Impact of good agricultural practices on technical efficiency of Tea small holders

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Introduction

Tea is pre-eminent among Sri Lanka's plantation crops and it is one of the most important industries in the country in terms of employment and foreign exchange earnings. Sri Lanka's tea small holders, who account for 76% of the national tea output, are the mainstay of Sri Lanka's tea industry, are facing some serious problems like increasing cost of production and reducing marginal profits that will directly contribute towards reducing the national tea output in the future. However, given the high cost of production, there is a belief that it is very difficult to increase profitability without increasing costly inputs (Basnayake *et al*., 2002). Good Agricultural Practices (GAPs) addresses environmental, social and economical sustainability and often in combination with effective input use, is one of the best ways to increase smallholder productivity without costly inputs (Poisot *et al*., 2004). Having identifying the importance of GAPs in tea industry, this study was conducted to find out the impact of GAP adoption on technical efficiency of tea small holders in Sri Lanka

Methodology

84 tea small holders were selected as the sample, among tea small holders in Kuruvita DS Division using multistage sampling. Four TI ranges (Wewalwaththa, Erathna, Eheliyagoda and Kiriella) in Kuruvita were selected and 21 tea small holders were selected from each TI range.

Data collection was carried out by using structured questionnaire. The questionnaire includes two basic parts, part one is consisted basic inputs to measure technical efficiency and other part is used to collect data to find about the adoption level of tea small holders to Good Agricultural Practices on tea cultivation. To measure GAP adoption level questions were prepared under 14 GAP principles specifically to tea cultivation as recommended by Tea Research Institute (Zoysa, 2008). Stochastic Frontier Production model was used to measure the technical efficiency. STATA statistical package, Minitab software and Microsoft Excel were used to data analysis.

$$\text{GAP Adoption Level} = \frac{\text{Number of GAP principles adopted by TSH}}{\text{Total GAP Principles}} \times 100 \quad (1)$$

GAP adoption level was measured using above equation for each TSH. Two empirical models were used to measure the factors affect production and to measure technical efficiency.
One of the empirical models is Cobb-Douglas function. In our calculation variables are explained by following Cobb-Douglas equation

$$= {}_0 + {}_1 \; {}_1 + {}_2 \; {}_2 + {}_3 \; {}_3 + {}_4 \; {}_4 + {}_5 \; {}_5 + {}_6 \; {}_6 + \quad (2)$$

Table 1: Description of variables for Cobb-Douglas model

Notation	Name of Variable	Remarks
	Log value of total green leaves	Kg
	Parameter for intercept of regression line	None
	Log of tea land extent	Acres
	Log of family labor	Hours
	Log of hired labor	Hours
	Log amount of fertilizer	Kg
	Log amount of agrochemicals	Rupees
	Log amount of Dolomite	Kg
	Stochastic Error term	None

The other empirical model used was Technical Inefficiency Function. A technical inefficiency effect was defined Battesse and Coelli (1995) and explained according to that explanation.

$$= + \quad _{=1,2,\dots\dots,} \qquad (3)$$

is technical inefficiency, is the vector of explanatory variables associated with the technical inefficiency effect, δ is the vector of unknown parameter to be estimated and is unobservable random variables.

In the model specification,

$$= {}_0 + {}_1 {}_1 + {}_2 {}_2 + {}_3 {}_3 + {}_4 {}_4 + {}_5 {}_5 + {}_6 {}_6 + {}_7 {}_7 + {}_8 {}_8 + {}_9 {}_9 + {}_{10} {}_{10} + \qquad (4)$$

Table 2: Inefficiency Variables

Notation	Inefficiency Variables	Unit
	Age of the farmer	In years
	Education of the farmer	In years
	Occupation of the farmer	Dummy, if tea only = 1, otherwise=0
	Gender	Dummy, if male=1, female=0

	Experience in tea cultivation	In years
	Age of plantation	In years
	Trainings	Number of times attend
	Membership of association of TSH's	Dummy, if member=1, nonmember=0
	Adoption level to GAP	In percent

Results and discussion

This section summarizes the descriptive statistics of the data and the outcome of the empirical models used to analyze the data. Following table shows summery statistics of GAP adoption level of TSH in the area.

Table 3: Summery Statistics of GAP adoption level

Respondents	Mean	StDev	Median	Minimum	Maximum
N= (84)	55.57	8.754	56	22	72

Source: Minitab 14 analysis of survey data

There were past studies which have measured adoption levels according to the number of practices respondents have adopted (Bang, 2012; Boz I, *at el* 2011). In my study also I used the number of GAPs TSHs have adopted and divide them into two levels as adaptors and non adopters.

Sample was divided to GAP adopters and non adopters. 43 TSHs who scored 56 or more was grouped as GAP adopters and 41 TSHs who scored below 56 are grouped as GAP non adopters.

The maximum likelihood estimates of the parameters of the stochastic frontier production function are presented in Table 4. The estimate of Γ is 0.926, which indicates that the majority of error variation is due to the inefficiency error Ui. (and not due to the random error Vi). This indicates that the random component of the inefficiency effects does make a significant contribution in the analysis.

Table 4: Estimates of the Stochastic Frontier Production Function

Variable	Coefficient	Std. Err		>|t|
Land extend	0.966147***	0.0813178	11.88	0.000
Family labour	0.045638***	0.0156336	2.92	0.004
Hired labour	0.0419136**	0.0189145	2.22	0.027
Fertilizer	-0.0026291	0.030904	-0.09	0.932
Chemicals	-0.027902**	0.012909	-2.16	0.031
Dolomite	-0.0193065	0.017832	-1.08	0.279

Cons	8.671964	0.248668	34.87	0.000
	0.5071351			
Γ	0.9262876			
Log likelihood	-48.618234			

** Significant at 10 % ** Significant at 5 % and *** Significant at 1 %*

Source: from STAT version 11 analysis of survey data

Maximum likelihood estimates of the stochastic frontier model were estimated for green leaf yield as a function of land extend, family and hired labour, fertilizer, agrochemicals and dolomite, using Cobb-Douglas model. Land extend, family labour and hired labour showed significant effect on yield in a positive way, chemicals also were showed a significant effect but in a negative way.

According to Summery Statistics of Technical Efficiency from STATA version 11, mean technical efficiency of TSH in Kuruvita is 63.17

Table 5: Determinants of inefficiency Cobb-Douglas model

Variable	Parameter	Coefficient	Std Err	p value
Age	δ_1	0.0321381	.0263658	0.223
Education	δ_2	-0.0130145	.126756	0.918
Occupation	δ_3	0.0596928	.4865421	0.902
Gender	δ_4	-1.016146**	.486411	0.037
Experience	δ_5	-0.049053	.0327829	0.135
Age of plantation	δ_6	0.0268849	.0411904	0.514
Trainings	δ_7	0.1533232	.1161482	0.187
Membership of associations	δ_8	-0.1328316	.5093004	0.792
GAP Adoption	δ_9	-0.12193***	.030065	0.000

** Significant at 10 % ** Significant at 5 % and *** Significant at 1*

% Source: STAT version 11 analysis of survey data

Gender and GAP adoption level has significant effects on technical inefficiency. The coefficient for GAP adoption level is -0.12193 and significant at 1% level on technical inefficiency.

Conclusion

Knowledge of TSH's about GAP'S are not in a satisfactory level in this area. The results obtain of the stochastic frontier estimation revealed that, average technical efficiency of TSH's in Kuruvita given by the Cobb- Douglas model is 63.18 per cent. Therefore there is a scope of further increasing output by 36.82 per cent without increasing the level of inputs. From the factors considered which affect technical efficiency, gender of farmer and GAP adoption affect significantly at 5% and 1% levels respectively.

Male TSHs appeared to be more technically efficient than females. This may be due to male TSHs have more contact with society around them, specially with other tea small holders than typical Sri Lanka women in village. Sri Lankan women have more responsibly on house hold work than men, so they have less time to spent in farming may be another reason.

GAP adoption is positively significant at 1% level with technical efficiency. Mean technical efficiency of GAP adopted famers shown to be 71.9% while 54.1% for non adopters. As the definition says Good Agricultural Practices are practices that address not only environmental and social sustainability but also it addresses economic sustainability. By adopting GAPs TSHs can increase their technical efficiency.

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