

## **Productivity Variation Among Tea Smallholders in Up Country of Sri Lanka**

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### **Introduction**

Tea smallholding sector in Sri Lanka plays a vital role in the economy and accounts for 69% of the total tea production (Central Bank, 2011). However, tea productivity varies among tea small holders due to many reasons (Anonymous, 2011). An attempt was made to compare the variation in productivity among the tea small holders, examine contributory factors for productivity variation and suggest appropriate strategies for improving productivity.

### **Materials and Methodology**

This study was based on the primary and secondary data. The primary data were collected during the period of May –July 2012 from randomly selected hundred tea smallholders in the Up-country Wet Zone through a well designed pretested questionnaire. Secondary data were collected from literature to identify variables that affect to tea productivity and to refer different models. Maximum likelihood estimates of the stochastic frontier model (using Cobb - Douglas and Translog models) were estimated for green leaf output as a function of land extent, family labour, hired labour, fertilizer, chemicals, and Zn. The determinants of technical efficiency such as age of farmer, health condition, experience, education level, occupation, type of tea and practicing intercropping were estimated following the Battese and Coelli (1995) specification. Tabular techniques were also used to analyze data.

Production function:

$$Y_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + V_i - U_i$$

Where:  $\ln$ -Denotes Natural logarithms;  $Y_i$ -Out put (Kg of green leaf);  $X_1$  family labour (man days);  $X_2$ -hired labour (man days);  $X_3$ . extent of land (ac);  $X_4$ . fertilizers (kg);  $X_5$ . chemical (cost);  $X_6$ . Zn (cost);  $\beta_i$ 's-Unknown parameters to be estimated;  $V_i$ -Represents independently and identically distributed random errors  $N(0, \sigma_v^2)$ . These are factors outside the control of the smallholder;  $U_i$ . Represents non negative random variables which are assumed to be account for the productivity inefficiency. Which are independently and identically distributed as  $N(0, \sigma_u^2)$

Inefficient function:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + W_i$$

Where:  $Z_1$ . Age of operators (years);  $Z_2$ . Dummy variable (Health of operator value of one if the smallholders are health, zero otherwise);  $Z_3$ . Experience (years);  $Z_4$ . Dummy variable (Practicing intercropping value of one if yes and zero if otherwise);  $Z_5$ . Dummy variable

for type of tea, (a dummy variable equal to one if VP tea is grown, zero otherwise);  $Z_6$ , dummy variable for occupation, (equal to one if the small holders are involved in tea holding only, zero otherwise) ;  $Z_7$ , Education (years);  $W_i$ , unobservable random variables; and  $\delta_i$ s - Inefficiency parameters to be estimated.

## Results and discussion

The findings of the study showed that age of the sample of the small holders ranged from 36 to 85 years and majority of the sample belonged to above 60 years age category (35% from the total sample). 68 % of the sample had completed the secondary education and 11 % of sample had obtained GCE A/L or higher education. 20 % of sample completed only primary education and 1 % of sample had not attained to school education. Majority of the small holders included in the sample are males (67 % of the sample). Minimum and maximum period of experience was 3 and 50 years, respectively. The study also revealed that the large proportion (68%) of small holders had less than one acres of tea cultivated land. Annual income of the tea small holders in study group varied from 24,000 rupees to 7,20,000 rupees. Mean annual income was 2,19,687 rupees. Most of them (71.87%) belonged to  $\leq 2, 99,999$  rupees annual income category.

Productivity among the tea smallholders in the study area is highly varied (from 73 to 2201 kg/ac/yr). Majority of farmers (46 %) had below 500 kg/ac/yr productivity level while only few farmers (8 %) had productivity level above 1501 kg/ac/yr.

The study also found that an average green leaf output was 3203kg/ac/year. The highest and lowest green leaf output was 10235 and 339 kg/ac/year respectively. Average size of the tea land was 1.11 acres. Average number of hired labour by smallholder was estimated as 121 man days/ac and maximum number of man days used was 723 man days/ac/yr (Table 1).

Table 1: Summary Statistics of variables in the stochastic frontier production functions

| Variables                           | Sample mean | Standard deviation | Minimum value | Maximum value |
|-------------------------------------|-------------|--------------------|---------------|---------------|
| Output (green leaf – kg/ac/yr)      | 3203        | 2251.77            | 338.67        | 10235.43      |
| Family labour used (man days/ac/yr) | 118         | 126.39             | 0             | 497.3         |
| Hired labour used (man days/ac/yr)  | 121         | 125.58             | 0             | 723           |
| Extent of land (ac)                 | 1.11        | 1.05               | 0.13          | 7             |
| Quantity of fertilizer (kg/ac/yr)   | 496         | 283.88             | 0             | 1600          |
| Chemicals cost (Rs/ac/yr)           | 1107        | 1855.85            | 0             | 14000         |
| Zn cost (Rs/ac/yr)                  | 100         | 154.00             | 0             | 778.38        |
| Age of famers (years)               | 56          | 11.46              | 36            | 85            |
| Experience (years)                  | 21          | 11.68              | 3             | 50            |
| Education (years)                   | 10          | 3.34               | 1             | 14            |

According to the results of Cobb-Douglas production function, family labour, hired labour, quantity of fertilizer, chemical and Zn cost showed significant positive impact on output.

Table 2: Parameter estimates of the stochastic frontier (Cobb-Douglas model)

| Variables      | Parameters | Co-efficient | Standard Error | P Value |
|----------------|------------|--------------|----------------|---------|
| Constant       | $\beta_0$  | 6.2249**     | 0.4956         | 0.000   |
| Family labour  | $\beta_1$  | 0.0873*      | 0.0474         | 0.065   |
| Hired labour   | $\beta_2$  | 0.1698**     | 0.0352         | 0.000   |
| Land           | $\beta_3$  | 0.0861       | 0.0929         | 0.354   |
| Fertilizer     | $\beta_4$  | 0.1399**     | 0.0524         | 0.008   |
| Chemical       | $\beta_5$  | 0.0475**     | 0.0177         | 0.007   |
| Zn             | $\beta_6$  | 0.0768**     | 0.225          | 0.001   |
| $\sigma^2$     |            | 0.714        |                |         |
| $\gamma$       |            | 0.783        |                |         |
| Log-likelihood |            | -89.10       |                |         |
| LR-Test        |            | 21.81        |                |         |

\*, \*\*, Significant at 10 % and 5 % probability level

The estimated Maximum Likelihood co-efficient for hired labour, family labour, amount of fertilizer, chemicals and Zn cost showed positive values of 0.1698, 0.0873, 0.1399, 0.0475 and 0.0768, respectively. This indicated that increment of the inputs such as hired labour, family labour, fertilizer, chemical and Zn by one per cent will increase output by 0.1698, 0.0873, 0.1399, 0.0475 and 0.0768 per cent, respectively (Table 2).

The mean technical efficiency of the tea small holding sector was found to be 40.35 % , which highlighted that the output could be increased by 59.65 % if all farmers achieved the technical efficiency level of the best farmer. The distribution of technical efficiencies of tea small holdings in Up Country ranged from as low as 3.39 % to as high as 95.33 %.

The estimated coefficients in the inefficiency model are of particular interest to this study and are depicted in Table 3. Co-efficient of health and experience showed negative values and it suggested that the healthy and experienced farmers were more efficient than others. The inefficiency decreases with experience and this can be explained by most of the experienced farmers used to cultivate high yielding tea cultivars and they tend to follow recommendations of the Tea Research Institute. The positive and significant coefficient for occupation suggested that the farmers who are involved only in tea cultivation holdings as full time farmers were found to be less efficient than others.

Table. 3: Inefficiency effects model

| Variables     | Parameters | Co-efficient | Standard Error | P Value |
|---------------|------------|--------------|----------------|---------|
| Constant      | $\delta_0$ | 3.1908       | 1.9986         | 0.110   |
| Age           | $\delta_1$ | -0.0234      | 0.0256         | 0.361   |
| Health        | $\delta_2$ | -1.2567**    | 0.592          | 0.034   |
| Experience    | $\delta_3$ | -0.0582*     | 0.0304         | 0.056   |
| Intercropping | $\delta_4$ | -0.4465      | 0.5092         | 0.381   |

|             |    |         |        |       |
|-------------|----|---------|--------|-------|
| Type of tea | 85 | -0.6283 | 0.6481 | 0.332 |
| Occupation  | 86 | 0.9892* | 0.5763 | 0.086 |
| Education   | 87 | -0.0702 | 0.0651 | 0.281 |

\*, \*\*, Significant at 10 and 5 per cent probability level

The constraints/problems faced by the smallholder when engage in farming as a business were also studied. Major constraints highlighted by them in order of ranking were high cost of production, low price received for the green leaves, lack of knowledge on tea cultivation and lack of institutes related to tea industry, labour shortage and limited land for tea cultivation.

### Conclusion

Productivity among the tea smallholders in the study area is highly varied (from 73 to 2201 kg/ac/yr). The efficiency of tea small holders was ranged from 3.39 % to 95.33 %. Family labour, hired labour, amount of fertilizer, chemical and Zn cost, health condition and experience of the farmers were identified as the contributory factors for productivity variation in small holders in Up Country.

Awareness programme on adaption of good agricultural practices (fertilizer, Zn application, maximum utilization resources (labour, land) and knowledge on tea farming would be better strategies to improve production efficiency of the smallholders in the up country.

### References

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