An Analytical Study on Influencing Factors of Tea Production in Assam

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Abstract: India was the largest tea producing country in the world till 2006. But due to steady growth of production of China at a rate of 8.8 percent per year since 2001, India's position has been pushed to 2nd place in 2006 . The growth of production as well as export of tea has shown a disappointing trend with respect to other leading tea producing countries namely China in the recent years. India produces 945.97 million kgs in 2005 having contribution 27.36 percent of world production share in that year 2005 and was leading tea producing country in the World. After slipping the position to second in the year 2006, the production increases to 1208 million kg in the year 2015 with 23 percent share of world tea production and still remain in the 2nd position. Now China is the leading producer and Kenya is the leading exporting country in the world. Since Assam alone produces more than 52 percent of the national production, it is required to increase its production and productivity level to regain India's global position. The tea produce in Assam are among the finest across the globe. The climate of the region helps in producing tasty tea. In this context, a details analytical study of factors affecting tea production in Assam has been undertaken. Data collected from the field was analysed by SPSS software. Factor analysis was carried out to get the reduced number of variables which affect tea production in Assam.

Key Words: Tea Production, Productivity, SPSS, Factor Analysis.

I. Introduction

Tea industry of India is one of the oldest industries in India having 180 years old history. The East India Company after losing its monopoly in China in 1832 has taken up cultivation of Tea in India (Assam) in 1834. The credit for creating India's vast tea empire goes to the British, who discovered tea in India. The first commercial batch of Tea ever produced outside of China came from Assam in 1839. The first tea garden in India was opened by British at Lakhimpur district of Assam in 1835 . The first commercial batch of tea ever produced in Assam arrived at England in 1838. Subsequently tea gardens were opened for cultivation of tea plants in the different districts of Assam. These gardens were managed under different companies. The oldest tea company in India "The Assam Company" was accordingly formed in England in 1839 with a capital of Rs. 5 lakh . Still this company is in operation and managing several tea gardens. Since then, tea continues to be the most popular drink in India. From official conferences to railway station, tea (chai) remains the favorite hot beverage among Indians (almost 85% of the total households in the country consume about 81% of the total tea produced.

This sector is crucial to Indian economy. The Tea Industry is one of the oldest organized firm sectors with a large network of tea producers, retailers, distributors, auctioneers, exporters and employees. India is one of the world's largest producer and consumer of tea, which accounts for 27 percent of the world production and around 12percent of the world tea export. Tea export from India,

estimated at Rs 17.31 billion during financial year 2006, accounting for 0.4 percent of country's export in value terms, ranks as the fourth-largest agro export item from India. The industry employs around 1.27 million people at the plantation work and that of 2 million indirectly of which 50 percent are women workers (second largest employer in the organized sector after Indian Railway). In India, there are about 1700 processing units engaged in tea production; while around 1686 big (more than 100 hectares) planters with an output of 1200 Mkg. Besides, as an agro-based industry, the development of plantation industry has contributed greatly towards rural development and urbanization of remote hilly areas by optimum use of land, opening up road and other communication network in those areas.

Tea is commercially cultivated in 16 states of 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. About 78% of the country's total area under plantation is located in North East India. The tea originating from Darjeeling , Assam and Nilgiris are well known for their distinctive quality worldwide. The tea production in India includes small and big growers. Small tea growers are economically and socially susceptible in India as they are mostly marginal farmers. In India, tea production was first started in Assam in the year 1835. Since then, tea has been cultivating in the most of the parts of Assam and turned as single largest industry in terms of employment. Assam occupied unique place in India by producing 52 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.

Table:1. Tea at a glance: as on the year 2015

Sl No.	Description	Remarks
01	Tea Production in world	5304MKg
02	Tea Consumption by tea producing countries itself	4999Mkg
03	Tea export in world	1801Mkg
04	Highest tea producing country	China (2278 Mkg)
05	Highest tea exporter country	Kenya (450 Mkg)
06	Tea Production in India	1207 Mkg
	Tea Consumption in India	948Mkg
07	Tea Export from India	234Mkg
08	No. of tea producing states in India	16
09	No. of big tea estates in India (size more than 10.12 Ha)	1686
10	No. of Small Tea Growers in India (size less than 10.12 Ha)	157504
11	Highest tea producing state in India	Assam
12	Tea Production in Assam	653Mkg
13	No. of big Tea Estates in Assam	761
14	No. of Small Tea Growers in Assam	83880

Source: ITC report 2016 and Tea Board of India report 2016

II. Objective of the Study:

a) To find the present scenario of tea production in Assam in context to national scenario.

b) To find factors affecting tea production in Assam.

III. Review of Literature:

Mann (1907) and Harison (1965) were of the opinion that, for the growth of tea plant, the climatic conditions as to air, moisture and temperature within the soil climate, are very essential. Apart from ideal climate, the proper drainage, very deep cultivation, deep

trenching, green cropping and mulching etc. are important at the beginning of a tea plant Which allow the roots to develop in a healthy and vigorous manner for raising of crop productivity.

Basu and Sharma (1969) observed the low average yield in the plains of West Bengal, North bank, South bank and Cachar districts and find that, despite considerable improvements in agro-chemical techniques, the average yield is not going to increase at significant rate. Thus, it declines during the last two decades. With a view to finding out the possible reasons for low yields as well as its downward tendency, once the tea plant attains the age of 25 years it stabilizes its yield. They come to the conclusion that the plant age and kind of tea plant uprooting and replanting soil and soil management, infilling and management, shade and drainage are the main factors for increasing the yield rate.

Grice (1971), made an experiment between the shade and the cultivation of tea and showed how per hectare yield under different degree of shade is affected by nitrogen, soil type and age oftree. The physical factors of tea gardens are equally important which vary yield pattern. In this connection, there are numerous studies.

Chakravartee (1971) tried to show how the pattern of crop distribution obtains from unpruned tea and pruned tea affect the yield of tea. They tried to relate the seasonal change in the direction of movement of photosynthesis from the maintenance leaves of unpruned bushes and suggested that pruning is important operations, which decides the productivity of tea bushes. The following inferences can be drawn from their studies: (a) the October is the earliest possible month to commence resting of tea bushes prior to pruning. (b) the resting earlier than October does not help in building up starch reserve in the roots as the photosynthesis from the maintenance leaf canopy are still moving upward. (c) Considering all these factors, December and January are to be ideal months for pruning tea bushes in North-East India.

Biswas (1981) tried to study all these factors on experimental basis, which are based on 16 to 18 years of data of monthly yield, rainfall and related data, which were collected from the tea estates of N.E. India.

Biswas and Chakravarti (1992) opined that balanced fertilizer use for tea is an important measure for increasing productivity. While studying the Nitrogen-Phosphate-Potassium (NPK) manuring in mature tea, using yield-fertilizer relationship, they found that annual application of balanced dose of NPK is needed to maximize the productivity level. For sustaining a yield of about 23 q/ha in different regions, generally a dose of nitrogen in the range of 100-140 kg/ha, phosphate between 20-50 kg/ha and potash between 80-140 kg/ha would be required.

Sinha, *et. al.* (1992) found that application of elemental sulphur 20-40 kg/h increased significantly during three years of experimentation in tea estates in N. E. India. They suggested that sulphur should be introduced as a routine fertilizer input particularly in cases where SOA (ammonium sulphate) is not applied.

Borbora, Baruah and Kar (1994) emphasizes on mechanical plucking to maintain the plucking round during peak cropping season, which coincides with higher absenteeism of pluckers, to check the plucking cost and to provide an mechanical aid for increasing plucker's productivity, to harvest the increased production economically and, thereby, maintain the profitability of tea industry in long run. Maximum gain in quality of tea can be observed with an increasing proportion of "two-and-a-bud" shoots in harvest during fast growing period and fast fermenting clone. However, equal proportions of both 'three-and-a-bud' and 'two-and-a-bud shoots' yield during the early and mid seasons and in the medium or low fermenting clones. During the late season, maximum gain in yield with minimum reduction in quality can be obtained in increasing the proportion of "three-and-a-bud" shoots in harvest.

Chakravartee, Biswas and Bordoloi (1994) observed the adverse effect of unscientific pruning was observed when they attempted to evaluate the effects of pruning cycle of different lengths, both in plains and hills. They came to conclusion that for sustaining both crop and quality of tea, repeated adoption of pruning cycles of 3-4 years length may not sustain high productivity without due care to

age, vigour and bush frame and 3 years cycle help sustaining productivity better than 4 years cycle. Plucking standard has a direct bearing on yield and quality of tea.

Barman (1994) try to explain how density of shade influences and physiology in the metabolic processes for higher yield in the studies entitled 'Influence of Shade on Physical Parameters in Tea'. They come to the conclusion that shade reduces the leaf temperature from full sun - 30% - 50% - 70% shade by *1* °C in each case and the higher reduction of leaf temperature was found with 70% shade. They also observe that shade influences the plants to retain more water for higher turbidity of cells and the water potential is higher in shaded than unshaded conditions. However, these studies do not cover all the aspects of ecological factors, which are more responsible for the higher productivity and yield. As it is seen, climate has been changing and most of the areas taken for the present study area suffer from flood during rainy season. In the present section of review, it may be said that most of the studies are area specific and based on some particular parameters of physical factors of land, which may not be applicable to all the areas, which results in negligence of integrated approach. After reviewing the concerned literature on ecological and physiographical factors of tea cultivation in Assam, it may be concluded that the underground water, terrain conditions and climatic factors especially rainfall and temperature are major factors which influence the production and productivity of tea. The proper drainage and tree shades are the common activities in the tea-farms to stabilize the effects of such physical factors and to regulate the growth of tea plants.

V. Research Methodology:

Research Approach:

The study is explorative, descriptive, and analytical and survey based in nature. The study based both primary and secondary data.

Data Collection: Both primary and secondary data have been collected for the purpose of the study. Primary data was collected through structured questionnaire. To get personal views and in depth details, interview with managers of sample tea estates have been done. Secondary data was collected from related literature published in books, journals, reports, statesman, bulletins, tea statistics and the reports of respective sample tea estates.

Sampling Procedure:

a) **Universe of the study:** Exhaustive list of Tea Estates/Gardens of Assam registered with Tea Board of India having a size of more than 10.12 hectare taken as the universe of the study. The total number of tea estates as per aforesaid criteria i.e. plantation size above 10.12 hectare in Assam registered with Tea Board of India is 761. Hence the universe for this study is 761(GOA; 2015).

b) **Sampling Method:**

Universe for this study is spread in different geographical location of Assam. Most of the tea estates are located in the far flanged area. Considering these facts, researcher used judgment sampling method for the study.

c) Sample Size:

i) 10% of sampled Tea estates selected through judgment sampling method to meet the objectives of the study. Hence, total sample size is 76. Two respondents taken from each sampled tea estates namely one as General Manager/Manager/ Asst. Manager/Deputy Manager wherever is applicable and another as factory manager. Hence, total size of respondents is 152 (76 tea estates X 2). Data collected through structured questionnaires in five point Likert scale indicated most important to not important indicating the intensity of the variables.

Data Analysis:

Statistical tools like (i)Linear Growth Rate Analysis (ii)Trend Analysis (iii) Correlation Analysis (iv) Factor Analysis and statistical software SPSS were used by the researcher.

VI. Data Analysis and Findings:

A. Present scenario of tea production in Assam:

An attempt is made to examine the present scenario of tea production in Assam in context to nation. It is initiated with estimation of index numbers of tea production of Assam and national tea production using these indices an attempt is made to find the pattern of growth.

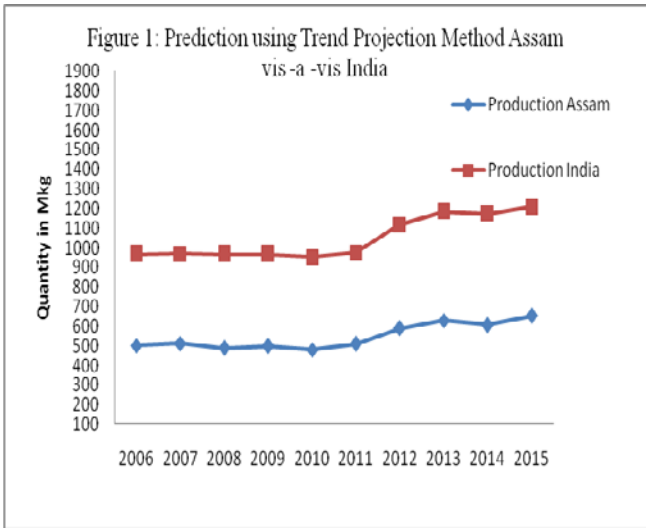
Table: 4. Index numbers of Tea Production of Assam and India

(Base year 2006=100)

Year	Assam	India
2006	100	100
2007	102	100
2008	97	100
2009	99	100
2010	96	98
2011	101	101
2012	117	115
2013	125	122
2014	121	121
2015	130	125

Source: Computed from Tea board of India Reports

Figure 1. Production of Assam vis –a- vis India



The figure 1 shows the prediction using trend projection model of tea production of Assam vis – a vis Tea production in India. A constat flat curve observed for both Assam as well as India during the period 2006 to 2011. In the year 2012, tea production of assam increases with respect to the previus year 2011and hence the curve gone toward upward direction. Same pattern also observed for the production curve of India in the year 2012. In the year 2013, the curve of Assam gone upward further indicating incraese in tea production in compare to the preveious year 2012. Here also similar patter shown by the curve of India with an incraesing trend with respect to the corresponding previous year. In the year 2014, tea production of Assam decreases as indicated by the slop of the curve and same slope reflected in the tea production of India for the 2014. The tea production of Assam again incraeses in the year 2015 as

reflected from the slop of the curve, in the same year tea production of India also incraeses. Thus it is observed that the trend of tea production of India is completely influenced by the tea production in Assam.

Table: 5. Growth Rate Analysis:

Production (in Mkg)	Year		Percentage of Growth
	2006	2015	
Assam	502.04	652.95	30%
India	967.71	1207.23	24.75%

Source: Calculated by the researcher from Tea Board of India report.

Growth of tea production in Assam and India during the period 2006-2015 were calculated by using simple percentage. It is observed from the analysis that the growth rate of Assam is 30% and that of India is 24.75%. The growth rate of Assam is higher is due to increase in number Small Tea Growers in Assam during the period.

Correlation Analysis using SPSS software:

Table. 6: Correlation table of Tea production in Assam and Tea Production in India

		Production of Tea in Assam	Production of Tea in India
Production of Tea in Assam	Pearson Correlation	1	.990**
	Sig. (2-tailed)		.000
	N	10	10
Production of Tea in India	Pearson Correlation	.990**	1
	Sig. (2-tailed)	.000	
	N	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation Table 6 shows that there is a strong positive Pearson correlation (R=.990) between production of tea in Assam and production of tea in India. The ANOVA test shows that the production of tea in Assam (p=.000 < .01) is statistically significant in relation to production of tea in Assam. A simple regression was fitted and the equation thus obtained is as follows:

Production of tea in India = 152.009 + 1.639 production in Assam

B. Factors affecting tea production in Assam:

The researcher identified the factors affecting tea production in Assam on the basis of established literature. A tabular form structured questioner in English language prepared with twenty seven identified variables to collect field data from respondents of the sampled tea estates. Five point Likert scale indicated most important (score =4) to not important (score =0) used to find the strength of the variables. Data collected from 76 tea estates of different district of Assam; taking one respondent as tea General Manager/Manager/ Asst. Manager and another from Factory Manager with total 152 respondents. Data have been compiled in the excel sheet and then transfer to SPSS software for analysis. The factor analysis carried out by SPSS software and factors were extracted by principal component analysis method.

Table: 7. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.600

Bartlett's Test of Sphericity	Approx. Chi-Square	1.941E3
	df	351
	Sig.	.000

Table: 8. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.670	13.593	13.593	3.670	13.593	13.593	3.545	13.130	13.130
2	2.707	10.026	23.619	2.707	10.026	23.619	2.142	7.932	21.062
3	2.174	8.053	31.672	2.174	8.053	31.672	2.073	7.677	28.739
4	1.851	6.857	38.529	1.851	6.857	38.529	1.959	7.257	35.996
5	1.664	6.161	44.690	1.664	6.161	44.690	1.587	5.878	41.874
6	1.584	5.866	50.556	1.584	5.866	50.556	1.530	5.668	47.542
7	1.346	4.983	55.540	1.346	4.983	55.540	1.514	5.609	53.151
8	1.185	4.388	59.928	1.185	4.388	59.928	1.353	5.013	58.164
9	1.150	4.259	64.187	1.150	4.259	64.187	1.316	4.875	63.039
10	1.083	4.010	68.197	1.083	4.010	68.197	1.240	4.593	67.632
11	1.037	3.842	72.039	1.037	3.842	72.039	1.190	4.407	72.039
12	.952	3.525	75.564						
13	.858	3.178	78.742						
14	.814	3.014	81.756						
15	.741	2.744	84.500						
16	.695	2.576	87.076						
17	.668	2.475	89.551						
18	.625	2.315	91.867						
19	.585	2.165	94.032						
20	.513	1.899	95.931						
21	.379	1.404	97.335						
22	.281	1.041	98.376						
23	.157	.581	98.957						
24	.121	.449	99.406						
25	.097	.359	99.765						
26	.052	.194	99.959						

Table: 8. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.670	13.593	13.593	3.670	13.593	13.593	3.545	13.130	13.130
2	2.707	10.026	23.619	2.707	10.026	23.619	2.142	7.932	21.062
3	2.174	8.053	31.672	2.174	8.053	31.672	2.073	7.677	28.739
4	1.851	6.857	38.529	1.851	6.857	38.529	1.959	7.257	35.996
5	1.664	6.161	44.690	1.664	6.161	44.690	1.587	5.878	41.874
6	1.584	5.866	50.556	1.584	5.866	50.556	1.530	5.668	47.542
7	1.346	4.983	55.540	1.346	4.983	55.540	1.514	5.609	53.151
8	1.185	4.388	59.928	1.185	4.388	59.928	1.353	5.013	58.164
9	1.150	4.259	64.187	1.150	4.259	64.187	1.316	4.875	63.039
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22	.281	1.041	98.376						
23	.157	.581	98.957						
24	.121	.449	99.406						
25	.097	.359	99.765						
26	.052	.194	99.959						
27	.011	.041	100.000						

Extraction Method: Principal Component Analysis.

Table: 9. Rotated Component Matrix[a]

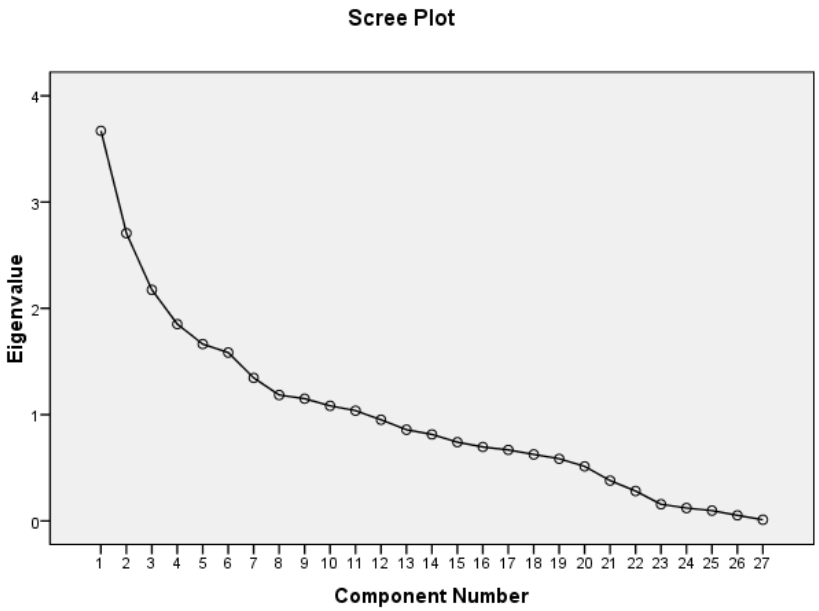
	Component

	1	2	3	4	5	6	7	8	9	10	11
VAR19	.965										
VAR21	.936										
VAR22	.888										
VAR20	.852										
VAR14		.941									
VAR16		.936									
VAR17		.933									
VAR15		.926									
VAR4			.967								
VAR5			.966								
VAR7				.945							
VAR8					-.825						
VAR6					.655						
VAR2						.762					
VAR3						.680					
VAR25							.733				
VAR24							-.617				
VAR23							-.426				
VAR18								-.729			
VAR10								.473			
VAR11									.698		
VAR13									.523		
VAR12									-.561		
VAR1										.861	
VAR9											-.706
VAR27											.694
VAR26											.500

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.
Rotation converged in 13 iterations.

VAR1: Rainfall; VAR2: Temp; VAR3: Humidity; VAR4: Windflaw; VAR5: Pressure; VAR6: Soil Condition; VAR7: Verity of Tea Leaf; VAR8: Road Connectivity; VAR9: Irrigation; VAR10: Drainage; VAR11: Electricity; VAR12: Fuel; VAR13: Coal; VAR14: Technology of Plantation; VAR15: Technology of Plucking; VAR16: Technology of Processing Green Leaf; VAR17: Technology of Packaging ; VAR18: Pesticides; VAR19: Fertilizer; VAR20: Cultivating Material; VAR21: Irrigation Material; VAR22: Packaging Material; VAR23: Worker Cost; VAR24: Material Cost; VAR25: Capital Cost; VAR26: Welfare Cost; VAR27: Subsidized ration



Result of the analysis comprises with Correlation, KMO and Bartlett's Test, Total Variance Explained, Rotated Component Matrix and Component Transformation Matrix. Correlation table shows the well relation amongst all the variables under consideration. It can be revealed from KMO and Bartlett's Test that the KMO value is .6 and the analysis is significant at .01 level. There are eleven factors extracted by using Principal component analysis and Kaiser Normalization method. The factor loading .4 is taken as threshold limit and hence factor loaded with .4 and above has been extracted. The Eigen value of these eleven factors is greater than one and total cumulative percentage of Rotation Sums of Squared Loadings of these factors is 72% indicating good acceptability of result. The components are renamed as follows:

Component 1 (FAC1)	Material	Component 7(FAC7)	Input Cost
Component 2 (FAC2)	Technology	Component 8 (FAC8)	Infrastructure
Component 3 (FAC3)	Weather Condition	Component 9 (FAC9)	Energy
Component 4 (FAC4)	Varity of Tea	Component 10(FAC10)	Rainfall
Component 5 (FAC5)	Soil type	Component 11(FAC11)	Welfare
Component 6 (FAC6)	Environment		

It is observed from the Table 8 that the extracted component 1 which is renamed as "Material" has the highest loading 13.59 percent amongst all eleven components. Hence the material has the highest influence in the tea production in Assam. The component 2 that is renamed as Technology has loading 10.02 percent followed by "Weather Condition" loaded by 8.05 percent. The other components which are renamed as Varity of Tea, Soil type, Environment, Input Cost, Infrastructure, Energy, Rainfall and Welfare are loaded by 6.85 percent, 6.16 percent, 5.86 percent, 4.98 percent, 4.38 percent, 4.25 percent, 4.01 percent and 3.84 percent respectively.

V. Conclusion:

The growth of production of tea production in Assam, which is the back bone of the economy of state as well as largest employment generator, are not up to the mark. It is observed from the study that the growth of tea production in Assam is at per with the tea production of India. The production growth rate of tea in Assam as well as India was almost nil during the last decade. The growth rate of tea production in Assam started increasing from the year 2010 and similar pattern seen for the national production also. As Assam contributing more than fifty percent of national production, the trend of annual national production directly depends on the trend of annual tea production in Assam. The correlation analysis shows a strong positive correlation between the tea production in Assam and the tea production of India. The most of the big tea planters have been withdrawing plantation as these companies are mainly emphasizing on packaging and marketing of tea using their own brand. The situation has been improving since 2010 in both state as well as national level due to increase in the number of Small Tea Growers (STG). In Assam, unemployed youth took tea production in small scale basis as their livelihood options and number of Small Tea Growers increases considerably in the upper Assam districts. Different factors that influence the tea production of Assam have been indentified from the field survey. Twenty seven different identified variables were deduced to eleven variables through factor analysis using principal component analysis method. Materials influence highest in the tea production of Assam followed by technology, weather condition. Variety of tea, soil condition and rainfall came as individual variables which effect tea production in Assam. Proper application and supply of material will enhance the tea production in Assam. Most of the workers of tea estates engage in plantation and plucking process. It is observed during the field visit that the most of the tea estates are suffering from the shortage of daily worker engage in plantation area. Some of the govt. scheme like MGNREGA influencing negatively in the tea production in Assam. The daily worker to be engaged by the tea estates are interested to work under such Govt. scheme instated of working in tea estates which leads to the worker crises. The interval of harvesting of tea leaf increase due to worker crises and hence the tea production as well as quality of tea decreases. To overcome such worker crises, new technology on tea plantation to be adopted for enhancing tea production in Assam.

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