome variable is the total paddy production.

Table 4. Effect of Extension Services Provided by ATMA on Paddy Output: Matching Estimates

Matching Algorithm	Outcome Variable	ATT	Standard Error	Number of Treated	Number of Observed
NNM	Paddy production	2.075	5.401	80	26
KM	Paddy production	4.349	5.678	80	78
RM	Paddy production	5.385	2.815	62	77
SM	Paddy production	0.466	8.625	80	78

From the above discussion, it is seen that the total production of the beneficiary farmers is more than the non-beneficiaries. The ATT results from the different matching methods indicate that the difference of the total production of the beneficiaries and the non-beneficiaries range between 0.47 quintals to 5.38 quintals. Similar findings have been documented by Hasan et al (2013) that access to extension services raised the value of crop production per hectare by 14.4 %. Several studies highlight that contact with extension services raises total output (Birkhaeuser, et al, 1991). Ali and Rahut (2013) and Teka and Lee (2019) found that beneficiary farmers obtained higher crop yields.

CONCLUSION

In this study, it is found that after sharing similar characteristics, farmers who were beneficiaries of ATMA had total production higher than the farmers who had never received extension benefits in any form. Differences in the average production of the beneficiary farmers and the non-beneficiary farmers have been found in the study, with the average production of the beneficiary farmers being more than that of the non-beneficiary farmers. This difference in the total production of paddy between the two groups of farmers can be credited to the utilization of the agricultural knowledge which the beneficiary farmers had received in the form of trainings programmes and method demonstration, provided by ATMA. The treatment effect analysis employed in the study revealed that the extension services provided by ATMA in the Golaghat district of Assam positively impact the income and production of the farmers. Since the majority of the farmers in the district comprise small and marginal farmers, therefore, the extension activities undertaken by ATMA are projected mostly towards these farmers and towards paddy cultivation which is the main crop cultivated in the district. Timely dissemination of extension services, which meet the actual needs of the farmers, can affect the farmers income and output production to larger extent.

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