# Chapter 1

## Introduction

### 1.1 The Context

India has a rich history of tea cultivation, consumption and export. It happens to be one of the largest producer, consumer and exporter of tea worldwide. Historically, tea plantation started in India and elsewhere in the world as an estate system under the colonial rule with the objective of exporting tea to the international market. This system was characterized by large holdings, corporate ownership, high capital base, monoculture, a hierarchical labour management system and a large work force employed as hired wage labour (Herath and Weersink, 2009). Under this system, tea production is essentially viewed as a management process that integrates vertically plantation agriculture into the tea processing, distribution and marketing chains. In the Indian context, the colonial economy preferred this single vertically integrated tea-estate model because of some specific reasons. As Hayami (2002) noted, tea plantations were initiated by the colonial ruler with the opening up of a large tract of frontier land that required huge initial capital investment. Virgin land had to be cleared and developed, and physical infrastructure, such as roads, irrigation systems, bridges, railway networks and docking facilities had to be constructed. Capital, in the form of machinery and equipment, had to be imported and redesigned to adapt local situations. Labourers were not only to be brought from the more populous region but had to be trained in the production of tea. In addition, tea plantations having the characteristic of being "enclaves", labourers were to be provided with permanent shelter and non-wage benefits such as healthcare, free fuel and subsidized rations etc. For investors to internalize gains from such high capital outlays, the plantation size must be large. Concurrently, as plantations were opened up along the unused frontier land of the colonial territory with poor infrastructure and transportation facilities, tea production requires the proximity of processing facilities and this is best facilitated in large plantations. In addition, the grant of large tracts of virgin land at a concessional rate had facilitated the establishment of tea plantation as vertically integrated system.

Another conventional explanation for the emergence of estate model of production is one that is based on the principle of internal economies of scale (Baldwin, 1956). It is argued that plantation has to be of specific size to be offered with scale efficiency gains. This explanation sounds well if crop production technology is found to be indivisible. However, this argument is questionable if crop production technology allows for divisibility. The large plantations are in fact needed due to external economies of scale which is to be derived from huge initial investment in tea plantations in virgin frontier lands (De Silva, 1982).

There is yet another reason to mention for the evolution of tea production under the plantation (or estate) system during the period of British colonialism. In the early periods of establishment of tea plantation under the colonial rule, most of the estates were possessed by British absentee owners, besides a few owners of Indian origin. As these people were unable to carry out efficient management of plantation enterprises, they often earned lower rate of return on their financial investments. This situation had led to the emergence of the institution called 'managing agency' which had taken over a wide range of tasks on behalf of the British absentee owners. With the advent of managing houses, British companies shifted towards more professional management of plantation enterprises. Towards the end of the nineteenth century, when the British companies extended tea cultivation, the managing companies expanded their activities, which included budgetary control, cultivation, manufacturing advice, exchange control, and staff recruitment at the higher level. Many of the early companies began to consolidate under the managing houses that had better access to the developed capital market of London. Thus, with time, the managing houses became more active and played the roles of producer, banker, shipper, broker and distributor. Moreover, these various roles of managing agencies were interlocked through vertical integration of production, processing and distribution (Sarkar, 2008). In addition, ensuring a regular supply of low wage labour, which had to be secured outside the country or region, caused the agency houses to keep the estates operationally large.

It follows logically from our previous discussion that under the colonial rule the large plantation system was adopted as the most effective type of production organization for extracting maximum profit accruing from the exploitation of sparsely populated virgin areas. Following Myint (1965), a noted development economist, this model of plantation development could appropriately be described as the 'vent-for-surplus-development". The basic idea underlying this model has been the exploitation of virgin land areas suited for the production of tropical crops but devoid of significant working class population who could produce and trade their commodities. The sole objective of introducing this model by the colonial rulers was to meet the demand for tropical products by the industrialized nations.

### 1.2 Global Structural Shifts in Tea Industry

The old organization of estate system of production has undergone some radical changes with the advent of small tea growers and introduction of bought leaf factories (BLF) in recent time. Following this change, the tea plantations are now globally characterized by a dualistic system of production – the plantation (or estate) system and the small growers' system. The small growers are producers of green leaf, a perishable input that has to be processed in a tea factory to convert to 'made tea". A number of studies have shown that the main criteria for drawing distinctions between these two sectors can be described in terms of landholding patterns, cultivation systems and labour utilisation patterns (Viswanathan et al. 2003; Hayami and Damodaran, 2004; Sarkar, 2008; Das, 2010, 2012; Thapa, 2012). First, the size of landholding is an obvious characteristic to distinguish smallholder sector from large estates. The former is comprised of land size from 10 to 50 hectares while the latter usually covers several hundred hectares. It is important to mention here that the definition of tea smallholder or small tea grower in terms of size of land holding varies across countries. For example, in Sri Lanka, "small-holding' means an area of land less than 50 acres (20.2 hectares). In India, a small-grower is one who cultivates 10.12 hectares or less and not possessing his own tea processing factory. In Indonesia, smallholders/ small growers are those who grow tea on land size between 0.8 to 2 hectares and sell tea without processing. Notwithstanding the variation in land size across the major tea producing regions of the world, the average holding size in most countries tend to be on the lower side, for example, less than 0.4 hectares in Indonesia, and between 0.7 to 4 hectares in different growing regions of India, with an average holding size of 1.6 hectares. More than 80 percent of small-holders in Sri Lanka hold less than 0.2 hectares (FAO, 2012).

As Hayami and Damodaran (2004) observed, a second criterion for identifying the smallholder sector is that it should be considered as a system consisting of small-scale tea planters holding land areas to grow green leaf only and bought-leaf factories (BLF) holding no farms to grow green leaf but specializing in manufacturing tea out of leaves purchased from smallholders. This decentralized system, consisting of independent small tea farmers and independent factories, contrasts with the plantation system in which production of tea leaves are integrated to the processing of leaves under a single management system (Hayami and Damodaran, 2004). There are two categories o BLFs − i) privately managed BLFs and ii) the government sponsored cooperative BLFs. The existence of the second category of BLFs is extremely prominent in countries like Kenya and Sri Lanka. It is relevant to mention in this connection that the decentralized system of production of tea under the small-grower system in those countries has led to the introduction of "price-sharing formula" which is supposed to ensure remunerative prices to small tea growers as well as a fair return to bought leaf factories. A key component for the successful implementation of "price-sharing formula" has been seen to be the extension and efficient operation of the BLFs under government sponsorship. This helps benefit sharing between the growers and the manufactures on a more equitable basis as compared to the privately managed BLFs. There is, however, a second factor on which the efficacy of the price sharing formula depends. It is the selling of bulk of produced tea through auction market. This guarantees transparency in price realization.

Finally, a key identifying factor of the small-holder tea sector is the favourable labour economics in terms of flexibility in the deployment of labour which is not in tandem with the estate sector. The main reason for the achievement of labour flexibility in this emerging sector is its overriding reliance on family labour and relatively diminutive reliance on hired labour (except during peak harvesting seasons). It has been observed that this sector is mainly reliant on the extensive use of low-opportunity cost family labour of women, children and aged family members who have little employment opportunity outside their own plantation. Another dimension of labour flexibility observed in this sector is the deployment of hired labour on the basis of piece rate contracts (Sarkar, 2008). This pattern of labour employment renders work in small plantations to be of unorganized nature which does not come under the domain of labour laws, such as the Plantation Labour Act (PLA) vis-à-vis minimum wage regulations. The unorganized nature of work also provides comparative cost advantage in small plantations in terms of payment of lower wages for hired labour relative to the estate sector. Some scholars have argued that these features of smallholder model of tea plantation along with the characteristics of small size of land holding, low initial investment for establishment of plantations, and a meager amount of interest costs on fixed and working capital have given it the character of peasant mode of production which is distinctly visible in traditional agricultural sector of developing countries (Hayami and Damodaran, 2004; Das, 2010).

According to FAO (2012), within the tea sector in producing countries, the small-holders' sub-sector is an important segment worldwide. Moreover, this segment has come to dominate the estate sector both in tea area and production in many leading tea producing countries such as

Kenya and Sri Lanka. In Sri Lanka, there are more than 400,000 small growers who constitute about 64 percent of total area under tea and 76 per cent of total production. In Kenya, on the other hand, with an estimated 560,000 small-holders, about 62 per cent of total production is derived from the sub-sector. The tea industry in China and Vietnam is essentially dominated by small growers. Small-holders account for 43 percent of the area under tea and 23 percent of production in Indonesia. According to FAO (2012) statistics, there has been an enormous growth in the small-holder sector as compared to the large-scale organized sector between 2001 and 2010.The area under small-holder during this decade has increased from 1,140, 700 hectares to 1,970,200 in China (a 72 per cent increase), from 85, 511 hectares to 115,023 hectares in Kenya (a 34 percent increase) and from 101,884 hectares to 132,000 hectares in Vietnam (a 30 percent increase). Between 1994 and 2005, the area under this sub-sector has increased by 48 percent in Sri Lanka.

**1.3 Extent of Small Growers across India**

In India, the small tea growers have emerged as a major stake holder of the country's tea sector. They have contributed significantly to the development and expansion of tea industry as a whole. According to a report published by the Parliamentary Standing Committee on Commerce (2012), the number of small tea growers in the country is estimated at 1, 60,000, accounting for a production of about 257 million kg of made tea, or roughly over 26 percent of the country's total production. The small tea plantations had registered their inception in India as early as in the 1960s in Tamil Nadu and Kerala. Gradually, they had spread significantly in Assam and West Bengal. Following the global trend of proliferation of small growers, there has been a stupendous growth of this sector between 2001 and 2010 in India. During this decade, the share of this sector in the total output has gone up from 11 percent to 26 percent. According to Tea Board statistics, at present the small tea growers in India accounts for 28 percent of the total area under tea cultivation with more than 2 lakh holdings and the average size of holding being less than 1 hectare. The very recent estimates reveal that the small growers produce nearly 300 million kg annually or roughly 30 percent of the country’s total production. The states that have witnessed the largest concentration of small growers in recent time in the country are Assam, followed by West Bengal and the north –east and southern states. The tea produced by small growers is mainly of CTC type. According to Union Commerce Ministry figures, the tea-industry in India has finally passed the one billion kilogram mark production in 2013. The ministry feels that the credit of surpassing this target goes to the huge promulgation of the small tea-growers.

In its 57th annual report, Tea Board of India, the apex body entrusted with the task of looking after the overall interests of tea industry, has described the small grower sector as "a force to reckon with that have made a significant contribution to total production of tea". It bears mention here that Tea Board started pursuing its policy on promotion of small growers as early as first half of the 1990s. The policy content was articulated in the Eighth Plan document (1990-95). The idea behind this policy initiative was to create a core of small growers to boost tea output. Under this policy, local village people are to be encouraged to take up the task of tea growing in areas on the periphery of a select number of large estates, referred to as "nucleus" estates, which would be required to assist the small growers with technical and managerial expertise as well as the requisite financial inputs. In addition, the small growers would sell green leaf to the nucleus estate factories at prices determined on the basis of green tea quality and the prices of made tea. As it follows, this policy was intended to serve dual purposes. First, it would achieve the goal of allowing the spread of tea cultivation in non-traditional areas with the diffusion of technological know-how to the small growers. Second, it would create an assured market for the small growers for the sale of green leaf. However, Bhowmik (1991) observed that the small grower promotion policy was basically the fallout of the failure of Tea Board's earlier policy of 15-year Tea Development Plan persuaded in the early 1980s.

Recently, to look after the interests of small tea-growers, the Union Government has constituted Small Tea Growers Directorate under Tea Board. The directorate has been specially constituted to ensure better execution and monitoring of various tea production promotion schemes and to help initiate a pilot programme on alternative market development for small tea growers in addition to providing systematic training and extension services. Moreover, the Tea Board of India has decided to set up 82 small-growers development cells across the country with the specific task of giving expert advice to small tea growers on quality control and sustainable production. The launch of these measures is a pointer to the importance the Union Government vis-à-vis the Tea Board is attaching to the small grower tea sector.

### 1.4 Emergence of Small Growers in West Bengal

Like the rest of India, the tea industry in West Bengal was initiated by the colonial ruler in early nineteenth century by bringing vast tracts of virgin lands under tea cultivation through the hiring of cheap migrant tribal labour. Traditionally, the organization of production of tea industry had remained estate-oriented since its inception. However, by the mid-1990s, the tea industry of West Bengal underwent a significant structural change in terms of emergence of small tea plantations and the introduction of bought leaf factories (BLF). According to the estimate of association of small tea growers, nearly 40,000 of small growers contribute around 33 percent of total tea production of North Bengal. The small growers in North Bengal are largely concentrated in North Dinajpur, Jalpaiguri, Coochbehar and at the Terai (the foothills of Darjeeling). The process of promulgation of small tea growers can be divided into three phases: the first phase covered a period from early 1980s to late 1980s, the second phase from late 1980s to mid-1990s, and the third phase covered the rest of the period up till now. Following this development, tea plantations had spread on a wide scale in non-traditional areas. It was presumably the tea boom in the 1980s that could be identified as the key driving factor leading to this proliferation phenomenon. The initial expansion of tea acreage into non-traditional areas was primarily due to management of large tea estates. Subsequently, this was carried out through involvement of local people in establishment of tea plantations.

### 1.5. Problem Perspective and Statement of the Problem

The considerable extension of tea plantation periphery by existing estate gardens and proliferation of small tea growers into non-traditional areas is a very significant phenomenon in four districts of North Bengal. In fact, following this development, there has been a radical restructuring of the tea industry in West Bengal in the past few decades in terms of changing pattern and composition of tea production and output. The activity of growing tea on small plots of land has emerged as a significant economic activity for the people at large in this region. Moreover, in terms of land-use change, crop transfer, employment generation, changing options of occupational choices, impact on living standard etc. this development has drawn attention of many academicians. These developments obviously necessitate a thorough study of economics of small tea growing to identify the economic push and pull factors that have contributed to the proliferation process of this emerging sector. The important areas of this proposed study are outlined as below.

The principal research problem of the study is the parametric and non-parametric analysis of production economics of small tea gardens which relates input and output factors. These input factors are nature of land, condition of soil, availability of irrigation, quantum of fertilizer used and use of various categories of labour force while the output factor is the yield of green leaf. The proposed analysis would help to understand production economics in terms of measurement of technical efficiency of production along with nature of returns to scale that emerges from the input and output relationship at the plantation level.

One of the major input factors is land. It has been reported since mid-eighties that gradually traditional crop land is being transferred to tea production in North Bengal. An important inquiry should be the nature and type of transferred land. If it is paddy land, then the obvious conclusion is that the paddy cultivation must have been becoming inefficient and hence, less productive and remunerative. Why this so happened must be examined carefully. On the other hand if fallow high lands are being transferred to tea cultivation, then the research question would have been that how this important input is utilized. A second important aspect of production economics involves the investigation of nature of returns to scale that emerges from the relationship between input and output at the farm level. The prevalence of increasing returns to scale indicates that production increases in a higher rate than the rate of increase of inputs used. This may happen also for the younger age of tea bush that results in more yield compared to aged tea bush. Generally it is known that up to the attainment of a certain age of tea bush, the growth of tea leaves remains in increasing order. If the factor of contribution of bush-age could be separated, then the increasing return to scale should indicate increasing contribution of other factors. It could also be the case that the relationship between input and output at the farm level is characterized by decreasing returns to scale. The subject of inquiry in such a case would be to answer why such a proliferation did occur despite having production inefficiency.

The second most important input after land is labour. It is to be noted that, unlike the estate gardens which employ hired wage labour brought from the outside region, the small tea gardens employ family labour and village people for their operation. It is a known fact that village people having skills in traditional agriculture have joined as labour in small tea garden without adequate skill in this sector. The skill and efficiency they attained with the passage of time may contribute positively in production. Thus, an important enquiry involves making an assessment of how important the contribution of gradually increasing labour skill is towards gaining production efficiency in case of small gardens. The second important aspect would be to investigate up to what extent this sector has been able to act as a major source of employment and livelihood for the population of the North Bengal regional economy. As this economy is often considered as backward in terms of lack of year round employment opportunities, the increase of social welfare in terms of greater employment opportunity and enhanced income and livelihood security is of immense significance for the people of this region. A related inquiry to be made in this regard is to find out what role does changing options of occupational choices play towards meeting the objective of securing descent livelihood.

Finally, a very pertinent issue of inquiry relating to tea industry in contemporary time North Bengal is the interdependencies among the small tea growers and the estate sectors. Conventionally, the phenomenon of the emergence of the small tea growing sector and its viability, the economics, and social contribution has been considered to be independent of the state of affairs of the sector consisting of large estates. On the other hand, it has often been alleged by many, especially the planters' circle, that an important cause of crisis of the organized sector of tea industry is the emergence and subsequent proliferation of small tea gardens. Thus, inter-relationship between these two sectors has become a major issue. Because of this, without probing into the inter-linkages between these two sectors, the inspection of small tea gardens and its economics cannot be complete. Again, if the dependencies between these two sectors are a bi-directional phenomenon, then the present economic state of affairs of the large tea estate sector is to be understood with respect to the commercial relationship with small tea gardens. Thus, an investigation of such interdependencies is required in order to make it reveal if there exists a mutually beneficial feedback mechanism as opposed to our conventional wisdom.

### 1.6 Review of Literature

The review of literature is structured around the schematic sections as follows. It starts with a brief account of general literature directly related to the proposed research area of our research problem. It covers various pertinent issues with which the researchers so far have dealt with and the important findings which have emerged out of their studies. The second section focuses on quantitative literature that covers relevant empirical methods and studies in the proposed research area. The final section seeks to locate the existing research gaps related to the proposed research area.

### 1.6.1 General Literature

There is substantial literature on small tea growers in the global context. However, in the context of India, there is only a few number of studies so far. The literature available in the Indian context (only with a few exceptions) has been arranged as under:

Bhowmik (1991) studied how Tea Board came up with the small grower promotion policy during the Eighth Plan period (1990-95) to boost tea output. He argued that this policy was to be viewed as the fallout of the failure of Tea Board's earlier policy of 15-year Tea Development Plan persuaded in the early 1980s in order to ease out the production shortfall crisis of the Indian tea industry.

The ILO (1994) study on "changing patterns in plantations" focused on three types of change that have occurred in plantation systems on a global scale in recent time. These include: 1) Privatization and changing forms of plantation ownerships; 2) Changing forms of commodity marketing; 3) Changing forms of production. The study noted that forms of production are changing in plantations, with plantation commodities including tea are grown on both smallholdings and medium-sized and large estates. The study found different patterns of labour utilisation across sectors. Smallholders rely essentially on family labour but also hire labour to meet seasonal activity peaks. Smallholders grow plantation commodities and food crops. Smallholders also sell their labour on a seasonal or casual basis on estates. Estates rely on permanent, seasonal or casual wage labour. According to the study, the estate mode of plantations is undergoing different processes of disintegration worldwide. Some estates have introduced tenancy arrangements whereby land is leased to employees producing under conditions specified by the estate. A variant of this arrangement is contract farming or out-grower scheme whereby, in addition to its own production, the estate buys under contract the produce of smallholders. This enables estates to concentrate on primary processing and to reduce their direct involvement in production.

Sivaram (1997) noted that the 'estate' oriented view of tea production has been worn away towards the end of the last century with the emergence and proliferation of non-traditional growers. The reasons cited by him for the disappearance of the traditional image of tea as a large-scale enterprise include higher land and labour productivity that ensure a production cost that is lower than that in the estate sector, the establishment and the increase of private (bought-leaf) factories, and the outsourcing of green leaf by the large estate to the emerging smallholder sector. However, his finding of higher productivity has been criticized on the ground that productivity in smallholdings masks the application of very high dose of unpaid family labour, which remains invisible (Sankrityayana, 2006).

Hannan and Butola (2006) gave an account of growth and development of small tea growers (STGs) in North Bengal and institutional constraints related with their proper functioning. Their study found that a good number of pineapple growers in this region started switching over to tea cultivation in their fields in the late eighties. The growers resorted to tea cultivation in their holdings due to paucity of available market for the pineapple as well as the absence of processing technology for the pineapple. The pineapple growers earned handsome profits from tea cultivation, which induced more and more villagers to abandon the cultivation of traditional crops and take up tea cultivation to earn steady income.

Sankrityayana (2006) made a critical assessment of the proliferation process of small tea growers in North Bengal by identifying the push and pull factors behind this phenomenon. He argued that the state policy of land redistribution since 1970s is an important push factor behind this new development. On the one hand, this policy had left little land that could be granted for new tea leases when the tea industry of West Bengal sought the release of such land, following the tea boom since mid-1980s onwards. On the other hand, a vast tract of land distributed among landless beneficiaries under this policy was frequently found unsuitable for paddy cultivation which was ultimately brought under tea cultivation by the land owners themselves. He opined that this situation resulted in the expansion of tea plantations into non-traditional areas comprising mostly of revenue lands of landless beneficiaries of the land redistribution policy. He identified labour flexibility as an important pull factor for the unprecedented growth of this non-traditional sector.

Sarkar (2008) conducted a case study in the North Bengal region to make a comparison between the BLF- smallholder sector and the estate sector on the basis of cost of production structure pertaining to both sectors. The cost of production in the BLF- smallholder sector was found to be considerably lower as compared to that of the estate sector mainly due to in-build labour flexibility of the former sector at the farm level vis-à-vis the processing level. On the basis of this finding, he has pointed out that, in order to achieve flexibility in the deployment of labour, the mode of production is shifting from the estate sector to the emerging smallholder sector. This finding is corroborated by the studies of Viswanathan et al.(2003), Hayami and Damodaran (2004) and Thapa (2012)

Das (2010, 2012) made a sample study on production process and other operational aspects of smallholdings tea plantations of Sri Lanka and Assam. The findings emerging from his study, especially with reference to Assam, have a lot of similarities with the findings that emerged from the study of Sarkar (2008). The study has found that this non-traditional sector has created higher employment opportunities for the rural people in terms of self-employment, particularly for the rural unemployed youth on different dimensions, compared to the subsistence agricultural sector. Not only that, the smallholdings tea plantations in Assam employ approximately four persons per hectare as compared to 2.06 persons per hectare overall employed in the tea sector. The study revealed that a substantial number of small growers in the study regions have opted for dual system of farming, that is to say, tea farming along with subsistence farming that includes paddy and vegetable cultivation. A segment of the small growers, on the other hand, supplement household income from sources such as wage earnings, shops, transportation jobs and private and government salaried jobs. There is also a category of small growers who rely entirely on income from tea. The study made a critical observation of the fact that in spite of the initiation of tea smallholding by the peasantry in Assam, the sector could not remain in the form of peasants' smallholdings recently with the entry of rich and landowning natives.

### 1.6.2 Quantitative Literature

A major area of study of the proposed research problem is the examination of efficiency in the production of output as well as in the utilisation of labour input by the non-traditional small tea growers. In general, the examination of efficiency is a central issue in the main stream theoretical and empirical production economics, which often comes under the nomenclature of neo-classical economics. It defines production process in terms of transformation of inputs into outputs in the most efficient manner. Thus, the idea of efficiency is in-built in the neo-classical theory of production. The literature of productive efficiency is broadly divided between two separate branches; the econometric (and parametric) Stochastic Frontier Analysis (SFA) and the nonparametric method of Data Envelopment Analysis (DEA). In the next section, we give a brief description of efficiency concepts and the unified conceptual framework of both kinds of efficiency measurement approach. This would be followed by an overview of quantitative procedures under each approach. As no empirical study involving the application of DEA approach in the proposed research area is found in the literature, we restrict ourselves to a summary presentation of few empirical studies involving the applications of SFA.

At the outset, we introduce the efficiency concepts that are found in the literature on efficiency. In simple terms, efficiency is defined as the ability of a firm to obtain maximum output from a given set of inputs (Coelli, Rao et al. 1998). A firm is said to be an efficient firm if it is obtaining maximum output from a set of inputs. Since the measurement of efficiency involves technical aspect of production process as well as market-driven factors (economic factors), e.g. allocative problems, the measurement of efficiency should of different types. The economic literature on production efficiency typically makes distinctions between technical, allocative, economic and scale efficiency. These different efficiency concepts are briefly explained below.

Technical efficiency (TE) is defined as the degree to which firms fail to reach the optimal production. A firm is said to be technically inefficient if it is not realising the technically feasible maximum production due to inefficient management of the resources.

Allocative efficiency (AE) relates to allocation of inputs in accordance with some specified principle of optimality such as cost minimization, revenue maximization, and profit maximization condition for exogenously given input and output prices. AE can be contrasted with TE by virtue of the fact that, while TE estimation does not require information on prices, estimation of AE does.

The combination of measures of technical and allocative efficiency yields a measure of economic efficiency (Farrell, 1957). It could happen that a firm is allocatively efficient but it is not realising technical efficiency. In such a case, the firm is said to be economically efficient. Alternative terminologies used for economic efficiency include price efficiency, cost efficiency etc.

Finally, scale efficiency (SE) is the potential efficiency gain from achieving optimal scale of operation. If a firm is scale inefficient, it means that it is operating with a plant size that is smaller or greater than the optimal plant size. If a farm is seen to be producing with a non-optimal plant size, it incurs more costs and earns less profit. It is important to mention that scale efficiency is internal to a firm and consequently, its determination is not dependent on market-driven factors (economic factors).

The analytical approach to the measurement of efficiency in production has originated from the works of Debreu (1951) and Koopmans (1951). Debreu provides the first measure of productive efficiency which is called "coefficient of resource utilisation". Debreu's measure of efficiency is called a "radial measure" of technical efficiency. Radial measures focus on the maximum possible proportionate reduction of all inputs or maximum possible proportionate expansion of all output. They are invariant of unit of measurement, that is to say, changing the unit of measurement will not change the efficiency score. With the application of the radial measure, the achievement of the maximum feasible input contraction or output expansion suggests technical efficiency even though there may remain slacks in inputs or outputs. This constitutes a major shortcoming of the Debreu's measure. Moreover, this approach is entirely conceptual without any focus on how efficiency could be identified.

Koopmans put forward a definition of technical efficiency as follows: an input-output vector is technically efficient if, and only if, increasing any output or decreasing any input is possible only by decreasing some other output or increasing some other input. Thus, Koopmans definition implies a non-radial measure of efficiency. This measure relates any production unit to a production unit of its efficient subset. It follows that this measure represents an improvement over Debreu's measure in terms of its ability to make inputs or outputs slacks equal to zero for a technically efficient production unit. This definition is, in fact, the adaption of Pareto concept of "welfare efficiency" by Koopmans for use in production economics. For this reason, this definition of efficiency is also referred to as the "Pareto-Koopmans" definition. However, it refers to an absolute standard of efficiency and as such its computational implementation is not possible. Thus, it remains entirely conceptual from empirical point of view.

Farrell (1957) revisits the works initiated by Debreu and Koopmans in a seminal paper 'Measurement of Production Efficiency' so as to provide them with empirical content. It is this empirical necessity which has motivated him to define technical efficiency in relative terms. More specifically, for Farrell, efficiency is to be defined relative to some benchmark level. The benchmark, which Farrell calls “efficient unit isoquant” that captures the minimum combination of inputs per unit of output required to produce a unit of output, is referred to as the “best practice frontier” and represents actual observed achievements in similar operations (Färe and Grosskopf, 1985). Hence, efficiency is a relative measure and indicates how close the actual or observed production is to the production corresponding to the “best practice frontier” level of operation. This approach to efficiency measurement is quite well-known in the literature as the “frontier approach”. Farrell further extends the works of Debreu and Koopmans to include allocative efficiency as an important component of productive efficiency besides technical efficiency. This has led Farrell to define overall economic efficiency which represents a combination of these two components of efficiency. According to Farrell, implicit in the notion of allocative efficiency is a particular behavioural assumption of the about the goal of the producer such as cost minimization, profit maximisation or revenue maximisation. He considers cost-minimisation to determine the proper technically efficient input-output vectors given the prevailing input and output prices.

Farrell has made a good deal of progress towards providing a theoretical framework for measuring efficiency empirically. His framework provides a way of differentiating efficient from inefficient production units. But it fails to show the way of practical identification of an efficient frontier from a given set of observations on inputs and outputs. For this reason, Farrell’s original model offers no guidance concerning either the identification of an efficient production unit or the degree of inefficiency of an inefficient production unit. Moreover, this model is of no help in the identification of a combination of efficient vectors (a subset of isoquant for each output) against which comparing an inefficient vector. Nevertheless, Farrell’s theoretical framework has led to the development of several techniques for the measurement of technical efficiency of production. These techniques can be broadly categorized into two approaches: the parametric stochastic frontier production function (SFP) approach and the nonparametric mathematical programming approach commonly referred to as data envelopment analysis (DEA).

### 1.6.2A Stochastic Frontier Regression (SFR)

One important line of empirical research that has proceeded in the aftermath of the publication of Farrell’s work is the SFR. This approach tries to operationalizing Farrell’s conceptual framework by specifying the frontier as a parametric function of inputs. It was initially applied for the measurement of technical efficiency (TE). Later on it has been extended to include allocative, cost and profit efficiency. The first statistical formulation of this method was independently proposed by Aigner *et al*. (1977) and Meeusen and van den Broeck (1977). The specification of the SFR model involves a production function which has a two-component composite error term−one to account for random effects and another to account for technical inefficiency. The advantage of this method is that it can make a distinction between technical inefficiency and statistical noise effects that originate from the data set. The stochastic frontier approach is considered very appropriate for assessing TE in a developing country agriculture, where data are often heavily influenced by measurement errors and other stochastic factors such as weather conditions, diseases, etc. (Fare et al., 1985; Kirkley et al., 1995; Coelli et al., 1998).

A pre-requisite for the estimation of stochastic production frontier is the specification of the particular functional form of the production function. A range of functional forms for the production function frontier are used in empirical studies, with the most frequently used being a translog function, which is a second order (all cross- terms included) log-linear form. This is a relatively flexible functional form as it does not impose assumptions about constant elasticities of production and nor elasticities of substitution between inputs (Corbo and Meller, 1979; Berndt and Christensen, 1973). Alternative production function specifications include the Cobb-Douglas and CES (Constant Elasticity of Substitution) production functions.

The estimation of the SFR model involves (i) estimating the parameters of the of the frontier function $f(x)$ which is to be specified a priori, and (ii) estimating inefficiency. Kumbhakar and Wang (2010) have given a detail account of the method of estimation of stochastic frontier production function. They have demonstrated that the method to be applied is the maximum likelihood (ML) and an essential requirement for the application of this method is the specification of distributional assumptions of the error terms. Since limited theory is available in guiding the choice of distributions, the distributional assumptions are often made heuristically. The various alternative distribution assumptions explored in the literature so far are: an exponential distribution (Meeusen and Van den Broeck, 1977); a normal distribution truncated at zero, (Aigner, Lovell and Schmidt, 1977); a half-normal distribution truncated at zero (Jondrow et al., 1982); and a two-parameter Gamma/ normal distribution (Greene, 1990; Pascoe *et al*.2003).It is to be noted that the estimates of technical efficiency are dependent on the specific distributional assumption on the error components.

Schmidt and Lovell (1979), extending the SFP model of Aigner *et al*. (1977) and Meeusen and van den Broeck (1977), demonstrate that it is possible to estimate technical and allocative efficiencies simultaneously provided an assumption is made that ‘the firm seeks to minimise the cost of producing its desired rate of output, subject to a stochastic production frontier constraint”.

A large number of studies are available on the use of SFP for the measurement of technical efficiency in agricultural production (Battese and Corra, 1977; Kalirajan, 1981a, 1981b, 1990; Dawson and Lingard, 1989; Battese, 1992; Battese and Coelli, 1995). The common objective of these studies is the evaluation of current performance and opportunities to improve the production performance of the crops under consideration. These efficiency studies have showed that it is possible to raise the productivity of the crop without actually raising the input application.

Hazarika and Subramanian (1999) examine technical efficiency of the tea industry in Assam using the stochastic frontier production function model. The study identifies high percentage of vacancy and old age of tea bushes as two important sources of inefficiency for the industry. The authors observe that these inefficiencies could be corrected through undertaking infilling, replanting and replacement planting.

Basnayake and Gunaratne (2002) estimated technical efficiency of the tea smallholding sector in mid country west zone of Sri Lanka. The objective of the study was to trace out the sources of inefficiency and investigate the robustness of measured technical efficiency in various functional forms specifications. The translog model has been found to provide better result than the Cobb-Douglas model.

Jayasinghe and Toyoda (2004) analysed the technical efficiency of organic tea small holdings in the midcountry wet zone of Sri Lanka using a stochastic frontier analysis. The study revealed a significantly positive relationship between technical efficiency and training of farmers.

Mahesh and Malaisamy (2004) conducted a study of measurement of technical efficiency of tea industry in the Nilgiri district of Tamil Nadu during the year 1998-1999 using the stochastic frontier model. The study found that the proportion of most efficient (91-99 per cent) category is much larger for corporate units in comparison with tea farmers.

Jayatilake (2006) made a study of the estimation of technical efficiency of tea manufacturing firms in Sri Lanka. The study revealed that there was a possibility to increase the production through efficiency improvement, thereby reducing the cost of production. The study further revealed that efficiency scores were subject to regional variation.

Baten et al. (2010) attempted to measure the status of technical efficiency of tea-producing industry for panel data in Bangladesh using the stochastic frontier production function, incorporating technical inefficiency effect. It was observed that Translog Production Function is more preferable than Cobb-Douglas Production Function. The results indicated that there is a great potential exists for tea industry to further increase the value added by a significant proportion using the available input, technology and efficiency improvement, thereby reducing the cost of production.

**1.6.2B Data Envelopment Analysis**

A second line of empirical research developed the Farrell's conceptual model of measurement of efficiency into the non-parametric linear programming model which is known as data envelopment analysis (DEA). The method of DEA generalized Farrell's measure of technical efficiency from the single-output to the multiple-output case. The development of this approach has also been motivated by the empirical necessity of treating Pareto-Koopmans' definition of technical efficiency as a relative notion, a notion that is relative to best observed practice in the reference set or comparison group. In DEA, the economic agent is referred to as a decision-making unit (DMU) to accord with the notion that we are assessing entities that have control over the processes they deploy to convert their inputs into outputs. We present below an overview of quantitative procedures within the framework of DEA.

In 1978, Charnes, Cooper and Rhodes (CCR) proposed what has been traditionally considered the first DEA model. The CCR model was developed originally in terms of a fractional programming problem. The optimal values given by DEA are actually the virtual multipliers. Those represent the associated weights of the inputs and outputs, respectively. The unit being evaluated will be called efficient if, by using the most favourable set of weights, the ratio of the weighted inputs over outputs is equal to one. The above fractional formulation can be transformed into a linear programming problem (LPP) (Charnes and Cooper, 1962) by maximising the numerator and setting the denominator equal to a constant. In the DEA methodology, this constant is considered to be equal to one, in order to get an efficiency rate upper-bounded by one.

The models presented initially were input-oriented models (CCR-I). Subsequently, the output-oriented model (CCR-O) was proposed where the efficiency has been defined as the ratio of the weighted sum of inputs to the weighted sum of outputs. Gradually, for solution of DEA models dual form is used (Charnes, Cooper and Rhodes, 1981). When the unit under evaluation, DMU, is rated as inefficient, the solution to the dual problem provides a number of DMUs- the peer group or reference set-which is rated as efficient with the weights of DMU. Moreover, the optimal solution of the model provides a virtual unit on the frontier constructed as a linear combination of the units in the reference set. The unit being evaluated should be transformed into that virtual DMU in order to become efficient. This is made by a radial reduction of the inputs or expansion of the outputs-for an input or output orientation, respectively- by means of the optimal value of the objective function.

The original model of CCR assumed constant returns to scale (CRS). Banker, Charnes and Cooper (BCC) (1984) extended their model and constructed a new model that allowed for variable returns to scale (VRS). The extension is made by the elimination of the postulate of linear combination by the convex combination on the production possibility set proposed in the CCR model. It makes the production possibility set as the convex hull, that is to say, the smallest convex set that encloses all observed DMUs.

The basic DEA models are referred to as the CCR and BCC models which provide us with technical efficiency measures. Banker (1984) suggested a method of estimating scale efficiency in the context of a multiple-input, multiple-output technology by focusing on the concept of "the most productive scale size (MPSS)". Ray (2004) observes that Banker utilizes Frisch's concept of technically optimal production scale to define the MPSS for the multiple-input, multiple-output case. Once the MPSS is defined, the maximum productivity attained at the MPSS is compared with the average productivity at the actual scale of production to measure scale efficiency. Although the method suggested by Banker's is based on the BCC model, it may be noted that Byrnes, Fare and Grosskopf (1984) independently constructed a nonparametric model allowing scale efficiency. Banker and Thrall (1992) derive a number of important results relating to the MPSS. It is relevant to note in this connection that, in the parametric literature, the primary interest has been on "scale elasticity" rather than on "scale efficiency".

Beyond the standard CCR and BCC DEA models, there are several other nonparametric models proposed independently in the literature. Some of these new areas of development include: graph hyperbolic distance function and the directional distance function models (Färe, Grosskopf and Lovell (FGL) (1985, 1994); Chambers, Chung and Färe, 1996); non-radial models allowing reduction of individual inputs and/or increase in individual outputs at different rates (Färe and Lovell (FL) (1978); Pastor, Ruiz and Sirvent, 1999); Free Disposal Hull (FDH) models dispensing with the convexity requirement and retaining the assumption of free disposability of inputs and outputs (Deprins, Simar and Tulkens, 1984; Tulkens, 1993); methods of assurance region (AR) analysis and Cone Ratio (CR) analysis for dealing with slacks, multiplier bounds and congestion (Thompson, Singleton, Thrall and Smith, 1986; Charnes, Cooper, Huang and Sun, 1990); DEA models addressing the issues of efficiency of merger and breakup of firms ( Bogetoft and Wang, 1996; Maindiratta, 1990). An extensive review of the above mentioned models is available in Ray (2004).

By far the most serious impediment to a wider acceptance of DEA approach as a valid analytical method in economics is that it is seen as deterministic and hence does not take into account random error. However, more recently, stochastic data envelopment analysis (SDEA) models have been proposed. Since DEA is an extreme point technique, noise (even symmetrical noise with zero mean) such as measurement error can cause significant problems because the solution to optimization problems is sensitive to changes in data. As a consequence of this, theoretical attempts to incorporate these stochastic errors were made. ADEA applications are based on the theoretical paper by Land et al. (1993) where the authors use their new models to examine the efficiency of the same schooling programme for disabled scholars as in Charnes et al. (1978). In Land et al. (1993), the authors discussed the prospect of stochastic DEA and constructed their own model. They introduced the stochastic component to DEA and derived the model as a chance constrained version of BCC output oriented model in envelopment form. Further, Land et al. (1993) transformed these problems to their deterministic non-linear equivalents, which allowed them to determine the efficient DMUs.

## 1.7. Objectives of the Study

The main objectives of the study are as follows:

1. To trace the origin, growth and consolidation of small tea growers in North Bengal including socio-economic background of small growers.

2. To study the land utilisation pattern of small tea growers.

3. To estimate technical efficiency for evaluating the productivity performance of the small tea gardens applying suitable non-parametric optimization method, such as data envelopment analysis (DEA), and to identify sources causing economic inefficiency of tea small holdings.

4. To identify the nature of returns-to-scale and its impact on production and cost structures of tea smallholdings.

5. To estimate technical efficiency of the small tea gardens using parametric stochastic frontier approach.

6. To assess the relative effects of various productivity parameters on tea production and productivity using stochastic frontier regression analysis.

7. To determine the optimum efficient size of small tea gardens with the use of both parametric and non-parametric techniques.

8. To make an assessment of the nature and extent of production and productivity dependence of large tea estates on small tea plantations in terms of green leaf outsourcing.

## 1.8. Research Questions of the Study

1) What are the economic push and pull factors that could explain the significant growth of tea smallholdings in recent times in North Bengal?

2) Does the socio-economic background of small tea growers suggest the entrance of occupationally diversified rural peasantry in tea smallholdings? Or, does it signify land diversion vis-à-vis land dispossession of small and marginal farmers?

3) Does small growing of tea represent an efficient mode of production due to better utilisation of land and labour resources?

4) What is the nature and magnitude of capital investment for the establishment of small tea gardens?

5) Do the small tea gardens perform efficiently in terms of technical efficiency? Is there any optimum efficient size of them?

6) What is the pattern of input use in small tea plantations? What are the relative effects of various input variables on tea production and productivity in the smallholding tea sector?

6) What kind of returns to scale emerges from the relationship between input and output at the farm level?

7) What are the various sources of interdependence between the large tea estates and small tea plantations?

**1.9. Hypotheses of the Study**

The research objectives as stated above lead to the following hypotheses to be tested by the study:

1. Tea cannot be grown as a smallholder peasant's crop with a very low capital investment at the initial stage as well as in subsequent periods.

2. The emergence of small tea plantations signifies the transfer of paddy cultivation land to tea plantation.

3. The efficiency gain from small tea plantations is not significant in terms of technical efficiency score, or in other words, the inefficiency in resource use is wide spread among them.

4. The small tea plantations cover larger land areas for their efficient operation.

5. There is no criterion to suggest that a small tea plantation has been of specific optimum size for extracting maximum efficiency gain.

6. The achievement of efficiency gain is largely region-specific.

7. There is no scope of increasing yield further through increased use of inputs like land, labour, fertilizers, irrigation etc.

8. There is no favourable labour economics in terms of employment generation in the small tea sector in comparison to the large estate sector.

9. The large tea estates and small tea plantations are operating independently.

### 1.10. Data, Variables and Method of Sample Drawing

The study is based on primary data collected from field survey administered among the small tea growers in the study region. The area of sample-study consisted with nine regions spread over four districts of North Bengal. In each of these locations, there is a significant concentration of small tea growers. The method of sample drawing for the collection of data is designed to be cluster sampling where clusters consist of sample study locations of tea smallholders. This sampling method permits us to draw sample randomly when no single list of population members exists, but local lists do exist. In the context of the present study, it is important to mention that in the absence of any complete enumeration survey undertaken by the concerned authority, no single exhaustive list of STGs is available with the government departments. Only local lists of growers are available with primary producer' societies (PPSs) or self-help groups (SHGs) operating in different tea smallholding sub-regions. Due to this problem, the method of cluster sampling has been used for the collection of data from the survey respondents. In the context of the present study, the application of this method consists in drawing a random sample in each location from a local list of growers who are enrolled with PPSs or SHGs. But local lists of DMUs are available with self-help groups (SHGs) in different tea smallholding sub-regions. The sample consists of 124 small tea growers.

The summary statistics of output and input variables used in this study are depicted in the following table

Table 1.1 Summary Statistics of Variables

| Variables | Range | Minimum Value | Maximum Value | Mean | | Std. Deviation |
|---|---|---|---|---|---|---|
| | Statistic | Statistic | Statistic | Statistic | Std. Error | Statistic |
| **Output variable** | | | | | | |
| Green leaf | 189500.5 | 499.5 | 190000 | 31452.70 | 2813.49 | 31329.70 |
| **Input variable** | | | | | | |
| **Economic input** | | | | | | |
| Area (acre) | 23.5 | 0.5 | 24 | 5.40 | 0.45 | 4.98 |
| Irrigation (hours) | 636078 | 0 | 636078 | 5429.97 | 5127.39 | 57096.21 |
| Nitrogen fertilizer (kg) | 11950 | 50 | 12000 | 1327.25 | 136.29 | 1517.64 |
| Potash fertilizer (kg) | 6000 | 0 | 6000 | 735.34 | 75.80 | 844.04 |
| Phosphate fertilizer (kg) | 12000 | 0 | 12000 | 708.59 | 118.10 | 1315.09 |
| No of plants | 138480 | 3000 | 141480 | 31307.14 | 2575.23 | 28676.51 |
| Labour days employed in a plantation | 8009 | 24 | 8033 | 2080.17 | 158.75 | 1767.79 |
| Foliar nutrients and pesticides | 109080 | 920 | 110000 | 22632.36 | 1903.31 | 21194.34 |
| Cow dung manure | 27013.5 | 0 | 27013.5 | 4530.66 | 453.02 | 5044.57 |
| **Soil related input** | | | | | | |
| Soil Ph value | 2.32 | 3.02 | 5.34 | 4.35 | 0.04 | 0.42 |
| Soil potash | 244.18 | 7.35 | 251.53 | 65.11 | 5.09 | 56.73 |
| Soil Phosphorous | 125.7 | 4.8 | 130.5 | 27.46 | 1.74 | 19.40 |
| Soli Sulphur | 1141.78 | 0 | 1141.78 | 34.69 | 9.05 | 100.73 |
| Soil Nitrogen | 0.97 | 0.01 | 0.98 | 0.09 | 0.01 | 0.09 |

*Source: Field Survey, 2007-08*

## 1.11. Methodology of the Study

The first and fundamental theoretical concept underlying efficiency measurement is the definition and characterization of "production technology". The knowledge of "production technology" is fundamental for building up any theory (or model) of efficiency measurement, whether be it parametric or non-parametric. This is because efficiency and/or inefficiency of a production unit is to be understood in terms of weather the unit under consideration is capable of making best use of the technology available to it in running its production operation. A production unit that is incapable of utilizing technology in the best possible way in producing output from inputs is termed as inefficient. For this reason, the beginning point of efficiency analysis is the conceptualization of "production technology".

Any production technology is defined to be a process (or an activity) that transforms input vectors $x = (x_1, x_2, \cdots, x_m)$ into output vectors $y = (y_1, y_2, \cdots, x_s)$ and can be characterised by the production possibility set

$$T = \{(x, y): y \text{ can be produced from } x; x \geq 0, y \geq 0\} \cdots\cdots\cdots (1)$$

The set T contains all feasible combinations of inputs $(x)$ and outputs (y). When a sample of input-output bundles is observed for $j^{th}$ $(j = 1,2, \cdots, n)$ production unit, we assume further that

$$(x_j, y_j) \in T \text{ for } j = 1,2, \cdots, n \cdots\cdots\cdots (2)$$

where $x_j = (x_{1j}, x_{2j}, \cdots, x_{mj})$ and $y_j = (y_{1j}, y_{2j}, \cdots, x_{sj})$

The input $(x)$ and output $(y)$ vectors are assumed to be nonnegative but at least one component of every input and output vector is positive. This implies components of $x$ and $y$ are semi-positive with a mathematical specification $x_j \geq 0, y_j \geq 0$. Therefore, each production unit is supposed have at least one positive value in both input and output vectors. A pair $(x, y)$ of such semi-positive input $x \in R^m$ and output $y \in R^s$ is called an activity where components of each such vector pair is a semi-positive orthant in $(m + s)$ dimensional linear vector space having 'm' dimensional input vectors and 's' dimensional output vectors, respectively. Thus, the set T actually represents the set of feasible activities. The set T is supposed to have a set of characteristics such as it is to be bounded, compact, closed, convex and non-empty.

In the 1-output case, the frontier or graph of the technology is defined by the production function

$$g(x) = \max\ y : (x, y) \in T$$

That is, for any input bundle $x^0$, $g(x^0)$ is the maximum quantity of $y$ that can be produced.

An equivalent definition of production possibility set can be formulated as

$$T = \{(x, y): y \leq g(x);\ x \geq 0, y \geq 0\}$$

In the parametric stochastic frontier analysis, one arbitrarily picks up a functional form for $g(x)$, such as the Cobb-Douglas form. In DEA, one only makes a number of assumptions about the underlying technology that would be consistent with many different functional forms of the production function but does not select any particular function.

### 1.12 Chapterization Scheme

The thesis spans over eight chapters including the introductory one. Chapter 2 traces the origin, growth and consolidation of small tea growers in North Bengal. It also seeks to enumerate the economic push and pull factors contributing to this transformation of tea industry in West Bengal.

Chapter 3 is planned to deal with the socio-economic and demographic profile of small tea growers, who are the respondents of the survey. It also contains an analysis of characteristics of lands holdings on which small tea plantations stand and land utilisation pattern of the sample STGs.

Chapter 4 makes an endeavour to estimate technical efficiency (TE) of small tea growers with the application of the technique of Data Envelopment Analysis (DEA). It also tries to show whether potentials exist for improving the productivity performance with proper utilisation and allocation of the existing resources. Furthermore, an attempt has been made in this chapter to determine the optimum efficient size of the small tea plantation on the basis of DEA efficiency scores.

Chapter 5 concentrates on analysis of scale efficiency and returns-to- scale. In this chapter, we also try to identify the sources, if any, causing economic inefficiency of tea small holdings. Along with these, we seek to evaluate the nature of production and cost structures under which STGs are operating.

Chapter 6 carries out stochastic production frontier analysis for the measurement of technical efficiency. Using stochastic frontier regression results, it tries to assess the relative effects of various productivity parameters on tea production and productivity so that the relative importance of each parameter could be better understood.

Chapter 7 is an attempt to explore different dimensions of interdependencies between the organized and unorganized sectors of North Bengal tea industry.

Finally, chapter 8 presents a summary of empirical findings of the study. It also points out certain thrust areas where there is ample scope of extending the present study.