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Abhijit Das
Department of Agricultural Economics, Dr. Rajendra Prasad Central Agricultural University, Pusa, (Bihar), India

Rajesh Kumar Bishnoi
School of Agribusiness and Rural Management, Dr. Rajendra Prasad Central Agricultural University, Pusa, (Bihar), India

RR Mishra
Department of Agricultural Economics, Dr. Rajendra Prasad Central Agricultural University, Pusa, (Bihar), India

Corresponding Author:
Abhijit Das
Department of Agricultural Economics, Dr. Rajendra Prasad Central Agricultural University, Pusa, (Bihar), India

Tea (*Camellia sinensis*) cultivation and its economic aspects in Assam (India)

Abhijit Das, Rajesh Kumar Bishnoi and RR Mishra

Abstract
The present study aimed at estimating the cost involved in production of green tea leaves for small tea growers and income generated thereof in Sonitpur district of Assam. The primary data were collected from 100 small tea growers drawn from fifteen randomly selected villages of two randomly selected blocks of Sonitpur district of Assam by conducting interview of individual respondents. It was observed that total cost of cultivation for lower-small, medium-small and higher-small tea growers was Rs.139339.47, 144767.21 and 152710.68, respectively. The total cost of the three categories of the small tea growers indicated that the total cost varied directly with the land size of small tea growers. The examination of efficiency parameters of tea cultivation indicated that yield (tonne per ha), gross return (Rs. per ha), net return (Rs. per ha), benefit-cost ratio and cost of production of green tea leaves (Rs. per tonne) per ha of tea plantation were 28.59, 483639.68, 338033.80, 3.30 and 16916.39, respectively.

Keywords: Benefit-cost ratio, costs of cultivation, cost of production, small tea growers.

Introduction
Tea is one among the world's hottest beverages. It is known as the queen of beverages and is an evergreen perennial crop. Tender shoots of the tea plant *Camellia sinesnsis* comprising two to three leaves and bud are used for making the commercial Black (fermented) or Green (unfermented) tea. Tea is basically a rainfed crop, and is usually grown in areas where annual rainfall varies from 1150-6000 millimetres. The ideal temperature for growth is 18-20 ^{0}C and 4 hours average daily sunshine. Deep, well drained, acidic soils having a pH range from 4.5-6 is ideal for the crop. It can be grown 2000 meters above mean sea level. Humidity conditions also have an impact on tea production and yield, with relative humidity of 80-90 percent being considered favourable during the growth period of tea plants. Wild plants can be up to 9 meters high, but on tea plantations they are cut back to a bush of about a meter in height so that the workers can pluck leaves easily. The plant produces pointed, leathery, dark leaves, small white flowers and seeds.

The major tea growing areas in India are concentrated in Assam, West Bengal, Tamil Nadu and Kerala. Other areas where tea is grown to a small extent are Karnataka, Tripura, Himachal Pradesh, Uttaranchal, Arunachal Pradesh, Manipur, Sikkim, Nagaland, Meghalaya, Mizoram and Bihar (Kiran, Subhasini, & Harish, 2014) [3]. Assam is the largest producer of quality tea in India, contributing about 51.90 percent of the country's total tea production. During the year 2017, out of a total area of 480.20 thousand ha and production of 983 million kg, Assam alone accounted for 282.10 thousand ha of area and 657.24 million kg of production, constituting 58.72 and 56.11 percent of area and production, respectively (Tea Statistics, Tea Board India, 2018).

The production of tea in India takes place in both large plantation and small gardens. Small Tea Growers (STGs) are defined, as a person or group having plantation area up to 10.12 has. STGs are producing nearly 35 percent of the total tea production of the country (Abdul, 2007) [1].

Some studies have been conducted on tea production in the state. Most of the studies are focused on the socio-economic profile of small tea growers. But there is dearth of studies related to economics of small tea grower's (STG) tea production in the state. In this backdrop, it was considered worthwhile to conduct a study on economics of tea production. Consequently, the present study was conceptualised and proposed to be undertaken. The main objective of the study was to study the costs and returns in STG's tea production.

Materials and Methods
Selection of state:
The major tea manufacturing states of India are Assam, West Bengal, Tamil Nadu and Kerala. Other areas where tea is grown to a small extent are Karnataka, Tripura, Himachal Pradesh,

Uttaranchal, Arunachal Pradesh, Manipur, Sikkim, Nagaland, Meghalaya, Mizoram and Bihar. The state of Assam covers 55.55 percent area under tea cultivation in India and produces 51.90 percent of country's total production of tea. Hence, Assam was chosen purposively for the study.

Selection of district
Out of all 33 districts of Assam, Sonitpur district is one of the leading tea growing districts of Assam and the rate of growth in the number of small tea growers in the district is very rapid and noticeable. Hence, Sonitpur district was chosen purposively for the study.

Selection of blocks
Sonitpur district has 7 community development blocks namely Balipara, Borchalla, Bihuguri, Dhekiajuli, Gabharu, Naduar and Rangapara. Out of these 7 blocks, Balipara and Dhekiajuli were selected randomly for the study.

Selection of villages, small tea growers
The Dhekiajuli block has 796 number of revenue villages (census 2011) out of which 10 leading tea growing villages namely, 1.No. HugrajuliBagan, Ali SingaGaon, DhekiajuliBagan, KachariGaon, HabiGaon, Ghoramora, MazbatGaon, PirakataGaon, Salmari, and SingariAtiGaon were selected.The Baliparablock has 10 revenue villages (census 2011) out of which 5 tea growing villages namely Balipara, Chiloni, Chariduar, Dekargaon and Ghoramari were selected randomly.Out of the selected villages from the two blocks, 50 small tea growers were selected from villages under Dhekiajuli block and 50 small tea growers were selected from the villages under Balipara block randomly.

Tabulation and Analysis
The raw data thus collected were summarized and analysed in such a form that end product which was given in a tabular form, became pertinent to the objective of the study. The subsequent master tables were prepared benefitting to objective of the study. The entire information was arranged in a manner to provide base for future analysis, thus, facilitating interpretation of the result.

Cost of cultivation
Establishment cost: It is the cost incurred during the first two years of establishment of tea garden. The cost incurred comprises cost of land preparation, soil testing, layout and draining, staking and digging pits, application of pesticide on pits and pit mixture preparation, planting, shade planting, organic mulching, hired machine power (Tractor, disc plough), centering, topping.

Maintenance cost (Variable cost): It includes all the costs incurred annually for the maintenance of tea during gestation period which starts from the 3rd year onwards. It includes labour cost (plucking), tipping, infilling, material cost (Plant protection chemicals, fertilizer, irrigation, etc.).

Fixed cost: A fixed cost is an expense or cost that does not change with an increase or decrease in the number of goods or services produced or sold. It includes establishment cost of tea garden for one year, depreciation of machines, land revenue and taxes, interest expenses.

Depreciation of machineries: Depreciation on each equipment and machinery owned by the growers calculated for individual grower based on the purchase value using the straight-line method.

$$\text{Depreciation} = \frac{\text{Purchasevalue} - \text{junkvalueattheendofeconomiclifeofassets}}{\text{Averagelife(inyears)oftheassets}}$$

Total cost of cultivation= Total variable cost + Total fixed cost
Net return (Rs. per ha) = Gross return-Total cost of cultivation
Benefit-cost ratio= Gross return ÷ Total cost

Simple tabular analysis was used to work out the cost of cultivation of tea. The total input cost of crop was distributed for one ha of land. The benefit-cost ratio was worked out by dividing the gross income by respective cost of cultivation. Net return was obtained by deducting total cost of cultivation of a crop from the gross return.

Results and Discussion
The information related to socio-economic profile of the small tea growers obtained from the study area is presented in the following paragraphs under the different sub heads. The small tea growers were divided in three categories according to their land holdings, viz. lower-small tea growers (0-2.5 ha), Medium-small tea growers (2.5-5.0 ha) and higher-small tea growers (5.0 ha and more) for analysis.

Establishment Cost
A tea plantation is supposed to take around three years for establishment. The period is also known as gestation period. Establishment cost is the cost incurred during the first three years of establishment of tea garden. This cost once incurred remains valid for the entire life of the garden. The expected life of a tea plantation is assumed to be of 50 years. The establishment cost of a tea plantation of small tea growers is presented in Table 1. It may be observed from the table that the cost incurred in establishing a tea garden for lower-small, medium-small and higher-small tea growers was estimated Rs.166968.14, 213965.24 and 223473.87 per ha respectively. Similar results were also reported by Kiruthiga and Damodaran (2016) [4].
The table revealed that total cost of establishment of a tea plantation of small tea growers was Rs.201469.08 per ha. Out of the various cost items the cost of planting materials or cuttings (Rs.77741.00 per ha) occupied first rank and it alone contributed for 38.58 percent of the total establishment cost. Next in importance was charges for hired human labour, which amounted to Rs.30696.68 per ha and its share in total establishment cost was 15.23 percent. Cost of irrigation pump set occupied third rank and it constituted 13.38 percent (Rs.26966.66 per ha) of total establishment cost. Cost of weedicides was another importance item of cost, occupying fourth rank and it constituted 13.13 percent of total establishment cost. The sample tea growers had to spent a substantial amount (Rs.9035.35 per ha) on purchase of insecticide which was considered essential for development of healthy tea plantation and accounted for 4.48 percent of total establishment cost. Organic mulch in the form of water hyacinth, shade plants, manures, fungicides et cetera were other less important items of expenditure in total establishment cost
Land holding size wise analysis of the small tea growers revealed that charges for hired human labour was 15.37

percent (Rs.25665.67 per ha) in lower-small tea growers, 14.33 percent (Rs.305657.88 per ha) in medium-small tea growers and 16.00 percent (Rs.35766.50 per ha) in higher-small tea growers. Interest on establishment cost emerged as another most important item claiming 7.83 percent (Rs.13080.45, 13652.12, and 14279.52 per ha for lower-small, medium-small and higher-small tea growers) of total establishment cost.

Table 1: Breakup of establishment cost involved in green tea leaf production

(Rs. per ha)

Particulars	Lower-small	Medium-small	Higher-Small	Overall
Soil testing	450.00 (0.26)	450.00 (0.21)	450.00 (0.20)	450.00 (0.22)
Hired human labour	25665.67 (15.37)	30657.88 (14.33)	35766.50 (16.00)	30696.68 (15.23)
Hired machine power	2688.87 (1.61)	2956.60 (1.38)	3558.00 (1.59)	3067.82 (1.52)
Planting material	77741.00 (46.56)	77741.00 (36.33)	77741.00 (34.78)	7741.00 (38.58)
Irrigation pump set	-	39700.00 (18.55)	41200.00 (18.43)	26966.66 (13.38)
Shade plants	3018.00 (1.80)	3018.00 (1.41)	3018.00 (1.35)	3018.00 (1.49)
Weedicide	25688.00 (15.38)	26200.40 (12.24)	27500.00 (12.30)	26462.80 (13.13)
Manure	3000.00 (1.79)	3200.45 (1.49)	3345.60 (1.49)	3182.02 (1.57)
Fertilizer	1245.50 (0.74)	1383.00 (0.64)	1390.00 (0.62)	1339.50 (0.66)
Insecticide	8876.50 (5.31)	9024.00 (4.21)	9205.55 (4.11)	9035.35 (4.48)
Organic mulching	2500.35 (1.49)	2518.00 (1.17)	2566.00 (1.14)	2528.12 (1.25)
Fungicide	3013.80 (1.80)	3463.79 (1.61)	3453.70 (1.54)	3310.43 (1.64)
Interest on establishment cost @ 8.5 percent	13080.45 (7.83)	13652.12 (7.83)	14279.52 (7.83)	13670.70 (7.83)
Total establishment cost	166968.14 (100.00)	213965.24 (100.00)	223473.87 (100.00)	201469.08 (100.00)

Figures in parentheses are percent to the total

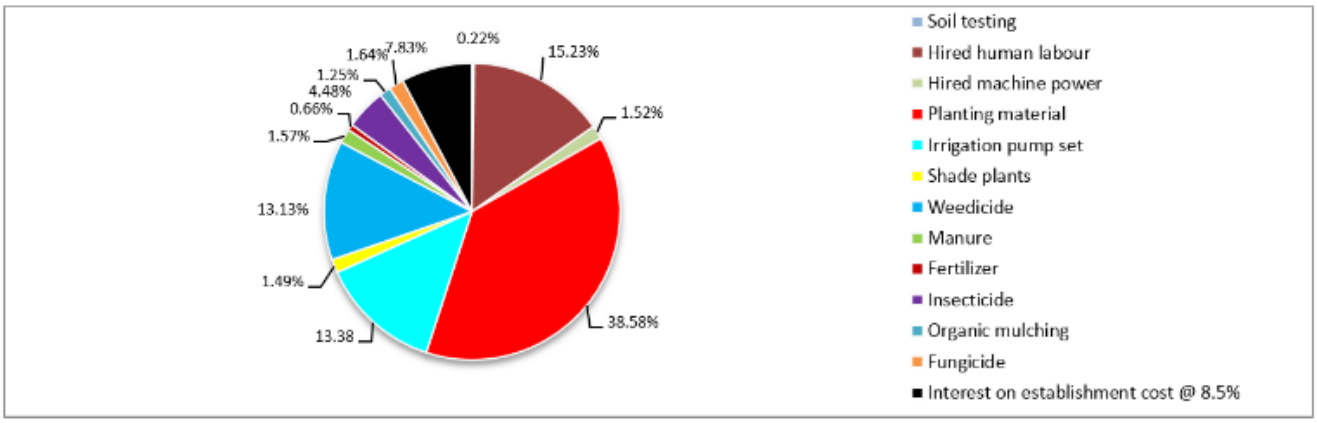

Fig 1: Share of different items to total establishment cost

Maintenance Cost

Maintenance cost is the cost associated with keeping a tea plantation in working order and good condition. It includes all the cost incurred annually for maintenance of a tea garden annually from fourth year onwards. Various operations carried out in green tea leaf production are – irrigation, manuring, application of nutrients and plant protection materials, infilling of plants et cetera. All these operations are done manually and are dependent on hired human labour. Therefore large number of human labour is required to perform these operations. The variable cost of a tea plantation of small tea growers has been shown in Table 2.

The results presented in Table 2 revealed that the total variable cost involved in running a small tea plantation amounted to Rs.138551.14 per ha. Out of this, charges for hired human labour were Rs.79823.95 per ha. Hired human labour alone accounted for more than fifty percent (57.61 percent) of the total variable cost. It emerged as the most important item of variable cost. The cost of fertilizer was Rs.14773.13 per ha and was next to charges for hired human labour. It constituted 10.66 percent of total variable cost. It was closely followed by interest on maintenance cost which was estimated at Rs.10854.24 per ha constituting 7.83 percent of total variable cost. The cost of weedicide occupied third position in order of importance; it amounted to Rs.11861.51 per ha and its share was 8.56 percent in the total variable cost. Some less important items of variable cost were cost of insecticide, cost of fungicide, cost of manures, etc. Latif, Amjad, Hussain, Shah, and Hussain (2012) [5] also reported similar kind of results. Land holding size wise comparison of cost of various items of variable cost exhibited almost similar trend.

Hired human labours are required for most of the operations in the process of production of green tea leaves. That's why charges of hired human labour were observed to be higher. Fertilizer is sprayed frequently (4 to 5 times in a month) as it is considered to improve the quality of green tea leaves. Higher price of fertilizers may be another reason for higher cost of fertilizers. Similarly tea plantation is infested with broad –leaf weeds which results in reduction in yield of green tea leaves. Weedicide is frequently used (3 times a month) to kill these weeds. As weedicides were also available in market at a higher price, hence the higher cost of weedicides.

Table 2: Breakup of variable cost involved in green tea leaf production

(Rs. per ha)

1	Particulars	Lower-small	Medium-small	Higher-Small	Overall
	Hired human labour	77854.55 (57.95)	78567.30 (57.43)	83050.00 (57.46)	79823.95 (57.61)
2	Irrigation	0.00 (-)	577.75 (0.42)	565.80 (0.39)	381.18 (0.27)
3	Manure	5200.00 (3.87)	5255.80 (3.84)	5467.20 (3.78)	5307.67 (3.83)
4	Fertilizer	14439.50 (10.74)	14500.90 (10.60)	15379.00 (10.64)	14773.13 (10.66)
5	Weedicide	11240.90 (8.36)	11500.82 (8.40)	12842.80 (8.88)	11861.51 (8.56)
6	Insecticide	6100.77 (4.54)	6500.42 (4.75)	6588.90 (4.55)	6396.70 (4.61)
7	Fungicide	5534.80 (4.11)	5621.10 (4.10)	5633.60 (3.89)	5596.50 (4.03)
8	Infilling (Plant cost)	3452.25 (2.54)	3553.55 (2.59)	3663.00 (2.53)	3556.27 (2.56)
9	Interest on maintenance cost @ 8.5 percent	10524.94 (7.83)	10716.60 (7.83)	11321.18 (7.83)	10854.24 (7.83)
	Total variable cost	134347.71 (100.00)	136794.24 (100.00)	144511.48 (100.00)	138551.14 (100.00)

Figures in the parentheses indicate percentages to the total.

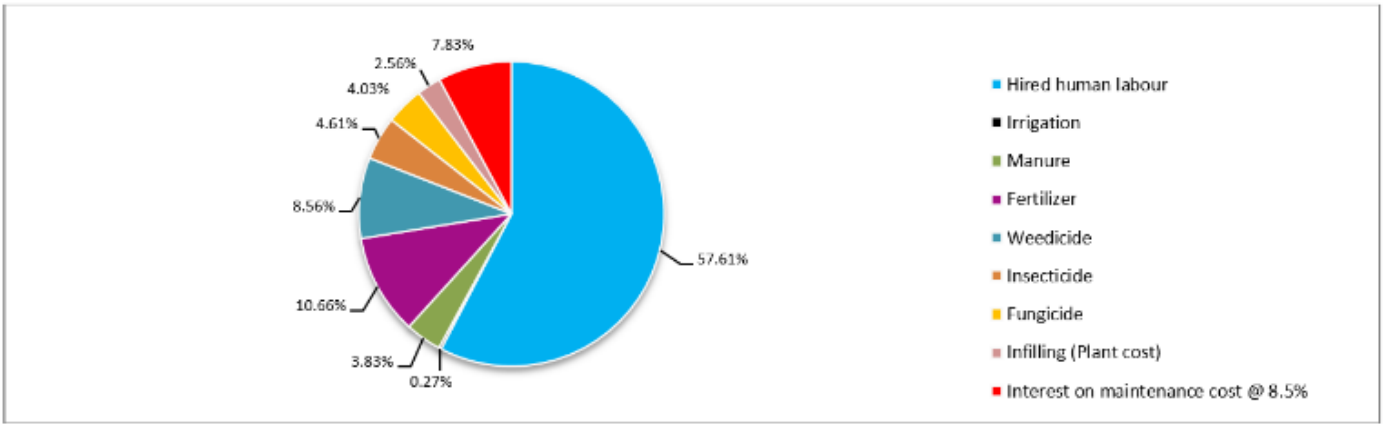

Fig 2: Share of different items to total variable cost

Fixed Cost

Fixed cost is the cost which does not vary with the level of output. It remains same irrespective of the level of production. Various items of fixed cost required for running a tea plantation are establishment cost, depreciation on implements and machineries, land revenue and taxes and interest on fixed capital et cetera. The fixed cost of a tea plantation of small tea growers is presented in Table 3.

Table 3: Breakup of fixed cost involved in green tea leaf production

(Rs. per ha)

Particulars	Lower-small	Medium-small	Higher-Small	Overall
Establishment cost**	3339.36 (66.89)	4279.30 (53.67)	4469.47 (54.51)	4029.38 (57.12)
Depreciation of machines (Rs. per year)	1120.80 (22.45)	2866.90 (35.95)	2880.50 (35.13)	2289.40 (32.45)
Land revenue	36.92 (0.74)	36.66 (0.45)	36.95 (0.45)	36.84 (0.52)
Interest on fixed capital @11 percent	494.68 (9.90)	790.11 (9.90)	812.56 (9.90)	699.12 (9.90)
Total fixed cost	4991.76 (100.00)	7972.97 (100.00)	8199.20 (100.00)	7054.74 (100.00)
Total cost (Total Variable cost + Total Fixed cost)	139339.47	144767.21	152710.68	145605.88

Figures in the parentheses indicate percentages to the total.

** Total establishment cost ÷ Expected life of a tea plantation (50 years).

The perusal of Table 3 revealed that the total fixed cost involved in running a tea plantation amounted to Rs.7054.74 per ha. Establishment cost alone accounted for more than half of the total fixed cost (57.12 percent). It was the most important item of fixed cost. Depreciation on implements and machineries was estimated at Rs.2289.40 per ha and was next to charges for establishment cost. It constituted 32.45 percent of total fixed cost. Yogish (2017) [6] also reported similar kind of results. Interest on fixed capital was also a substantial amount with a share of 9.90 percent among various items of fixed cost. It was followed by land revenue, which was estimated at Rs.36.84 per ha constituting 0.52 percent of total fixed cost. Latif, Amjad, Hussain, Shah, and Hussain (2012) [5] also found similar kind of results. Land holding size wise comparison of cost of various items of fixed cost showed a similar trend. The share of fixed cost and variable cost in total cost was analysed and findings is presented in Table 4.

The perusal of Ttable4 revealed that total cost of lower-small, medium-small and higher-small tea growers was Rs.139339.47, 144767.21and 152710.68 respectively. The total cost of the three categories of the small tea growers indicated that the total cost varied directly with the land size of small tea growers. As size of land holding increased, the total cost also increased. It may be mainly due to increase in fixed costs with increase in size of land. A note-worthy point of the analysis was that share of fixed cost in total cost increased with increase in land holding size. In case of lower-small tea growers, share of fixed cost was 3.58 percent of total cost while in case of medium-small and higher-small tea growers it accounted for 5.50 and 5.55 percent of total cost respectively. The percentage share of variable cost in total cost increased with decrease in size of land holding. It was 96.42, 94.50, and 94.43 percent in case of lower-small, medium-small and higher-small tea growers, respectively.

However, the quantum of variable cost showed increasing trend as the farm size increased.

Table 4: Share of fixed cost and variable cost in total cost of cultivation

(Rs. per ha)

Particulars	Lower-small tea growers	Medium-small tea growers	Higher-small tea growers	Overall
Total fixed cost	4991.76 (3.58)	7972.97 (5.50)	8199.20 (5.55)	7054.74 (4.85)
Total variable cost	134347.71 (96.42)	136794.24 (94.50)	144511.48 (94.43)	138551.14 (95.15)
Total cost	139339.47 (100.00)	144767.21 (100.00)	152710.68 (100.00)	145605.88 (100.00)

Figures in the parentheses indicate percentages to the total.

Efficiency parameters

The yield (tonne per ha), gross return per ha, net return per ha, benefit-cost ratio and cost of production of green tea leaves were some of the efficiency indicators on the basis of which lower-small, medium-small and higher-small tea growers were compared is presented in Table 5.Tea is a unique plantation crop and recommended package of practices has to be followed for producing quality green tea leaves. Any deviation in application of inputs in tea plantation may result in loss of production leading to economic loss to the tea grower. This may be the reason for low variation in efficiency of production of green tea leaves. Adhikari, Regmi, Gautam, Thapa, and Joshi, (2017) [2] reported similar kind of results.

Table 5: Cost and returns from tea cultivation

(Rs. per ha)

Particulars	Lower-small	Medium-small	Higher-Small	Overall
Yield (t per ha)	27.02	29.50	29.25	28.59
Gross return	477236.52	484328.65	489353.86	483639.68
Net return	337897.05	339561.44	344842.38	338033.80
Benefit-cost ratio	3.27	3.32	3.28	3.30
Cost of production of green tea leaves (Rs. per tonne)	17662.34	16417.92	16730.05	16916.39

Conclusions

An attempt was made to work out establishment cost incurred in setting-up of a tea plantation. The analysis revealed that for lower-small, medium-small and higher-small tea growers, there were Rs.166968.14, 213965.24 and 223473.87 per ha, respectively. The total variable cost involved in running a small tea plantation amounted to Rs.138551.14 per ha. The total fixed cost involved in running a tea plantation amounted to Rs.7054.74 per ha. The total cost of cultivation for lower-small, medium-small and higher-small tea growers was Rs. 139339.47, 144767.21and 152710.68 per ha, respectively. The total cost of the three categories of the small tea growers indicated that the total cost varied directly with the land size of small tea growers. A note-worthy point of the analysis was that share of fixed cost in total cost increased with increase in land holding size. The percentage share of variable cost in total cost increased with decrease in size of land holding. However, the quantum of variable cost showed increasing trend as the farm size increased. The results of efficiency parameters of tea cultivation shows that as land size increased, gross return also increased accordingly, but when net returns were compared medium-small tea growers showed highest return, benefit-cost ratio also showed similar trend. This could be due to less cost associated with production of green tea leaves for medium-small tea growers. The important policy that should be adopted by the higher-small tea growers is to utilize their recourses properly so as to reduce their production cost, which will lead to increase in net income as well as benefit-cost ratio.

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