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Key Elements of Technology Package Influencing Annual Tea Production of Small Tea Growers (STGS): Insight from Biswanath District of India

Aditya Gogoi

Abstract: ***Though the tea sector of Assam is primarily dominated by the estate sector comprising of large tea gardens, the relevance of small scale tea plantation can never be denied as nearly 30% of the state's tea production is contributed by Small Tea Growers (STGs). In fact the quality of green tea leaves produced by the Small Tea Growers (STGs) has outclassed that of the tea leaves produced by the estate sector. Since tea plantation is a technology intensive practice, the growers are bound to adopt certain technology components like artificial fertiliser, artificial pesticide, HYV clone, artificial water supply facility, etc. All these elements constitute a technology package which helps the tea growers to reap greater benefit in tea cultivation. This study is a humble attempt to investigate the marginal impact of each element of the technology package adopted by the Small Tea Growers (STGs) on their annual green tea leave production. Moreover it also tries to figure out the jeopardised effect of the technology package used in tea cultivation on environment and health.***

Keywords: tea sector; Small Tea Growers (SYGs); technology component; technology package; marginal impact; annual green tea production.

I. INTRODUCTION

Assam, which is considered as the gateway to North-East India, is blessed with heavy potential for development of resource based industries. Evan after having a 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 pace 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 for industrial development of the state. Among a few agro based industries of the state, tea industry is regarded as the best managed agricultural enterprise, not only as income generating prospect but also as an employment generating one. 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 industryof Assam contributes more than half of the nation's total tea production.

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* Correspondence Author
Aditya Gogoi*, Research scholar, Department of Economics, Gauhati university, Guwahati, Kamrup, Assam, India, 781014, E-mail: gogoiaditya93@gmail.com

Tea industry became the instrumental for expansion of hard infrastructure like roadways, railways and utilisation of hilly terrain in Assam many a time. It was said to be an industry providing all round stimulus for 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 for 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 system of production, processing and sale was controlled by the big tea planters. 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 at any case (Directorate of Economics and Statistics, 2016).

Like any other industry or enterprise, tea industry also comprises of a complicated set of technology. It uses a wide array of upgraded technology right from the levelling of land to processing the tea leaves to made tea. However the extent of use of technology used in the estate sector is far greater and wider than those undertakings of the small growers (STGs). But the use of technology by the small tea growers (STGs) in low scale does not necessarily omit the importance and impact of technology on tea production in small holding. Adoption of improved technologies such as using high yielding verities, chemical and bio-chemical fertilisers, use of pesticides, different mode of irrigation facilities for water supply and provision of training facilities regarding small scale tea plantation do in fact greatly influence the yield of green tea leaves produced by the Small Tea Growers (STGs).

While talking about technology package, the present study only stresses on HYV clone, chemical and bio-chemical fertilisers, chemical pesticide, irrigation facility and provision of training to the STGs.

The reason behind considering only these technology components is that most of the tea growers are acquainted with these elements. On the other hand the logic behind choosing Biswanath district as the geographical study area is that the district still deprives of a systematic study on small holding tea cultivation in spite of having the second highest annual yield rate across the state (Directorate of Economics and Statistics, 2016).

As most of the researches seem to ignore the unregistered or informal sector of the economy, the case is similar to the unregistered tea growers also. Though numbers of study has been conducted on registered tea growers of various parts of the state, no modest attempt has been made to cover the unregistered growers till date. Bearing this fact in mind the researchers try to highlight the effect of the above mentioned technology elements on the annual green tea leaves production of the unregistered growers.

II. REVIEW OF LITERATURE

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 package of technology as one of 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.

Nzomoi et.al (2007) analysed the determinants of technology adoption of horticulture produce in Kenya where the authors have divided the modern technologies into four principle types, e.g. biological technology including new crop verities as well as other incorporated materials of biological nature, chemical technology such as chemical fertilisers, chemical measures for pest and disease control, mechanical technology which is consisted of farm machineries and equipments and at last management technology including knowledge relating to decision making and managing the farming activities without any direct involvement of new materials. The paper sites that education level of the farmers, local and indigenous technology, professional membership and governmental involvement are among the variables which positively influence the technology adoption and the variables which have negative influence on the same are financial constraints, land tenure system and land size or farm size. The concluding remarks made by the authors are that technology adoption can be said to be dependent on farmers' characteristics and other factors exogenous to the farm.

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.

Barua et al. (1998) studied the relationship between technology gap and six socio-economic variables, which results a 19.92%-48.07% technology gap among the majority of tea growers. He found that educational qualification and mass media exposure have a significant negative relationship with technological gap.

III. OBJECTIVES OF THE STUDY

The entire study is driven by the following sole objective:

"To investigate the influence of major components of the technology package used by the Small Tea Growers (STGs) on their annual tea production of the study area."

IV. METHODOLOGY

A. Coverage

The study is strictly restricted to the Biswanath district of Assam only. Out of the seven development blocks of the district, only two blocks, namely Chaiduar and Pub-Chaidur, are selected as most of the tea growers concentrate in these two blocks.

B. Data type, Data source and Sampling design

The study entirely thrives on primary data collected through a comprehensive field survey. Data has been collected by conducting personal interview of the sample tea growers. Since the unregistered growers do not fall under any govt.

purview and their population size is generally unknown, calculation a definite sample size on the basis of conventional sampling technique is not possible. As a result the researchers are bound to depend on **"snow ball sampling"** method to construct a standard sample size. In this case eighty tea growers, forty growers from each of the selected development blocks, are taken as sample regardless of the population size.

C. Line of analysis

Various elements of the technology package like HYV clone, chemical and bio-chemical fertilisers, pesticide, artificial irrigation facility and provision of training to the tea growers do in fact greatly influence the annual yield of green tea leaves. Therefore it becomes imperative to analyse the marginal impact of each of these elements on per acre annual green tea leaves production.

Among different method to analyse the marginal impact of a single or multiple independent variables on a dependent variable, "Multiple Linear Regression" method has been selected for fulfilling the objective of the present study.

The multiple regression model adopted for fulfilling the proposed objective is formulated as follows:

$$\mathbf{Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \partial_1 D_{1i} + \partial_2 D_{2i} + U_i, \quad i = 1, 2, 3 \ldots n}$$

Where

Dependent variable:

$\mathbf{Y_i}$= Annual green tea leaves production of the i^{th} grower per acre.

Independent variable:

$\mathbf{X_{1i}}$= Numbers of HYV clones used by the i^{th} grower per acre.

$\mathbf{X_{2i}}$= Amount of fertilisers used by the i^{th} grower per acre.

$\mathbf{X_{3i}}$= Amount of pesticides used by the i^{th} grower per acre.

$\mathbf{D_{1i}}$= Whether the growers use artificial irrigation facility (First dummy variable).

1= Yes

0=No

$\mathbf{D_{2i}}$ = Whether the grower is acquainted with training facility (Second dummy variable)

1= Yes

0= No

$\mathbf{U_i}$ = Error term, where $U_i \sim N(0, \sigma^2)$

Co-efficient:

$\boldsymbol{\beta_0}$ = Intercept or constant term.

$\boldsymbol{\beta_1}$ = Marginal impact of HYV clone on annual tea production other things remaining constant.

$\boldsymbol{\beta_2}$ = Marginal impact of fertiliser on annual tea production other things remaining constant.

$\boldsymbol{\beta_3}$ = Marginal impact of pesticide on annual tea production other things remaining constant.

∂_1 = Marginal impact of irrigation facility (First dummy variable) on annual tea production other things remaining constant.

∂_2 = Marginal impact of training facility (Second dummy variable) on annual tea production other thing remaining constant.

It is important to note that among the explanatory variables; HYV clone, fertiliser, and pesticide are **ratio scale variables** and irrigation facility and provision of training facility are **nominal variable**, which are coded as **dummy variable.**

For each coefficient, the null hypothesis is that the population value of that coefficient is zero, indicating that the particular regressor has no influence on the regressand, holding the other regressor value constant. The null hypothesis that is going to be tested for this purpose is:

H_0: Each component of the given technology package has no significant impact on annual tea production of Small Tea Growers (STGs) in the study area ($\mathbf{H_0}$=0).

V. RESULTS AND DISCUSSION

A. Estimation of the model

During the procedure we use software package SPSS to estimate the regression model. After putting the sample data according to the above mentioned multiple regression model we have obtained the result as shown in the following table.

Table- I- Model outcome

Dependent variable: Annual Tea Yield (in kg.s)		
Method: Least Square		
Sample: 80		
Degree of freedom: 79		
Variables	**Estimated co-efficient**	**t statistic**
Constant	833.658***	13.372
$\mathbf{X_1}$(HYV clone)	1.823***	5.572
$\mathbf{X_2}$(Fertiliser)	88.941**	8.032
$\mathbf{X_3}$(Pesticide)	30.955**	1.789
$\mathbf{D_1}$(Irrigation facility)	4.662	0.561
$\mathbf{D_2}$(Training)	11.065*	0.283
$\mathbf{R^2}$	0.78	
F statistics	52.329***	

Source: STATA result

,* and * denotes significance level at 1%, 5% and 10% significance level respectively.*

B. Explanation and interpretation of the results

The results obtained from the above table have shown that all the components of the technology package have positive effect on annual tae production of the growers. If we choose 10% significance level, each of the estimated coefficients, other than that of irrigation facility, is statistically different from zero. It is seen that the coefficient of HYV clone is significant at 1% significance level while those of fertiliser and pesticide are at 5% level. On the other hand training facility is significant at 10% significance level. Irrigation facility is not significant at all. That means each of the explanatory variables, other than irrigation facility, is an important determinant of annual tea yield. As more HYV clone, fertiliser and pesticide are used in the cultivated areas, tea production increases. The explanation of the training facility will be the identical.

Since all the coefficient of the explanatory variables, excluding that of irrigation facility, are statistically different from zero, we can reject the null hypothesis for variables HYV clone, fertiliser, pesticide, and training facility.

Various coefficients of the estimated model can be interpreted as follows:

Since the productive capacity of HYV clone is much higher than that of traditional clone, the estimated equation shows that each additional unit of HYV clone will raise the annual tea production by 1.823k. g. per acre.

Likewise use of one additional k. g. of fertiliser will lead to increase of tea production by 88.941k. g. per acre. It is due to the well known fact that artificial fertiliser enhanced the fertility of soil by manifold. However the fact should not be forgotten that increase in soil fertility

as a result of artificial fertiliser is a matter of time only. Once the optimal point is reached, the law of diminishing return to factor will occur and further use of artificial fertiliser will result no increase in soil fertility. Again, one litre extra use of pesticide can produce extra 30.955k. g. of tea per acre. But this may not be the full picture of the story.

There is a recommended norm of using pesticide for the growers. Overuse of pesticide beyond the recommended level may compromise the quality of the tea leaves to be produced.

On the other hand a Small Tea Grower (STG) having training facility can produce 11.065k. g. of green tea leaves more than a grower without having training facility. This reflects that growers acquainted with training facility use various technology components more efficiently than those who are not acquainted with training facility.

Irrigation facility is found to be insignificant at all. No grower witnesses significant increase in production of tea leaves even after having artificial irrigation facility. This indicates that natural rainfall in the study area provides enough water to grow tea bushes optimally.

VI. IS ADOPTION OF CHEMICAL FERTILISER AND PESTICIDE ALWAYS GOOD

The technology package we are talking about consists of chemical fertiliser and pesticide along with HYV clone, irrigation facility and provision of training. Chemical fertiliser and pesticide though boost the tea production of the cultivated land, but this is not permanent. If somehow the use of chemical fertiliser and pesticide crosses the prescribed norms, their impact turned to be detrimental rather than positive. Overuse of fertiliser and pesticide not only pools down the land productivity but also leads to compromise of quality of tea to be produced.

Adding salt to the wound, increasing use of chemical fertiliser and pesticide in tea plantation brings heavy threat to environment, health and production of other crops. Growing loopholes of using chemical fertilisers and pesticide in a bid to shoot up the tea production are very evident from the study area itself.

The following points provide an insight of the problems, all of which are caused by overusing chemical fertiliser and pesticide in tea plantation, faced by the respondents which they unfolded during the field survey in the study area.

- Perpetuating use of chemical fertiliser and pesticide in tea plantation in both Pub-Chaiduar and Behali block tends to ruin the bio-diversity once easily available.
- Overuse of fertiliser and pesticide is the root cause of emerging land and water pollution in the study area. This in turn is making the health status of the people residing near tea gardens vulnerable.
- Pesticides are often drained out to the nearby water bodies during the rainy seasons and ultimate result is the extinction of numbers of aquatic species.
- Since tea plantation is becoming a lucrative business every day, more and more people in the study are seen to be involved in the practice. But the tendency is only resulting in a reduction in of land coverage available for traditional rice cultivation. Moreover many people use forest land and Public Grazing Range for tea cultivation without proper permission from concerned authority and thereby contributing to the decaying forest cover in the adjacent areas.
- Excessive use of chemical fertiliser and pesticide can also off set the required quality of produced tea.

VII. CONCLUSION

The study finds that almost all the elements of the technology package used by the growers are highly influential on annual green tea leaves production. It is also witnessed that insufficiency of adequate information regarding the use of chemical fertiliser and pesticide causes improper use of them, as a result of which the threat on environment and health status of the people surrounding the tea gardens seems looming larger. The situation demands a holistic initiative from the side of the local and state government to organise and conduct training programme and workshop more frequently so that the growers becomes aware of the proper and prescribed application of such technology components. However the desired target will be unfulfilled without voluntary and active participation of the growers themselves.

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AUTHORS PROFILE

Aditya Gogoi, **Current status:** Phd research scholar Department of Economics, Gauhati University, Assam.

Educational qualification:
(1) M.A.: Department of Economics, Gauhati University, Assam.
(2) M.phil: Department of Economics, Gauhati University, Assam

Research works:
(1) Use, adoption and impact of technology package on annual tea production of Small Tea Growers (STGs): A case study of Biswanath district of Assam (M.phil Dissertation)
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