**THE EFFECT OF FERTILIZER
SUBSIDY ON SMALL-SCALE PADDY
PRODUCTION IN SRI LANKA: A CASE
IN HINGURAGGODA DIVISIONAL
SECRETARIAT DIVISION IN
POLONNARUWA DISTRICT**

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Abstract

At present, the expenditure on fertilizer subsidy has become a heavy burden on the budget in Sri Lanka. The studies which attempted to analyze the impact of fertilizer subsidy on the productivity of paddy farming also provide rather mixed results. Thus, the present study aims to identify the effects of government fertilizer subsidy policy on the productivity of small-scale paddy farming in Sri Lanka by employing the econometric model developed by Hu and Antle (1993). The primary data for the study were drawn from a field survey conducted in the Hinguraggoda Divisional Secretariat division in Polonnaruwa district. The results revealed that fertilizer subsidy has a positive impact on the productivity of paddy farming, but with decidedly less responsiveness (highly inelastic) indicating the need for agricultural policy priorities to enhance the positive responsiveness of fertilizer subsidy on farm productivity. The results further revealed a positive relationship between the level of farmer education and the productivity of a paddy farm. The study suggests the need of farm-level experiments (soil analysis, technological adaptations, water management techniques, type of adaptable paddy varieties, and extension inputs) to enhance the positive responsiveness of fertilizer subsidy policy on small-scale paddy farm productivity in Sri Lanka.

Keywords: *Fertilizer subsidy, paddy farming, small-scale paddy farmers, Sri Lanka.*

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INTRODUCTION

After regaining independence, every successive government in Sri Lanka acknowledged the role of agriculture in the economic development and prioritized the development of agricultural sector by implementing various agriculture development programs such as land reforms and settlement programs, irrigation development projects, guaranteed price schemes, free extension services, and agricultural subsidy schemes. In Sri Lankan domestic agriculture, paddy is the main crop grown by the farmers. At present, the paddy sector occupies 34% of the cultivated area of domestic agriculture and provides a livelihood for approximately 1.8 million farmers (Prasanna & Ranathilake, 2018). About 75% of paddy cultivated area is irrigated, and a majority of the farmers (approximately 70%) are smallholders owning less than 1 ha land area (Weerahewa, 2004). Currently, 95% of the national rice requirement is fulfilled by domestic production.

Many researchers have identified land as constant factor for paddy farming in Sri Lanka, and hence, the productivity increase in paddy farming was recognized as a viable instrument that can focus towards enhancing paddy production of the country, and thereby self-sufficiency rate (The World Bank, 2003). With the introduction of *Green Revolution technology* since the 1960s, the farmers used modern rice varieties (high yielding varieties - HYVs), which are more sensitive to inorganic fertilizer and other agro-chemicals (Kikuchi et al., 2002; Irangani & Shiratake, 2014). Since a majority of farmers are resource-poor smallholders, the government of Sri Lanka provides fertilizer at subsidized rates over many decades to promote paddy farmers applying modern fertilizers through reducing the input cost, to increase per acre paddy yield and enhance marketable paddy production at the farm level. From 1962 to 1989, the main three types of fertilizers – Nitrogen (N), Phosphorus (P), and Potassium (K) were provided at subsidized rates. The fertilizer subsidy was abolished from 1990 to 1994, and re-started only for Urea in 1994 and continued until 2005. In 2005, providing the three types of fertilizers at Rs. 350 (US\$ 3.07) per 50 kg bag of fertilizer was restored (Weerahewa et al., 2010).

According to paddy farming statistics, initially, a stagnated or a sluggish nature of productivity improvement of paddy farming could be observed in the country since the mid-1980s. For instance, paddy production in the country increased from 3,566 kg to 4,372 kg per hectare by only 22.6% from 1985 to 2016 (Central Bank of Sri Lanka, 2017). Secondly, many studies reported the declining profitability of paddy farming (Prasanna & Ranathilake, 2018). These two facts made farmers move away from paddy farming or shift to other profitable crop systems. By considering these facts, the government continues the fertilizer subsidy program as a tool to address the above issues.

The government expenditure on fertilizer subsidy has become a heavy burden to the budget (Wijetunga et al., 2008; Weerahewa et al., 2010) and it aggravates with the escalating import price of fertilizer (Rajapaksha & Karunagoda, 2008). It also has a

serious of unsolicited macroeconomic implications. For instance, in 2017, the government expenditure on fertilizer subsidy was Rs. 30.4 billion which is 15.8% of the recurrent cost of the government (Central Bank of Sri Lanka, 2017). In 2017, the total fertilizer subsidy cost was 4% of the total budget deficit. The subsidy covers more than 90% of the total import cost of fertilizer. In 2017, the government spent Rs. 15,703 million on fertilizer imports. As stated at the outset, the rural economy is primarily based on paddy cultivation. Thus, the agricultural policies of the government have immensely focused on increasing the per acre paddy yield and paddy production to enhance the net earnings of rural paddy farmers through increased marketable surplus.

Among the policies, the fertilizer subsidy program is the most expensive, and politically and socially sensitive program. Some studies argued that the impact of fertilizer subsidy policy on the productivity of paddy farming in the long-run would be destructive due to its negative effect on soil fertility (The World Bank, 2003). It also questions the contribution of the subsidy policy to motivate farmers to utilize organic manure in farming, which is environmentally and economically sustainable. Further, many issues related to fertilizer subsidy policy have been reported such as the quality of fertilizer, over-application of fertilizer at the field, administrative issues, and corruptions.

The existing state of knowledge in the field revealed a mixed effect of fertilizer subsidy policy on the productivity of paddy farming – positive effects (Abeygunawardhana & Arden, 1986; Herath et al., 2013; Yamaguchi & Sanker, 2007; Bandara & Jayasuriya, 2009; Jayawickrama & Sudarshani, 2010; Weerahewa et al., 2010), and no significant effects (Ekanayake, 2006). Aluwihare and Kikuchi (1991) emphasized the need for suitable rice varieties with higher responsiveness to fertilizer, to gain the real effects of fertilizer subsidy. Some studies suggest a gradual withdrawal of fertilizer subsidy in parallel with effective alternatives such as marketing- and extension-oriented policies (Ekanayake, 2006). Some research argued that the aim of the fertilizer subsidy to the farmers, particularly the marginalized farmers, is to avoid adverse effects of government policies on farming communities (Ekanayake, 2006). These studies also noted the positive impacts of fertilizer subsidy for improving the living standards of poor farmers and reducing their burden on variable costs (Herath et al., 2013; Wanninayake & Semasinghe, 2014).

Figure 1: Fertilizer subsidy and total paddy production in Sri Lanka, 1996 – 2015

Source: Central Bank of Sri Lanka, Annual reports

Given this backdrop, this paper attempts to identify the effects of fertilizer subsidy on the productivity of paddy farming in Sri Lanka. In this connection, the study focuses to identify factors affecting the paddy production in Sri Lanka and factors determining the variability of fertilizer subsidy, and to examine the degree of responsiveness of fertilizer subsidy on factor productivity of paddy farming.

LITERATURE REVIEW

Annually, the Sri Lankan government allocates a massive sum of money for fertilizer subsidy – for instance, Rs. 30.4 billion in 2017 – aiming to increase the productivity and production of paddy farming, while addressing the issue of rising cost of production. The subject of fertilizer subsidy in paddy farming is gaining an increasing interest today among the scholars due to various reasons such as the heavy burden on the government budget, negative externalities due to over-utilization of fertilizer, particularly the issue of soil fertility, health issues, and inefficiency in resource allocation in farming. However, the theoretical and empirical investigations on this subject produce mixed results. This section of the paper attempts to review the existing state of knowledge in the field to identify the effects of fertilizer subsidy policy on paddy cultivation in Sri Lanka.

Ekanayake (2006) investigated the impact of fertilizer subsidy on paddy cultivation in Sri Lanka by employing three demand functions for major fertilizers. The study identified the variability of fertilizer price has no statistically acceptable effect on fertilizer usage in paddy farming. The findings suggest that fertilizer subsidy is not a primary determinant of paddy production in Sri Lanka, and thereby proposes gradual withdrawal of the subsidy. As an alternative approach, the study noted the importance of an effective paddy marketing system to generate a profitable outcome than the fertilizer subsidy policy.

However, these study findings are entirely based on macro-level secondary data and do not capture the issues related to the subsidy policy at the ground level.

Using 54 years' secondary data analysis on three main fertilizers applied in paddy farming and paddy production data, Samarasekara (2015) confirms the significant and positive impact of fertilizer subsidy on fertilizer usage, productivity improvement, and the extent of paddy cultivation in Sri Lanka. These findings contradict with the results of Ekanayake (2006). Further, the study suggests the withdrawal of fertilizer subsidy would have a negative impact on farm productivity and living standards of a majority of rural farmers in the country.

Conducting a field research study in minor irrigation systems in Monaragala district, Wijayasena and Thiruchelvam (2009) studied the impact of fertilizer subsidy on yield and organic manure usage in paddy farming. The findings indicated a significant effect of the subsidy on the cost of production (40% reduction) but less effect (8.6%) on yield improvements. Perera et al. (2017) assessed the impact of fertilizer usage on paddy productivity and analyzed the economic impact of policy change of fertilizer subsidy – the movement to cash transfer which further confirms the significant effect of fertilizer application on paddy yield. The study also identified the policy change on subsidy as a viable solution to avoid over-application of fertilizer in paddy fields.

Wijetunga et al. (2008) attempted to study the effect of fertilizer subsidy on paddy production in the Minipe scheme by employing a production function approach. Data for the study were drawn from 191 farmers in major, minor, and rain-fed systems by a questionnaire survey. The study identified the fertilizer subsidy as a crucial determinant of the use of fertilizer in paddy production. By employing Trans-log profit function, Rajapaksha and Karunagoda (2008) have analyzed the impact of fertilizer subsidy on paddy supply and fertilizer demand. The study was dependent on secondary data in four districts, i.e., Polonnaruwa, Hambanthota, Kurunegala, and Kalutara. The results indicated the paddy price as a deterministic factor for fertilizer demand and paddy production than fertilizer subsidy.

METHODOLOGY

The Econometric Model

As outlined in the study background, the main aim of this study is to identify the effects of government fertilizer subsidy policy on the productivity of small-scale paddy farming in Sri Lanka, and also to investigate the effects of farmers' educational level and infrastructure facilities in the agricultural sector on small-scale paddy farming. In this connection, the econometric model developed by Hu and Antle (1993) to examine the relationship between agricultural policy and productivity in paddy farming was

employed. Due to the nature of the phenomenon to be studied, the econometric model was specified as follows:

$$Q = b_0 L^{b_1} A^{b_2} M^{b_3} F^{b_4} e^u \text{ --- (1)}$$

$$TFP = b_0 = \frac{Q}{L^{b_1} A^{b_2} M^{b_3} F^{b_4} e^u} \text{ --- (2)}$$

$$NPC = aQ^{a_1} I^{a_2} C^{a_3} e^v \text{ --- (3)}$$

Where Q represents farm output, L represents the amount of labor, A represents farm size, M represents the cost of machinery, and F represents the cost of fertilizer. Total Factor Productivity (TFP) can be derived using model (1) (see equation 2). The aggregate nominal protection coefficient (NPC) is used as a proxy variable to indicate the subsidization of the agricultural sector by Hu and Antle (1993). The NPC is a function of output (Q), per capita income (I), and per capita agricultural land (C) (see equation 3). Finally, the TFP function estimated the relationship between government policy and farm productivity as specified in equation (4).

$$b_0 = b_{01} + b_{02}(NPC) + b_{03}(N) + b_{04}(E) \text{ --- (4)}$$

Where b_0 represents productivity in paddy farming, NPC represents the fertilizer subsidy, N represents the infrastructure facilities, and E represents the farmers' educational level (years of formal education). Due to the complexity of data on government subsidies on agriculture, the study considered only the fertilizer subsidy.

As farmers' agricultural infrastructure facilities is a qualitative variable, equation (4) was modified as follows:

$$b_0 = b_{01} + b_{02}(NPC) + b_{03}(D1) + b_{04}(D2) + b_{05}(D3) + b_{06}(D4) + b_{07}(D5) + b_{04}(E) + u_i \text{ --- (5)}$$

As a dummy variable, the agricultural infrastructure facilities were divided into 5 categories as transport facilities($D1$), storage($D2$), institutional marketing facilities($D3$), institutional credit facilities ($D4$) and irrigated water supply($D5$).

Sampling and Data Collection

The study employs both primary and secondary data for the analysis. The primary data for the study were drawn from a field survey conducted among 150 farmers in Bubula and Raja-Elagama villages in Hinguraggoda Divisional Secretariat area in Polonnaruwa district by administering a pre-tested semi-structured questionnaire in *Yala* season 2014 and *Maha* season 2014/15. Farmers for the survey were selected using the simple random sampling method. The secondary data for the study were obtained from the reports published by the Central Bank of Sri Lanka, Census and Statistical Department of Sri

Lanka, Department of Agriculture, and Hector Kobbekaduwa Agrarian Research Institute.

RESULTS AND DISCUSSION

Descriptive Profile of Surveyed Farmers

Socioeconomic profile of the sample revealed that almost all farmers are smallholders with an average farm size of 2.75 acres. The average age of a farmer is 48-years with 26 years of farming experience. It implies that most farmers are in the middle age, economically active, and experienced in farming. But it also indicates that paddy farming is less attractive to younger persons in the area. All farmers use their own land for rice cultivation. The average paddy production per acre is 2,191 kg. The average selling price of paddy in the concerned season of the study was Rs. 51.5. The average unit cost of production and average unit profit of paddy farming in the area are Rs. 20.59 and Rs. 30.91, respectively.

Table 1: Socioeconomic Profile of the Surveyed Farmers in the Survey Area

Item	Number/value	Remarks
Age of household head	48	
Household size	4.9 (person)	
Educational level of the farmer	9.2 (years)	
Farming experience	26 (years)	
Farm size	2.75 (acre)	
Average harvest	2,191(per acre)	
Average selling paddy price	(Rs. 51.5/per kg)	(Average price for Nadu and Samba)
The average unit cost of paddy cultivation	(Rs. 20.59/per kg)	Except land, family labor cost, water, and fertilizer subsidy costs

Source: Field survey, 2018

Factors Affecting the Production of Paddy Farming

Many studies have cited the positive relationship between the production (output) of paddy farming and input applications (Dayal, 1984; Huffman & Evenson, 1992; Block, 1994). Those studies further noted the farm size, level of mechanization, amount of fertilizer application, and high-yielding varieties as critical factors that are highly responsive to the production and productivity of paddy farming.

Table 2: Estimated Results of the Production Function

Variable	$R^2 = 0.9638$; $F = 234.61$; $N = 150$	
	Coefficient	<i>P</i> value
Constant	3.955327	0.000
Land size (A)	0.7677513	0.000
Labor usage (L)	0.2073365	0.000
Machinery cost (M)	0.2432719	0.000
Fertilizer application (F)	-0.5000906	0.302

Source: Author's estimation based on field survey data

Table 2 presents the results of the estimated production function. It implies the positive and statistically significant relationship between productivity of paddy farming and inputs - land size, the amount of labor usage, and machinery cost. *F* value (0.0026) of the model confirms the overall significance of the model and 0.96 of R^2 value indicates that the employed explanatory variables explain 96% of the variation of the dependent variable (productivity of paddy farming). The outcome further indicates the negative relationship between the productivity of paddy farming and fertilizer application. Even though this study does not provide sufficient evidence to explain the reasons for the stated negative relationship between two variables, the World Bank (2003) has emphasized that overutilization of fertilizer application will reduce the soil fertility of paddy lands in the long-run.

Factors Explaining the Variability of Subsidization of the Agricultural Sector Fertilizer Subsidy

As employed by Hu and Antle (1993), equation (3) estimations analyze the relationship between NPC measured using fertilizer subsidy as a proxy variable, and total paddy production, farmer income, and per capita land availability. For the total paddy production and farmer income, the one-year lag value of each variable was used as per the nature of the study problem.

Table 3 presents the results of the estimated model (3). The model is overall significant, and $R^2 = 0.96$ indicates employed independent variables in the model explain 96% variability of the dependent variable. Results reveal that paddy output and per capita income of farm household do not have a statistically significant effect on NPC. It interprets that the variability of the variable fertilizer subsidy enjoyed by small-scale farmers in the survey area are not affected by the level of per capita income of farm household and paddy output. It further indicates that fertilizer subsidy policy did not

consider the farm household income level and derived output per farmland in determining the subsidy level, and questions the rationality of fixing the level of fertilizer subsidy at the farm household level.

The variable per capita paddy land has a statistically significant effect on the level of fertilizer subsidy in the region. The possible explanation for this statistically significant and positive relationship is the fertilizer subsidy policy at the farm level– the level of fertilizer subsidy is determined based on the size of paddy land owned by each farmer. As a result, in terms of the land ownership size, rich and poor farmers equally enjoy the fertilizer subsidy. As cited in the literature (Ruttern & Vernon, 1987), in traditional agriculture, it is expected the constant returns to scale, but differences in the output among farmers are broadly explained by the differences in inputs of both land and fertilizer. However, the constant returns hypothesis is subjected to two significant assumptions: first, the assumption of factor divisibility, and second, the supposition of common factor prices regardless of the farm size. These results do not indicate this situation.

Table 3: Factors Explaining the Variability of Fertilizer Subsidy at the Farm Level

	R ² =0.9638	F =227.46	N=150
Variable	Coefficient	P>(t) value	
Constant	3.95532	0.159	
Output (Q)	0.91396	0.160	
Per capita income (I)	-0.01848	0.416	
Per capita paddy land (C)	7642.18	0.000	

Source: Field survey, 2014

Effects of Fertilizer Subsidy on the Productivity of Small-scale Paddy Farming in the Survey Area

Table 4 presents the results of the estimated total factor productivity equation (equation 5) which establishes the relationship between farm productivity and fertilizer subsidy policy. The performed F-test confirmed the overall validity of the model and $R^2 = 0.68$ indicates 68% of the variability of the dependent variable farm productivity is explained by the incorporated independent variables- fertilizer subsidy, infrastructure facilities, and farmer educational level- in the model.

Table 4: Factors Affecting Total Factor Productivity in Small-scale Paddy Farming in the Survey Area

Variables	Coefficient	$R^2=0.68099$ p>(t)value
Cons	0.054118	0.888
lnNPC	0.078708	0.033
D ₁ (transport facilities)	dropped	-
D ₂ (storage)	0.034392	0.284
D ₃ (institutional marketing facilities)	-0.004829	0.897
D ₄ (institutional credit facilities)	0.011040	0.737
D ₅ (irrigated water supply)	dropped	-
lnE (Year of Schooling)	0.344229	0.002

Source: Field survey, 2018

The results reveal the nominal protection cost, which was measured using the cost of fertilizer subsidy, and farmers' educational level, have statistically significant and positive impacts on total factor productivity of paddy farming reflected from farm productivity, though coefficients are highly inelastic. It indicates that fertilizer subsidy contributes to enhancing the total factor productivity of paddy farming. The positive impact of farmers' educational level on total factor productivity indicates the farmers' ability to manage the resources at the farm level and adaptation of new technologies in farming with a better educational level. Specifically, when farmers apply new types of fertilizer, they need to understand the given necessary extension concerning the way of use, application amounts, and suitable periods for the application. Less ability to understand these facts lead to creating various side effects for both human and environment, and reduce the productivity of the paddy land. Even educated farmers can understand the side effects of the non-optimum application of fertilizer and its adverse impact on farm productivity. Most farmers get information and the know-how related to market prices, new varieties of seeds, pesticides, and fertilizer through many sources. Besides, they do inventions and innovations on paddy cultivation.

The effects of irrigation facilities on total factor productivity were identified by incorporating five dummy variables – transport facilities, storage facilities, institutional facilities, formal sector credit facilities, and irrigation water supply. The estimates do not indicate significant effects of infrastructure facilities on farm productivity. The dummy variable transport facilities and irrigation water supply were dropped from the model because of non-variability of the data as all farmers equally access the irrigation water under *Giritale* scheme, and all farmers do not have issues of transport facilities with regard to inputs and output in paddy farming.

The variable institutional marketing facilities had a negative sign but were statistically insignificant. The farmer interviews revealed that less involvement of government in the paddy purchasing mechanism has resulted in non-realization of a guaranteed price at the paddy market in the survey area. Also, no government storage facilities are available in the area, and thus, farmers have to sell their harvest soon after harvesting at a relatively low price.

The paddy marketing related data available in the agrarian service center in the area revealed that the Paddy Marketing Board (PMB) purchase only less than 10 percent of the total paddy production under guaranteed price. Also, farmers have to wait in long queues to handover paddy to the PMB and wait some months to receive money. Further, farmers have to fulfill many conditions such as moisture level and high standards of paddy. Therefore, farmers prefer to sell their paddy harvest directly to private traders at low prices. Such factors do not encourage farmers to engage in paddy farming commercially and increase the productivity of paddy farming.

CONCLUSION

The present study aimed to identify the effects of government fertilizer subsidy policy on the productivity of small-scale paddy farming in Sri Lanka by considering the paddy farming in the Hinguraggoda DS division in Polonnaruwa district as a case. The results revealed that fertilizer subsidy has a positive impact on the productivity of paddy farming, but with decidedly less responsiveness (highly inelastic). Since a majority of paddy farmers are smallholder and resource-poor in the country, and the available land is a limiting factor for farming, one of the best ways to uplift the farmers' income is the productivity improvement of paddy farming. Thus, the study results confirm the significance of the fertilizer subsidy policy in terms of uplifting farming income via productivity improvements.

As the policy leads to reduce the cost of inputs of paddy farming, it leads to motivate farmers for paddy farming, and its positive impact on farm productivity leads to an increase in the marketable surplus. Thus, it could be assumed that the protection cost (deadweight losses) of the subsidy policy is offset by the positive effects to motivate farmers to continue with paddy farming. This is essential to establish the self-sufficiency in paddy production and establish the food security of the country, to have positive effects on the productivity of paddy farming and thereby increase the marketable surplus of paddy production, and uplift the smallholder paddy farmers' income.

The positive but less responsiveness of fertilizer subsidy on farm productivity indicates the need for agricultural policy priorities to enhance the positive responsiveness of fertilizer subsidy on farm productivity. Annually, the government of Sri Lanka allocates massive sums of money as fertilizer subsidy. For instance, the government spent Rs. 30.4

billion on fertilizer subsidy in 2017 (Central Bank of Sri Lanka, 2017). Hence, it is evident that the optimum rate of fertilizer application, which gives the highest rate of productivity of paddy farming at farm level, varies based on the field condition of each farm or each irrigation system or non-irrigation system, adoption of fertilizer application techniques, type of rice variety grown by farmers, water management techniques at the farm level, and the effectiveness of agricultural extension network in each system. It could be argued the changes in factor prices (fertilizer price) would motivate farmers to discover the best or improved technologies to gain productivity advantages of farming. Though this argument matches with the theory, the technology development in agriculture in Sri Lanka is purely controlled by the Sri Lankan government. Thus, this study emphasizes technology development or research inputs in agriculture initiated by the government-led institutions with regard to productivity improvement of paddy farming would broaden the scope for factor substitution in response to the price change of fertilizer due to the subsidy policy. Thus, farm-level experiments (soil analysis, technological adaptations, water management techniques, type of adaptable rice varieties, and extension inputs) are needed to enhance the positive responsiveness of fertilizer subsidy policy on farm productivity.

The study further revealed the positive relationship between the level of farmer education and the productivity of a paddy farm. It complies with the theory – a positive correlation between human capital development and firm productivity. However, further analysis is needed to clarify the effects of farmer education, particularly the farmer training program, on rational utilization of fertilizer subsidy. Further, the infrastructure facilities do not have significant effects on farm productivity, mainly due to institutional barriers, and the government involvement in materializing the GPS and formal sector credit provisions is at a minimum level.

As explained in economic theories, any subsidy program conveys a cost to the society – called ‘deadweight loses.’ These study findings confirmed the benefits of fertilizer subsidy to smallholder farmers are diverse due to its impact on productivity improvement that increases the marketable surplus of production and motivating farmers for paddy farming due to the reduction of input cost. However, the findings further indicated the need for improving the positive responsiveness of fertilizer subsidy on farm productivity through farm-level experiments.

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