EFFICIENCY LEVELS OF SMALL TEA GROWERS IN UDALGURI DISTRICT OF ASSAM

Dissertation Submitted to Sikkim University in Partial Fulfillment of the Requirements for Award of the Degree of

MASTER OF PHILOSOPHY

Submitted by

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DECLARATION

I hereby declare that the issues and matters expressed in this dissertation entitled **"Efficiency Levels of Small Tea Growers in Udalguri District of Assam"** submitted to Sikkim University is my own and original work. Any content or any part of this dissertation has not been submitted to any other institutions or for any academic purposes and also it has not been presented by anyone anywhere.

This is being submitted in partial fulfillment for the requirement of degree of **Master of Philosophy** in the Department of Economics, Sikkim University.

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CERTIFICATE

This is certified that the dissertation entitled **"Efficiency Levels of Small Tea Growers in Udalguri District of Assam"** submitted to Sikkim University in partial fulfillment of the requirements for award of the Degree of **Masters of Philosophy in Economics** is the result of research work carried out by **Miss Bondona Lama** under my direct supervision. The contents or part of the thesis has not been submitted anywhere for any degree, diploma or for any other academic purposes.

She has given due acknowledgement to all those who have helped her directly or indirectly in the course of the completion of this research work.

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"Efficiency Levels of Small Tea Growers in Udalguri District of Assam"

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CHAPTER 1

INTRODUCTION

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Introduction

1.1 Introduction:

Tea is an important plantation crop produced mainly in India, China, Sri Lanka and Kenya these countries account for 79% of world tea production and 72% of world tea exports (TBI report 2014-15). In year 2014, India's share accounted for 23% of the total World Tea production. In the same year the total tea production of the other major tea producing countries, China, Kenya and Sri Lanka were- 2096, 445and 338 million kg respectively of the total world production of 5173 million kg (TBI). India is the second largest producer of Tea in world after China.

1.1.1 *Small Tea Growers:* It is known that tea is cultivated in large tea plantations covering hundreds of hectares of land; for example the Temi Tea Estate of Sikkim covering 177 hectares of lands. But tea is also cultivated by some small growers in some small plots of land. The tea growers cultivating tea in small plots of land are called small tea growers. In India tea gardens with up to 10.12 hectares of land under tea cultivation are considered as small tea gardens and all other gardens having more than that much amount of land are considered large plantations. In India tea is produced in both large and small tea gardens. In year 2011, there were 1,57,504 small and 1686 large tea gardens in India, covering 1.62 lakh and 4.18 lakh respectively. Assam has the largest area under small tea gardens in India with 66804 registered[1] small tea gardens covering 55% of total small tea grower's area and

[1]Registered small tea growers are those, which are registered with the Tea Board of India as small tea growers. It may be either group or individual owned. In some states of India registration of small tea growers is linked with the availability of proper land documents, only with land possession certificate they can apply for Tea Board registration, Assam is one of them.

contributing more than 42% of total Small Tea Growers' production in India (TBI, 2012).Cultivation of tea on a small holding is a usual practice in much major tea producing countries like China, Japan, Sri Lanka, Indonesia etc. The concept of small cultivation of tea first came from Kenya. At present the small tea growers in Kenya cover more than 79000 hector of tea area[2]. In India, during 1990's due to the underdeveloped and subsistence nature of agriculture, the farmers started to look for an alternative livelihood with small tea cultivation. Tea cultivation on small holdings is a good alternative for the farmers since it gives work and income throughout the year and it does not involve risks like crop failure as involved in other farming. Small tea cultivation is an alternative for the farmers as well as for the growth of the whole tea industry. Small tea gardens help in increasing the tea production by increasing the land under tea. Since, setting up a new large plantation is not easy. Tea Board of India has been giving many facilities to the small tea growers to increase the gross area under tea and increase the total output (Bhowmik, 1991). The small tea growers produce tea leaves and sell them either to Bought Leaf Factories (BLFs) or to the large plantations. Some of the small growers also have their own micro factories where they process the tea leaves in their own factories.

1.2 Research Problem:

The first small tea garden in Udalguri district was established in 1992 after that lots of unemployed youths have opted for small tea cultivation as their profession. In year 2014 the number of small tea gardens in Udalguri district was 2242; the number increased by 1562 and became 3804 in 2015 (TBI). And in 2016 the total number of registered small tea growers in Udalguri district is 6951. This implies that the small tea cultivation is growing at a very high rate in Udalguri district. With

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[2] Retrieved from www.upasitearesearch.org, 10/07/2016

increase in numbers of the Small Tea Growers (STGs), the area under cultivation of STGs is also growing; in 2016 the total area under small tea growers in Udalguri district is 7370.2 hectares. Despite of the rapid growth in numbers as well as area of STGs in the district it's average tea productivity per hectare is still very low compared to all Assam average. The average productivity of small tea gardens of Assam was 9728.64 kg/hectare in 2014-15, while in the same period average productivity of Udalguri district was only 5200 kg/hectare (Mudoi and Dutta, 2016). This low productivity of the small tea growers of Udalguri, as the economic theory says, may be due to misallocation of input mix, inappropriate use of inputs, untimely use of inputs and inappropriate choice of technology. One way to find out the actual causes behind the low productivity situation of the STGs of Udalguri district is to studying the levels of efficiency of the STGs in the district, given the available resources and facilities for tea production. Thus, economic efficiency study of the growers will be useful in determining the efficiency level of STGs and the causes of low productivity of the STGs of the district so that appropriate steps to mitigate them can be suggested that will help in further growth and development of the small tea production as well as uplifting the socio-economic status of the growers. Small tea cultivation plays an important role in the economy of India. Many studies have been carried out in many fields of agriculture and tea industry of India, and World. But only a few studies are available on the issues of small tea growers in India and World and no study has addressed the issue of estimating the efficiency levels of these small tea growers. Thus an attempt has been done to bridge this gap by studying and estimating the efficiency levels of the small tea growers of Udalguri district of Assam. Since, this aspect of the production problem has not been empirically studied at the micro level of Udalguri district; thus, the present study focuses on studying the levels of efficiency of the small tea growers of Udalguri district and the factors affecting it. Small tea growers in Udalguri district are both group owned and individually owned in nature. Daadi et al (2014) in his study of technical efficiency of mango out grower farm management type found differences in efficiency of the individually owned and group owned farms. There is a possibility that in case of small tea growers also there are some differences in efficiencies between group owned and individually owned small tea growers. Studying these differences will be helpful in increasing production and efficiency of the small tea growers.

1.3 Research Questions:

The present study has framed the following research questions -

- Whether the small tea growers of Udalguri district are economically efficient or not?
- What are the factors affecting the economic efficiency of the small tea growers of Udalguri district?
- Whether there exists any difference in economic efficiency levels of the individual and group owned small tea growers of Udalguri district?

1.4 Objectives of the Study:

- To estimate the economic efficiency levels of the small tea growers of Udalguri district.
- To study factors affecting the differences in the economic inefficiency levels of the small tea growers of Udalguri district.
- To evaluate the differences in economic efficiency levels of the individual and group owned small tea growers of Udalguri district.

1.5 Hypotheses of the Study:

- The small tea growers of Udalguri district are fully efficient and no variation in the production is caused by inefficiency but by statistical error or random error.
- Socio-economic features of the small tea growers, different input costs and basic features of the small tea gardens do not affect significantly to the inefficiency of the grower.
- There is no difference of the economic inefficiency between the individual and group owned small tea growers.

1.6 Literature Review:

1.6.1 *Concept of Efficiency:* Farrell (1957) for the first time investigated the structure of productive efficiency. In his paper, overall productive efficiency has been decomposed into technical efficiency and allocative efficiency. After the pioneering work of Farrell (1957), many researchers gave serious considerations to the possibility of estimating frontier production functions. Among them the work of Aigner, Lovell and Schimdt (1977) and Meeusen and Broeck (1977) are some of the most significant ones.

1.6.2 *Types of Efficiency:* Economic efficiency can be decomposed into technical efficiency and allocative efficiency. The product of technical and allocative efficiency is the overall economic efficiency. Technical Efficiency studies are mainly concerned of maximizing output with the available inputs and technology. Technical Efficiency measures a firm's success in choosing an optimal set of inputs; it is defined in relation to a given set of firms, in respect of a given set of factors measured in a specific way, and any change in these specifications will affect the measure (Farrell, 1957). It measures how efficiently technology is employed in the use of inputs to achieve a given level of output. Farrell (1957) decomposed overall productive efficiency into technical efficiency and allocative efficiency.

Allocative Efficiency (or Price Efficiency) a firm's success in producing maximum output from a given set of inputs (Farrell, 1957). It measures firm's success in choosing optimal proportions, i.e. where the ratio of marginal products for each pair of inputs is equal to the ratio of their market prices (Bashir, 2005). It is, marginal revenue of all inputs being equal to their marginal costs (Belbase and Gabowski, 1985). The product of technical and allocative efficiency is the overall economic efficiency (Farrell, 1957).

1.6.3 ***Measurement of Efficiency:*** There are two common methods used by most of the studies for empirically estimating the performance of firms in terms of efficiency, namely non-parametric linear programming approach and parametric econometric approaches. Parametric methods are those for which we know that the population is approximately normal, or we can approximate using a normal distribution after we invoke the central limit theorem. Stochastic frontier analysis is an example of parametric model. Non parametric models are statistical techniques for which we do not have to make any assumptions of normality for the population we are studying. That is why non parametric methods are also called distribution free methods. Data Envelopment analysis is a representative of non parametric methods.

The parametric models can be separated into deterministic and stochastic models. The deterministic models assume that any deviation from the frontier is due to inefficiency, while the stochastic approach allows for random error too. The deterministic models can be estimated using both COLS (Corrected form of Ordinary

Least Squares) and MLE (Maximum Likelihood Estimation) methods. The Stochastic models can be estimated using MLE only.

Among the available methods of Efficiency estimation, the most popular among the researchers are- Parametric Stochastic Frontier Analysis and non parametric Data Envelopment Analysis.

The measures of efficiency as introduced by Farrell (1957) had been used widely, while undergoing many refinement and improvements. One such improvement is the introduction of stochastic frontier model by Aigner, Lovell and Schimdt (1977) and Meeusen and Broeck (1977) which enables one to measure farm level technical, allocative and economic efficiency using maximum likelihood estimate. Aigner, Lovell and Schimdt (1977) for the first time provides an appropriate specification of the disturbance term, by defining the disturbance term as the sum of symmetric normal and (negative) half-normal random variables. A firm has to face two types of errors one is random variation in their abilities to utilize best practice technology a source of error which is one sided ($\varepsilon_i \leqq 0$) and/ or an input quantity or measurement error in maximum output attainable, a symmetric error (Aigner, Lovell and Schimdt, 1977).The error positive error component represents the symmetric disturbance: these are assumed to be independently and identically distributed. The non-positive error component is assumed to be distributed independently of the positive error component, and to be less than or equal to 0 Aigner et al (1977).

Developments in Farrell's methodology is also done by Meeusen and Van den Broeck (1977) who also introduced stochastic production function simultaneously with Aigner, Lovell and Schimdt (1977) and applied COLS to estimate productive efficiency. Similar to Aigner, Lovell and Schimdt (1977), Meeusen and Broeck too stated that not all of the disturbances in the value of production from the frontier results solely from human errors, but some result from inefficiency, occurring due to randomness in the real sense and due to specification and measurement errors. Unlike Ordinary Least Square (OLS) regression analysis, a Stochastic Frontier Analysis (SFA) technique allows for measurement of Efficiency by decomposition of the error components to normally and non-normally distributed random error components (Aigner et al., Meeusen and Broeck, 1977). Following the specifications of Aigner, Lovell and Schimdt (1977) and Meeusen and Broeck (1977) the stochastic production frontier can be written as,

$$y_i = F(x, \beta)\, e^{\varepsilon} \qquad i = 1, 2, \ldots, N \qquad (1)$$

Where y_i is the output for the i^{th} firm, x_i is a vector of k inputs (or cost of inputs), β is a vector of k unknown parameters, ε_i is the error term. The error term is composed of as follows-

$$\varepsilon_i = v_i + u_i\,, \qquad i = 1, \ldots, N \qquad (2)$$

After the works of Aigner, Lovell and Schimdt (1957) and Meeusen and Broeck (1957), many more improvements have been done upon Farrell (1957)'s idea of productive efficiency. Both the models of Aigner, Lovell and Schimdt (1957) and Meeusen and Broeck (1957) were originally designed for analysis of cross sectional data. However, subsequently various models were introduced to account for panel data, (e.g. Battese and Coelli, 1995; Kumbhakar and Lovell, 2000). Since in this study the data to be collected are of cross- sectional in nature, we will be using the SFA model as introduced by Aigner, Lovell and Schimdt (1977) and Meeusen and Broeck (1977).

A nonlinear non-parametric programming model provides a new definition of efficiency for use in evaluating activities of not-for profit entities participating in public programs (Charnes, Cooper and Rhodes, 1978). The Data Envelopment Analysis (DEA) model developed by Charnes, Cooper and Rhodes (1978) is a non-parametric mathematical programming technique for the construction of a production frontier based on the notion of input oriented technical efficiency (Din, Ghani and Mehmood, 2007) The non-parametric approach to efficiency measurement obtains technical efficiency estimators as optimal solutions to mathematical programming problems. Charnes, Cooper and Rhodes (1978) formulated the Data Envelopment Analysis (DEA) methodology, which defines a non-parametric frontier and measures the efficiency of each unit relative to the frontier. The frontier is approximated by a piecewise linear facets. The DEA model of Charnes et al. (1978) assumes Constant Returns to Scale (CRS) and can be either input or output oriented. In the input orientation the efficiency scores relate to the largest feasible proportional reduction in inputs for fixed outputs, while in the output orientation it corresponds to the largest feasible proportional expansion in outputs for fixed inputs.

Banker, Charnes and Cooper (1984) extended the CRS DEA model of Charnes, Cooper and Rhodes (1978) to account for variable returns to scale (VRS). The estimated technical efficiency from the output oriented VRS DEA of each firm unit is always higher than or equal to that in the input oriented CRS DEA as the VRS DEA is more flexible than the CRS DEA (Theodoridis and Anwar, 2011).

However, DEA model is not fully free from any deficiencies. First, DEA approach does not account for the measurement error and statistical noise that may influence the shape and position of the frontier. Secondly, it does not allow for conventional tests of hypothesis, which are typical of the econometric approach. In addition, the non-parametric approach provides only an upper bound to the true efficiency measures because all deviation from the production frontier is attributed to inefficiency. The SFA has the advantage in handling measurement errors but the functional form should closely match the properties of the underlying production technology. Therefore in this study we apply SFA model with Cobb-Douglass form of production function.

1.6.4 ***Empirical Outcomes:*** Many scholars have studied economic efficiency in many fields around the world. In India such studies have been done by scholars like Karthik, Alagumani and Amarnath (2013), and Sensarma (2005). Studies have been done in all the sectors from agriculture to manufacturing and in service sector etc. In the manufacturing sector studies have been done by scholars like Diaz and Sanchez (2008), Bravo- Ureta et al. (2007), Mok et al. (2010), Krishna and Sahota (1991), Hall and LeVeen (1978), Din, Ghani and Mehmood (2007), Seth (1995) and in the field of agriculture studies have been done by the following scholars - Akpan et al (2013), Sadiq & Isah (2015), Adeyemo et al. (2013), Belbose and Gabowski (1985), Abedullah et al. (2007), Bashir et al (2005), Karthik et al (2013), Ambalil et al. (2012) Ayaz and Hussain (2011), Daadi et al. (2014) and in service sector studies have been done by Carpenter II and Noller (2010), Valdamanis (1990), Titus and Pusser (2011), Rai (1996), Sen Sarma (2005). The mostly used methods for measuring economic efficiency by these scholars are parametric Stochastic Frontier Analysis (Carpenter II and Noller, 2010; Sadiq and Isah, 2015; Diaz and Sanchez (2008), Din, Ghani and Mehmood, 2007; Karthik, Alagumani and Amarnath, 2013; Ambalil et al, 2012; Li and Li, 2011; Ayaz and Hussain, 2011; Akpan et al, 2013; Adeyemo et al, 2005; Sensarma, 2005; Bagi, 1984; Golder, Renganathan and Banga, 2004; Titus and

Pusser, 2011; Rai, 1996) and non parametric Data Envelopment Analysis (Kader et al, 2010; Abedullah et al, 2007; Theodoridis and Anwar, 2011; Mok et al, 2010). Economists have utilized SFA techniques to examine the efficiency of profit maximizing firms a variety of industries such as agriculture, (e.g. Battese and Coelli, 1995; Karthik Alagumani and Amarnath, 2013), manufacturing (e.g. Diaz and Sanchez, 2008), health (e.g. Jacobs, 2006; Rosenman 2001), sports (e.g. Young, 2014), banking, (e.g. Ngan, 2014), insurance, (e.g. Rai, 1996) etc.

Since our concern in this study was efficiency of small tea growers which comes under agriculture, more concern has been given about the researches done in the agriculture field. First attempt has been made to discuss the importance of efficiency and productivity study in the field of agriculture. To improve farmers' income from production, farm inputs have to be applied efficiently. Economic Efficiency is measured by the relationship between the value of the ends and the value of the means rather than physical quantities (Daadi, Gazali and Amikazun, 2014). In India Agriculture and Allied Services employs a large percentage of population 51 (19.81, in World) percent contributing 15.35(3.83, in World) percent to the Gross Value Added (GVA) and remains a viable sector in the world (World Bank National Accounts Data, 2010, CSO 2015). Economically, human wants are numerous and resources to achieve them are scarce. The scarcity of resources is the major factor that makes the improvement in Efficiency very much important to an economic decision maker or to a society. A strong and an efficient agricultural sector would enable a country to feed its growing population, generate employment, earn foreign exchange and provide raw materials for industries. Because of the importance of efficiency, many researchers have conducted research on efficiency in many fields including agriculture, as mentioned earlier. The mostly used inefficiency variables in the field of agriculture are as follows- age of the farmer, education level of the farmer, farming experience, farm size, education level (Abedullah, Kousher and Mushtaq, 2007; Daadi et al, 2014; Ayaz and Hussain, 2011; Karthik, Alagumani and Amarnath, 2013; Ambalil et al, 2012; Akpan et al, 2013; Adeyemo et al, 2013; Sadiq and Isah, 2015). Along with these variables some researchers have also used the following variables- gender of the farmer (Daadi et al, 2014; Akpan et al, 2013), Gender of the household head of the farmers (Ambalil et al, 2012), size of the farmer household (Daadi et al, 2014; Ambalil et al, 2012; Akpan et al, 2013; Adeyemo et al, 2013; Sadiq and Isah, 2015), credit availability (Ayaz and Hussain, 2011; Akpan et al, 2013), availability of extension services (Akpan et al, 2013; Sadiq and Isah, 2015, Ambalil et al, 2012). The most common variables included in the production functions by the researchers to study agricultural productivity are as follows- area under cultivation, farm size, cost of planting materials, fertilizer cost, labour hours, farming experience, manure, herbicides cost, irrigation hours, age of plantation, weeding expenditure, age and schooling years of the farmer (Abedullah, Kouser and Mustaq, 2007; Daadi et al, 2014; Ayaz and Hussain, 2011; Karthik, Alagumani and Amarnath, 2013; Ambalil et al, 2012; Akpan et al, 2013; Adeyemo et al, 2013; Belbase and Grabowski, 1985). The results of the available studies in efficiency study in the field of agriculture shows that, for most of the studies age, education level, training, farming experience, credit availability, farm size, awareness of the farmer, access to extension services, cost of fertilizer and co operative membership are found to be positively significant in increasing farm efficiency (Abedullah, Kouser and Mustaq, 2007; Ayaz and Hussain, 2011; Karthik, Alagumani and Amarnath, 2013; Ambalil et al, 2012; Bashir and khan, 2005; Akpan et al, 2013, Adeyemo et al, 2013); While along with these variables Belbase and Grabowski (1985) found labour hours, income and cost of planting material to be positively significant in increasing farm efficiency. On the contrary to this, Daadi et al (2015) found age, household size, education level and farming experience have no significant effect on farm efficiency and gender of the farmer and farm management type has significant effect on efficiency. Adeyemo et al (2013) found that age and farming experience contributes to the farm inefficiency.

1.6.5 ***Studies on Small Tea Growers:*** Many researchers have studied different aspects, problems and prospects of the small tea growers in India and in other countries. Most of the studies carried on in this field are socio-economic studies. Reddy and Bhowmik (1989) studied the role of co-operative factories for the growth of the STGs of Nilgiri STGs. He found that the co-operative factories have helped the STGs of Nilgiri in ensuring fair prices from the Bought Leaf factories. He also found that STGs are more enterprising than the large estates in raising their area and production. Most of the lands under small tea production are agricultural land; farmers are replacing paddy and other food crop cultivation by small tea gardens (Barua, 2015). Barua (2015) did a study of the STGs of Sonitpur district Assam, to know about their basic problems, and found that the main problems faced by small tea gardens are-oscillation of prices of tea leaves, heterogeneity in formation of producer’s co-operatives, inexperienced tea leaves agents, scarcity of labour, lack of irrigation facilities, Imposition of levies by the State, Theft of green tea leave, problems with the growers association and pressure of militant groups. Soy (2009) in a study of the STGs in Kenya found that the physical environment plays vital role in increasing the profitability of the STGs. Soy (2009) also found factory production capacity acts as serious constraint by restricting the leaves from the farmers in the peak period and there is need for providing training to the farmers for increasing their efficiency and enhancement of the production technology. Mudoi and Dutta (2016) tried to determine the main reasons behind the rapid growth of the STGs in Golaghat district of Assam, and found that opportunity of self employment is the most potential factor for the growth of the STGs. Other factors found in the study of Mudoi and Dutta (2016) are availability of own land, availability of raw materials and gaining social prestige.

In India, Small gardens constitute 98.94% of total number tea estates and 26.32 of total production (TBI, 2011). In 2014, small tea growers (STG) provided 170 million kg made tea, contributing 33 percent to the total production and 28 percent of the area[3]. The STGs of Assam contribute more than 30% of total tea produced in Assam. Despite the growing importance of small tea gardens in the field of tea production and socio economic conditions of the growers residing especially in the rural areas, no research to date has addressed the efficiency of these small tea growers and their productivity, therefore in this research paper endeavor has been made to bridge this gap of literature by estimating and studying the efficiency levels of small tea growers in Udalguri district of Assam.

1.6.6 ***Summary of The Literature Review:*** First of all no study till date has addressed the issue of economic efficiency estimation of the small tea growers. Though many researchers have carried out many studies about small tea growers almost all of them are socio-economic studies. But many economic efficiency studies have been done in different sectors like agriculture, education, banking, insurance, manufacturing, health etc. After reviewing all these efficiency estimation studies it is found that the mostly preferred methods of efficiency estimation in the available literature are – Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis

[3] Information collected from AASTGA, All Assam Small Tea Growers Association, Tangla sub office, Udalguri, Assam.

(DEA). By studying the efficiency estimation studies carried out in agricultural sector it is found that Cobb-Douglass form is the most widely used form of production and cost function used by Li and Li (2011), Abedullah et al. (2007), Ambalil et al. (2012), Ayaz and Hussain, (2011). The mostly used production variables used by the researchers to estimate efficiency levels in agricultural sector are area under cultivation, cost of planting materials, fertilizer, labour hours, farming experience, manure, herbicides, irrigation hours, age of plantation, weeding expenditure, age and schooling years of the farmer used by Abedullah, Kouser and Mustaq (2007), Daadi et al. (2014), Ayaz and Hussain (2011), Karthik, Alagumani and Amarnath (2013), Ambalil et al. (2012), Akpan et al. (2013), Adeyemo et al. (2013) and Belbase and Gabowski (1985). The most widely used inefficiency variables to be found positively significant are age, education level, training, farming experience, credit availability, farm size, awareness of the farmer, access to extension services, cost of fertilizer, labour hours, farmers income and cost of planting material and co operative membership as found by Abedullah, Kouser and Mustaq (2007), Ayaz and Hussain (2011), Karthik, Alagumani and Amarnath (2013), Ambalil et al (2012), Bashir and khan (2005), Akpan et al. (2013) and Adeyemo et al. (2013), . The most widely used inefficiency variables to be found insignificant are Age, Household Size, Education Level and Farming Experience as found by Daadi et al. (2015).

1.7 Study Design:

1.7.1 *Data Source:*

Both primary and secondary data have been used in the study. Primary data have been collected to study the efficiency levels of the tea farmers at individual level. The nature of the data collected for estimation of efficiency levels of Udalguri district is primary data collected with the help of questionnaire survey of the study area. The study area in this study is Udalguri district of Assam. The reasons for choosing the study area have been broadly elaborated in Chapter 3. A total of90 registered small tea growers of Udalguri district from different villages of the district have been taken as sample, and from these 90 small tea growers the required information for the study has been collected. The sample has been randomly selected from the list of registered small tea growers available at the Sub Regional Office of Tea Board of India, Udalguri district.

1.7.2 *Type of Data:*

The primary data used for estimating farm (tea growers) level efficiency level have been collected directly from the tea growers of the Udalguri district of Assam with the help of a Schedule (typed in English). The researcher personally explained the questions in the local language. The data have been collected during June-July of 2016.

1.7.3 *Nature of Data:*

The information collected for this study is as follows-

- Socio economic features of the small tea grower
    - The size of the family of the small tea grower is taken in numbers of his family members excluding children below 1 years of age. Along with this information regarding the growers' religion, cast and the total family income in rupees excluding the income from tea is also collected.
    - The information about age of the grower is taken in years, education in total schooling years completed; farming experience in years for experience in cultivating tea, and training days in number of days has been collected.

- Information has also been collected regarding the number of males and females in the family, the age of the family members, income source of the working members of the family and their occupation, and the education levels of the family members in schooling years completed has also been collected.

- Basic features of the small of the tea garden
  - Information regarding total number of tea plants, age of the plants in years and regarding the garden type whether it is an individual or group owned garden type has been collected under this heading.
  - Information regarding the total land holding in bigha[4], total land under tea cultivation of the small tea grower and regarding ownership of land whether it was own land or leased in was collected during the field survey.
  - Information regarding input use of the small tea grower has also been collected during the survey. The main inputs used by the small tea growers are, fertilizer (Urea, SSP, MOP, NPK, DAP), micro nutrients (Bio-Vita, Zinc High etc.), pesticides (Dumite, Agradut etc.), Herbicide (Glycil, Glycos etc.), labour (hired male labour, hired female labour, family male labour, family female labour). The male labors work for 8 hours a day and the female labors work for 6 hours a day. The fertilizer amount used, timing of use and combinations used is different for different villages. The same is the case for pesticides and herbicides. All the information regarding inputs used, their quantity and timings have been collected for all the 90 small tea growers during the survey.
  - Input costs information of the small tea growers and their total cost has also been collected during the field survey. Input costs of the small tea growers include

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[4]Land information has been collected in local unit of measurement bigha. 1bigha= 1/7.5 hectare. Bigha has been taken as unit of measurement instead of hectare because while taking the land details in hectare the total area came in fractions which could create problems in the estimation of production function. Therefore, to avoid this problem the unit of measurement land in study has been taken in local unit of measurement bigha instead of hectare.

fertilizer cost and their prices, pesticides cost and their prices, herbicides cost and their prices, manure cost and its price, labour hours per hectare, cost per hectare, wage rate sex wise), working capital used and physical capital owned. The total cost and inputs prices in this study have been collected only for the survey year. The physical capital owned by small tea growers include different tools used in the tea cultivation (sprayer, kodali, axe, weeding hook, pruning knives, sickle, cutting knives, and vehicle).Bullocks and other physical capital like tractors, tillers etc are not used in tea cultivation therefore no information has been collected regarding them.

- Information about the total output and total revenue of the small tea growers has also been collected. Total output is the amount of leaves produced per in quintal, total revenue of the grower is derived by multiplying total output and the price of the leaves in rupees.
- Irrigation information is not included for estimation in this study because most of the small tea growers in the study area were found to not use irrigation in their small tea gardens.
- Credit details have also not been included for estimation in the study because it was found in the survey that most the growers do not go for credit, only a few grower have borrowed money from either bank or village moneylenders among them too, most of them have been found to have already fully repaid the money.

1.7.4 *Questionnaire Survey Procedure of the Study:*

All these information regarding the small tea growers were collected with the help of a questionnaire survey of 90 small tea growers selected randomly. The format of the research questionnaire used for this study has been given in the appendix at the end of bibliography of this dissertation. The questions in the questionnaire were asked to the main decision maker grower of the small tea grower family in case of individual growers. In case of the group small tea growers' questions were asked to the representative of the group, the main decision maker of the group as stated above. All the 90 respondents were investigated by the researcher herself. The questionnaire has been divided into eight heads.

The first head dealt with the name and address of the cultivator and the address of the small tea garden. Whether the garden was individual small tea garden or a group small tea garden was also asked under this head.

The second part dealt with the demographic particulars of the small tea growers' family. In case of group small tea growers only the family details of the main decision maker of the group were collected as a proxy for average family details of the group due to time constraint of this dissertation. Under this head information was collected about the total number of family members, their gender, age, relation to the main small tea grower, their marital status, schooling years completed, their main occupation, subsidiary occupation, and total annual income of each member of the family. In this part only the information regarding the other family members of the family excluding the main small tea grower were collected.

The demographic information of the main small tea grower was collected under the third heading. This was done so that the information of the main grower does not get mixed up with the information of his family. Under the third heading information about the gender, age, schooling years completed, marital status, other qualifications, main occupation, subsidiary occupation, farming experience in tea cultivation and total training days attended were collected.

In the fourth part of the questionnaire questions to collect information about the land details of the small tea grower were included. The questions were asked about the total land of the grower, amount of land under tea cultivation, land under other agricultural cultivation other than tea, whether the land is leased or own, whether any part of his/her own land have been leased out, total rent paid per year and total rent received per year on leased out land. Information about the total number of tea plants was also asked in this part along with information about the age of the tea plants in the small tea garden of the respondent.

In the fifth part of the questionnaire questions were set to collect information about the selling of the tea leaves by the small tea growers. Whether they sell tea leaves to the Bought Leaf Factories (BLFs) or to large tea gardens, whether they sold themselves or through agents, total annual amount paid to the agents, and price of the leaves were asked under this heading. Since the price of the leaves were fluctuating only approximate average price were asked.

In the sixth part of the questionnaire, information was collected about whether irrigation is done or not, if done in how much of total tea area irrigation is done and total annual production of tea leaves from the small tea garden. Average annual yield per bigha was calculated by the researcher herself, and the total annual revenue was also calculated by the researcher herself.

In the seventh part information about the quantity, price per unit and total annual cost of different inputs used for tea cultivation by the small the growers were asked. The information included the information about the male labour used, female labour used, *sardars*[5], new saplings planted in the survey year, manure used, fertilizers used with their names, pesticides used with their names, herbicides used with their names, physical capital owned by the grower, hired physical capital and its rent, irrigation details and working capital invested by the small grower in his/her tea cultivation.

And in the eighth part the credit details of the small tea grower have been asked. Whether credit had been taken for tea cultivation, if taken what was the source, in which year the credit were taken, what was the interest rate, how much is the total annual payment for the credit paid in the survey year, whether the credit is fully repaid or not, these were the questions asked to the grower in this part. At last signatures from the respondents were taken and were taken.

[5]Sardar is a local name used for supervisors; they supervise the labors and look after other works of the small garden. Sardars are normally hired when the owner of the small tea garden are either unable or facing some problems in performing these works themselves.

CHAPTER 2

CONCEPTUAL

DEVELOPMENTS

CHAPTER 2

Conceptual Developments

2.1. Introduction:

As per the objectives of this research work, the present chapter discusses about the basic concepts of productivity, efficiency and the methods used in measuring productivity and efficiency in details. Throughout this chapter the basic concept of productivity and efficiency has also been discussed along with the importance of efficiency measurement as well as available approaches to do so, and finally the basic characteristics of SFA and conceptual developments in SFA since it was first developed. Brief details about DEA, an alternative method to SFA for estimating efficiency levels, have also been discussed.

2.2 Importance of Measuring Efficiency:

Importance of measurement of efficiency lies in the importance of efficiency. Efficiency of a management firm, either it's an agricultural farm or an industrial unit, is very much important. Efficient utilization of scarce resources allows the firm to maximize the production and profits and minimize the costs. Inefficiency leads to increased costs, reduced production and profits and many other problems like misuse of the scarce resources. Efficiency measurement allows us to know the levels of efficiency of a particular unit and the factors which may affect the same. So, if the efficiency levels are low we can correct the situation with appropriate measures.

The concept of efficiency is very closely related to the concepts of production, cost, revenue and profit frontiers. A production frontier characterizes the minimum input bundles required to produce various outputs or the maximum output producible with a given set of input bundles, and a given technology (Kumbhakar and Lovell, 2000). Producers operating on their production frontier are labeled technically efficient, and the producers producing under their production frontier are labeled as technically inefficient. Thus technical efficiency is defined as the ability and willingness of producers to obtain maximum outputs at a given level of conventional inputs and technology (Shand and Kalirajan, 1994). Technical efficiency studies are mainly concerned of maximizing output with the available inputs and technology. Technical Efficiency measures a firm's success in choosing an optimal set of inputs; it is defined in relation to a given set of firms, in respect of a given set of factors measured in a specific way, and any change in these specifications affects the level of technical efficiency (Farrell, 1957). It measures how efficiently technology is employed in the use of inputs to achieve a given level of output. A dual cost frontier characterizes the maximum expenditure required to produce a given bundle of outputs, given the prices of the inputs used in the production process and given the technology remaining unchanged. The producers operating on their cost frontier are the cost efficient firms and those operating above their cost frontier are cost inefficient. Similar is the case for revenue and profit frontier, those producers operating on their frontiers are regarded efficient and those operating beneath it are regarded as inefficient.

2.3 Productivity and Efficiency:

2.3.1 *Difference between Productivity and Efficiency*: Productivity and Efficiency both are measures of performance of production units. The concept of productivity and efficiency are both very important and much studied concepts in the production literature of economics. Productivity growth is essential for growth of profit making production units as well as for the nation's growth; it is essential for structural transformation of the underdeveloped and developing countries. Low productivity leads to low income of the nation and low income is a serious bottleneck in the way of structural transformation of a nation. Efficiency changes affects the productivity of the nation and in turn affects the growth of the nation, it is one of the two important factors for improving the productivity, the other being technical progress. Productivity and Efficiency are very interrelated concepts, increase in output may be results of increased productivity, and with time more and more productivity may make the producers more strong and experienced and thus more efficient. One may easily be confused by productivity for efficiency or vice versa. Increase in both productivity and efficiency are the top most desires of producers. Despite of the similarities there is clear difference between the two concepts which can be understood by clearly understanding their definitions, what they actually stand for.

2.3.2 ***Meaning of Productivity:*** Productivity is the most commonly used and also the most easily understood measure of performance of a business firm or any decision making unit. Productivity is the amount of output per unit of input achieved by a production unit, it measures the total output produced with respect to each unit of inputs, the production technology remaining unchanged. Productivity measurement is only concerned about the amount or value of originally attained output levels and the units of inputs used in a particular point of time or a time period. Thus, the concept of productivity is directly related to the inputs used in the production process, when we talk about the productivity of a production unit what we actually refer to is productivity of the inputs used by the production unit in producing a particular output.

2.3.3 ***Meaning of Efficiency:*** Efficiency is also a measure of performance of a decision making unit, it means the ability of a production unit to obtain the maximum possible output with a given set of inputs and the technology remaining unchanged.

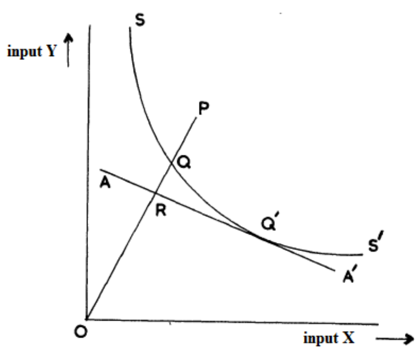
Efficiency, given the present production and technology and input quantities and costs, measures what is the highest level of output that could have been produced or in case of cost efficiency what are the minimum levels of cost attainable with the given level of technology and input availability. Efficiency is not directly concerned about what output is actually produced; it is mainly concerned about what is the optimum level of production or cost (in case of cost efficiency) given the technology and input sets and their respective cost conditions. Efficiency is a closely related and more specific concept to productivity in production analysis, which does not only examine output from a given input (or input set), but further compares the output to what can be achieved with the given input set (Daadi et al, 2014). The efficiency of a firm usually means its success in producing as large as possible an output from a given set of inputs (Farrell, 1957). As defined by Boyne (2003), efficiency is the ratio of outputs produced by an organization to the inputs required in producing those outputs. It is a relationship between ends and means. Efficiency is, therefore, a measure of how well the production or input transformation process is performing. It indicates how well an organization uses its resources to produce goods and services (Daadi et al, 2014).

Economic efficiency can be decomposed into technical efficiency and allocative efficiency. The product of technical and allocative efficiency is the overall economic efficiency.

Technical efficiency studies are mainly concerned of maximizing output with the available inputs and technology. Technical efficiency measures a firm's success in choosing an optimal set of inputs; it is defined in relation to a given set of firms, in respect of a given set of factors measured in a specific way, and any change in these specifications will affect the measure (Farrell, 1957). It measures how efficiently technology is employed in the use of inputs to achieve a given level of output. Farrell (1957) decomposed overall productive efficiency into technical efficiency and allocative efficiency.

Allocative efficiency (or Price Efficiency) is a firm's success in producing maximum output from a given set of inputs (Farrell, 1957). It measures firm's success in choosing optimal proportions, i.e. where the ratio of marginal products for each pair of inputs is equal to the ratio of their market prices (Bashir, 2005). It is, marginal revenue of all inputs being equal to their marginal costs (Belbase and Gabowski, 1985). The allocative efficiency is the firms' ability to adapt to the current as well as changing factor prices.

Figure 2.1: Isoquant Representation of Technical and Allocative Efficiency



In the figure 2.1 $SS^{/}$is the isoquant that represents the various combinations of two inputs X and Y that a perfectly efficient firm might use to produce its output. Say a firm is producing at point P. Q is an efficient firm using the two inputs in the same ratio as the firm at point P. Q produces the same output as P using only a fraction OQ/OP of the total input used by firm P. This OQ/OP is the technical efficiency of the firm P as defined by Farrell (1957). In the same figure, $AA^{/}$ is the ratio of the factor prices of X and Y, and with given the factor prices $Q^{/}$ is the efficient point not Q. The cost of production at point $Q^{/}$ is only a fraction OR/OQ of the costs at point Q. This fraction OR/OQ is the price efficiency or the cost efficiency of the firm Q as defined by Farrell (1957).

2.4 Different Approaches to Measuring Efficiency:

Several approaches to efficiency measurement have been developed, among these Stochastic frontier Analysis (SFA) and Data Envelopment Analysis (DEA) are the most popular in the measurement of the technical efficiency. SFA is a parametric and econometric approach while DEA is a non-parametric approach and used mathematical programming. But the pioneers in the field of efficiency measurement approaches are Farrell's (1957) approach, Pareto's approach and Koopmans (1951) approach who developed their approaches to measure efficiency long before the development of both these approaches.

2.4.1 ***Pareto's Approach:*** In addition to the engineering definition of efficiency (the ratio of amount of heat liberated in a given device to the maximum amount which could be liberated by the fuel being used.) the other such definitions of efficiency is called "Pareto Optimality" used in "Welfare Economics". This concept was formulated by Swiss Italian economist Vilfredo-Pareto. The Pareto optimality is defined as the position in the economy from which it is impossible to improve anyone's welfare by altering the given allocation (production or exchange) without affecting someone else's welfare. However, this approach does not allow inter-personal comparison.

2.4.2 ***Koopmans' Approach:*** Tjalling C. Koopmans (1951) a Dutch economist subsequently extended the definition of efficiency to "production economics" by introducing "efficiency price" to control production and exchange to positions that are similar to Pareto Optimum. This approach is further utilized in the DEA literature and termed as Pareto Koopmans definition of efficiency. The Pareto Koopmans efficiency and engineering concept of efficiency are related to each other by duality theorem of linear programming. In other words, there exists a dual to the one used to implement the engineering definition of efficiency, which uses the same set of data to arrive at a measure of Pareto Koopmans efficiency. At the corresponding minimum and maximum values of the Pareto Koopmans efficiency and the engineering sciences' scores are equal.

2.4.3 ***Farrell's Approach:*** The econometric estimation of productive efficiency was done for the first time by Farrell (1957). Farrell (1957) for the first time investigated the structure of productive efficiency and showed how to define cost efficiency and he also decomposed cost efficiency into technical and allocative efficiency. According to Farrell (1957) the efficiency of a firm usually means its success in producing as large as possible an output from a given set of inputs, provided all inputs and outputs are correctly measured. Farrell (1957) defined technical efficiency as a firm's success in producing maximum output from a given set of inputs while price efficiency as the firm's success in choosing an optimal set of inputs. Farrell (1957) stated his approach of efficiency measurement in two cases, one with constant returns to scale and single output to present his idea of technical and price efficiency with the help of a simple isoquant and the other with efficient production function with many inputs and outputs he described the case with increasing and decreasing returns to scale. Farrell (1957) approach of efficiency estimation was not an econometric approach, he used linear programming techniques.

2.5 Stochastic Frontier Analysis:

SFA originated with the works of Aigner, Lovel and Schimdt (1977) and Meeusen and Van den Broeck (1977). Both these SFA models shared the composed error structure, and were developed in a production frontier context. There are two error components one is intended to capture the effects of statistical noise and the other is intended to capture the effects of technical inefficiency. The inefficiency error component is negatively skewed in both the models, thus the producers operate on or beneath their production frontier. Aigner, Lovell and Schimdt (1977) assigned a half-normal as well as exponential distribution to the inefficiency error component while Meeusen and van den Broeck (1977) assigned only normal exponential distribution to the inefficiency error component. The model of Aigner, Lovell and Schimdt (1977) is expressed as $y_i = f(x_i; \beta) + \epsilon_i$, where, y_i = the maximum output obtainable from x_i, a vector of (non stochastic) inputs, and β is an unknown parameter vector to be estimated, and $\epsilon_i = v_i + u_i$ where v_i represents the symmetric disturbance, the u_i is the inefficiency component and is assumed to be distributed independently of v_i. Both the models used maximum likelihood to estimate statistical efficiency and provided an estimate of mean technical inefficiency in both the distribution cases of the inefficiency error terms.

2.5.1 ***Basic Characteristics*****:** SFA was developed for the first time simultaneously by Aigner, Lovell and Schimdt (1977) and Meeusen and Van den Broeck (1977). In simple words SFA is an econometric method of estimating the inefficiency component of the error term which causes deviation of the production function from the optimum frontier. Every producer wants his production process to operate on the optimum frontier so that the profits and costs are at their optimum levels. But it is the error term involved in the production function which causes any deviation of the same from the optimum frontier. The error terms associated with SFA are composed error terms, composed of a traditional random noise component and a one sided inefficiency component. In Stochastic Frontier Analysis we use econometric methods to estimate the optimum production frontier and to decompose the variations in output from the frontier due to random error term and the inefficiency component. The inefficiency component is skewed negatively in the case of production frontier, revenue frontier and profit frontier and positively skewed in the case of cost frontier with zero means. The production frontiers are stochastic and deviations from these are one sided due to one sided inefficiency component in the error terms. The parametric method of estimating the production, cost, revenue and profit frontiers with the help of these one sided inefficiency components is referred to as Stochastic frontier analysis (SFA) (Kumbhakar and Lovel. 2000).

As developed by Aigner, Lovell and Schimdt (1977) and Meeusen and Van den Broeck (1977), the SFA model can be expressed as equation (1) in chapter 1 as follows,-

$$y_i = F\,(\,x, \beta)\, e^{\varepsilon} \qquad i = 1, 2, \ldots, N \qquad (1)$$

Where y_i is the output for the i^{th} firm, x_i is a vector of k inputs, β is a vector of k unknown parameters, ε_i is the error term. The error term is composed of as follows-

$$\varepsilon_i = v_i + u_i\,, \qquad i = 1, \ldots, N \qquad (2)$$

The error component v_i represents the symmetric disturbance. The v_i is independently and identically distributed with zero mean and varianceσ_v^2. While u_i represents the inefficiency component and is independent of v_i. The u_i follows a one-sided distribution with mean zero and varianceσ_u^2.

2.5.2 *Evolution in Theory of SFA:* After the introduction of SFA by Aigner, Lovell and Schimdt (1977) and Meeusen and van den Broeck (1977), an unsolved problem was to separate the composite error term into its two components, as an improvement to the original model, Jondrow et al. (1982) proposed to provide technical efficiency of each producer in the sample by estimating either the mean or the median of the conditional distribution [u_i | v_i – u_i]. The possibility of producer specific estimates of efficiency greatly enhanced the appeal of SFA.

As an improvement to the single parameter half-normal and exponential distribution of the one-sided inefficiency component of the error term, researchers like Greene (1980) and Stevenson (1980) simultaneously proposed two-parameter Gamma distribution and Gamma and truncated normal distribution. Later on more flexible four parameter distributions were also used by researchers, but the two original single parameter distributions remain the widely used in the vast majority of empirical work. After the estimation of inefficiency for each producer came the estimation of the cost frontier and to decompose the cost inefficiency term into technical and allocative efficiency as suggested by Farrell (1957). Schimdt and Lovell (1979) accomplished the remaining difficult task of decomposing the inefficiency term into technical and allocative efficiency for the Cobb-Douglass case. Later, Kopp and Diewart (1982) analyzed the same decomposition for a translog production function case.

Formerly only Cross sectional data were being analyzed with the help of SFA, then for the first time Schimdt and Sickles (1984) extended the pioneering work of Hoch (1962) and Mundalak (1961), who utilized panel data in agricultural economics to study technical efficiency, by applying fixed effects and random effects methods to the efficiency measurement problem, where the effects are one-sided. A significant impact of this development was that the researchers were now able to do consistent estimation of the efficiency of the individual producers, which was not possible with the models involving only cross-sectional data. These panel data models were based on time invariant assumption, eventually these assumptions were relaxed by the works of researchers like Kumbhakar (1990), Cornwell, Schimdt and Sickles (1990), and Battse and Coelli (1992).

Fare, Grosskopf and Lovell (1983) for the first time investigated the structure of technical efficiency. They allowed for production of multiple products in the production technology they used, and decomposed the technical efficiency into the product of three terms: a Farrell measure of technical efficiency, a measure of input congestion, and a measure of scale efficiency. Thus Fare et al. (1983) stated that a firm is technically inefficient if it operates on the interior of its production set, if it operates in a congested region of its technology, or if it operates at too larger or too small scale.

Earlier studies used to adopt two stage estimation of the inefficiency term, one stage for the inefficiency of the producers and the other for studying the variation in the inefficiency among individual producers. But later by the works of Kumbhakar, Ghosh and McGukin (1991), Reifschneider and Stevenson (1991), Huang and Liu (1994) single stage estimation were developed in which explanatory variables were incorporated directly into the error component. In this approach either the mean or the variance of the error term is hypothesized to be a function of the explanatory variables, these works were associated with cross-sectional data on the sample firms. Later Battse and Coelli (1995) proposed a model for technical inefficiency effects in a stochastic production function for panel data which allows for the estimation of both technical change in the stochastic frontier and time varying technical inefficiencies.

2.6 Alternatives to SFA:

An alternative for SFA is Data envelopment analysis. As stated before Data Envelopment analysis is a non-parametric approach using mathematical techniques to production function and efficiency measurement. The non-parametric method of DEA was first introduced by Charnes Cooper and Rhodes CCR (1978) and was further developed by Banker, Charnes and Cooper BCC (1984). The DEA does not require any parametric specification of the production frontier and relies on a number of fairly general assumptions about the underlying production technology. The non-parametric approach to efficiency measurement obtains technical efficiency estimators as optimal solutions to mathematical programming problems. CCR (1978) formulated the Data Envelopment Analysis (DEA) methodology, which defines a non-parametric frontier and measures the efficiency of each unit relative to the frontier. The DEA model of CCR (1978) assumes Constant Returns to Scale (CRS). DEA models can be either input or output oriented. In the input orientation the efficiency scores relate to the largest feasible proportional reduction in inputs for fixed outputs, while in the output orientation it corresponds to the largest feasible proportional expansion in outputs for fixed inputs. Banker et al. (1984) extended the CRS DEA model of Charnes et al (1977) to account for variable returns to scale (VRS). Te estimated technical efficiency from the output oriented VRS DEA of each firm unit will be higher than or equal to that in the input oriented CRS DEA as the VRS DEA is more flexible than the CRS DEA (Theodoridis and Anwar, 2011).

DEA has several attractive features in comparison to the parametric stochastic frontier model, the DEA method does not require the prior specification of a functional form for the production function, rather than focusing on population averages, DEA concentrates on the revealed 'best-practice' frontiers. However, DEA is not fully free from any deficiencies. First, DEA approach does not account for the measurement error and statistical noise that may influence the shape and position of the frontier. Secondly, it does not allow for conventional tests of hypothesis, which are typical of the econometric approach. In addition, the non-parametric approach provides only an upper bound to the true efficiency measures because all deviation from the production frontier is attributed to inefficiency.

Theodoridis and Anwar (2011) in a study of 240 households surveyed from six regions of Bangladesh estimated and compared the technical efficiency obtained from DEA and SFA models to examine the impact of household endowments, like experience and education of the former on the variance of technical efficiency. The results found show that the mean technical efficiency of SFA is always expected to be higher than that of the DEA. The SFA findings were found to be supported by DEA results implying that they give similar results; the correlation between them was found to be positive and significant.

DEA may be a preferred method of estimation where random errors are unlikely; on the other hand SFA has the advantage in handling random errors. Since we are studying cultivation of tea by small tea growers, an agricultural product where random errors are obvious to occur. Thus one cannot afford to use DEA in this case. Therefore SFA has been used in this study to estimate the efficiency levels of small tea growers in Udalguri district. SFA can also be used to analyze both internal and external factors of technical efficiency; it is more suitable for this study which includes both internal and external factors.

CHAPTER 3

TEA PRODUCTION SCENARIO

CHAPTER 3

Tea Production Scenario

3.1 Introduction:

This chapter portrays a brief sketch of the Indian tea industry, especially focusing on the small tea sector of India and Assam. Attempt has also been made to discuss in more details about the small tea growers of Udalguri district of Assam and a brief outline of the study area has also been discussed in this chapter.

3.2 Tea Production:

The scientific name of tea plant is camellia sinesis. It is a species of evergreen shrub. Its leaves and buds are used to produce tea. The tea plant is mainly cultivated in tropical and subtropical climates, in areas with at least 127 cm of rainfall every year. Tea is cultivated at elevations up to 1500 meters. At higher elevations the plant grows more slowly and acquires more flavors. Tea requires a moderately hot and humid climate. Climate plays and very important and rather interesting role in tea cultivation. The same variety of tea plants produces tea of different flavor, taste, colors and smell depending on different soil and climatic conditions.

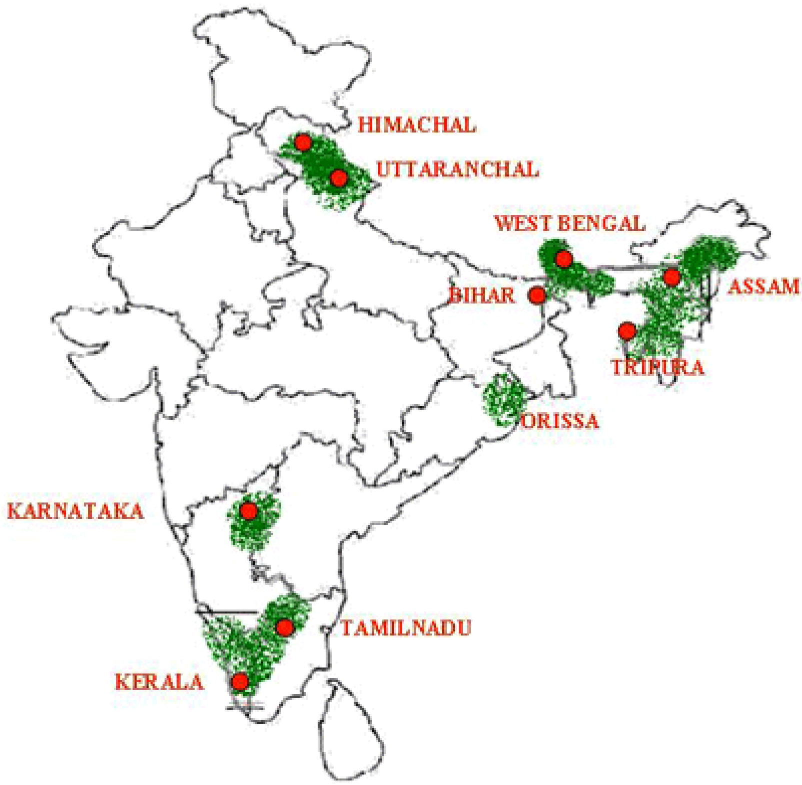
Tea can be placed both under agriculture and industry. Tea comes under both agricultural and industrial operations and rules and regulations. Like all other agricultural crops, tea is also grown on land and agricultural income tax is levied on tea. Tea undergo through all sorts of agricultural operations like, cultivating, plucking, manuring, irrigation, weed control, disease control, pest control etc. While the final product of tea comes from industrial process like, withering, rolling, fermenting, drying, weighing, sorting, cutting and packing and thus it comes under industry and is also subject to excise duty and cess. Tea industry also needs to use modern equipments for the industrial process it goes through. The tea industry also employs a large amount of labour in both agricultural and industrial process, and the marketing system is also unique from other agricultural products. The tea bush, its cultivation and harvesting are very different from and do not fit into any typical cropping pattern. The harvesting process and marketing are also very specific to tea and do not match to other crops, because of these reasons the tea industry stands apart and constitutes a self contained entity.

3.3 Indian Tea Industry:

3.3.1 *Origin and Development:* Tea is an important plantation crop produced mainly in India, China, Sri Lanka and Kenya these countries account for 79% of world tea production and 72% of world tea exports (TBI report 2014). Tea is grown in 16 Indian States Assam, West Bengal, Tamil Nadu, Kerala, Tripura, Himachal Pradesh, Uttarakhand, Bihar, Orissa, Karnataka, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Sikkim of which Assam, West Bengal, Tamil Nadu and Kerala account for about 98 per cent of the total tea production. Some of the important tea producing regions of India is shown in figure 3.1.

Total area under tea in India is 563.98 thousand hectares (TBI, 2013). About 78% of the country's total area under plantation is located in North East India. The teas originating from Darjeeling, Assam and Nilgiris are well known for their distinctive quality worldwide over and tea exports contribute significant amount of foreign exchange into the country. In year 2014 the Indian tea price in world auction price was 20.28 US$/Kg (TBI, Global Tea statistics, 2016). India is the second largest producer and third largest exporter of tea in world but the largest consumer of tea in World. 80% of India's domestic tea production is consumed internally; Indian consumption accounts for 20% of world tea consumption (59th Annual Reports, TBI 2012).

Figure 3.1: Tea Map of India



Source: Tea Board of India.

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[6](TBI, Global Tea Statistics, 2016).

world but the largest consumer of tea in World. 80% of India's domestic tea production is consumed internally; Indian consumption accounts for 20% of world tea consumption[7].

The history of Indian Tea Industry is as old as above 200 years by now. In 1837, the first English tea garden was established at Chabua in Upper Assam. In early decades of 18th century tea plants were discovered to be indigenously growing in the forests of Assam. Before that China had monopoly over the tea business in the world tea market. At that time drinking tea was a luxury entertained by the higher class people of the society. Lord William Bentinck in 1834 for the first time attempted introduce tea-culture in India bringing the seeds, saplings and trained manufacturers from China, but did not succeed at first in getting as a result as hoped. He also issued a circular asking for opinions regarding the most suitable places to grow tea in India; as a respond to the circular Captain Jenkins, the then in charge of Assam, sent samples of tea as well as tea leaves and seeds to Calcutta and thus it was officially accepted that tea can be grown in Assam. After that in 1840 the first tea company in India, the Assam Tea Company was established. After the introduction of tea in India its expansion was very rapid, it was not confined only to Assam but also in other regions of India like Darjeeling and different parts of South India. By 1852 Indian Tea was successfully competing with the China tea in London.

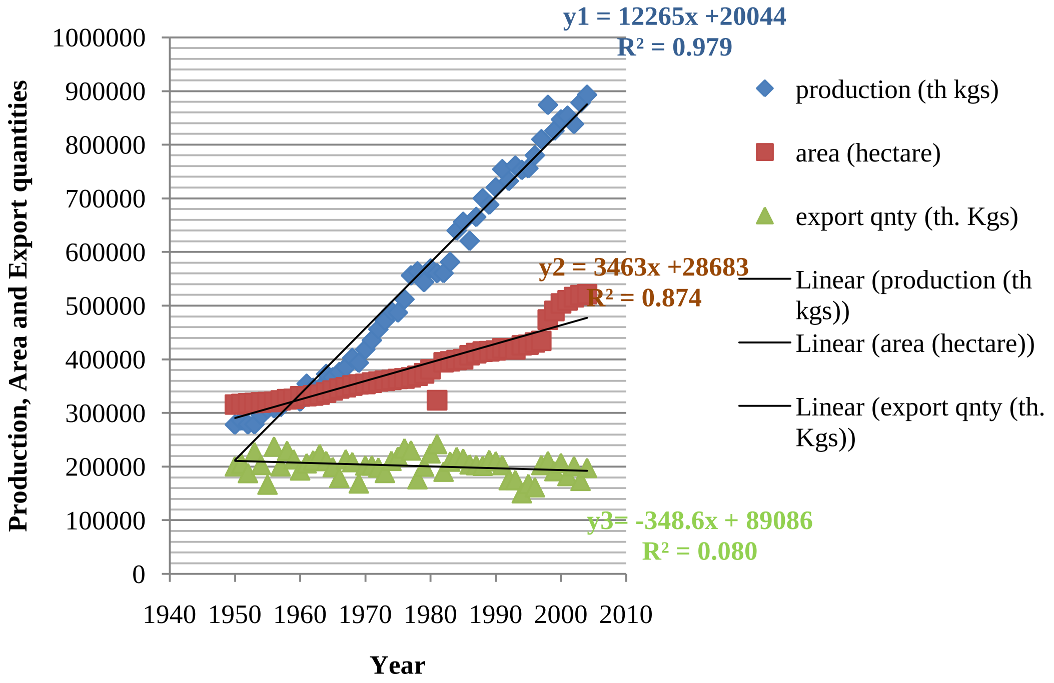
By 1950's Indian tea was at the top in the world tea market, and India was the largest producer and exporter of tea. Since that time the Indian tea industry has gone through many developments and its share of ups and down. After the establishment of a successful industry in Assam's Brahmaputra valley, the feasibility' of growing tea in the entire range of foot hills of the Himalayas and other parts of India was explored.

[7]Information collected from 59th Annual Reports of TBI, 2012.

By 1863, 78 plantations were established in Kumaon, Dehra Dun, Garhwal, Kangra Valley and Kulu (TBI). After the transfer of the present Darjeeling district to the East India Company in 1835 and initial trials in the 1840s, commercial plantations were started in Darjeeling in the 1850s and by 1874,113 gardens covering 18,888 acres of tea were opened and production touched 1.78 million kgs. In 1853 India exported 183.4 thousand kgs of tea. By 1870, that figure had increased to 6,700 thousand kgs and by 1885, it was 35,274 thousand kgs. Today, India is one of the world's largest producers of tea with 13,000 gardens and a workforce of more than 2 million people involved in its production.

The performance of Indian Tea industry in production, area and exports from 1950 to 2004 is depicted by fitting a trend line to its production, area, yield and exports in the following figure-

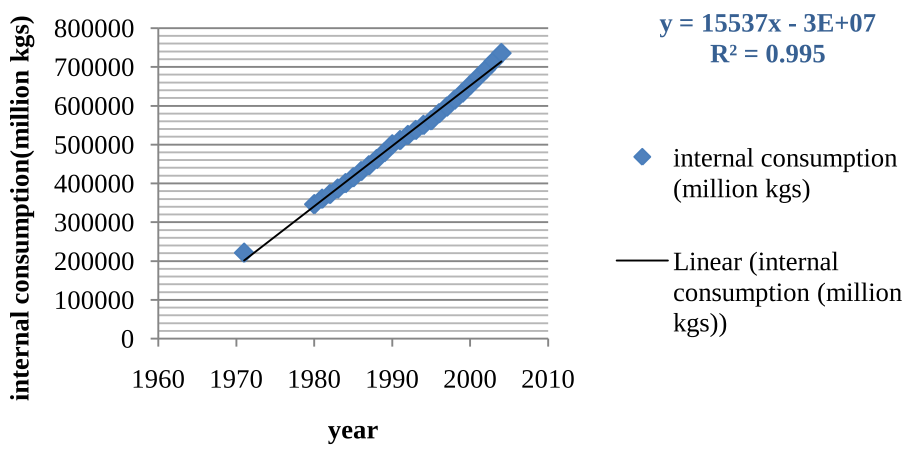
Figure 3.2: Trends in Production, Area and Exports from 1950 to 2004



Source: Tea Digest, Tea Board of India, 2004.

The total tea production in India in 1950 was 278212 thousand kgs which increased to 892965 thousand kgs in 2004, trend line fitted to the production of tea in India since 1950 to 2004 show that production had increased drastically in that period with average rate of 12265 thousand kgs in one year. Area under tea has also increased in that period but not in as much of a rate as production. Area under tea has increased at an average rate of 3463 hectare per year. In 1950 area under tea was 315656 hectare which increased to 521403 hectares in 2004. After 2004 also the growth of area under tea has been slow, in year 2013 it increase only to 563980 hectare from 521403 hectare in 2004. The growth in exports of tea has not been much in this period. The growth of export has been negative in this period with average rate of 348.6 every year. The reason for the huge difference between production and export of tea may be because of the huge amount of domestic consumption of tea. The average rate of growth of internal consumption of tea was 15537 thousand kg per year for the time period 1971 to 2004[8] as we can see in the following figure-

Figure 3.3: Trend of Internal Consumption of Tea, 1971-2004



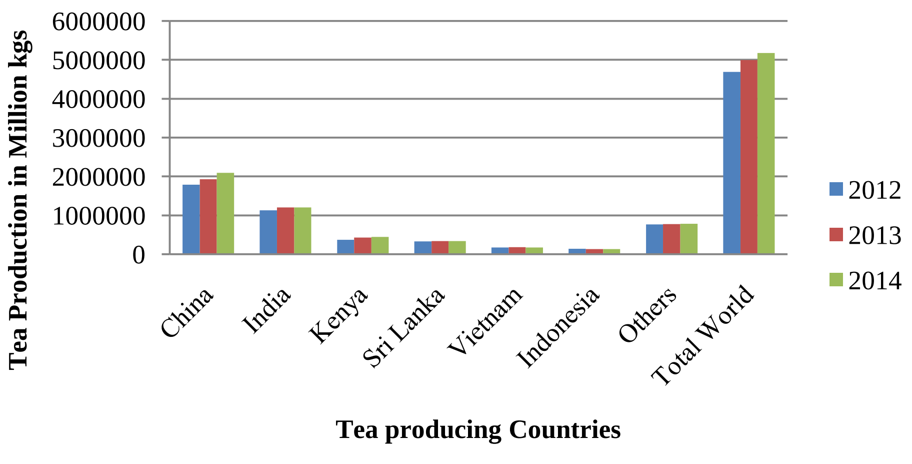
Source: Tea Digest, Tea Board of India, 2014.

[8] The internal consumption data contains data from 1971 to 2004 except for the years 1972 to 1979, for these years internal consumption data was not available.

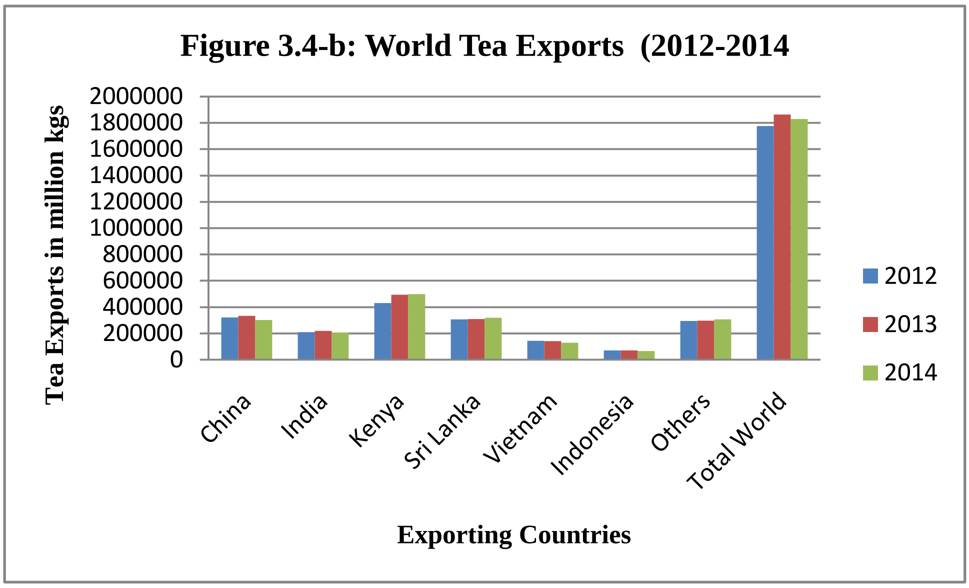
Thus the rate of growth of internal consumption of tea is even higher than the rate of growth of domestic production of tea; this may be the reason for negative growth rate of the tea exports in India.

Today, India is the second largest tea producers in the world. In year 2014, India's share accounted for 23% of the total World Tea production. In the same year the total tea production of the other major tea producing countries, China, Kenya and Sri Lanka were- 2096, 445, and 338 million kg respectively of the total world production of 5173 million kg (TBI, 2014). India is also the third largest exporter of tea in the World, first is Kenya and second China. The world tea productions and exports for the year 2012 to 2014 is expressed in the figure 3.3 and figure 3.4 respectively-

Figure 3.4-a: World Tea Production (2012-2014)



Source: Tea Board of India, Global Statistics, 2016



Source: Tea Board of India, Global Statistics, 2016

3.3.2 *Small Tea Cultivation in India:* Indian tea industry has lost its position substantially in the export market. On the other hand, productivity as well as quality of product is severely affecting due to old tea bushes which have already crossed their economic life, consequently the prices of tea at the tea auctions are not increasing, it's like Bhowmik (1991) stated "The tea industry of India in India is in Crisis". In recent years big tea plantations have started to lose competitiveness due to - imbalance in demand and supply, old bushes, negligence in maintenance, quality degradation, lack of investments, high cost of production, increase in social costs like - health care, education, housing etc., failure to place tea in upper- end markets, labour unrest, in experienced management (Borah, 2015). All these developments and challenges have led to closure of many tea garden/ estates recently in Kerala 20, 30 in West Bengal, about 70 in Assam (Borah, 2015). Many established tea producers like TATA Tea, Hindustan Lever and many established tea producers face loss in fiscal year 2016, due to factors like labour unrest, high payouts, and crop damages. Therefore, the future growth of tea industry will be dependent on the growth of small tea gardens only. With the taking up of tea cultivation on small scale by the local people will be an incentive for the sustainable development of the tea industry. While the global tea value chain is being restructured, India has witnessed a transformation. This transformation is marked by the failure of traditional command driven estate system of production to deliver and the rise of small tea growers (STGs).

The concept of small tea cultivation came into existence when Kenya in 1950's, had decided to produce tea for export. The Kenyan successful experience had created a modern trend of small tea growers in developing and underdeveloped countries. Since then, there has been a steady shift in tea cultivation from big plantation to small holdings (CDPA, 2008). Today, in most of the tea producing countries like China, Sri Lanka, Indonesia, Kenya, Bangladesh, Nepal, Vietnam etc., small tea cultivation significantly contributes to the country's total tea production along with the large estates. Tea cultivation on small holding is a recent development in Indian tea sector. After independence, during the successive five year plans the TBI had spent all its resources in trying to mobilize big tea estates to increase production or expand area under tea, most of its efforts borne little result (Bhowmik, 1991). Even with the Government investment through TBI and other agencies, there had been a marginal increase in production (Bhowmik, 1991). During that period production of tea were increasing at much slower rate than the rate of growth of internal consumption of tea, as we can also see in figure 3.1 and figure 3.2. Therefore tea exports were being curtailed so that the internal price does not increase much, and thus exports growth became almost stagnant. At first the Tea Board of India tried to improve the situation by means of increasing the production of the large tea plantations. In sixth and seventh plans all possible steps were taken in order to increase the tea production in India by means of the large plantations but the results were not as satisfactory as expected. Thus from 8th Five year plan (1992-1997) TBI laid down some emphasis on the promotion of Small tea growers. Thus the Tea Board of India started to encourage landless laborers and unemployed youths to take up tea cultivation in the tea growing areas of India so that the area under tea cultivation in India could be increased. The contribution of STGs in the total production of tea has shown an increasing trend since 1991 and it stands at about 30 per cent of the 980 million kg of tea produced in India in 2010 (TBI, 2012). In year 2011, there were 157504 small and 1686 large tea gardens in India, covering 1.62 lakh and 4.18 lakh respectively. India is the second largest producer of Tea in world after China, in 2015-16 total tea production in India was 1233.14 million kgs (TBI) India is an important tea exporter in world with exports of 12-13% of the total World Tea Exports ("Indian Tea Industry", 2016). India is also world's largest consumer of tea, more than two third of its own production is consumed by India, in 2015-16 while total production was 1233.14 million kgs total consumption accounted for 951 million kgs, 77.1 % of total tea produced in India (TBI). In India, Small gardens constitute 98.94% of total tea estates, 27.93% of total tea area and 26.32 of total production (TBI 2011). In 2014, small tea growers (STG) provided 170 million kg made tea, contributing 33 percent to the total production and 28 percent of the area (AASTGA). In India tea in small gardens is produced mainly in Assam, West Bengal, and Tamil Nadu along with some other states like Kerala, Karnataka, Tripura, Himachal Pradesh, Uttaranchal, Arunachal Pradesh, Manipur, Sikkim, Nagaland, Meghalaya Mizoram and Bihar.

3.4 The Tea Industry of Assam:

The state of Assam is the largest tea growing state of India, in year 2013-14 the total number of tea factories in Assam were 755 which produced 629.05 million kgs of tea which was more than half of the total tea produced in India in that year (TBI).

Figure 3.5: Map of Assam

Source: Official website of Assam, www.assam.gov.in

In the above figure 3.5 the map of Assam is shown with all its districts. Among these, the districts where tea is mainly cultivated are Dibrugarh, Tinsukiya, Jorhat, Lakhimpur, Sivsagar, Sonitpur, Udalguri, Karbi Anglong, Cachar, and Nagaon. Total area under tea cultivation in Assam is 312210 hectare (Indian Tea Association). More than 26% of total tea produced in Assam is contributed by the small tea growers in the region. In Assam tea is grown at elevations ranging from 45 to 60 meters above sea level. Average annual rainfall in Assam is 250 to 380 cm; in year 2014 actual rainfall (all seasons) in Assam was 1861.6 mm. The tea plants in Assam are grown in lowlands unlike the highland productions of Darjeeling and Nilgiris. This region is famous for their nature of being brisk, strong and malty with rich, deep amber color making it a perfect tea to wake up to, as opposed to the floral aroma of Darjeeling and Nilgiris. Both Orthodox and CTC (Crush/Tear/Curl) varieties of tea are manufactured in Assam. The orthodox variety has abundance bright, golden and chunky, tip from this state. The distinctive second flush orthodox Assam tea is much valued for their rich taste, bright liquors and is considered to be one of the choicest teas in the world and it also has a registered Geographical Indication (GI). Among the agriculture-based industries, tea occupies an important place in Assam. Tea industry plays a very special role in the State economy in particular and in the national economy in general. Tea industry has contributed substantially to the economy of Assam. About 17 percent of the workers of Assam are engaged in the tea industry. In Assam, tea is grown both in the Brahmaputra and Barak plains. Assam produces 51% of the tea produced in India and about 1/6th of the tea produced in the world. The history of the tea industry in Assam dates back to the year 1826, when indigenous tea plants growing in the plains of Assam came to the notice of the east India Company. As we have discussed above, Assam is the birthplace of Indian Tea Industry, this is where the first tea garden of India was established. Assam is the only region in the world that has its own variety of tea, called ‘Camellia Assamica’. Assam tea is generally harvested twice a year first flush plucked during late march and the second flush which is also called ‘tippy tea’ and is more prized is picked during November. This industry was an instrument for the development of hard infrastructure like railway, roadways and utilization of hilly terrain for tea plantation in Assam. Tea industry is said to be the only industry which had provided stimulus to the development process in Assam. Other than infrastructural developments, many ancillary industries like packaging materials, plywood, jute bags etc. were set in the state. Many people are engaged in different layers of supply chain of tea industry from factory to ultimate consumer.

3.4.1 ***Small Tea Cultivation in Assam:*** The tea industry of Assam is more than 180 years old. Though the tea industry of Assam is more than 180 years old, it took almost 150 years for the farmers of Assam to be interested in cultivating tea in small gardens. Even after the green revolution in India (1960's), the agricultural sector of Assam, remained underdeveloped, due to the lack of irrigation facilities, small holding size, lack of investment in modern technology, hilly terrain, poor infrastructure; insufficient government support etc. It compelled the traditional agriculturists in rural areas of Assam to look for alternative livelihood (Baruah, 2015). Tea cultivation on small holding was one of the alternatives they could sustain their livelihood in the long run. The first effort to popularize tea cultivation in small holdings in Assam was made in 1978 by Late Soneswar Bora (the then minister of agriculture and co-operatives Assam). His intention was to utilize available fallow land and attract young generation to agriculture sector and thereby to solve unemployment problem (Baruah, 2011). The first commercial tea plantation in a small plot of land was started in Golaghat district of Assam during 1978. Small tea growers contribute a lot to the development of the tea industry of Assam. The economic importance of small business like cultivating tea in a smaller scale in a developing country like India is enormous, as they play vital role in absorbing unaccountable no. of unemployed persons in rural and semi rural areas where these small tea gardens are mainly situated. It is estimated that in Assam about 5.55 lakh people are directly engaged with STG sector out of which 2.45 lakh is ex tea garden worker or the excess labour thrown out of the large tea estates, specifically women (AASTGA). Assam has the largest area under small tea gardens in India 82805 registered STGs in Assam covering 838800 hectares of land which produced 139491 thousand kg of tea leaves in the year 2015

(Assam Statistical Handbook, 2105) along with unregistered[9] STGs providing employment to more than 25000 people in the district, and it is also increasing rapidly (TBI).. The small tea gardens of Assam covers 55% of total small tea grower's area in India and contributes more than 42% of total STG's production in India (TBI, 2012). The small tea gardens in Assam provide employment to more than 5.55 lakh workforce (Banerjee and Banerji, 2008). The STGs of Assam contribute more than 30% of total tea produced in Assam. The average land holding per small tea garden in Assam is 1.34 hectares. Small tea gardens in India emerged in early 1980's (Statistical Handbook of Assam 2011).

Table 3.1: Production of Tea by Big and Small Growers in Assam 2013-14 and 2014-15 (Production in Million kgs)

	2013-14 (april-june)					2014-15 (april-june)				
	BG	SG	Total	SBG	SSG	BG	SG	Total	SBG	SSG
Assam	458.57	154.5	613.07	74.5	25.2	422.51	150.75	573.26	73.2	26.3
NE Region	473.56	168.1	641.66	73.8	26.2	436.88	163.94	600.82	72.71	27.29

Source: Retrieved from http://www.indiastat.com on 02/10/2015

Note: BG=big tea plantations, SG= small tea growers, SBG= share of big growers in total production, SSG= share of small tea growers in total production, NE= Total north east region.

It is clear from the Table 3.2 is that from 2013-14 to 2014-15 the share of small tea growers in total tea production have gone up from 25.2% to 26.3% in Assam. The cultivation of tea is gaining popularity among the farmers of Assam. Small tea

[9]Unregistered small tea growers are those small tea growers which are not registered with the Tea Board of India. It also may be either group or individual owned.

growers earn profit of Rs 50000 to 75000 in acre per annum which is manifold as compared to paddy and potato cultivation (Mitra, 1991).

3.5 Brief Sketch of the Study Area:

3.5.1 *Udalguri District:* The area of study of this research work is Udalguri district of Assam; it is surrounded by Bhutan and Arunachal Pradesh to north, Sonitpur district in east, Darrang district in the south and Baksa district in the west. Udalguri is a district of Assam situated on the northern side of river Brahmaputra having 1673.94 Sq Kms of total area and total population of 832769 of which 795191 are rural population i.e. 95.5 % of the total population (District Statistical Handbook, Udalguri 2013). Udalguri district is 126 Kms away from Guwahati, capital of Assam. There are 800 villages and 7 development blocks with two sub divisional blocks in the district. The soils of Udalguri district are more or less heterogeneous in nature. The northern part of the district is composed of clay and clay-loam soils whereas the middle part is loamy and sandy. The soil of the southern part of the district is composed of deposited sand and clay. The district has a sub-tropical humid climate with semi-dry hot summer and cold winter. During summer (May to Early September), heavy rainfall occurs due to south-west monsoon for which the district experiences flood. It is observed that the district receives an average annual rainfall (normal) of about 2,000 mm and the temperature varies between Max 34.500C and Min 13.500C. Relative humidity in Udalguri district ranges between 82% and 88%. These climatic conditions make Udalguri district suitable for tea cultivation.

3.5.2 *Tea Cultivation in Udalguri District*: Small cultivation of tea plays an important role in the economy of Udalguri district. Total area under tea cultivation in Udalguri district is almost 16% of the total net area sown in Udalguri and the share is increasing at a fast rate in year 2011 it was only 2% of the total agricultural land. Registered small growers alone cover 43.3% of the total tea area, while there is no information about area under unregistered small tea gardens in the district which if were available, would have made the figure even bigger. In Table 3.2 the total number of registered small tea growers and large tea growers of Udalguri district along with their area share is presented.

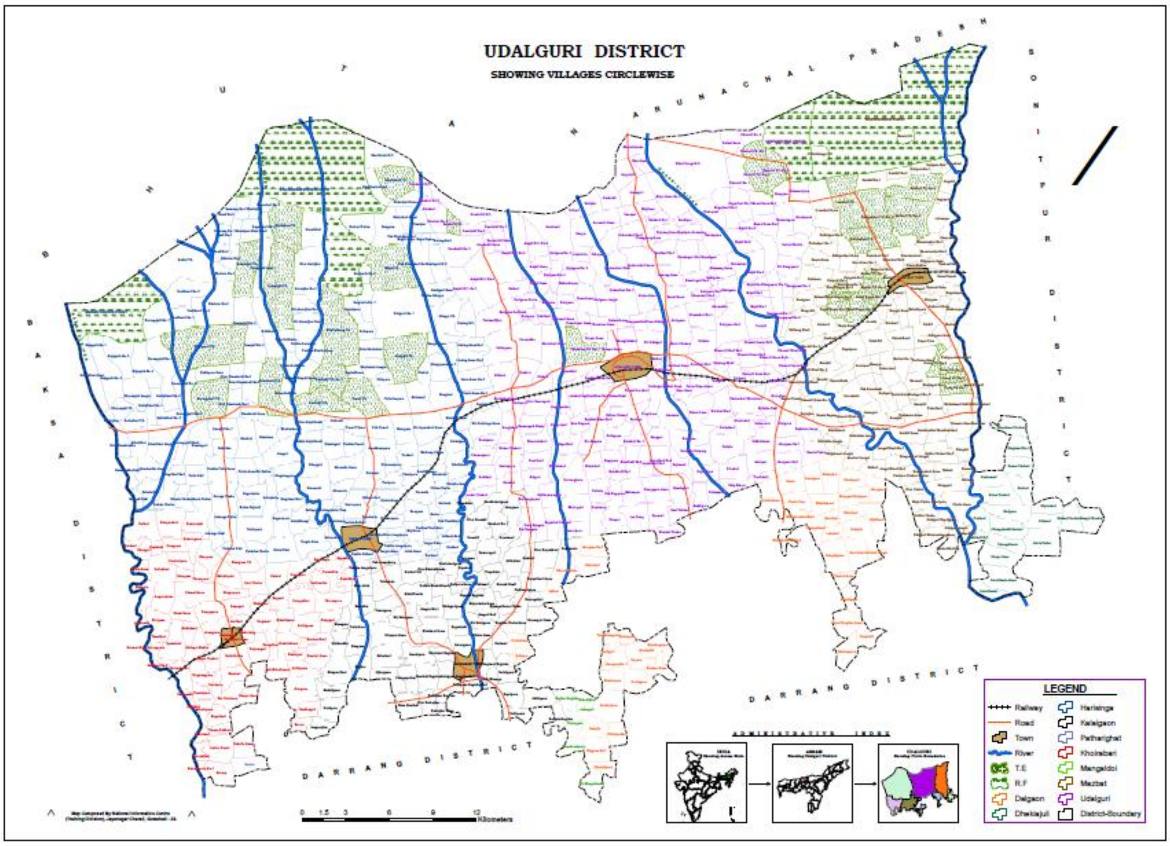
Table 3.2: Total Area under Small and Large Tea Gardens of Udalguri District

	Small Tea Growers	Large Tea Estates	Total
Total Area	6951	25	6976
Area (hectare)	7370.02	9652.95	17022.97
Percentage of total tea area (%)	43.3	56.7	100

Source: District Statistical Handbook Udalguri District, 2013-14

In the figure 3.6 the map of Udalguri district is given. In the figure, the revenue circles in which tea is cultivated are shown, which include Patharighat, Majbat, Harisinga and Udalguri. The area under tea shown in the map of Udalguri district is the area under large tea plantations, the small tea grower’s area are not shown in this map. There are 25 large tea gardens, 5126 registered small tea gardens along with unregistered small tea gardens in Udalguri district (Tea Board of India), but only the list of registered growers is available from the Tea Board of India. Small tea cultivation culture in Udalguri district started only in 1992 with one garden and now the total area under small tea growers in Udalguri district under registered small tea gardens is 7370.02 hectare in 2016.

Figure 3.6: Map of Udalguri District



Source: Official Website of Udalguri district, www.udalguri.gov.in

The small tea gardens are important income source particularly for the rural unemployed people, as the small tea gardens are mostly situated in rural areas. Udalguri district has the seventh highest number of small tea growers in Assam. The average land holding per garden is 1.06 hectare for registered growers. Some of the unregistered STGs are tiny and are not established for business purpose, but the rest are producing tea just like the registered small tea gardens, but for some reasons they have not been registered. The TBI is taking various steps to register the unregistered growers of the area.

3.6 Choice of the Study Area:

The area under small tea gardens as well as total numbers of registered small tea gardens in Udalguri district have drastically increased since the introduction of small tea gardens in the district for the first time by a batch of some unemployed youths in 1992, who established the first small tea garden in Udalguri district named as Moiderbari Tea garden. After that, many farmers started to cultivate tea in small gardens and in 2016 the number of small tea growers has gone up to more than 6000 registered along with unregistered small tea growers covering more than 7072.20 hectares of land in the district. Therefore a question regarding efficiency of this rapidly growing sector in the district may easily come into the mind of anyone. Despite of this fact till now no such study to estimate the productivity and efficiency of the small tea growers of Udalguri district has been done, therefore this topic and this particular study area has been selected for this research work. Another reason for selecting this therefore this study area is, despite of the homogeneity of climatic and soil conditions, the average production of small tea growers of Udalguri district is much lower than the average productivity of small tea growers of Assam as a whole. The average productivity of small tea growers of Udalguri district is around 1650 kg per hectare per annum on the other hand it is around 2300 kg per hectare per annum for Assam as a whole. Since productivity is also affected by efficiency levels, this may be an indication of low efficiency levels of the small tea growers of Udalguri district; one way to confirm is to estimate it.

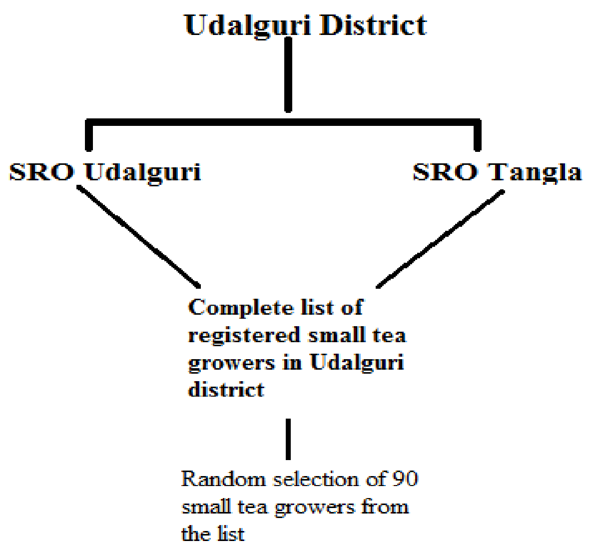
More than 95% of the total population of Udalguri district lives in rural areas. The another importance of this study is that if we can estimate the levels of efficiency of the small tea growers and the factors affecting it, we can improve the efficiency levels by concentrating more on those factors and by taking required steps as per the current efficiency levels. Since small tea gardens are mostly concentrated in rural areas, increasing the efficiency of the small tea growers of Udalguri district will help in increasing the productivity of the growers that will have positive effects in uplifting the socio-economic status of the rural population engaged in the cultivation by increasing their revenue. The increased productivity will help in further development of the STGs and development of the district as a whole. Thus, for these reasons this study has been done to estimate the efficiency levels of small tea growers in Udalguri district of Assam.

As mentioned earlier, the data required for this study has been collected from registered small tea growers of Udalguri district. A sample of total 90 small tea growers have been collected for this study out of which 21 were group[10] owned and 69 were individual[11] small tea growers. The sample have been selected randomly from the list of registered small tea growers collected from sub regional office of Tea Board of India in Udalguri district. In Udalguri district there are two sub regional offices (SRO) of Tea Board of India, situated one at Udalguri town and other Tangla town. From the two SROs the list of total small tea growers in the district was collected, thereafter 90 small tea growers were selected randomly from the list. A flow diagram of data collection procedure is given in the figure 3.7. In the sample only the registered small tea growers have been included because only the list of registered small tea growers

[10] In case of group small tea growers, the owners of the garden are a group of individuals, all the production and management decisions of group small tea gardens are taken collectively by the group.
[11] In case of individual small tea growers there is only one owner of the garden and all the production and management decisions of the garden are taken by that individual.

was available. In case of individual small tea growers there was only one owner of the tea garden and required information regarding the production and costs details were collected from the owner himself. But in case of group owned small tea gardens the owners were a group of individuals and due to this some problems occurred while collecting the family details of the group small tea grower household and in collecting information regarding the production and cost conditions of the group owned small tea garden. Collecting information from each member of the group would have required a lot of time. Thus due to time constraint of this M Phil dissertation each grower from the group were not investigated. From each group of owners of a small tea garden main decision maker of the group have been selected as a representative of the group who have all production and cost information of their garden. Only the selected representatives were asked all the information regarding their small tea garden. For the family details regarding the group of owners, only the family details of the representative have been considered for the study, as a proxy for the average scores of the family details of the entire group.

Figure 3.7: Sample Selection Procedure:



CHAPTER 4

ESTIMATION OF ECONOMIC EFFICIENCY OF THE SMALL TEA GROWERS

CHAPTER 4

Estimation of Economic Efficiency of the Small Tea Growers

4.1 Introduction:

In this chapter the estimation of technical and cost efficiency with SFA as well as the factors affecting them is discussed. The estimation of economic efficiency of the small tea growers as well as comparison of economic efficiency between individual and group small tea growers is also discussed. And lastly, the analysis of the found results after the estimation with respect to small tea growers of Udalguri district is done in this chapter.

4.2 Theoretical Model for the Study:

As discussed in the literature survey section in Chapter 1, Stochastic Frontier Analysis has been used for estimating the technical efficiency and cost efficiency levels of the small tea growers of Udalguri district. Maximum Likelihood Estimation of stochastic frontier production function and stochastic frontier cost function is done to determine the economic efficiency levels of small tea growers in the study area. Both stochastic frontier production and cost functions are assumed to be of Cobb-Douglass form. The choice of Cobb-Douglas production function has been made as it is the mostly used form of production function in the empirical studies especially the studies in the field of agriculture (Li and Li 2011, Abedullah et al 2007, Ambalil et al. 2012, Ayaz and Hussain, 2011). The efficiency and the factors influencing it will be jointly estimated with the stochastic frontier production function of the Cobb-Douglas form. Following the specifications of Aigner, Lovell and Schimdt (1977) and Meeusen and Broeck (1977) the stochastic production frontier can be written as-

$$Y_i = F(X_i; \beta)\exp^{\{v_i - u_i\}} \qquad i= 1, 2 \ldots n \qquad (3)$$

Where,

Y_i = the output for the i^{th} firm.

X_i = a vector of k inputs used by the i^{th} firm.

β = a vector of k unknown parameters to be estimated,

v_i = symmetric random variable, $iid \sim N(0, \sigma_v^2)$ which is associated with random factors that are out of the control of the small tea grower and capture the effects of statistical noise.

u_i = one-sided non-negative variable which follows a half-normal distribution and captures the effects of technical inefficiency component

The log-linear form of the Cobb-Douglas production function to be used in this study can be expressed as follows-

$$\ln Y_i = \ln\beta_0 + \sum_{j=1}^{N} \beta_j \ln X_{ij} + v_i - u_i \quad (4)$$

The technical efficiency (TE) of individual small tea growers is defined in terms of the ratio of observed output (Y_i) to the corresponding frontier output (Y_i*) conditioned on the level of input used by the farmers. Hence, the technical efficiency of a small tea grower is-

$$TE_i = Y_i/Y_i^* = f(X_i; \beta)\exp(v_i - u_i) / f(X_i; \beta)\exp(v) = \exp(-u_i) \quad (5)$$

The corresponding cost frontier of Cobb- Douglas functional form which is the basic for estimating the cost efficiency of the farmers is specified as-

$$C_i = g(Y_i\, P_{i;}\alpha)\exp(v_i + u_i) \qquad i = 1, 2, 3, \ldots n \quad (6)$$

Where,

C_i = total input cost of the i^{th} small tea grower.

Y_i = the output for the i^{th} firm

α = parameter to be estimated

p_i = input prices

v_i and u_i are the same as in equation (3)

The cost efficiency (CE_i) of individual farmers are defined in terms of their respective ratios of the predicted minimum cost (C_i) to the observed cost (C_i*)-

$$CE_i = C_i/C_i^* = g(Y_iP_i; \alpha) \exp(v_i+u_i) / g(Y_iP_i; \alpha) \exp(u_i) = \exp(v_i) \quad (7)$$

$$i = 1, 2, 3, \ldots n$$

The small tea growers' allocative efficiency can be estimated as the inverse of cost efficiency as follows-

$$AE_i = 1/CE_i \qquad i = 1, 2, 3, \ldots n \quad (8)$$

And as we know from the review of literature, the economic efficiency is the product of the allocative efficiency and the technical efficiency. Thus, we can estimate economic efficiency of the ith small tea grower as follows-

$$EE_i = AE_i \times TE_i \qquad i = 1, 2, 3, \ldots n \quad (9)$$

The variances of the random error term v_i (σ_v^2) and that of the technical and cost efficiency effects (σ_u^2) and overall variance of the model (σ^2) are related-

$$\sigma^2 = \sigma_v^2 + \sigma_u^2 \tag{10}$$

The ratio of σ_u^2 to σ^2 measures the total variation of output from the frontier which can be attributed to technical efficiency and cost efficiency-

$$\gamma = \sigma_u^2/\sigma^2 \tag{11}$$

$\gamma =$ It indicates relative variability of v_i and u_i that causes variation in Y_i from the frontier. When, σ_v^2tends to zero, it implies that u_i is the predominant error term i.e. all the variation in Y_i from frontier is because of technical inefficiency, then the value of γ becomes 1. And when σ_u^2 tends to zero, it implies that the symmetric error term, v_i is the predominant error term and γ will be tending to zero. This implies that the variation of Y_i from the frontier is mainly due to either statistical error or external factors that are not included in the model.

The relationship between the economic inefficiency levels of the small tea growers and the potential socio-economic factors affecting them can be specified with the help of the following inefficiency model-

$$u_i = \delta_0 + \sum_{i=1}^{N} \delta_i(Z_i) \qquad i= 1,2,\ldots\ldots n \tag{12}$$

Where,

u_i = Inefficiency of the i^th^ small tea grower.

Z_i = Factors affecting inefficiency of the i^th^ small tea grower.

The u_i in this study follows a half-normal distribution, because the half-normal distribution of u_i gives a marginally better fit than an exponential distribution of u_i (Aigner, Lovell and Schimdt, 1957).

The inefficiency model and the stochastic frontier production function as well as the stochastic frontier cost function are tested using the Generalized Likelihood Ratio test for testing if inefficiency effects are absent in the model. If the estimated value is above the Table value at least at 10% level of significance then the null hypothesis that inefficiency effects are absent in the model is rejected. The Generalized Likelihood Ratio is expressed as follows-

LR= -2 {LR of restricted model/LR of unrestricted model} (13)

4.3 Empirical Estimation of Stochastic Frontier C-D Production Function and Technical Efficiency:

The empirical Cobb-Douglass(C-D) stochastic frontier production model specified in this study for estimation is given in Equation (14)-

$$\ln Y_i = \beta_0 + \beta_1 \ln(LAB)_i + \beta_2 \ln(MANU)_i + \beta_3 \ln(FERTI)_i + \beta_4 \ln(PESTI)_i + \beta_5 \ln(HERBI)_i + \beta_6 \ln(AREA)_i + v_i - u_i \qquad i=1,2,3\ldots\ldots\ldots.90 \qquad (14)$$

Where,

Y_i = Total tea leaves produced (quintal/year)

LAB_i = Annual use of labour by the i^{th} small tea garden (man days[12]/bigha[13])

$MANU_i$ = Annual use of manure by the i^{th} small tea garden (kg/ bigha)

$FERTI_i$= Annual use of fertilizer by the i^{th} small tea garden (kg/bigha). Only NPK has been used for estimation in this study because only this is common among all the growers.

[12] 1 man day = 8 hours;
[8] 1 hectare = 7.5 bigha

$PESTI_i$ = Annual use of pesticides by the i^{th} small tea garden (ltr/bigha). For pesticides Agradut is common among all the growers, therefore only Agradut is used for estimation in this study.

$HERBI_i$ = Annual use of herbicides by the i^{th} small tea garden (ltr/bigha). For herbicides glycil is common among all the growers, therefore only glycil used has been used for estimation in this study.

$AREA_i$ = Total area under tea cultivation of the i^{th} small tea grower (bigha). Area under tea cultivation has been taken in local unit of measurement bigha.

And the technical inefficiency model of u_i used in this study is expressed in the Equation (15) and included the following variables-

$$u_i = \delta_0 + \delta_1 (FEXP)_i + \delta_2 (EDU)_i + \delta_3 (FAMSIZE)_i + \delta_4 (GENDER)_i + \delta_5 (GTYPE)_i \quad i=1,2,3,\ldots 90 \qquad (15)$$

Where,

$FEXP_i$ = Total farming experience of the i^{th} small tea grower (years)

EDU_i = Total years of schooling of the i^{th} small tea grower (years)

$FAMSIZE_i$ = Total number of family members of the i^{th} small tea grower (numbers)

$TRNG_i$ = Total number of training sessions attended by the i^{th} small tea grower (days)

$GENDER_i$ = Dummy for gender of the i^{th} small tea grower (1=male, 0=female)

As stated in the literature survey section many studies have found farming experience and education of the grower to be positively significant in increasing technical efficiency, as these variables increases the managerial skills of the grower. Therefore, education and farming experience of the grower has been included in the model. And as for testing the third hypothesis the garden type variable has been included in the inefficiency model. In some of the studies of efficiency gender of the grower has been found to be significant as stated in the literature survey, therefore to test the effect of gender on technical efficiency of small tea growers it has been included ass an inefficiency variable. As we have stated above u_i in this study follows half-normal distribution. The Maximum Likelihood Estimation method has been utilized in this study to estimate the Stochastic Frontier Production function and to estimate the inefficiency model with the help of FRONTIER 4.1 (Coelli, 1991).

The data used for the estimation of the parameters were cross-section in nature and were collected from 90 small tea growers of Udalguri district of Assam. The descriptive statistics of the variables used for estimation are presented in the following Table 4.1.To test if inefficiency effects are absent from the model, the production function have been estimated twice, first an OLS estimation without any restrictions and assuming that u_i is zero, and second an MLE estimation after putting restriction that u_i is not zero and by including inefficiency model variables into the model. Then a Generalized likelihood-ratio test of the two models have been done, and the result shows that LR value is significant at 1% level of significance with estimated value being 20.09 at degrees of freedom equal to 7.

Table 4.1: Descriptive Statistics of the Output and Inputs of Tea Production:

Variable	No. of Obs.	Mean	Standard deviation	Minimum	Maximum
Y (quintal/year)	90	313.69	335.65	25.6	1932
LAB (man days/bigha)	90	102.17	58.65	19.43	272
MANU (kg/bigha)	90	2.03	2.67	0.13	18.18
FERTI (kg/bigha)	90	263.14	184.92	28.13	1102.22
PESTI (ltr/bigha)	90	2.04	2.67	0.25	16.8
HERBI (ltr/bigha)	90	1.90	1.16	0.4	9
AREA (bigha)	90	13.86	14.32	2	74
FEXP (years)	90	8.83	4.49	3	24
EDU (years)	90	8.73	4.17	0	15
FAMSIZE (nos.)	90	4.89	1.67	2	11
TRNG (days)	90	4.02	10.66	0	90
GENDER (1=male,0=female)	90	0.911	0.29	0	1

Note: Figures in the bracket shows the unit of measurement of the variables used in the stochastic frontier production function.

The result implies that inefficiency effects are not absent from the model i.e. the variations in the output of the small tea growers of Udalguri district is not solely because of statistical error, some percentage of the variation is because of technical inefficiency of the growers.

Table 4.2: Maximum Likelihood Estimates of the Parameters of Stochastic Frontier C-D Production Function:

Variables	Beta Coefficient	t-Statistic
Frontier Production Function		
Constant	2.51	0.56
LAB (labour days/bigha)	0.19*	13.29
MANU (kg/bigha)	0.07	1.37
FERTI (kg/bigha)	-0.10***	1.70
PESTI (ltr/bigha)	-0.05	-1.21
HERBI (ltr/bigha)	0.20**	2.62
AREA (in bigha)	1.14*	49.37
Inefficiency Model		
Constant	1.46*	5.78
FEXP (years)	-0.04*	4.13
EDU (years)	-0.02***	-1.74
FAMSIZE (nos.)	-0.09*	-3.10
TRNG (days)	0.01	1.36
GENDER (1=male,0=female)	-0.36**	2.30
Sigma squared (σ^2)	0.08*	13.78
Gamma (γ)	0.67***	1.91
LR	20.09	
Mean technical efficiency	0.83	
N	90	

Note: *=significant at 1% level, **= significant at 5% level, ***=significant at 10% level.

Thus inefficiency effects have been estimated along with the stochastic production function with MLE to estimate the share of technical inefficiency in causing variations in output and to determine the factors affecting it. The results of the MLE estimates of the stochastic production function are shown in the Table 4.2. Education and farming experience of the small tea growers are very important variables that help to improve the managerial ability of the grower and both were added in the model with expectations that they will have positive impact on the levels of technical efficiency. The value of γ is 0.67 this implies that 67% of the total variation in output is due to technical inefficiency rather than random variability.

The results showed that all the variables in the frontier production function have the theoretically expected signs except for fertilizer and pesticides which have negative sign. This implies that by increasing the use of manure, labour days, area and herbicide the total output of the small tea growers can be increased. In the results fertilizer use and pesticides use have been found to have negative relation with the total output of the small tea growers. The reason for this relation is that on an average the growers are using excess amounts of fertilizers and pesticides which have resulted in occurrence of diminishing marginal returns with respect to fertilizer and pesticides use. But the coefficient value of pesticide is not significant, this implies that the diminishing marginal returns has just started with respect to pesticides, still the diminishing marginal returns effect due to its excessive use is not significant enough. This means that though the small growers of the study are using both pesticides and fertilizers in excessive amounts but the excess use of pesticides is lower in comparison to that of fertilizers. The relation of manure, labour, herbicide and area shows positive relation because the growers have not yet used these inputs up to the output maximizing levels. Thus there is still scope for increasing the total output of the small tea growers by increasing the use of these inputs.

Among the variables included in the inefficiency model i.e. farming experience, education, farm size, training days and gender all of these except training days have been found to be positively related to technical inefficiency. But the t-statistic value of training days found to be insignificant. This implies that training days has no significant effect on the technical efficiency levels of the small tea growers. This is contradictory to the results found by Abedullah, Kouser and Mustaq (2007). The reason for this result may be that the trainings being provided to the small growers in the study area is insufficient. Trainings are provided to the small growers for one day once a year. This may be possible that the growers do not learn much in the trainings or this also may be possible that the growers simply forget what is taught there. Therefore, the growers, even after attaining trainings, do whatever they feel right and whatever the other growers in his/her locality are doing.

The negative relation between farming experience and education levels is as per theoretically expected. Because increase in education level and farming experience is theoretically supposed to increase the managerial skills of the grower which increases his ability to make optimal and efficient use of the available resources and thus increases his technical efficiency. These results are similar to the results found in studies like Abedullah, Kouser and Mustaq (2007), Karthik, Alagumani and Amarnath (2013) and Bashir and Khan (2005). These studies have also found farming experience and education level of the grower to have negative relation with technical inefficiency levels. The result showing increase in technical efficiency with increase in family size may be because when the family size is big there is more possibility that more people from the family will help the grower in the works of tea garden. With more people working together division of labour may take place which ultimately increases efficiency of each person and as a result increase the technical efficiency level for the particular grower. While if the grower would have worked alone with no help from family members due to small size of family, he might have had to do all the work by himself with no opportunity to attain higher efficiency levels through division of labour.

The coefficient of dummy for gender is also found to have negatively related to technical inefficiency with value -0.58 the benchmark category for dummy for gender for this study was female therefore, the implication of the found results is that male small tea growers are 58% technically more efficient than female small tea growers. The reason for this result may be that the females are less educated in the study area than the males. In Udalguri district, female literacy is only 58.05% whereas male literacy is 72.58%[14]. The females are also physically weaker than the males while in tea cultivation physical strength is very much required. May be due to these reasons the male growers have been found to be more technically efficient in the study area.

The family size of the grower has also been found to have negative relation with the technical inefficiency levels of the small tea growers. This implies that when the family size of the grower increases his technical efficiency level also increases. The reason for this is when family size increases there is more possibility that more family labour will help the grower in the works of the garden. And family labour are not like hired labour, they divide all the work of the garden among themselves and the grower and all of them work do their own set of work. So this results in division of labour and increases the technical efficiency of the small tea grower. Training days

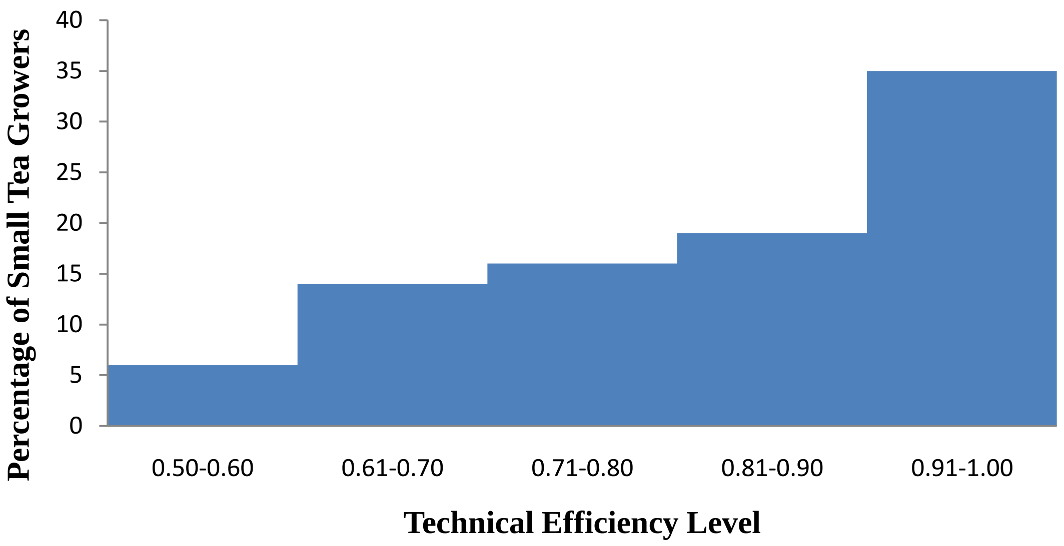
[14]Source: Circle wise population and literates in Udalguri district, District statistical handbook Udalguri, 213.-14

has been found to have insignificant but positive effect on the technical inefficiency levels of the small tea growers. This is because of the insufficiency of the trainings being provided to the small growers. Trainings are given to all the growers together once a year for one day. So most of the growers do not even remember what is taught in the trainings because their education levels are low and learning abilities are also low. And some of the growers are simply lazy to follow the instructions given in the trainings. Thus due to these reasons the growers do not follow what is taught in the trainings and do whatever they feel right or whatever the other small tea growers in his locality are doing resulting in insignificant effect of the training days of the grower on his technical efficiency levels.

The mean level of technical efficiency shown in the results is 83%. This implies that on average of the small tea growers of Udalguri district fell short of maximum frontier level of technology by 17%, and there is scope for increasing total output by increasing the technical efficiency without even increasing the use of inputs. From the results of the technical inefficiency model, it is clear that the growers can increase their income by increasing their education level and by increasing their farming experience. This implies that with passage of time the small growers will become more experienced and hence more efficient in utilizing the available resources. The small tea growers can also go for attaining more education, both academic and farm specific education, to increase their efficiency levels. The groups formed should split into individual growers to increase their technical efficiency levels.

The mean technical efficiency of the small grower is 83% which ranges from 52% to 100% with 13% standard deviation. A diagram representation of the frequency distribution of the small tea growers of the study are with respect to their technical efficiency levels has been given in figure 4.1.

Figure 4.1: Frequency Distribution of Small Tea Growers based on their Technical Efficiency Levels



The diagram representation of the frequency distribution of the technical efficiency scores of the small tea growers in figure 4.1 reveals that technical efficiency 6% of the total small tea growers ranges between 50%-60%. And 38.9% of the small tea growers' technical efficiency is more than 90% up to 100%. 54.45% of the small tea growers' technical efficiency lies between 60% and 90%, thus there is scope for increasing the productivity of the small tea growers by increasing their technical efficiency levels.

4.4 Empirical Estimation of Stochastic Frontier Cost Function and Allocative Efficiency:

The empirical model of stochastic frontier cost function of individual farmers used in this study for estimation of cost efficiency of small tea growers is as follows-

$$\ln TC_i = \alpha_0 + \alpha_1 \ln(MWAGE)_i + \alpha_2 \ln(FWAGE)_i + \alpha_3 \ln(MPRICE)_i + \alpha_4 \ln(FPRICE)_i + \alpha_5 \ln(CAP)_i + \alpha_6 \ln(PPRICE)_i + \alpha_7 \ln(HPRICE)_i + \alpha_8 \ln(Y)_i + v_i + u_i \quad (16)$$

$$i=1,2,3\ldots.90$$

Where,

TC_i = Total cost of the i^{th} small tea grower (Rs)

$MWAGE_i$ = Male wage rate of the i^{th} small tea grower (Rs)

$FWAGE_i$ = Female wage rate of the i^{th} small tea grower (Rs)

$MPRICE_i$ =Manure price of the i^{th} small tea grower (Rs/kg)

$FPRICE_i$ = Fertilizer price of the i^{th} small tea grower (Rs/kg). Since NPK is the only common fertilizer among the small tea growers only its price has been used in this study for estimation. The other fertilizers like MOP, DAP and SSP are not used by every growers, some of them use them while others do not. Therefore to avoid problems of missing variables the prices of these fertilizers have not been used for estimation.

CAP_i =Annual working capital used + physical capital value discounted at 12% (in Rs)

$PPRICE_i$ = Pesticide price of the i^{th} small tea grower (Rs). Since Agradut is common pesticide used by the small tea growers its price has been used for estimation in this study.

$HPRICE_i$ = Herbicide price of the i^{th} small tea grower (Rs). Glycil price only has been used for estimation in this study because it is the common herbicide used by all the small growers of the study area.

Y_i = Total tea leaves produced in the survey year of the i^th^ small tea grower (quintal)

The inefficiency variables used for estimation of cost efficiency of small tea growers is given below-

$$u_i = \delta_0 + \delta_1 (FEXP)_i + \delta_2 (EDU)_i + \delta_3 (GTYPE)_i + \delta_4 (OCCU)_i \qquad i=1,2,3\ldots9 \qquad (17)$$

Where,

u_i = cost inefficiency of the i^{th} small tea grower

$FEXP_i$ = Total farming experience of the i^{th} small tea grower (years)

EDU_i = Total years of schooling of the i^{th} small tea grower (years)

$GTYPE_i$ = dummy for ownership type of the i^{th} small tea grower (1=group owned small tea garden, 0=individually owned small tea garden)

$OCCU_i$ = dummy for main occupation of the i^{th} small tea grower (1= tea cultivation, 0=others)

The education and experience of the small tea growers play very important role in managerial skill improvement of the small tea growers as stated earlier; therefore these two variables are included in the inefficiency model for estimating cost efficiency levels. Dummy for main occupation is also expected to have significant impact over cost efficiency levels because many growers in the study area have been found to take up tea cultivation as part time occupation while others take it up as full time occupation so this may have impact on the cost efficiency levels of the small tea growers.

Table 4.3: Descriptive Statistics of the Total Cost and Factor Prices of Tea Production:

Variable	Total Obs.	Mean	Standard deviation	Minimum	Maximum
TC (Rs)	90	252600.2	239068.4	19680	1291060
MWAGE (Rs)	90	153.56	35.74	120	250
FWAGE (Rs)	90	128.22	21.28	100	220
MPRICE (Rs/kg)	90	118.71	294.29	10	2400
FPRICE (Rs/kg)	90	17.20	5.76	8	36
CAP (Rs)	90	9625.21	23103.9	230	116680
PPRICE (Rs/ltr)	90	1486.3	585.67	200	2200
HPRICE (Rs/ltr)	90	343.29	158.74	35	1300
Y (quintal)	90	313.69	335.64	25.6	1932

Note: Values in the bracket are the units of measurement of the dependent and independent variables used in the stochastic frontier C-D cost function.

To estimate the difference in efficiency levels of individual and group owned small tea growers is one of the three objectives of this study, thus to estimate the grower specific and average cost efficiency levels of small tea growers garden type has been included as an inefficiency variable in the model. The Descriptive statistics of the total cost, input prices and the inefficiency variables used for estimation of stochastic frontier cost function and the inefficiency model is given in the Table

4.3.The cost efficiency of the small tea growers of the small tea has been estimated by simultaneously estimating the stochastic frontier cost function in Equation (16) and the inefficiency function in Equation (17) using maximum likelihood estimation (MLE) method. The results of the MLE estimation are given in the Table 4.4.

A Generalized Likelihood Ratio test is done for testing if cost inefficiency effects are absent from the model. The estimated LR value (19.73) was more than Table value of χ^2 at 6 degrees of freedom, thus rejected the null hypothesis. This implies that cost inefficiency effects are present in the model. In the inefficiency model value of γ is 0.66 at 1% significance level. This implies that 16% of the total variation in total cost is due to small tea growers' cost inefficiency.

In the results all the inefficiency variables are found to be significant. All these inefficiency variables have negative signs except the dummy for garden type. The coefficient value of dummy for garden type is positive with value 0.71. The benchmark category for the dummy was individual ownership, thus the implication of the result is that the individually owned small tea growers are 71% less inefficient than the group small tea gardens. These results are similar to the results found by Daadi et al. (2013) who found that group growers are less efficient than the individual or family growers. In the present study the reason for this result may be attributed to the fact that most of the groups of the tea growers are not formed with commercial purpose to increase output or to increase efficiency. These groups are formed in order to get registered from the Tea Board of India together so that the time cost involved in getting every small tea grower registered individually can be reduced. Due to this reason the commitment of the small tea growers to the group is not as much as it is expected, therefore the individual small tea growers are more efficient than the group small tea growers in the study area.

Table 4.4: MLE Estimates of the Stochastic Frontier C-D Cost Function:

Variables	Beta Coefficient	t-ratio
Frontier Cost Function		
Constant	4.29*	3.48
MWAGE (Rs)	0.82*	2.65
FWAGE (Rs)	-0.10	-0.23
MPRICE (Rs/kg)	-0.01	-0.62
FPRICE (Rs/kg)	-0.17*	-2.74
CAP (Rs)	0.12*	3.51
PPRICE (Rs/ltr)	0.01	0.32
HPRICE (Rs/ltr)	0.08***	1.52
Y (quintal)	0.58*	9.14
Inefficiency		
Constant	-1.02*	-3.40
FEXP (years)	-0.06*	-3.11
EDU (farmers schooling in years)	-0.03***	-1.97
GTYPE (0=individual, 1=group)	0.71*	3.65
OCCU (1=tea, 0=others)	-0.58**	-2.57
σ^2	0.17*	6.65
γ	0.66*	3.19
LR	19.73	
Mean Cost Efficiency Estimate	1.11	
N	90	

Note: N=90, *= significant at 1% level, **= significant at 5% level, ***=significant at 10% level.

The value of dummy for main occupation -0.58 implies that the growers whose main occupation was tea cultivation are 58% more cost efficient than the growers who take up tea cultivation as part time cultivation. The reason for more cost efficiency of the growers whose main occupation was tea cultivation could be that those growers whose main occupation is tea cultivation devote more time, commitment and effort to main occupation is always more in comparison to subsidiary occupation. While those growers whose main occupation is other than tea cultivation may not get enough time to do their work of the garden, and some of them hire *sardars* to perform their share of work at the garden but the *sardars* may not be as interested in efficient production as the grower himself.

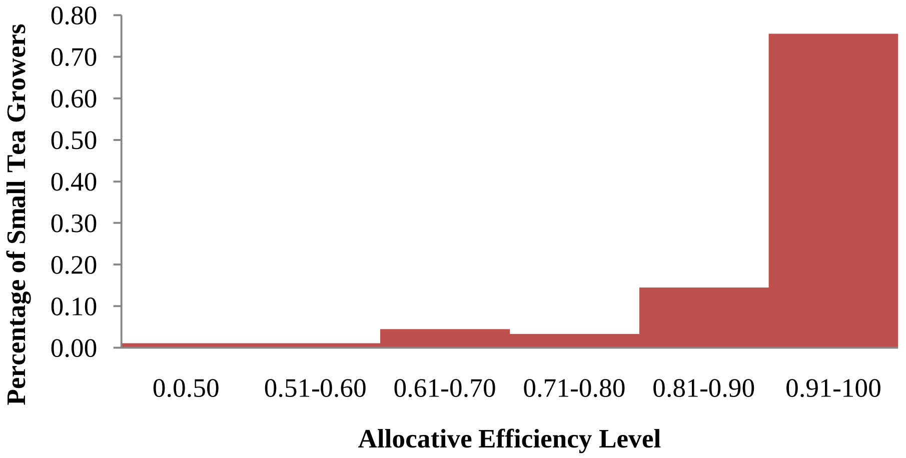
The coefficient value of farming experience has negative sign with value -0.06. This implies that with one year increase in farming experience, the cost inefficiency of the small tea growers decreases by 6% i.e. the growers with more farming experience are more cost efficient than the farmers with less farming experience. The coefficient of education also has negative sign with value -0.03 which implies that one year increase in schooling of the grower decreases their cost inefficiency by 3%. These results are similar to the results found by studies like Abedullah, Kouser and Mustaq (2007), Ayaz and Hussain (2011), Karthik, Alagumani and Amarnath (2013), Ambalil et al (2012), Bashir and khan (2005), Akpan et al. (2013) and Adeyemo et al. (2013). The reason for increase in cost efficiency as a result of increase in farming experience and education may be because of increase in managerial skills of the small grower with increase in education and farming experience.

In the results of the stochastic frontier cost function it has been found that 1% increase in male wage rate raises the total cost of the small tea grower by 82%. This is because male labour is very crucial to tea cultivation and even if the wage rate rises the growers do not reduce the use of male labour. But when female wage rate rises the growers reduce the use of female labour and substitute it with either male labour or family labour. That is why the results show negative relation of the female wage rate to the total cost of the small tea grower. But the value is insignificant; this implies that though the growers reduce the use of female labour to some extent as the female wage rate rises but the reduction is not significant enough to lower the total cost of the grower. In case of fertilizer the results show that increase in its price reduces the total cost of the small grower, this is because when the price of fertilizer increases the small growers reduce the use of fertilizer. The growers are doing this without adversely affecting the total output because they are already using excess amount of fertilizer as shown by the negative relation between fertilizer use and total output of the small growers. Pesticide price also shows negative relation to total cost but insignificant, because even when the price of pesticides increases the growers reduce only small amount of pesticides because pesticide use is very crucial to tea cultivation. Herbicide has positively significant relation to the total cost of the small tea growers this implies that even when the price of herbicides go up the growers do not reduce its use. The effect of rate of interest increase on capital used has been found to have positive relation with the total cost; this implies that even when the rate of interest goes up the small growers do not reduce their use of capital in the garden.

The value of the coefficient of total output 0.58 which is positively significant implies that the small tea growers of Udalguri district are operating on increasing returns to scale. The scale efficiency of the small growers is,- 1/0.58=1.72. This implies that 1%increase in the scale of inputs of the growers will increase their output by 172%.

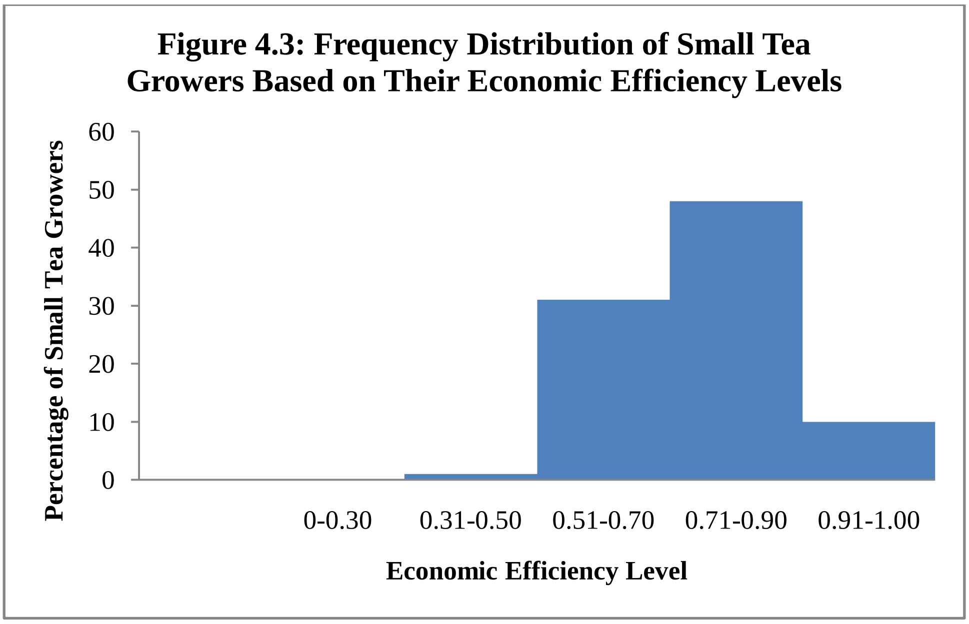
The mean cost efficiency score of 1.11 implies that on average small tea growers of Udalguri district are operating 11% above the optimum cost frontier. Since for the estimation of Economic Efficiency levels both technical efficiency and allocative efficiency scores are required, therefore the allocative efficiency of the individual small tea growers is derived by putting the value of individual cost efficiency scores in the Equation (8). The mean allocative efficiency of the small tea growers is 0.91 which ranges from 0.76 to 0.97 and Standard deviation 0.05. A diagram representation of the frequency distribution of the small tea growers based on their allocative efficiency has been presented in the figure 4.2.

Figure 4.2: Frequency Distribution of Small Tea Growers Based on Their Allocative Efficiency Levels



4.5 Economic Efficiency Estimation and Results:

After that the individual Economic Efficiencies of the small tea growers is derived by putting the values of individual allocative efficiency scores and individual technical efficiency scores in the Equation (9). The mean Economic Efficiency level of the small tea growers as shown is 0.76 which ranges from 0.34 to 0.95 with standard deviation of 0.13. This implies that the small tea growers of Udalguri district are 76% Economically Efficient i.e. there is still 24% scope for increasing the total output of the small tea growers by increasing their Economic Efficiency with the available levels of inputs and technology. A diagram representation of the frequency distribution of the small tea growers based on their economic efficiency levels is given in the figure 4.3.



From figure 4.3 it is clear that 53% of the small tea growers belong to the economic efficiency level 71% to 90%.

4.5.1*Comparison of the Economic Efficiency Levels of Group and Individual Small Tea Growers:* To fulfill the third objective of this study, the efficiency level differences between individual owned and group owned small tea growers have been tested with the help of Wilcoxon rank-sum (Mann-Whitney) test. The results of the test have been presented in Table 4.5. In the results of the Mann Whitney test it is found that the *p* value is very low and thus rejects the null hypothesis that there is no difference between the economic efficiency levels of individually owned and group owned small tea growers. And also shows that the probability of the economic efficiency of individual garden type being greater than the economic efficiency of the group owned garden types is 73.7%. Thus from the results it is clear that the individual small tea growers are more economically efficient than the group small tea growers.

Table 4.5: Results of Two-sample Wilcoxon Rank-Sum (Mann-Whitney) Test:

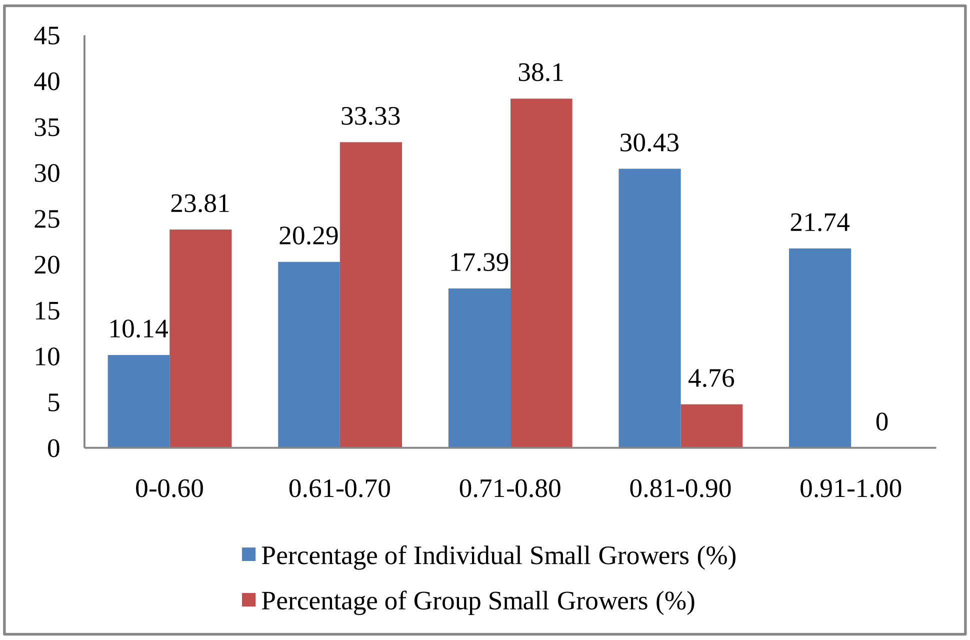
Garden type (1=Group growers, 0=Individual growers)	Observations	rank sum	Expected
0	69	3482.5	3139.5
1	21	612.5	955.5
combined	90	4095	4095
z	3.274		
Prob > |z|	0.0011		

Ho: economic efficiency of (garden type 0) = economic efficiency of (garden type 1)

Probability of {economic efficiency of (garden type 0) > economic efficiency of (garden type1)} = 0.737

The figure 4.4 shows that larger percentage of individual growers are concentrated in the higher economic efficiency level while higher percentage of group small growers are concentrated in the lower economic efficiency groups. Thus from Table 4.5 and figure 4.4 it is clear that the individual small tea growers are more economically efficient than the group small tea growers of the study area. These results are contradictory to those found by Daadi, Gazali and Amikuzunu (2014) in which it was found that group managed agricultural farms were more efficient than the individually managed farms. But In the study of Daadi, Gazali and Amikuzunu (2014) only the technical efficiency of the group and individually managed farms were compared, while in this study of small tea growers economic efficiency levels of the small growers are compared which include not only technical efficiency but also cost efficiency levels.

Figure 4.4: Frequency Distribution of the Group and Individual Small Tea Growers Based on Their Economic Efficiency Levels



CHAPTER 5

CONCLUSION

CHAPTER 5

Conclusion

5.1 Introduction

An attempt has been made in the present study to estimate and study the economic efficiency levels of small tea growers of Udalguri district of Assam, and their factors affecting the economic efficiency levels. The study had been undertaken to find and study the answers to the following research questions, - i) whether the small tea growers of Udalguri district are Economically Efficient or not? ii) What are the factors affecting the economic efficiency of the small tea growers of Udalguri district? And iii) whether there exists any difference in Economic Efficiency of the individual and group owned small tea gardens? The research objectives set for answering the proposed research questions were as follows, -i) to estimate the Economic Efficiency levels of the small tea growers of Udalguri district, ii) to study factors affecting the differences in the Economic Efficiency levels of the small tea growers of Udalguri district and iii) to evaluate the differences in Economic Efficiency levels of the individual and group owned small tea growers.

Only primary data has been used for estimation of the efficiency levels in the present study. The primary data were collected from 90 small tea growers of Udalguri district. The sample were selected randomly from the list of registered small tea growers collected from the two sub-offices offices of Tea Board of India in Udalguri district, one situated in Udalguri town and the other in Tangla town. The data were collected through a questionnaire survey of the randomly selected 90 small tea growers of Udalguri district.

For fulfillment of the first objective, economic efficiency levels were estimated using Stochastic Frontier Analysis Method. Since economic efficiency is the product of technical efficiency and allocative efficiency, the factors affecting technical and allocative efficiency also affects the economic efficiency levels of the small grower. Therefore, as fulfillment of the second objective the factors affecting economic efficiency of the small growers had been determined by determining the factors affecting the technical and allocative efficiency of the small tea growers.

5.2 Implications and Suggestions:

The small tea growers of Udalguri district are 76% economically efficient i.e. there is still 24% scope for increasing the total output of the small tea growers by increasing their economic efficiency with the available levels of inputs and technology. 53% of the small tea growers belong to the economic efficiency level 71% to 90%. Since there is still scope for increasing the output of the small tea growers by increasing their economic efficiency levels importance should be given to improving the economic efficiency levels by increasing the technical and cost efficiency levels of the growers.

The economic efficiency is the product of technical efficiency and allocative efficiency. Thus the factors affecting technical and cost efficiency also affect the overall economic efficiency.

5.2.1 ***Suggestions for Improving Technical Efficiency:*** While estimating technical efficiency, except training days all other variables had been found to have significant effect. Steps like trainings should be given more frequently and attempt should be made to make it more understandable and simple so even the less educated growers can understand and remember everything taught in those trainings. Another step which can be taken is while teaching the growers what to do what not to do, the training authorities should also tell them bad affects of not following the training lessons so that the small tea growers will realize what they are doing wrong. Even after taking all these steps some of the growers may not follow what is taught in the trainings. For making sure that the tea growers are following what is taught in the small, inspections should be done in the small tea gardens from time to time.

Farming experience and education level of the grower had been found to have negative significant effect on technical inefficiency. Thus by increasing the farming experience and education levels the technical efficiency of the small tea growers can be increased. For increasing the technical efficiency of the small tea growers, adult education programs should be undertaken by government for educating the uneducated small tea growers. And more educated but unemployed youths should be encouraged to take up small tea plantation as their main occupation. Unemployed educated youth can be encouraged to take up tea cultivation by providing credit facilities and by giving sufficient trainings regarding small tea cultivation. While providing education to the small tea growers along with formal education farm specific education regarding tea cultivation should also be provided to the small tea growers to increase their technical efficiency.

It has also been found that with increase in family size the technical efficiency of the small tea growers also increases. And the male small tea growers were found to be 36% more technically efficient than the female growers. Thus, more importance should be given to increase the efficiency of the female small tea growers so that they also can increase their output. For this special training programs should be undertaken for the female growers, better work environment should be created for female growers, and adult education programs and farm specific education programs should be more targeted towards the female small tea growers.

5.2.2 ***Suggestions for Reducing Cost Inefficiency:*** In case of cost inefficiency all the inefficiency variables, farming experience, education of the farmer, dummy for garden type and dummy for main occupation, had been found to have significant impact. Farming experience and education levels were found to be positively related to cost efficiency levels. Thus, importance should be given to providing education to the less educated small growers through programs as suggested above. For increasing cost efficiency of the small tea growers along with formal education and farm specific education market information should also be given to them so that the growers can adapt better to their current factor prices.

The results also showed that individual garden types are more cost efficient than the group garden types. In the results of Mann Whitney test to test the difference between economic efficiency levels individual owned and group owned small tea growers also it was found that the individual owned small tea growers are more economically efficient than the group owned small tea gardens. Thus steps should be taken to encourage small tea growers to cultivate tea individually not in groups. Most of the times groups are formed in order to easily get registered at the Tea Board of India, thus for discouraging group formation and for encouraging individual cultivation of small tea growers the registration process of the small tea growers with TBI should be more uncomplicated so that the individual growers can also get registered easily with the TBI without having to form groups. In this way group will be formed only with commercial purpose and their technical efficiency levels with increase.

The growers who had taken small tea cultivation as main occupation were found to be more cost efficient than the others in the results. Thus, there is need to provide knowledge to those who take up tea plantation as subsidiary occupation that they can improve their output if they give some more time and effort to efficiently manage the production and cost decisions of small tea cultivation.

5.2.3 ***Suggestions for Government Policies:*** In the current study it has been found that the small tea growers are using excessive amounts of fertilizer which has negative relation with total output and it has also been found that when the cost of fertilizer goes up the small tea growers reduce its use. Thus, government should take policies to remove subsidies from fertilizer so that its price goes up and the small tea growers reduce the use of fertilizers. This will reduce the total cost of the small tea growers and will increase their total output as well.

Pesticide use has also been found to have negative relation with total output implying excessive use of pesticides. But price rise in case of pesticides have been found to have no significant impact on its use. Therefore awareness programs should be undertaken by government to make aware the small tea growers about the adverse affects of excessive use of pesticides, so that the small tea growers reduce the use of pesticides which will increase their total output.

In the study it has also been found that capital use is very crucial to the small tea cultivation. Even if the rate of interest goes up the growers do not reduce their use of capital. In this study capital includes both physical capital and working capital. Government should take policies to provide subsidy on physical capital necessary for tea cultivation like sprayers, different tools, this will reduce the total cost of the small tea growers.

5.2.4 ***Long Run Implication of the Study:*** In the results it has also been found that the small tea growers are operating at increasing returns to scale. Thus, in future the small tea growers can increase more of their output by increasing their inputs scale. But since some inputs like fertilizer and pesticides have been found to have negative relation to total output, the small tea growers while increasing their scale of production may increase all other inputs but not fertilizer and pesticides. Because any further increase in fertilizer and pesticides will further reduce the total output of the small tea growers.

5.4 Limitations of the Study:

The first limitation of this study is that only one district from Assam had been selected for studying the economic efficiency levels. Further scope for study is there to study the inter district economic efficiency levels of the small tea growers and to study the economic efficiency levels of small tea growers of Assam as a whole. There is also possibility of differences in factors affecting efficiency levels of small tea growers in different districts of Assam which can be further studied.

The next limitation is that only SFA has been used as method of estimation of economic efficiency levels. Many agricultural studies have employed both SFA and DEA to estimate economic efficiency levels to compare the results from both the models. There is scope for similar studies in the field of studying efficiency levels of small tea growers of Udalguri district.

In the present study cross section data had been used to study the economic efficiency levels of small tea growers for the survey year. There is also scope for studying the efficiency levels of the present study area with the help of panel data to study the behavior of efficiency of the small tea growers over time.

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APPENDIX-A

M Phil Research Questionnaire

Topic: Efficiency levels of Small Tea Growers in Udalguri District of Assam

Year: 2016-17

1. Name and Address of the Cultivator:

a) Name of the Tea Garden:

b) Nature of ownership: (0=individual; 1=group)

c) Number of group members:

d) Name (or names for group small tea gardens) of the cultivator:

i)

ii)

iii)

e) Village Name:

f) Post:

g) Police Station:

h) District:

i) Sub Division:

j) Development block:

2. Demographic Particulars of the family of the small tea grower other than the main small tea grower[15] of the family: (excluding new-born babies under age 1 year)

Family member no.	Sex %	Age	Relation to MST[16]	Marital status@	Education#	Main occup-ation*	Subsidiary occupation*	Income (yearly)
1								
2								
3								
4								

[17]

3. Details of the main small tea grower of the household.

Sex%	Age (years)	Education#	Other qualify-cations	Marital status @	Main occupation*	Subsidiary occupation*	Farming experience in tea (years)	Trainings attended (years)

[18]

[15] Main small tea grower of the family refers to the main decision maker of the household with respect to small tea cultivation who may or may not be the head of the household, for group small tea growers the main small tea grower is the main decision maker of the group.
[16] MST= main small tea grower of the family
[17] % 1= male; 2= female; 0=Trans gender; @ 1=Married, 2=Unmarried, 3=Divorcee; #Total years of schooling attained.; * 1= tea cultivation, 2=agriculture (except tea cultivation), 3=self-employed, 4=Salaried (public), 5=salaried (private), 6=pensioner/retired, 7=student, 8=unemployed, 9=other (under-aged, over-aged)

[18] % 1= male; 2= female; 0=Trans gender; @ 1=Married, 2=Unmarried, 3=Divorcee; #Total years of schooling attained; * 1= tea cultivation, 2=agriculture (except tea cultivation), 3=self-employed, 4=Salaried (public), 5=salaried (private), 6=pensioner/retired, 7=student, 8=unemployed, 9=other (under-aged, over-aged)

4. Area of agricultural holdings as on date of the survey (area in hectares)

No. of fragments	Area (bigha) [19]	Area under tea (bigha)	No. of tea plants	Age of the tea plants (yrs)	Area under other cultivation (bigha)	Total rent paid per yr (Rupees)	Total rent received per yr (Rupees)
Leased in land							
Own land							
Total in hectares							

5. Selling of tea leaves:

a) Selling of tea leaves: (1=BLF; 0=large factories) b) Sold directly (0) or through agent (1):

c) Amount paid to the agents (Rs/yr): d) Price of leaves (Rs/kg):

6. Production, Area and Yield rate in the survey year:

Category of land	Area (in bigha)	Total tea produced per year (quintal/year)	Average annual yield (kg/bigha)	Total revenue from tea leaves/year (Rs)
Irrigated				
Un Irrigated				
Total				

[19] 1hectare= 7.5 bigha

7. Input used for tea cultivation for small tea growers in the survey year.

Ser no.	Resources		Quantity*	Price per unit (Rs)	Total cost per yr (Rs)
1	Male labour				
2	Female labour				
3	Supervisor (or *sardar*)				
4	Saplings planted				
5	Manures				
7	Fertilizer				
8	Pesticide				
9	Herbicide				
10	Physical capital (hired)				
11	Physical capital				

	(own)				
12	Irrigation				
13	Working capital				

[20]

8. Credit details of the respective small tea growers:

Credit Source	Amount (Rs)	Year of taking credit	Interest rate (%)	Total amount paid of the credit in the survey year (Rs)	Fully Repaid (y/n)

Date:

Signature of the investigator

Remarks (if any)

Date:

Signature of the respondent

[20] The unit of labour is labour days per year (1 Labour Day=8 hours); unit of measurement for supervisor is number of supervisors employed; unit of measurement for fertilizer and manure is kg/bigha and for pesticides and herbicides liter/bigha; for physical capital total numbers is the unit of measurement, and for working capital unit of measurement is total amount in Rs per year.