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# TECHNICAL AND ALLOCATIVE EFFICIENCIES OF RICE FARMING UNDER MAJOR IRRIGATION IN MAIN RICE GROWING DISTRICTS OF SRI LANKA *

H.U. WARNAKULASOORIYA[1] AND W. ATHUKORALE[2]

[1] *Socio Economics and Planning Centre, Department of Agriculture, Sri Lanka*
[2] *Faculty of Arts, University of Peradeniya, Sri Lanka*

## INTRODUCTION

Efficiency of rice farming is a subject that has been substantially researched in Sri Lanka (Ekanayake, 1987; Ekanayake and Jayasuriya, 1987; Ekanayake and Jayasuriya, 1989; Karunarathna and Herath, 1989; Aruna Shantha *et al.*, 2013). Most of the previous studies have concentrated on technical efficiency measurement and overlooked measurement of allocative efficiency component. Many previous studies are location specific, and have not measured cost of inefficiency to farmers/society. Therefore, a study was conducted with the objectives to measure technical and allocative efficiencies of rice farming under major irrigated water regimes in Ampara, Pollonnaruwa, Anuradhapura and Hambantota main rice growing districts, and to measure costs of these inefficiencies to the rice farmers during 2009 *Yala* and 2009/10 *Maha*, seasons.

## MATERIALS AND METHODS

Primary data collected by Socio Economics and Planning Centre of the Department of Agriculture for Cost of Cultivation study were used. Stochastic frontier production functions of Cobb-Douglos form were estimated for 252 rice farms in *Yala* 2009 season and 248 rice farms during Maha 2009/10 season that represented irrigated water regimes of Ampara, Pollonnaruwa, Anuradhapura and Hambantota districts. The following Cobb-Douglos stochastic frontier production function model was used.

* *See "Tropical Agriculturist" Volume 163 for details.*

$$\ln Y_j = \alpha + \sum_{j=1}^{3} \theta_k D_k + \sum_{j=1}^{3} \beta_j lnX_{ij} + \varepsilon_j$$

Where $y_j$ is the output of $j^{th}$ farmer, $D_k$={0,1}, k, is a dummy variables that takes value of 1 for $k^{th}$ district and 0 for other districts, Xij are inputs denoted as: Landj (land extent used by $j^{th}$ farmer), $Labou_r$ (amount of labour used for production operations), $Capital_j$ (operating expenditure incurred on all inputs except labour), $\varepsilon_j$ is a composite error tem where $\varepsilon_j = v_j - u_j$: $v_j$ ,is an error term assumed to be distributed identically and independently as N $(0,\sigma_v^2)$ that reckons random variation of output, and $u_j$, is one sided (uj≥0) error term that reckons variation of output due to inefficiency. In this paper $u_j$ is assumed to follow a half normal distribution (u. N (0, $\sigma_u^2$). The efficiency parameter $\gamma = (\sigma_u^2/\sigma_u^2 + \sigma_v^2)$ lies between 0 and 1, and if. $\gamma = 0$, the difference between farmer's production and production estimated by the frontier function is entirely due to statistical noise. Conversely, $\gamma = 1$ indicates that the difference of actual and estimated production is entirely due to less than efficient use of technology.

Technical, allocative, and economic inefficiencies are measured in input space. Potential cost savings by eliminating technical, allocative, and economic inefficiencies for each farm was estimated, sample aggregates of cost savings were computed, and per hectare cost savings for the sample computed and multiplied by district harvested extent to compute cost savings for the district. Frontier 4.1 software (Coeli, 1996) was used to estimate the model. The output based technical efficiency index $[TE_j^{[o]}]$ introduced by (Farrel, 1957) is given by the software. Farrel (1957)'s input based technical efficiency for a double log frontier production function is given as $TE_j^{[i]} = [TE_j^{[o]}]^{(1/\Sigma\beta_i)}$ where, $\Sigma\beta_i$ is the sum of estimated production elasticities or scale coefficient. The allocative efficiency of the firm j is estimated by minimizing the cost of the firm at the firm's output level relative to the stochastic frontier production function.

## RESULTS AND DISCUSSION

The estimated production functions are given in Table 1. The intercept terms in frontier production functions of both *Maha* and *Yala* seasons are significant. The exponential values of the dummy variable coefficients exhibit the level of productivity differences among districts. With the same level of input use in farms of Ampara district, yields in farms of Polonnaruwa district are lower by 15% during *Yala* season, and 17% higher during *Maha* season whereas yields in Hambantota district are higher by 13% in *Yala* season, and 22% higher in *Maha* season. The coefficients for land, labour, and capital, which are elasticities of production, are highly significant during both seasons except in the case of labour during *Yala* season where the level of significance is only 10%.

The averages of the four districts are 0.741 (*Yala*) and 0.825 (*Maha*) of technical efficiency, 0.848 (*Yala*), and 0.724 (*Maha*) of allocative efficiency, and 0.634 (*Yala*) and 0.606 (*Maha*) of economic efficiency. The potential aggregate cost savings for the four districts by eliminating both technical and allocative inefficiencies are Rs billion 7.7 for *Yala* season, Rs. billion 18.8 for *Maha* season, and Rs. billion 26.5 annum. It is evident that costs savings possible by eliminating technical and allocative inefficiencies are considerable at individual farmer level and district aggregate level. The aggregate welfare gain estimates in the four districts indicate that economically rational investment to disseminate technology among farmers could be justified

**Table 1. Estimates of stochastic frontier production functions.**

| **Variable** | **Frontier Production Function in** | | | |
|---|---|---|---|---|
| | ***Yala* 2009** | | ***Maha* 2009/10** | |
| Intercept | 3.444*** | (5.563) | 5.765*** | (9.135) |
| Anuadhapura | - 0.0157 | ( - 0.2) | 0.059 | (1.556) |
| Hambantota | 0.119** | (2.025) | 0.198*** | (5.184) |
| Polonnaruwa | - 0.165** | (-2.669) | 0.156*** | (4.15) |
| Ln Land | 0.573** | (6.746) | 0.732*** | (9.52) |
| Ln Labour | 0.108* | (1.776) | 0.068*** | (2.046) |
| Ln Capital | 0.432*** | (7.738) | 0.198*** | (3.246) |
| $\sigma^2$ | 0.25*** | (7.08) | 0.086*** | (6.705) |
| Γ | 0.847*** | (7.08) | 0.802*** | (11.427) |
| Log likely hood Function | - 18.26 | | - 18.79 | |

**Note:** *** significant at 1% level, ** significant at 5% level, * significant at 10% level, t ratios are in parenthesis

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