Key Factors Influencing Small Tea Growers (Stgs) Of Biswanath District Of India To Adopt Technology Package

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Abstract: Decline in quantity and quality of tea produced by estate sector of Assam, the major tea producing region of the world, paved way for emergence of a new concept since late 70s of the last century. Many educated youth from both urban and rural areas saw tremendous potential in small scale tea cultivation. As of now these (Small Tea Growers) of the state contribute more than 30% of the annual green tea production. Due to growing demand for tea within and outside the state these growers are tempted to adopt certain technology package in order to boost production. Available literature and data shows that chemical/bio-chemical fertiliser, pesticide, HYV clone, irrigation facility and provision of technology are most common element of the technology package adopted by the growers. However some growers restrain themselves from adopting any of these technology elements. Rather they prefer to depend on natural factors like rainfall, organic fertiliser, etc. This research work is a humble attempt to figure out and analyse the major factors which prompt the grower to adopt the above mentioned technology package. Eighty growers, both adopter and non-adopter of the technology package, were selected as sample and data were collected through door to door investigation. For fulfilling the purpose the method of Maximum Likelihood (ML) is used after filling a logistic regression model. According to the statistical results factors other than provision of training are found to be statistically insignificant.

Keywords: Small Tea Growers (STGs), technology package, technology element, Maximum likelihood, logistic regression model.

INTRODUCTION:

Assam, which is considered to be the gateway of North-East India, is blessed with heavy potential for development of resource based industries. Though there are numbers of industries like tea, petroleum, plywood, paper, fertilisers, cement, coal, sericulture, handloom and handicraft, cottage, tourism, etc., the state is still unable to channelize its abundant resources to accelerate the speed of industrialisation. Multiplicity of problems like drought of capital, vulnerable law and order situation, dearth of basic and economic infrastructure, etc. are the major obstacle in development pathway of the state. Among a few agro based industries of the state, the tea industry is regarded as the best managed agricultural enterprise, not only from income generating point of view but also from employment generating perspective. Among the Indian states Assam has been the prima donna in tea production due to its soil species suitable for tea cultivation and according to Tea Board of India (2015) the tea industry of Assam contributes more than half of the nation's total tea production. Tea industry became the instrumental for expansion of hard infrastructure like roadways, railways and utilisation of hilly terrain in Assam over the course of time. It was said to be an industry providing all round stimulus to the development roadmap of the region. Originally tea was considered as a plantation crop which is cultivated in large estates comprising of a huge area, producing a single agricultural product as a business purpose. Until early 50s of the recent century, it was thought to be the sole way to produce tea on commercial basis, where the integrated process of production and sale was controlled by the tea planters.

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The concept of small tea cultivation came into limelight in 1950s after a rigorous and successful experiment made by Kenya. The venture pushed the planters to make a steady shift from big plantation to small holding (CDPA, 2008). Today in most of major tea producing countries like India, China, Nepal, Sri Lanka, Indonesia, Vietnam, Bangladesh, etc., the small tea growers (STGs) make a handsome contribution to the nation's total tea production along with large estates.The basic reason behind the uprising of small tea growers (STGs) in Assam is the decline in both quantity and quality of tea production in the estate sector. In Assam the emergence of small tea cultivation was dated in late 1970s. Though as many as 850 tea states of the state, setting tea industry on the driver's seat of Assam's industrial periphery, continue to play their vital part, the ever increasing significance of small tea growers since its inception cannot be denied in any case (Statistical Handbook of Assam, 2016). Industrial sector, comprising of both agricultural and manufacturing enterprise, is highly linked with the development pathway of a nation. In Assam the tea industry has been the backbone among the industrial configuration. The tea industry is a whole set of agricultural and manufacturing practices. Plantation of tea is the core part of agricultural practice, while processing of tea leaves to made tea is an integral part of manufacturing practice. The recent time witnessed a radical change within the tea industry of Assam due to the rapid emergence of Small Tea Growers (STGs), as out of the total tea production of the state almost 30% comes from the small holding tea growing sector. Available data shows that these Small Tea Growers (STGs) are mostly acquainted with a general technology package including chemical/bio-chemical fertilisers, pesticides, HYV clone, irrigation facility and provision of training facility. All these components definitely provide notable contribution on the production of the growers. On the other hand the adoption of these technology components depends on various factors like age, education, experience, land size and provision of training facility available for the growers. All these factors have more or less impact on the use of different components of the given technology package. The present study would try to analyse the different factors responsible for adoption of various components of the above mentioned technology package.

REVIEW OF LITERATURE:

EMERGENCE OF SMALL TEA GROWERS (STGs) IN ASSAM:

Even though the effect of green revolution of mid 1960s was a lucrative one for some Indian states, the agriculture sector of Assam still remained fragile due to various reasons like marginal size of land holding, unavailability of irrigation facilities, lack of investment in modern technologies, hilly terrain, dilapidated infrastructure, deficiency in government support, etc. The malnourished agriculture sector of the state compelled the traditional agriculturalists in rural Assam to look for an alternative livelihood. Tea cultivation in small holding was one of the few options open for them. The failure of the tea estates to meet the anticipated yield target paves the way for small holding tea cultivation. In Assam it is found that 51% of the tea bushes are more than 40 years old in the estate sector, which causes stagnant production over the years. Further, the re-plantation rate is never been more than 0.4% of the aggregate acreage in a year in recent times, though the prescribed annual norm is 2% (Baruah, 2008). All these forces were enough for the small tea cultivation to expand through more and more coverage. The year 1978 witnessed a new era in Assam's tea history after the clarion call from Late Soneswar Bora, then Minister of Agriculture and Co-operative of Government of Assam. He urged the local people to open small tea gardens by abolishing all the barriers relating to the growth of the sector. Numbers of entrepreneurs from districts like Golaghat, Tinsukia, Sivsagar, Jorhat and Dibrugarh of upper Assam took this call as a welcome prospect for future transformation of socio-economic life of rural Assam and started planting tea in their land which hitherto have been either lying vacant or was being utilised for cultivating some other crops. The message soon spread to every nook and corner of Upper Assam and the small and marginal farmers, the unemployed youth took up tea plantation on land belonged to them, Public Grazing Range (PGR) or the barren land belong to government. The phenomenon became one of the stupendous economic and people oriented drives towards addressing unemployment, which becomes a striking fear among the masses in the recent time (Borah and Das, 2015). The basic reason behind the uprising of small tea growers (STGs) in Assam is the decline in both quantity and quality of tea production in the estate sector. In Assam the emergence of small tea cultivation was dated in late 1970s. Though as many as 850 tea states of the state, setting tea industry on the driver's seat of Assam's industrial periphery, continue to play their vital part, the ever increasing significance of small tea growers since its inception cannot be denied in any case (Statistical Handbook of Assam, 2016).

ADOPTION, USE AND IMPACT OF TECHNOLOGY ON PRODUCTION OF SMALL TEA GROWERS (STGs):

There is extensive literature on various issues concerning adoption, use and impact of different kind of technologies available with our hand. From the viewpoint of economic commonsense everyone's contention is that adoption and use of any kind of upgraded technologies makes the mechanism of production process much smoother and easier. In case of agricultural practices, where land possesses the vital characteristic of diminishing return, use of sophisticated technology becomes as vibrant as in the industrial sector. Though the available literature make enough sense to count the concept of technology among the most influential factors in the modern era, few systematic works have been undertaken to assess the use and impact of technologies on tea production of a region. Even there would be fewer works done about the same effecting the tea production of the small holding sector. The following paragraphs will try to frame the literatures made on adoption and impact of technologies on tea production of small holding tea growers. Shintani (1991) in his research paper analysed the changing pattern of technological background of the tea manufacturing sector of Japan. Tea production is basically consisted of cultivating the tea plant and processing raw tea leaves. The annual yield of tea per unit land area increases as the area in which only tea is planted increases and as planting and management techniques, such as use of fertilisers, pesticides, etc. are developed and used. The author also studies about the process in which the tea manufacturing techniques changed from hand rubbing method to semi-mechanical method and finally to mechanical method of Japan's tea manufacturing sector. Concerning about agricultural extension, Van and To-The (2014) pay attention to the mechanical efficiency; especially regarding the use of fertilisers and training facility in tea production in the North-Eastern Vietnam; using stochastic production frontier. They underline that tea production of the region suffers a strong inefficiency as the technical efficiency, i.e. using fertilisers and provision of skill, is on average hardly equal to 32%, reflecting the existence of high potential for improving technical efficiency. Therefore the fundamental concern remains to identify the factors which are responsible for production inefficiency. Jayamanne et al. (2002) in their paper stated that the extent or degree of adoption of recommended technology; which is grouped into 11 packages including selection o clones, fertilisers application, soil and moisture conservation, field establishment, training, infilling, weed control, pruning, shading, pest and disease control and plucking; is a vital element for tea production in the small holding of low country Sri Lanka. They found that the mean adoption level is 71%. Packages including plucking, clone selection, field establishment and fertiliser application have the highest adoption level whereas some packages such as pest and disease control and weed control are amongst the marginally adopted packages. They further found that the adoption level has positive correlation to education, number of dependents, pattern of labour use and subsidies. However it is negatively correlated to land extent. Samaraweera et al. (2013) reveals that the existing technological know-how of small tea growers in Sri Lanka is very poor and it exhibits dramatic changes with various cultural practices. Knowledge regarding planting material selection and nursery management is found to be most deficient followed by pest and disease control measures. Poor extension service is the chief drawback among smallholder around the region. To counter the deficiency in technical know-how, especially on planting material selection, nursery management and pest and disease control, the authors recommended that individual method or field to field method is the best option among many. Tanui et al. (2012) in their paper show their concern over alarmingly low uptake of tea farming technology packages by smallholder tea cultivators of Kenya despite possessing high potential. The study indicates a significant gap in the ongoing policies for tea sector and technology transfer worth exploring in the small holder tea sector of Kenya. The study further asserts that lack of knowledge on socio-economic factors that constrain the adoption of tea farming technology packages by smallholder tea cultivators might be the root cause behind the extensive gap exists on the adoption rate of technology within the estate sector and smallholder tea grower's sector. The results inferred from the study demonstrated that head gender, benefits awareness, cost awareness and extension services are among the most influential factors which affect the adoption decision of tea farming technology whereas head education, household size and co-operative membership play the lowest influential role in the same.

OBJECTIVES OF THE STUDY:

The present is a humble attempt to fulfil the following sole objective. "To analyse the factors determining the adoption of the given technology package by the Small Tea Growers (STGs) in the study area."

MATERIALS AND METHODS:

COVERAGE:

The study is strictly confined to the newly announced Biswanath district only. Out of seven blocks of the district Behali and Pub-Chaiduar block are selected. The reason for choosing these two blocks is that most of the Small Tea Growers (STGs) are largely concentrated in these two blocks.

SOURCE OF DATA AND SAMPLING TECHNIQUE:

The study relies on the primary data collected through a structured interview schedule. 10% of the Small Tea Growers (STGs) of each chosen block was selected as sample following the stratified random sampling method. Among the sample growers 60% is adopter and the remaining 40% is non-adopter of the given technology package.

LINE OF ANALYSIS:

The following logistic regression model is used to examine the determinant of technology adoption among the STGs. In the proposed model adoption of technology is regarded as dependent variable whereas age, education, experience, land size and provision of training are considered as explanatory variables.

$$Y_i = \beta_0 + \beta_1X_{1i} + \beta_2X_{2i} + \beta_3X_{3i} + \beta_4X_{4i} + \delta D_i + U_i \qquad i= 1,2,\dots,n. \;\dots\dots\text{(i)}$$

Where,

Dependent variable:

Y_i = Whether adopt technology package or not

1 = Adopter

0 = Non-adopter

Independent variable:

X_{1i} = Age of the i^{th} grower (in years)

X_{2i} = Education of the i^{th} grower (in years of schooling)

X_{3i} = Experience of the i^{th} grower (in years)

X_{4i} = Land size of the i^{th} grower (in acre)

D_i = Whether acquainted with any training facility or not

1 = Yes

0 = No

U_i = Error term, where $U_i \sim (0, \sigma^2)$

β_0 is the intercept or constant term and β_1, β_2, β_3, β_4 and δ are the slop coefficients of the given model.

Among the explanatory variables age, education, experience and land size are ratio scale variable whereas provision of training is a dummy variable.

Equation (i) can be rewritten as

$$Y_i = \beta X + U_i \;\dots\dots\dots\;\text{(ii)}$$

$$\text{Where } \beta X = \beta_0 + \beta_1X_{1i} + \beta_2X_{2i} + \beta_3X_{3i} + \beta_4X_{4i}$$

Since the dependent variable is a nominal variable and takes the value of 1 (adopter) and 0 (non-adopter), there is no point in using Linear Probability Model (LPM). This is due to the following reasons.

(a) The LPM assumes that the probability of adopting technology moves linearly with the value of the explanatory variable, no matter how small or large that value is.
(b) By logic, the probability value must lie between 0 and 1. But there is no guarantee that the estimated probability values obtained from the LPM will lie within this limit. This is because OLS does not into account the restriction that the estimated probabilities must lie between 0 and 1.
(c) The usual assumption that the error term is normally distributed cannot hold when the dependent variable takes only values 0 and 1.
(d) The error term in the LPM is heteroscedastic, making the significance tests doubtful.

For all these reasons, LPM is not the preferred choice for modelling dichotomous variables. The alternative ways to analyse the above mentioned model is the logit and probit (Gujarati, 2015). However in this context we will confine our study in logit model only.

Let's assume that the decision of a grower to adopt or not to adopt technology depends on an unobservable utility index I_i^*, which depends on the above mentioned explanatory variable, that is age, education, experience and land size of the grower. The index can be expressed as the following

$$I_i^* = \beta X + U_i \;\dots\dots\dots\dots\dots\dots\;\text{(iii)}$$

Where, i = i^{th} grower, U = Error term and βX is as defined in equation (ii).

Now it becomes reasonable to assume that

$$Y_i = 1 \text{ (a grower adopts technology), if } I_i^* \geq 0$$

$$Y_i = 0 \text{ (a growers does not adopt technology), if } I_i^* \leq 0$$

That is, if a grower's utility index I exceeds the threshold level I^*, the grower will adopt technology package; but if it is less than I^*, the grower will not adopt technology.

To make this choice operational, it can be thought in terms of the probability of making a choice, say the choice of adopting technology (i.e. Y = 1)

$$\Pr(Y_i=1) = \Pr(I^* \geq 0)$$

$$= \Pr(\beta X + U_i) \geq 0 \dots\text{(iv)}$$

$$= \Pr[U_i \geq -(\beta X)]$$

Now this probability depends on the distribution of Y_i, which in turn depends on the probability distribution of the error term, U_i. if this probability distribution is symmetrically around its mean value, then equation (iv) can be written as

$$Pr(U_i \geq -\beta X) = Pr(U_i \leq \beta X)\ldots\ldots\ldots\ldots(v)$$

Therefore,

$$P_i = Pr(Y_i=1) = Pr(U_i \leq \beta X)\ldots\ldots\ldots(vi)$$

Obviously P_i depends on the particular probability distribution of U_i.

The logit model assumes that the probability distribution of U_i follows the logistic probability distribution, which in our study can be written as

$$P_i = 1/1+e^{-Zi}\ldots\ldots\ldots\ldots\ldots\ldots (vii)$$

Where P_i = probability of adopting technology (i.e. $Y_i = 1$) and

$$Z_i = \beta X + U_i\ldots\ldots\ldots\ldots\ldots\ldots\ldots (viii)$$

The probability that a grower will not adopt technology (i.e. $Y_i = 0$), is given by

$$1-P_i = 1/1+e^{Zi}\ldots\ldots\ldots\ldots\ldots\ldots\ldots (ix)$$

As Z_i ranges from $-\infty$ to $+\infty$, P_i ranges between 0 and 1.

Since these equations are non-linear, we can use a simple transformation to make the model linear in the Xs and the coefficients. Taking the ration of equation (vii) and (viii), that is the probability that a grower is an adopter against the probability that the grower is non-adopter, we obtain:

$$P_i/1-P_i = 1+e^{Zi} / 1+e^{-Zi}\ldots\ldots\ldots\ldots\ldots(x)$$

Now $P_i/(1-P_i)$ is simply the odd ratio in favour of adopting technology- the ration of the probability that a grower is a technology adopter to the probability that the grower is not a technology adopter.

Taking the log of equation (x), we obtain the following result

$$L_i = \log(Pi/1-P_{i)}) = Z_i = \beta X + U_i\ldots\ldots\ldots\ldots(xi)$$

The equation states that the log of the odds ratio is a linear function of the β_s as well as the X_s. L_i is known as the logit (log of the odds ratio) and hence the name logit model for equation likes (xi).

RESULTS AND DISCUSSIONU: ESTIMATION OF THE MODEL:

The logistic regression model is run by the statistical software package STATA (14th version). Results achieved after putting every data point in the above mentioned logit model is demonstrated in the following table.

TABLE 1: *MODEL OUTCOME:*

Dependent variable: Adoption of technology				
Method: Maximum likelihood (Binary Logit)				
Sample size: 80				
Degree of Freedom: 79				
	Estimated co-efficient	Std. Error	Z-statistics	Probability
Constant	-0.903	3.569	-0.25	0.800
X_1	-0.447	0.033	-1.37	0.172
X_2	-0.057	0.219	-0.03	0.979
X_3	0.430	0.091	0.48	0.635
X_4	0.245	0.188	1.30	0.192
D	2.928	0.621	4.71	0.000***
Pseudo R^2	0.348			
LR-statistics	38.55			
Probability (LR)	0.000***			

Stata outcome

*,** and *** indicates significance level at 10%, 5% and 1% respectively

EXPLANATION AND INTERPRETATION OF THE RESULT:

The result obtained from the above table shows that among the explanatory variables age and education has negative effect and the remaining three variables have positive effect on the dependent variable. That means young are less educated growers are more likely to adopt the given technology package. On the other hand growers with higher experience, larger access to land and acquaintance with training facility are more likely to adopt the same. The table clearly shows that provision of training is highly significant at 1% significance level while the other variables are insignificant all. This results brings out the interpretation that any growers who is acquainted with any kind of training about small scale tea cultivation is a adopter of the given technology package. The interpretation of the various coefficients of a logistic model is not similar to that of Linear Regression Model (LRM). Given the values of the explanatory variables, the probability of adoption of technology can be calculated by putting the values of the explanatory variables in equation (vii), which was as follows.

$$P=1/1+e^{Zi}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(vii)$$

If the values of the explanatory variables are given as follows

Age of the grower (X_1) = 30 years

Education (years of schooling) of the grower (X_2) = 15 years

Experience of the grower in tea plantation (X_3) = 10 years

Land size of the grower (X_4) = 3 acre

Whether acquainted with training (X_5) = Yes.

Then, we will obtain the following probability value

$$P \sim 0.007$$

That is, the probability that a person with the given characteristics will have only 0.7% probability of adopting the technology package in tea plantation. The measure of goodness of fit used in Linear Probability Model, that is R^2, is nor very meaningful when the dependent variable takes the values of 1 and 0. For the logistic model a similar measure called Pseudo R^2 whose value also lies between 0 and 1. The value of Pseudo R^2 in this case is 0.3476. However value of Pseudo R^2 in a logit model has little meaning. What is most important in such case is the expected sign of the regression coefficient and their statistical significance.

CONCLUSION:

The probability obtained from the above mentioned logit model also determines the technical efficiency of the growers. Higher the probability of adopting the technology package, more efficient is the grower and vice versa. Therefore we can say that an elder grower with higher experience is technically more efficient than a younger grower with less experience and less education. Further training makes the growers to use other technology components more skilfully and efficiently. It is the responsibility of the state and local authorities to provide easy and quality training facility to the interested growers. However, given the rapid climate change, conventional technology package may turn disastrous for the growers. Therefore developing and adopting an eco-friendly and less polluting technology package is the need of the hour.

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