DOI : 10.18843/ijms/v5i2(2)/12
DOI URL :http://dx.doi.org/10.18843/ijms/v5i2(2)/12

Development of Productivity Measurement Model with Special Reference to Tea Production in Assam

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ABSTRACT

Assam is the largest tea producing state in India which occupied its unique position by producing more than fifty percent of national tea production . In the year 2015-16, Assam produces 653 Million kg of tea which is fifty three percent of national production. Tea Plantation area of Assam is about 3.22 Lakh hectares which is also more than half of the country's total area under tea. Tea industry extended largest support by generating highest employment opportunities in Assam by providing average daily employment to more than six lakh persons in the State, which is around fifty percent of the total average daily waged employee in the country. Assam teas are popular in the foreign countries due to their strong, brisk and full bodied liquor. The industry plays a vital role in the state economy by earning foreign currency as well as through direct and indirect taxes. The growth rate of production of tea in India in general and Assam in particular is not satisfactory in compare to the other tea producing countries like China, Sri Lanka, Keniya etc. Attention to be given for substantial growth of tea production of Tea Industry of Assam Assam which is the one of the major backbone of economy of the state as well the country. This paper aims to analyze the total productivity and partial productivity for tea production Assam. Data collected trough field survey were analyzed using MINITAB-18 statistical software to find the relationship amongst different variables.

Keywords: Tea Production, Total Productivity, Partial Productivity, Regression Analysis.

INTRODUCTION:

Tea industry of India is one of the oldest industries in India having more than 180 years old history. East India Company loses its legal monopoly of trade between China and British in the year 1832. As a result, the cultivation of tea was taken up to India in 1834. Presently, India produces 23 percent of world tea production and consumes around 21 percent of total world consumption which is around 80 percent of tea produced inside India. In the year 2015, India produced 1208 million kg of tea from total plantation area of 564 thousand hectare with an average yield of 2142 kg per hectare. India earned foreign exchange of Rs 4086 crores in the year 2015 by exporting 217.67 million kg of tea with an average price of Rs 187.7 per kg. In the same year, India imported 18.61million kg of tea having cost of Rs 236 crores with an average import price of Rs 127 per kg. Tea industry provides direct employment of 1.27 million workers mainly drawn from the backward and socially weaker section of the society out of which around 50 percent are women worker (second largest employer in the organized sector after Indian Railway). Tea is commercially cultivated in 16 states in India viz, Assam, West Bengal, Tamil Nadu, Kerala, Karnataka, Tripura, Uttarakhand, Himachal Pradesh, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Odisha and Bihar . Out of which Assam, West Bengal, Tamil Nadu and Kerala are accounted for more than 95% of the total tea production in India.

Assam occupied unique place in India by producing more than fifty percent of the national production having plantation area of about 3.22 Lakh Hectares which is more than half of the country's total area under tea. Assam teas are popular in the foreign countries which maintaining its international reputation and commands significant share in the World Tea Market due to their strong, brisk and full bodied liquor. Tea industry extended largest support by generating highest employment opportunities in Assam. It is the single largest industry in Assam that provides average daily employment to more than 6.86 lakhs persons in the State, which is around 50 percent of the total average daily waged employee in the country. This Industry also helps in providing indirect employment in different sectors like road construction, transportation, warehouses, manufacture of plywood, tea chest, paper, card board, aluminium foil, tinplate, metal fittings, fertilizers, insecticides, pesticides, iron, steel, coal, etc. The growth rate of production of tea in India in general and Assam in particular is not satisfactory in compare to the other tea producing countries like China, Sri Lanka, Keniya etc. India was occupied first position till 2005 in terms of world tea production, but China occupied first position in terms of production in the year 2006 forced India in second position. Since then India could recovered its position in the world tea market. Growth of production of tea in India is less comparatively other tea producing country which is an alarming factor for Indian economy. Productivity is the important area for the tea production. In the paper researchers attempted to develop the relationship among different productivity variables like total productivity and partial productivity on tea production of Assam.

OBJECTIVE OF THE STUDY:

a) To find total productivity and partial productivity for Tea production in Assam
b) To establish a relation between total productivity and partial productivity for tea production in Assam.

REVIEW OF LITERATURE:

Harlar (1956) has been elaborated through his writing regarding price and production. He described price realization and production of finished tea.

Goswami (1963) tried to analyse the relation between the selling price and the costs of production of manufactured tea. It is important for the tea manufacturer to understand their cost of production. He emphasized on the need for the systematic organization of the underdeveloped sectors of economy and for building up leadership in the various industrial sectors of economy.

Basu (1969) found low average yield in the plains of West Bengal and Assam and also found that, despite considerable improvements in agro-chemical techniques, the average yield is not going to increase at significant rate. They came to the conclusion that the plant age, tea plant uprooting, replanting soil, soil management, shade and drainage are the main factors for increasing the yield rate.

Biswas (1971) pointed out that proper rainfall distribution as well as the soil type and depth of soil should be examined as it affects the annual yield of tea and stresses the need of irrigation to optimise the yield.

Borbora (1971), using statistical methods in design and improvement, tried to explain that proper scientific drainage in tea is an important factor for sustained production. Satyanarayana (1971) also suggested as the water is not well distributed throughout the year and hence drainage can play important role by lowering the water level to prevent the injection.

Grice (1971) showed through his experiment between shade and cultivation of tea, how yield per hectare under of different degree of shade is effected by nitrogen, soil type and age of the tea. However in his study, he could not recognize the composite effect of several production factors and productivity of tea.

Chakravartee (1971) showed how the pattern of crop distribution obtains from unpruned tea and pruned tea affect the yield of tea. Author tried to relate the seasonal change in the direction of movement of photosynthates from the maintenance leaves of unpruned bushes. He suggested that pruning is important operations, which decides the productivity of tea . His study revealed that December and January are to be ideal months for pruning tea bushes in North-East India.

Biswas (1977) found that the field management factors play the important role to the yield rate of tea. He tried to find the field management and environmental factors from long term effects on yield of tea.

Ashby (1977) given a detailed description about the drying and processing of beans and leaves and about the by-products that can be developed in the process An introduction on tea, the history of tea and the main tea growing countries are explained by him. The details of planting, fostering, manufacturing, and pest control measures in tea cultivation are also explained in his book.

Borbora, Jain and Rahman (1981) found that with improvement in the cultural practices and management, the

young tea could be brought into bearing earlier than before and more crop could be harvested.
George (1982) pointed out that the domestic consumption has been increasing at an average annual growth of 5 per cent while the production has been increasing at a rate of 3.5 per cent per annum. Due to lack of development activities in tea plantations most of them became unproductive.
Radhakrishnan (1997) observed that there is scope for developing tea plantations in Wayanadu District of Kerala The average yield of Wayanadu in 1997 was 2300 kg./hectare. Recurring draught is one of the major factors affecting productivity here. Radhakrishnan suggested that replantation, rejuvanation, pruning, infilling and shading with trees are options before planters for improving productivity. The organic content of soil may be enriched by burial of prunings. By introducing these aspects, the author argues that, the yield level of tea in die district can be increased by 25 per cent to 30 per cent.
Muraleedharan (1998) gives a description about the innovations in this aspect by UPASI. They have developed two types of staffing (pruning) machines and two models of plucking machines. But die machines have some drawbacks such as high weight, over heating, noise and problems related to technical services and spare parts.
Hudson (1998) studies on harvesting which is an important aspect in tea plantation industry. He found that plucking of leaves accounts for about 60 per cent of the field cost and 20 per cent of the production cost Plucking interval is a determining factor in plucking. During peak season shear harvesting can be adopted. Alternate row lane plucking in mature fields will increase plucking average. Pruned bush height of 40 inch is suitable in tea culture.
Mitra (1987) showed the variation in productivity of tea in different size of the gardens. But he has not mentioned his clear view regarding the variation from large size to small size of garden.
Daimari (2003) studied on productivity of tea gardens in Upper Brahmaputra Valley. He studied land and laour productivity where he found that labour productivity is a negative function of labour intensity. High levels of labour productivity in the areas of low labour intensity. He found that 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.
He observed that the distributional patterns of land productivity and 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. The small size gardens employ more number of labour including child labour. High concentrations of population with low literacy and medical facilities have negative impact on labour productivity
Gupta and Dey (2010) in their article 'Development of a Productivity Measurement Model for Tea Industry' attempted to propose a relatively simple productivity measurement model for tea industry. A case study conducted in a tea garden of Assam to explore the performance of the model is offered. The model satisfies the six criteria of measurement theory such as validity, comparability, completeness, timeliness, inclusiveness and cost-effectiveness.
Anil (2013) observed that India occupies the last position among the major tea producing countries regarding yield per hectare apart from exceptional geo-agro-climate situation has created unique conditions that are very suitable for growing a super fine quality of tea. The average tea yield among the major tea producing countries is 2235 Kg/ha, where as it is 1693 Kg/ha in India. Future prospect of the tea plantations may jeopardize due to various constrains and weakness if due attention and appropriate measures are not taken in time.
Nath and Dutta (2015) studied on various factors affecting cost of black tea production. They observed that labor and material productivity has the major influence on total productivity. Energy and welfare also take major role among the factors of tea production. The cost of labor and material can be reduced or controlled to some extent. They suggested that welfare cost can be considered as social cost.

METHODOLOGY:

The study is based on primary data collected through structured questionnaires, personal interviews, field visits. The secondary data gathered from related literature published in the journals, newspaper, books, statements, reports. The nature of study is primarily quantitative, descriptive and analytical.

Productivity:

Productivity is defined by different authors in different ways by considering types of product and nature of production units.
i) Martinich (1997) defined productivity as the amount of output produced devided by the amount of input used.

The greater the amount of output from a fixed quantity of inputs, higher the productivity. Similarly smaller the quantity of input required to produced a fixed amount of outputs, the higher the productivity.
ii) According to Bedi (2008), productivity is defined as the ratio of output produced to the input used in its production. Following mathematical expressions on productivity given by him:
Productivity = output ÷ Input
Productivity = number of unit produced ÷ man-hour used
Productivity = number of unit produced ÷ capital employed
Productivity = number of unit produced ÷ machine -hour used
According to him, if inputs are of different resources for example, labour, material, power etc in productivity calculations, a common unit of these inputs has to be considered.
Productivity = number of unit produced ÷ (cost of labour + cost of material + cost of power)

iii)According to Chery (2013), productivity is known as the ratio between the output and input. Mathematical expression given by Chery is as follows:
Productivity = amount of output ÷ amount of input.
Multifactor productivity = Production at standard price ÷ (labour + material + overhead + capital) price
Labour Productivity = Worker output expressed in rupees ÷ worker salaries and wages in rupees.
Material Productivity = Production output in rupees ÷ (raw material + packaging material + supplies) in rupees
Capital Productivity = Total sales in rupees ÷ depreciation in capital assets in rupees

Productivity Analysis Models:
Following are some well known productivity model defined by different authors:
Kendrick Creamer Model:
Kendrick Creamer published their productivity model in the book titled "Measuring Company Productivity" in 1955. Their indices are basically two types namely total productivity and partial productivity. Their model is suitable for company level but not suitable for industry level as it is not covered inputs like energy, business services etc.
Criag-Harris Model:
Craig and Harris (1972-75) using the index approach at the company level, they define total productivity measure. This method is suitable for computation of productivity at firm level, service sector and yields physical productivity. But it is not suitable for tea industry because it does not take into account all inputs relevant to tea industry.
American Productivity Centre Model:
American Productivity Centre has shown that productivity relates profitability and price factor. The model is suitable for accounting productivity at business level and easy to compute productivity with managerial data like profitability and price recovery factor. But it is not suitable for tea industry because it does not considered physical quantity of finished product produced which may not be properly represented by profitability.
Productivity Accounting Model:
H. S. Davis introduced the Productivity Accounting Model which takes into account of all possible outputs and inputs used, keeping aside external factors such as price rise etc. This model is one of the best models which fulfills almost all the requirements of accounting for productivity. It takes care of all types of inputs in terms of monetary equivalent and outputs also and keeps out external factors such as price rise etc.
Productivity Model for a Tea Industry:
This model has been published by R. Gupta and S.K. Dey
This model is shown as Pt =Qt / (L+C+R+E+S+Q). In this modified model all values relating to outputs and inputs are in monetary equivalent deflated to a base year using a suitable price Index or an average inflation rate so as to take care of quality.
The productivity accounting model has been used in this study as it It takes care of all types of inputs in terms of monetary equivalent and outputs also and keeps out external factors such as price rise etc.

Data Collection Instruments:
Questionnaire: Structured questionnaires in tabular format handed over to the officials of the tea estates. Filled up questionnaires was collected after some days with due communication to the officials over mail and phone call.
(ii) **Sampling Procedure:**

Type : Descriptive
Universe of the study: Exhaustive list of Tea Estate of Assam registered with Tea Board of India having size more than 10.12 hectare is the universe for this study. The total number of large tea estates (having size more than 10.12 Hactare) in Assam registered with Tea Board of India as on 08-09-2010 is 643. Hence universe is 643.
Sample Size: 5% of sampled Tea estates were selected through purposive sampling method. Hence sampled tea estates are 32.
Statistical Tool used: Tabular data were analysed using MINITAB-18 statistical software .

DATA ANALYSIS AND FINDINGS:

This modified model proposed by the researcher using Productivity Accounting Model where all major inputs which affect the cost of tea production has been taken in to cosideration is as follows:

Total Produtivity (T) = $Q_t/(L_i + E_i + M_i + C_i + W_i + S_i + Q_i)$

Where,
Qt = Total Monetary value of output,
L_i = Worker input, E_i =Energy input, M_i = Material input, C_i = Capital input, W_i = Welfare input,
S_i = Subsidized ration input, Q_i = Miscellaneous input. All the inputs are in monetary value.
Details description of the various input are as follows:
a)Worker input (L_i): It includes salary of executive staff, salary of office staff, salary of permanent workers, salary of temporary workers, bonus , contribution toward PF, leave encashment, overtime wages, incentives, extra duty allowance.
b) Energy input (E_i): It includes electricity cost, furnace oil cost, diesel cost, coal cost, crude oil cost, cost of natural gas, cost of fuel etc.
c)Material input (M_i): It include cost of purchased green leaf, cost of pesticides, cost of insecticides, cost of packaging materials, cost of irrigation materials, cost of fertilizers, cost of weedicides, cost of nursery materials etc.
d) Capital input (C_i): This input includes cost of land, buildings, machineries, vehicles, factory, tools & equipments, insurance, bank interest, depreciation on assets etc.
e) Welfare input (W_i) : welfare cost of worker include cost of education, health, crèech, safety, entertainment, maternity benefit etc.
f) Subsidized ration input (S_i): It includes the cost subsidized ration issued to the worker and staff.
g) Miscellaneous input (Q_i) : It includes expenditure like repairing, head office expense, consultancy, audit, social overheads, telephone bills, mobile bills, internet bills, transportation charges, taxes, legal cost, guest expenditure, promotional activities etc.
Mathematical equations for Partial Productivities L, E, M, C, W, S, Q can be given by:
Worker Produtivity (L) = Q_t/ L_i Energy Produtivity (E) = Q_t/E_i
Metarial Produtivity (M) = Q_t/ M_i Capital Produtivity (C) = Q_t/C_i
Welfare Produtivity (W) = Q_t/ W_i Subsidised ration Produtivity (S) = Q_t/ S_i
Miscelleneous Produtivity (Q) = Q_t/Q_i
Data collected from the different sampled tea estates are regressed using regression software MINITAB-18 to see the correlation amongst the total productivity and partial productivity and also to established relation between total productivity and partial productivity.

Regression Analysis: T versus L, E, M, C, W, S, Q

Table 1: Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	7	0.267037	0.038148	176.36	0.000
L	1	0.017441	0.017441	80.63	0.000
E	1	0.006321	0.006321	29.22	0.000

Source	DF	Adj SS	Adj MS	F-Value	P-Value
M	1	0.005048	0.005048	23.33	0.001
C	1	0.013710	0.013710	63.38	0.000
W	1	0.002795	0.002795	12.92	0.005
S	1	0.002776	0.002776	12.83	0.005
Q	1	0.006797	0.006797	31.42	0.000
Error	10	0.002163	0.000216		
Total	17	0.269200			

Table 2: Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.0147076	99.20%	98.63%	96.18%

Table 3: Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	0.0132	0.0525	0.25	0.806	
L	0.1238	0.0138	8.98	0.000	1.71
E	0.03028	0.00560	5.41	0.000	3.20
M	0.01575	0.00326	4.83	0.001	2.12
C	0.01107	0.00139	7.96	0.000	3.14
W	1.877	0.522	3.59	0.005	1039533.09
S	-3.97	1.11	-3.58	0.005	1039811.64
Q	0.005328	0.000950	5.61	0.000	3.02

Inference: Result of ANOVA test for all variables shown in Table 1. The table implied that the worker productivity L (p=.000 < .01) is statistically significant related to the total productivity of tea. The energy productivity E(p=.000<.01) is showing statistically significant to the total productivity (T). The p value of material productivity (M) p=.001 is less than .01 implied that the it is statistically significant with the total productivity (T). Capital productivity C is also statistically significant with the total productivity as the p value .000 is less than .01. Welfare productivity (W) is also statistically significant to the total productivity (T) as the p value (p=.005) is less than .01.Similar pattern shows by the subsidized ration productivity (S) with the total productivity (T) as the p=.005 is less than .01. The table also revealed that the miscellaneous productivity Q (p=.000 < .01) is statistically significant related to the total productivity of tea.

Table 2 shows the pearson correlation R^2 = 99.2% . It implied a strong correlations amongst all these seven variables L, E, M,C,W,S,Q with T. It is shown that 99.2% of the weightage of T governed by these seven variables.

The co-efficient for regression model is given in the table 3. It is seen that variables L, E, M, C,W, Q are positively correlated with the total productivity T. While the variable "S" is negatively correlated with the total productivity T. The regression equation thus obtained for the analysis is as follows:

The total productivity and partial productivity is related through the regression equation

$$T = 0.0132 + 0.1238\ L + 0.03028\ E + 0.01575\ M + 0.01107\ C + 1.877\ W - 3.97\ S + 0.005328\ Q$$

CONCLUSION:

The study established a relation between the total productivity and the partial productivity for tea production in Assam. The regression equation and the productivity analysis shows that welfare productivity has the highest co-efficient followed by worker productivity and then followed by energy productivity. Hence the welfare productivity, worker productivity and energy productivity has major influence in the total productivity of tea production Assam. Subsidized ration has a negative influence in the total productivity which is to be reduced.

Material productivity, capital productivity and miscellaneous productivity has less influence in the total productivity. To increase the total productivity, input cost involve in worker is to be reduced. Welfare cost and energy cost are also to be reduced to increase the total productivity. Worker productivity can be reduced by using automated machine in plantation and processing of green leaf. Most of the workers are involved in plucking of green leaf. The cost of the same can be minimized by using mechanical plucking machine, which will increase the quality of plucked green leaf and will minimize worker cost.

RECOMMENDATIONS:

Following recommendations are extended based on the study :

a)Increase in Production:

Total productivity of is directly proportional to the total price realization of finished product. Hence to increase in total productivity of tea for tea production in Assam, total annual tea production is to be increases. Age of the most of the tea bushes in Assam are more than 50 years and hence annual yield per hactre of tea production of such bushes are less. Such old tea plant area should be re -planted with new tea plants with modern plantation technology to increase in growth of production per hectare. Genetically modified variety of tea should be planted to get good flavor and optimum production.

b) Use of Modern Technology:

Tea estate should use latest automated machineries for plantation and plucking. Most of the tea estates in Assam are suffering from the shortage of worker, which directly impact on the total production of tea in Assam. Some of the tea estates are even could not manage the minimum duration of plucking due to shortage of worker. It affects the productivity of tea as well as quality of tea production in Assam. Use of automated machines can minimize worker cost and it will increase annual production. Also most of the tea manufacturing factories are with very old machinery. These factories should be automated and quality of the tea to be monitored in each and every instant during manufacturing of tea. The quality of tea can be standardized by proper monitoring and adjusting different parameters during manufacturing time using advance software.

c) Invention of Machineries:

Government should grant more research fund for inventing modern machineries considering the hilly geographical location of Assam. Most of the workers in tea productions are involve in the tea plantation and green leaf plucking. Authorities should give more attention to develop such machineries in context to the geographical location of Assam which are useful in tea plantation like pruning, irrigation, spraying, plucking etc.

d)Lowering input Cost:

For survival of tea industry and for optimum surplus, unit cost of production is to be lowered. Due to inflation and domestic price rise, wages of employees in tea industry is to be hiked. Hence alternate measure to be taken to reduce other input cost and with optimum utilization of gardens resource. Big tea estates can use their space for production of electricity by using solar energy/ wind energy which will decrease energy input cost of production. Organic farming is another key suggestion to decrease material input cost of production.

e) Proper Marketing:

It has been observed that tea growers are interested to just sell tea to the bulk purchaser who is readily available even by compromising price. No one want to go for regarding promotion of own manufactured tea by proper marketing. To survive tea industry in future, the grass root level producer are to be market their tea product properly to reach directly to consumer. Producer should directly reach to the consumer by using appropriate marketing tools like advertisement, participating to expo, government and Pvt. Sponsor events, campaigning etc. Marketers play a major role in the value chain of the tea industry. They include packeters/blenders from national brand companies.

f) Appropriate Pricing:

It is seen that the fall prices of Assam tea is only for bulk selling while retail price of tea in the market is quite satisfactory. It implies that the tea producers are not getting the proper price benefit though demand of the same tea in market is high. High quality and high flavoured of Assam tea sell by using other brand in retail market and hence Assam tea losing dignity. Fall of price for bulk sell can be prevented if tea growers sell with own branding and packaging as Assam brand has high demand.

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