Spatial Variation in Productivity of Tea Gardens in Upper Brahmaputra Valley

Abstract

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Statement of the Problem:

Tea is considered to be the most well organized agro-based industry. It provides direct employment to workers of which a sizeable number are women. Besides this, people derive their livelihood from ancillary activities associated with production value addition and marketing of tea. Substantial foreign exchange earnings with negligible import content and contribution to state and central exchequers are the other important economic features of the Indian tea industry.

But with high cost of production, low prices, stagnating domestic demand, declining exports and loss in foreign exchange earnings and India's position in world market is under severe threat are the major problems faced by Indian tea industry.

Thus, the health of the tea industry has an immediate socio-economic impact in the tea growing areas of Upper Brahmaputra Valley where most of the tea gardens are located.

Objectives:

The proposed study focuses attention towards the following objectives:

(1) to examine the variation in production and productivity level of tea, and.

(2) to find out causes of their areal variations.

Research Questions:

There may be a good deal of explanation of the problems of optimization of tea production with respect to its factors. However, the following two research questions are posed here to stream line the discussion and explanations to fulfil the objectives.

(a) How do the physical factors responsible for the variation in the level of production and productivity?

(b) What are the socio-economic characteristics of Gardens labourers and how it influences the tea production in different agro-ecological conditions of tea cultivation.

Methods Used and Data Collection:

The geographical explanation and answers of such research questions may be given by viewing the physical factors of land and their areal variations to specify the areas of various agro-ecological conditions to find out the causes of areal differentiations in tea productivity. The main parameters of physiographic personality of the study area, namely, relief features, soil and climatic conditions, vegetal cover conditions and agricultural practices have been considered to identify the areal variations of such parameters. Agro-ecological zonation are prepared to show the homogeneous physical conditions. It would be helpful in explaining the areal variations accruing in the productivity of tea in the area.

Secondly, the question is closely related to the study of socio-economic characteristics of labourers and their families residing in the gardens and influencing

directly or indirectly the production processes of tea cultivation. The detail answer of this question and explanations of socio-economic characteristics of gardens labourers have been extended at two stages:

(a) The first stage explanation is forwarded by considering the parameter of the each and every gardener, which are related to:

(i) the tenurial system prevailing in the gardens

(ii) the productivity attributes,

(iii) the demographic features of the gardens, and

(iv) the social amenities available for the people of tea gardens.

(b) The second stage explanation of the problems as posed in the research questions is forwarded by adopting sample design of the gardens and the house-hold surveys of selected households. The following criteria have been adopted to choose the gardens

(i) Remotivity/accessibility of garden from road size

(ii) Size of the garden

(iii) Available infrastructure

The sample tea gardens five from each agro-ecological zones are selected by adopting above bases of garden selection. Further, 15 household from each sample garden are chose randomly considering household size and its socio-economic level, so as to include the variety of households to infer the results.

Further, the primary survey of these selected households was conducted by preparing the schedule/questionnaire. After collecting data, the tabulation was done by processing the raw data into required formats through computer.

As far as required data are concerned for the same procedure, the information required have been collected from the following sources:

1. the geographic information for delineation of agro-ecological zones of the study area have been generated from R. F. 1/1 million map of the Upper Brahmaputra valley. Drainage pattern, micro relief features and geomorphic conditions are interpreted from these maps.

2. District wise soil series data are collected from the Regional Office, Natural Bureau of Soil Survey and Landuse Planning, Jorhat. The soil profile properties of different soils of the tea gardens are analysed by 'Toklai Tea Research Institute'. The published materials available there have been used to highlight the soil and climatic conditions of the area.

3. The garden-wise survey was conducted during the fieldwork. With the help of B.A./B.Sc. students during the years 1997-98 and 1998-99, a garden-to-garden survey was conducted to collect the data of socio-economic and landuse parameters of the gardens.

4. The primary socio-economic survey of selected households also conducted to give more detail explanations of causes of low levels of productivity in the tea gardens.

Chapterization:

The content of the present study are organized into the following chapters:

Chapter I deals with introduction, performance of tea in state economy has been discussed. Since tea is both plantation-cum-industry, the role of tea to the agricultural and industrial development of Assam has been discussed considering data of 46 years (1953-54 to 1998-99), statement of the problem, objectives and research question.

In Chapter II, a review of relevant literature has been carried out.

Chapter III deals with the geographical and non-geographical factors influencing the production of tea.

Chapter IV includes the socio-economic characteristics of the tea gardens. It has been examined from five different angles like land productivity, labour productivity, garden size, density of population and family size.

Chapter V deals with production and productivity. In this chapter a comparative study has been made between land productivity and size of the garden and labour productivity and labour intensity to analyse the socio-economic conditions in the different agro-ecological conditions.

Chapter VI includes findings, suggestions and conclusion.

3.0: Findings:

After a detailed investigation of the production and productivity pattern against the backdrop of physical as well as socio-economic characteristics of tea gardens, the following facts have been derived:

3.1: Physiographic Attributes and Tea Production:

While examining agro-ecological conditions, more specifically, the impact of climatic elements, (temperature, rainfall, humidity, evaporation and sunshine) on the productivity of tea in the study area, the following facts have been derived as:

(i) The fluctuations of climatic factors over time shows that rainfall has the most fluctuating tendency (cv = 87.72%) in the valley followed by evaporation (cv = 34.60%) due to monsoon characteristics of climate. However, annual temperature does not vary much, ranging from 22.60°C (1985) to a maximum of 24.20°C (1994). Sunshine is fluctuating significantly. However, it has a great impact on yield.

(ii) The correlation matrix of these elements reveals that rainfall and evaporation, as the main elements of climate, are highly and positively corelated with temperature, while sunshine is negatively related with rainfall (r = – 0.5997). It indicates that, during the rainy season, the atmosphere becomes cloudier and, consequently, there is no sunshine. However, higher degree of radiation can be observed during the monsoon period. As a result, the gardens are having 'shadow trees'. The temperature ranging between 23°C and 25°C, rainfall between 200 and 250 mm with 5 to 6 hours of daily available sunshine, are the most suitable climatic conditions for the growth of tea in the valley.

(iii) The regression analysis of these climatic elements (considered as independent variables) with tea yield (dependent variable) shows interestingly that these five climatic elements have an overall effect of 20.11% to the total growth of tea production. Out of the total, the effect of temperature is calculated as 3.35% and that of evaporation is 11.09%. The analysis shows that evaporation is the most determining factor of tea yield rather than sunshine and relative humidity. Undoubtedly, evaporation is controlled by temperature and rainfall. Therefore, all the three elements of climate (Temperature, Rainfall and Evaporation) have a significant effect of 16.77% out of total 20.11%.

3.2: After examining the characteristics of soil of different agro-ecological zones of the study area and their relationship with the cultivation of tea, the following facts have been emerged:

(i) There are areal variations in the textural properties of the soils. For instance, the coarse sand is dominant in the flood plains ranging from its 80 to 92% in the aggregate size particles in the soils. It is followed by old alluvium ranging from 84 to 89% in the "Built-up" area of central parts and then the foothill areas where coarse sand varies from 63.5% to 73.1% in the soil aggregate composition.

(ii) It is noticed, that the aggregate size of top soil particles of below 1 mm diameter are dominant in the new alluvial soils of Flood Plain and in the adjacent areas of Central Plain of old alluvium. Bigger size of soil particles above 5 mm diameter are recorded very less in the soils of old alluvial and sub-montane Foot Hill soils. It is found that the particles of topsoil are moderate in its size (2-5 mm diameter) and account for about one-third soil particles in almost all type of soils in the study area. It shows that the infiltration

rate is lesser in the Flood Plain because of dominance of coarse sand (size of soil particles below 1.0 mm diameter) and higher in foothill zone of sub-montane where bigger soil particles constitute the composition of soil texture.

(iii) So far as the chemical properties of the soil are concerned, it reveals that the soil of the valley is highly acidic in nature, as the pH value ranges from 3 to 5. The highest pH value is recorded in the old alluvial, which is 4.7 followed by Foot Hill soil with 4.5. In the Flood Plain soil, it is 3.9. However, soils are rich in calcium and magnesium, especially in the Flood Plain and Central Plain areas due to lesser effect of leaching. The C/M ratio is normal in these plains with 15 and 13 respectively. The content of phosphorous penta-oxide (P_2O_5) is recorded high with the moderate quantity of potassium dioxide (K_20) in the soils of foothill areas. Presence of high organic carbon in the soil indicates suitability for tea cultivation. The Central Plain has a balance distribution of all the soil minerals. So it shows, that central part of the alluvial plain provides most suited soil for tea cultivation.

(iv) Land productivity is noticed very high (5394 kg/ha) in the fertile soil conditions of Central Plain where pH is recorded 4.7 with suitable organic carbon contents in the soil. The soil conditions of Flood Plain of new alluvium are also favourable for tea production. Hence, the land productivity is marked moderate (5033 kg/ha) in these areas.

3.3: The soil and climatic conditions of land are the major driving factors of tea production and level of productivity. The favourable land conditions prevail in the "Built-Up" areas of Central Plain with old alluvial deposits, where about 49.5% of the total gardens have been accounted for. The moderate conditions of land are prevailing in the

Flood Plain of new alluvial deposits, where 31.6% gardens are located. While the number of gardens are registered about 84 in number (i.e. 18.8%) only in the Foot Hill zone.

4.0: Socio-economic Characteristics:

In order to examine the socio-economic characteristics of gardens in the light of the selected parameters (namely garden size, land and labour productivity, population density and family size), the following facts have been drawn:

4.1: Considering farm size as determinant, it has been observed that:

(i) Population density is recorded higher (as 4-5 persons per ha) in the medium size gardens (400-800 ha) in all the agro-ecological zones.

(ii) The higher percentage of child labour, i.e. more than 3% to the total work force, is prevalent in the smaller-size gardens (200-400 ha) of the Foot Hill areas and medium to large- size (400-1000ha) gardens of the Flood Plain. It shows that the gardens of Flood Plain areas employ more percentage share of child labour. It is because of prevalence of illiteracy, poverty and high population pressure in the frequent flood areas.

(iii) Pressure on hospitals and schools are recorded very high in the large and very large size of tea gardens in all the agro-ecological zones. It shows that the social amenities are poor in larger gardens.

(iv) So far as economic characteristics of tea gardens are concerned, it is found, that land as well as labour productivity vary significantly in different agro-ecological zones. However, the levels of land as well as labour productivity are recorded very high (above 2000 kg/ha and even 2000 kg/person) in the small size of gardens (below 200 kg/ha)

generally in all types of agro-ecological conditions. The level of land and labour productivity diminish as garden size increases. This decrease is recorded faster at smaller size gardens and *vice-versa*. It reveals that heterogeneous natural conditions of the larger gardens negatively influence the land productivity, while the large amount of labourers and high population density in the larger gardens tend to decrease the labour productivity in all the agro-ecological zones of the Upper Brahmaputra valley.

4.2: Examining socio-economic characteristics in relation to land productivity, it has been noticed that the land productivity is influenced not only by the conditions of land, but also the size of the gardens where a variety of land conditions prevail. Larger-size gardens have heterogeneity of land conditions and the smaller-size gardens are more homogeneous in their natural conditions, and consequently, they do not have much diverse conditions of economics of production scales.

(i) The size-wise distribution of gardens shows that the highest concentration of small to very small size of gardens (below 400 ha) is noticed in the central plains, where agro-ecological conditions are characterized with alluvium soils. Most of the gardens have low levels of productivity (below 3000 kg/ha) in these areas. The relationship between garden size and land productivity is found negative ($r = -0.7376$) throughout the study period. The average productivity level is recorded very low (2153 kg/ha) in the Foot Hill zone.

(ii) A major share of total tea production is contributed by the low productivity of small size gardens, which are characterized as the gardens of high concentration of population which supplies unlimited labour including the child-labour to the production processes with poor social amenities and low wage rates to the labourers. Within each agro-

ecological zone, the 75 gardens out of total 84 (i.e., nearly 88.2%) fall under the category of low to very low levels of land productivity (0-4000 kg/ha) in Foot Hill zone, the 183 gardens out of 218 (i.e., 83.9%) in the same category of land productivity in Central Plains and the 115 gardens out of 139 (i.e., 82.7%) in the Flood Plains. Therefore, the concentration of gardens is towards low to very low levels of land productivity and the major amount of tea production comes from these categories of low productivity levels. It means that the economy of tea production has been resting upon the low level of productivity in the gardens.

4.3: Considering socio-economic characteristics with respect to labour productivity, it is observed that the labour intensity does not vary much in different agro-ecological zones. However, high pressure of population and available labour force diminish the level of labour productivity in the gardens. Tea cultivation being labour intensive still has traditional method of tea processing. Main findings of socio-economic characteristics of the gardens in the light of labour productivity are summarized below.

(i)An average labour productivity level is recorded 4516 kg/person in the tea gardens of the study area. It varies areally according to the variations in agro-ecological conditions of gardens. The Central Plains of old alluvial has the highest level of labour productivity (5815 kg/person of labour force) while the Flood Plain of new alluvial soil has the productivity level very close to its average (4522 kg/person). The lowest labour productivity is observed in the Foot Hill zone. The labour intensity in the Central Plain is recorded much lower. On account of low labour intensity and favourable physical conditions of land, the labour productivity appears to be higher in this zone.

(ii) There is a large concentration of gardens (i.e., 87%) towards the categories of low to very low labour productivity (3000 kg/person) where population density is much higher. There is an unlimited pressure of labour supply, which diminish the level of labour productivity in the gardens.

(iii) It is found that the higher percentage of child labour (upto 4.5%) is employed in tea practices in the low labour productivity gardens of the Foot Hill zone. The population density is also recorded very high (350 persons/sq km) in these gardens of Flood Plain areas. The higher the population density, greater is the supply of more labour force to the garden. On account of high population density in the gardens of Flood Plain, the population pressure is greater due to the supply of more labour to the tea cultivation at lower wage rate, even some times, the supply of child labor also.

(iv) Labour productivity is a negative function of labour intensity. Areas of low labour intensity, found along the main line of communication, have high levels of labour productivity. On the other hand, the remote areas, where the transport and communication facilities are poor, have low level of labour productivity with high labour intensity. In the gardens of Foot Hill zone, the labour productivity is recorded low. The labour productivity is relatively higher in Central Plain zone with a few gardens having high labour productivity.

(v) The quality of labour is one of the parameters, which has been correlated with labour productivity. Low labour productivity in the Foot Hill as well as Flood Plain zones are observed because there is a greater share of unskilled labourers which increases the labour intensity.

In the end, it is observed that tea production of the gardens is labour dominated, supplied by the heavily loaded demographic expansion with high population density and poor availability of poor social amenities. The concentration of labour force with its high population density and higher supply of child labour has been noticed in the gardens of low labour productivity. It shows that population pressure (i.e., indication of higher labour intensity) influences the socio-economic status of labour and declines the level of labour productivity in the Upper Brahmaputra Valley.

4.4: After observing socio-economic attributes in relation with the population density, the following findings have been drawn.

(i) Generally, more than a half of the numbers of gardens falls under the category of low population density (below 3 persons/ha) in almost all the agro-ecological zones. However, the population is more concentrated in the gardens of medium population density (4.00-8.00 persons/ha).

(ii) The family size and the population density are positively related to each other. It means, bigger the size (4 to 8 persons/family), higher is the population density with more share of child labour in the gardens of Upper Brahmaputra Valley.

4.5: More characteristic features in the context of family size are given below.

(i) The medium size families (4 to 6 persons/family) dominate in the gardens of Foot Hills and Central Plain zones. However, more than 80% gardens fall under the category of small family size (1 to 3 persons). It is a fact, that bigger families have higher percentage share of labour force. As family size increases, it increases more non-working population, especially child labour, as it is a primary stage of growth. It indicates, that the

gardens of larger family size have high population concentration with high density, of which most of them are non-working population. It establishes the fact that the labour size in the bigger families with higher share of child labour (1–3%) noticed in all the agro-ecological zones.

(ii) Social amenities, like sanitation and medical facilities, are not proportionate to the family size. For example, one toilet serves two families of 6 persons in the gardens of Central Plain areas. Similarly, one doctor serves more than 2000 persons in the Central Plain and even more than 2500 persons in the gardens of Flood Plain. It means that the facilities are very poor in these gardens.

5.0: While Examining the productivity pattern in various agro-ecological zones the following facts have been emerged.

(i) There is low to very low level of land productivity (below 5000 kg/ha) in all the agro-ecological zones. About 86% of the tea gardens fall under these categories of low land productivity.

(ii)The areas of high and very high land productivity (above 7500 kg/ha) are located along the National High Way, especially in the southern Central Plain zone.

(iii) The amount of tea production is not uniformly distributed in the various productivity categories of gardens in the different agro-ecological zones. About 64% of the total volume of production comes from very low land productivity (0-2500 kg/ha) categories of almost all the agro-ecological zones. The very high category of land productivity (above 10,000 kg/ha) contributes only 7.6% of the total volume of production.

5.1: The nature of bi-variate frequency distribution (Land productivity vs. Garden size) reveals that there is imbalance in the average frequency distribution of tea gardens in the different agro-ecological zones. The following facts have been observed from the distribution:

(i) The medium and large size gardens have low land productivity in all agro-ecological zones.

(ii) A few small size gardens come under high and very high level of land productivity.

5.2: Physical Conditions of Land and Tea Leaf Growth:

There is direct effect of soil and climatic conditions on the growth of tealeaf in the different agro-ecological zones. The experiment on the growth of tealeaf of Foot Hill zone and Central Plain shows the following results. In the Foot Hill zone, the average rainfall, during the experimental period, (20.6.2001-26.6.2001) was recorded 0.79 mm per day, where as it was 6.5 mm per day in the Central Plain zone. Such significant differences in rainfall have a great impact on the leaf growth of a particular zone.

As far as the soil conditions are concerned, the Foot Hill zone is very much subjected to leaching processes. The intensive leaching, which continues in humid conditions, wash away the chemical properties of the soil which directly affect the proper growth of the roots and, accordingly, the growth of leaf. On the other hand, the soils of Central Plain zone formed by older alluvium, are very much suitable for root development and likely to be rapid percolation. Consequently, it appears a better root and leaf growth of tea plants.

(i) The average length and perimeter of tealeaves are 4.11 cm and 9.74 cm respectively in the Foot Hill zone, which is comparatively smaller than the zone, namely Central Plain where the average length and perimeter is about 5.11 cm and 11.8 cm respectively.

(ii) There is slower growth of tealeaf in less rain as observed from the experiment. The leaf growth is 4.11 sq cm/day in the Foot Hill when rainfall is recorded only 0.79 cm/day. In Central Plain, where rainfall is recorded 6.5 mm/day, the growth was 7.98 sq cm/day. It shows a direct affect of rain on the tealeaf growth.

5.3: Ground Water and Productivity of Tea:

Though the upper part of the Brahmaputra Valley is characterized by congenial agro-ecological conditions for tea cultivation, the impact of ground water on productivity of tea appeared to be less influential as the roots of tea plants do not grow much below the soil surface.

5.4: Effects of Fertilizers and Machines:

Besides the physical and socio-economic factors, the technological factors also play an important role in the cultivation and production of tea. The following observations are made from the present study:

(i) There is a positive relationship between land productivity and use of fertilizers. The urea is used intensively in Flood Plain zone (340 kg/ha annually) rather than in Foot Hill (264 kg/ha), while MoP (Mauriate of Potash) and Rock Phosphates are used more in Central Plain zone (146 kg/ha and 142 kg/ha) respectively. As a result, the highest land productivity is found in this particular zone, which is about 2.20 thousand kg/ha.

(ii) The lower level of tea productivity in Flood Plain zone is attributed to seasonal floods

at the peak of manufacturing seasons. In the Foot Hill zone, it is due to high vulnerability to the attack of pests and weeds being surrounded by forests.

(iii) It is noted, that though the machineries and the fertilizers are more intensively used in Flood Plain zone as compared to the other two zones, the land productivity is low due to natural flood hazards.

In the end, it can be said that the distributional patterns of land productivity as well as labour productivity of the tea gardens are not only the function of physical factors of land alone, but also concentration of population density and unlimited supply of labour, which is also attributed to the productivity level. In all type of agro-ecological conditions, the small size gardens employ more labour force, including child labour. High concentrations of population with low literacy and medical facilities also have negative impact on the level of labour productivity in these gardens.