

An Economic Evaluation of Fertilizer Subsidy on Paddy Production in Sri Lanka

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Introduction

The rice sector plays an important role in the domestic agriculture of Sri Lanka. During the period 2000-2019, annual average contribution of rice farming to agricultural GDP of the country was 20 per cent (Central Bank of Sri Lanka, 2019). The rice sector had been facing unprecedented challenges in Sri Lanka since the early 1960s, such as stagnant yield, diminishing income due to escalation of costs of production, and abandonment of rice lands (Athukorala et al. 2012). These issues were mainly due to low productivity. From the late 1960s to early 1970s the government identified the need to increase productivity of rice farming. Subsidies played an important role in increasing productivity. Besides food security, the government subsidy programmes in a developing country also targets poverty alleviation, rural development, and increased revenue.

The Government of Sri Lanka has entered the chemical fertilizer market since 1962 with the introduction of a fertilizer subsidy scheme. At present, paddy cultivation in Sri Lanka largely depends on subsidies which are not highlighted in policy discussions. Fertilizer subsidy is the most controversial input subsidy program provided for paddy farming. It was initiated in 1962 with the introduction of High Yielding Varieties (HIVs) during the Green Revolution. At present fertilizer subsidies on paddy farming account approximately 50% of the overall use of chemical fertilizer in the country and it is approximately Rs. 40 billion in value (Central Bank of Sri Lanka 2018). Given this background, this study focused on identifying the relative advantage of the fertilizer subsidy scheme of paddy in Sri Lanka.

Objectives

The main objective of the study was to investigate the relative advantage of the fertilizer subsidy scheme among different districts in Sri Lanka. It is also sought identify the cost and benefit of giving a fertilizer subsidy to paddy farmers in the country.

Methodology

This study used secondary data on paddy production and the fertilizer subsidy in Sri Lanka between 2005 and 2019 which includes all 25 districts. Main variables used in this analysis were total paddy production (MT), fertilizer subsidy expenditure (Rs / billion), value of total paddy production (Rs / billion) and land extent cultivated (hectares). This study used panel data techniques. The pooled OLS model is given by Equation 1.

$$Y_{it} = \beta_0 + \beta_1 F_{it} + \beta_2 L_{it} + \beta_3 D_1 + \beta_4 D_2 + \beta_5 D_3 + v_{it} \quad (1)$$

Where, $i = 1, 2, \dots, 25$ (districts); $t = 2005, \dots, 2019$ (year); L = cultivated land area; F = Expenditure on fertilizer subsidies; D_1 = dummy variable (1 if Yala season, 0 otherwise); D_2 = dummy variable (1 if dry zone, 0 otherwise); D_3 = dummy variable (1 if Intermediary zone, 0 otherwise); Y_{it} = dependent variable which is the average production by each district in year t , β_0 = Y intercept across all district. v_{it} = white noise error term.

Study also used random effects model given by Equation 2,

$$Y_{it} = \beta_0 + \beta_1 F_{it} + \beta_2 L_{it} + \beta_3 D_1 + \beta_4 D_2 + \beta_5 D_3 + w_{it} \quad (2)$$

Where, $w_{it} = \mu_i + v_{it}$ with μ_i being unobservable household effects, in particularly, unobservable district effects lie precisely in μ_i .

Results and Discussion

Table 1 show that there is not much difference between the two seasons (Yala and Maha) and other climatic zones. According to average cultivated land areas, intermediate and dry zone are slightly larger by extent than the other regions, but the data show that the extent of land has no effect on paddy productivity. The wet zone reported the lowest average cultivated extent, but paddy productivity (kg/ha) is almost the same as in other zones. The lowest average fertilizer expenditure was identified from the wet zone.

Table 1: Average Figures with Different Seasons and Climatic Zones

Variable	Yala Season	Maha Season	Dry Zone	Wet Zone	Intermediate Zone
Paddy Yield (Kg/ha)	3,983	3,871	4,173	3,418	4,402
Land Area (ha)	26,271	14,875	27,566	8337	29,043
Fertilizer Expenditure (Rs/ MT)	934	512	982	284	1,007

Note: All the information related to paddy yield and cultivated land area are taken from the website of Department of Census and Statistics in Sri Lanka.

As a part of the analysis, we estimated the tolerable level of output for each year (see Table 2 below). The purpose of this calculation is to identify the effectiveness of providing a fertilizer subsidy for paddy production in Sri Lanka. A wide variation between years was observed due to changes in the subsidy amount granted. Total government expenditure on subsidy as a per cent of total value of the paddy output varies from 9 % to 36 % over the study period.

Table 2: Tolerable Level of Output of Paddy for Yala / Maha Season

Year	Subsidy as a % of total value of the paddy	Deduction Ratio (Yala)	Deduction Ratio (Maha)
2005	21.52	78	78
2006	23.59	79	78
2007	22.84	78	75
2008	17.70	84	88
2009	15.38	81	88
2010	14.72	84	88
2011	16.79	85	85
2012	18.61	76	78
2013	9.48	90	88
2014	20.90	80	80
2015	16.14	84	83
2016	18.85	59	40
2017	36.14	66	62
2018	22.62	70	71

Note: Deduction Ratio is estimated based on the total cost of fertilizer subsidies and total value of paddy output in the country in each season.

When estimating the panel data model, we first tested for the correlation of unobservable individual district effects and determinants of average

production of paddy. For this purpose we used the Hausman test. This tests the null hypothesis for non-existence of correlation between unobservable individual effects and determinants of the average yield, against the alternative hypothesis of the existence of correlation. If the null hypothesis is not rejected, we can conclude that the correlation is not relevant and therefore a panel model of random effects is the most appropriate way of carrying out the analysis. In this study we first ran the pooled OLS fixed effects and then the random effects model incorporating all variables. Based on the various tests including the Hausman test, the latter model was selected and estimated after controlling for different variables.

The results of the random effects model are reported in Table 3. We also estimated the different versions of the models by controlling for different variables. Accordingly, in Table 3, model 1 (M1) includes only the fertilizer subsidy variables, model 2 (M2) includes cultivated land area related variables in addition to the fertilizer variable and we include the dummy variables in model 3 (M3). When comparing results between different models, it is clear that most parameter estimates of all the models are statistically significant, indicating their importance in rice production in Sri Lanka.

Table 3: The Results of the Random Effects Model

Variables	M1	M2	M3
Fertilizer subsidies (F)	0.888*** (0.021)	0.177*** (0.000)	0.170*** (0.019)
Cultivated land area (L)		0.807*** (0.019)	0.807** (0.019)
D1			-0.010 (0.018)
D2			0.141*** (0.018)
D3			0.179*** (0.026)
Constant	-3.060*** (0.126)	-0.214* (0.129)	-0.238* (0.125)
Observations	677	677	677
R-squared within	0.393	0.823	0.823
Between	0.974	0.971	0.986
Overall	0.866	0.948	0.962

Note: Standard errors in parentheses. ***, **, and * denote 1%, 5 % and 10 % levels of significance respectively.

The fertilizer subsidy variable is significant in all the specifications of the models and takes the expected sign. However, it becomes clear, as expected, that the effect of fertilizer subsidies is gradually decreasing when more variables are introduced into the model. The coefficient value of this variable becomes gradually lower.

Conclusion

The result of the study shows that while there is a significant variation of total paddy production, the ratio between the value of total fertilizer subsidies and the value of total rice production in the country varies from 9 % to 36 % during the study period. Furthermore, panel data regression results confirm that total fertilizer subsidies, cultivated land area and regional variation have significant impacts on total paddy production in the country. The results of this study will help the government to understand the effectiveness of the existing subsidy program and design a more appropriate as well as targeted system in the future.

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