An Economic Analysis based on Equivalent Variance of the Fertilizer Subsidy: A Case of Mahaweli System H in Sri Lanka

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Abstract

The theory of equivalent variance postulates that, cash transfers are preferred over material subsidies as overall production is expected to increase if the government grants a cash transfer equivalent to the value of the material subsidy. In line with this theoretical argument, the government of Sri Lanka recently undertook a major change in the agriculture subsidy policy by converting the material fertilizer subsidy in to a cash transfer. However this policy reform has received many criticisms from several parties, including the farmers and farmer representatives. The study aims at analysing the economic impact of this policy change on the paddy output by employing macro and micro perspectives. The analysis is based on time series data from 1961 to 2013 at national level and survey data on the Yala seasons of 2015 and 2016 at micro level. The survey was conducted using cluster sampling method and Meegalewa Grama Niladhari division in Mahaweli System H was selected for this purpose. The findings of this study indicate that fertilizer is a significant determinant of the paddy output in Sri Lanka. Further, it was revealed that the government has not allocated a cash transfer equivalent to the material fertilizer subsidy provided under the former subsidy scheme. Thus, a significant reduction can be expected in the paddy output in the Yala 2016. The study recommends that the government should grant equivalent cash transfer or encourage organic fertilizer usage in order to reap the benefits of this policy change.

Keywords: Paddy Cultivation, Fertilizer Subsidy, Cash Transfer, Equivalent Variance

INTRODUCTION

Fertilizer subsidies represent a significant segment of the Agricultural policy of most developing countries. For Sri Lanka too fertilizer subsidy has become the lime light of the Agricultural Policy. Rice being the staple food of Sri Lanka, it is clear that paddy cultivation is the single most important crop occupying a 34% of the cultivated area (Department of Agriculture - DOA, 2016) in Sri Lanka. Paddy is cultivated during two seasons; Yala and Maha and Maha season yields a higher annual average harvest (Central Bank of Sri Lanka, 2014). Despite budgetary constraints, successive governments have provided significant fertilizer subsidies to paddy farmers with the intention of increasing paddy production. As can be seen in Figure 1 the expenditures on fertilizer subsidy as a percentage of total government expenditures has gradually increased over the period of 1996 to 2011 and thereafter a drastic drop can be seen.

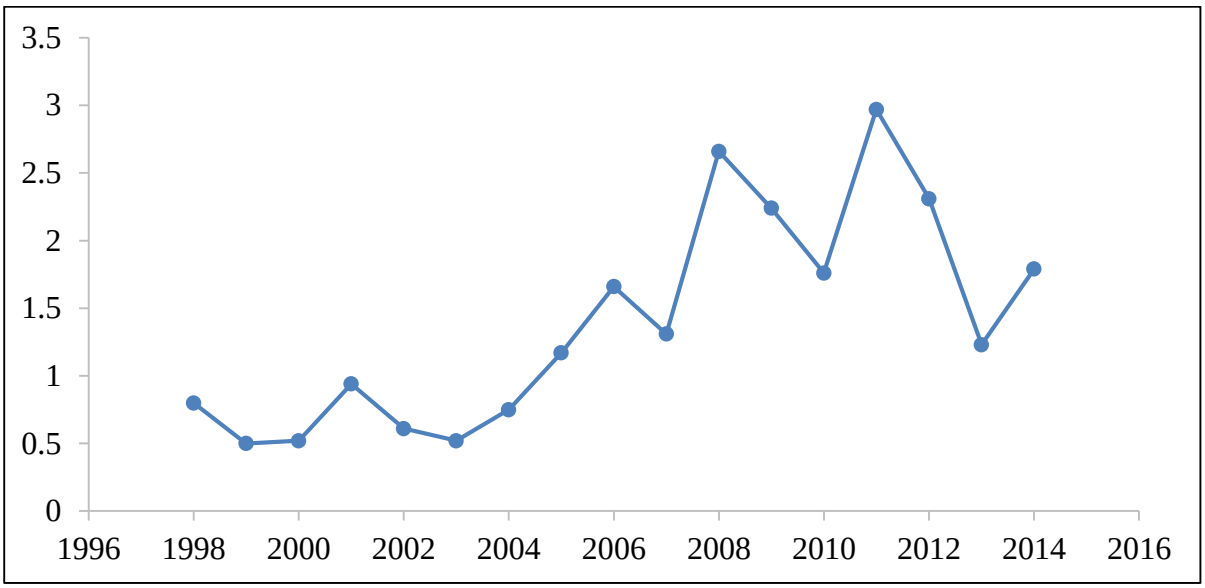

Figure 1: Government Expenditure on the Fertilizer Subsidy (% of total government expenditure)

Source: Weerahewa et al., 2010

The common practise of the governments was to give the fertilizer subsidy in kind to the farmers. That is, farmers were given the material fertilizer subsidy and three main types of fertilizers were distributed under this programme. Those three main fertilizer types are; urea, triple super phosphate (TSP) and potassium chloride (MOP). The present government which came in to the power in 2015 has proposed a new policy to give the fertilizer subsidy as a direct cash transfer. Accordingly, the 2016 budget declared that the government intends to

convert the subsidy to a cash allowance of Rs.25, 000 per hectare per year. Such a policy change was taken mainly to encourage farmers to move away from using chemical fertilizers and to encourage them to use organic fertilizer. This would also ensure that farmers have access to good quality fertilizer, instead of low quality fertilizer that is often given on the subsidy. At the same time the present government intends to reduce the intermediary costs as well as encourage the farmers to use the fertilizer in the most efficient manner (Imtiaz, 2015).

Although the government has proposed to make changes to the fertilizer subsidy scheme, there is much debate on this policy change. The cost to the government of the fertilizer subsidy as a cash transfer is much less, as the cost of administration of the material subsidy scheme which has to be borne by the government could be reduced. That is because direct cash transfer schemes are relatively easy to administer, and leakages would be lower (Ceylon Today, December 2015). However, there is much resistance to this change from the farmers' side. Hence there are many arguments over this matter.

This policy change can be analysed in terms of various aspects including the economic impact on overall paddy production, impact on the farmers, impact on government budget etc. The present study intends to highlight the economic impact of this policy change using the theoretical underpinning of equivalent cash transfer. It is the belief of economists that cash transfers are preferred over material subsidies. Furthermore according to the Equivalent variationtheory, if the cash transfer is equivalent to the value of the fertilizer which was transferred under the material subsidy scheme, the benefits reaped should be higher. Thus, the present study is centred on this theory and impact of this policy change.

Research Problem

Economists believe that the cash transfer is more effective and economical compared to the material subsidy. Accordingly, the government of Sri Lanka has given a cash transfer equivalent to Rs.25, 000 per hectare per year to the farmers. Under the new scheme cash amounts were transferred to the bank accounts of the farmers. In accordance to the theoretical underpinnings, the ideal situation is that an equivalent cash transfer must generate equivalent benefits or even greater. However, the pilot survey revealed that the intended benefits have not been reaped through this policy change. Hence, this sets the need to analyse the economic impacts of the policy change with special reference to the theory of equivalent variation.

Research Objectives

- To find out whether the cash transfer is an equivalent transfer
- To explore the impact of this policy reform on the average paddy production

LITERATURE REVIEW

Nicholson and Snyder in 2006 have brought forward a theoretical argument on in-kind transfers and cash transfers. It was stated that a cash transfer would generate greater welfare for the beneficiaries rather than the in-kind transfer. The authors have used the indifference curve and the budget constraints under the utility theory to explain their argument. As can be seen in Figure 2 below, with a cash transfer being granted to the poor, they are now able to consume at point B, where the consumption is greater in the good X, also utility is higher at this point at higher indifference curve IQ_2. This explanation was used for consumption and the present study uses the same concept for production.

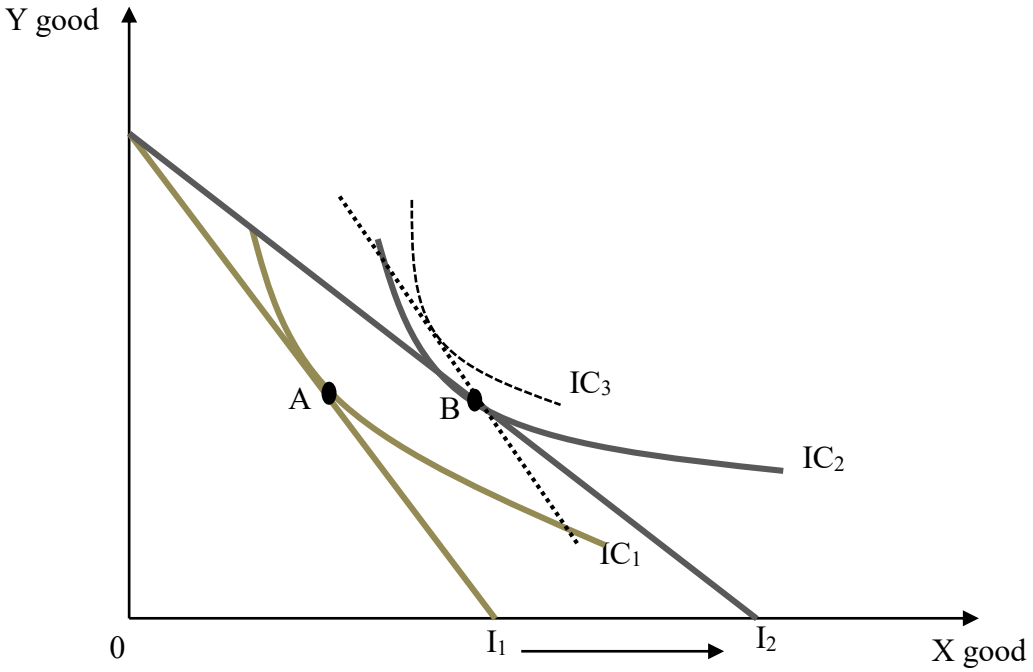

Figure 2: Effect of Equivalent Cash Transfer on Utility

Source: Nicholson & Snyder, 2006

It is also important to look into the relationship between fertilizer input and production of paddy. In this regard regression analysis is a common tool used to build up the relationship between fertilizer and paddy output and the present study too suggests such a model to analyse the relationship. However, regression analysis requires considering other inputs as

control variables and it is noticed that some studies have identified different inputs affecting the paddy production.

Idiong (2007) etimated the production function for paddy using stochastic frontier method, indicated that labour, land and seed inputs have significant relationships with paddy output whereas fertilizer was an insignificant factor. The study observed that majority of farmers have not applied fertilizer due to the belief that a well puddle soil requires little or no fertilizer application. Additionally, capital also showed an insignificant relationship causing the low usage of capital inputs. The study found that labour as the most important variable with elasticity of 0.75 which implied that increasing labour input by 10 per cent will result in about 7.5 per cent increase in paddy output.

Mishra & Marothia (1975) identified land as the most important factor that determines paddy output. However, India has faced a situation of land scarcity due to massive population growth. As a result, the study suggests that the scarce land in India can be saved through heavy application of fertilizer on land. Moreover, the study reveals that the present output of paddy can be obtained by using more fertilizer with low land extent. Therefore, Mishra et al., pointed out that land and fertilizer can be considered as substitutes to a certain extent. Khan & Heady (1972) also found similar results and noticed that one ton of fertilizer nutrient can replace 33.58 acres of land in production of paddy.

Basically, paddy is a labour-intensive crop and according to Bardhan (1973) labour has always been found to be highly significant. In Sri Lanka, farmers use both family labour and hired labour in paddy production. However, the indicated a heterogeneous nature of those two types of labour in terms of productivity. The reason can be partially attributed to the caring and attention that the farmers devote when working for own paddy lands. On the contrary, hired labour is more specialized in farming activities than family labour. Hence, the study found that the hired labour is more efficient than family labour.

Chandrasiri and Karunagoda (2008) estimated paddy production function with land, agrochemicals, machinery, and fertilizer inputs. The results indicated that there exist regional differences in relationships in Sri Lanka. The North Central Province recorded significant relationships with land, agrochemicals and fertilizer while in the North Western Province land, weedicides, pesticides, fertilizer and machinery cost were significantly related.

Karunaratne & Herath (1989) examined the efficiency of rice production in Sri Lanka. The study used the farm size, amount of fertilizer, cost of agro-chemicals, labour and cost of hired equipment to derive production functions for Maha and Yala seasons separately. The farm size (land) recorded a positive and highest coefficient of elasticity in the Maha season. This shows that the land is the most important variable in that season. Accordingly, when doubling the land when other inputs held constant, output would increase by 87 per cent. In Yala season also land coefficient was positive and significant. The coefficient of labour in Maha was not significant, but the opposite has been observed in the Yala season. During Yala labour was not intensively used indicating possibility to increase output by increasing labour input. However, the production elasticity of labour was higher than that of land. Karunaratne et al., found a positive and significant impact from fertilizer on paddy output in Maha season. In contrast, that was opposite in Yala season due to the shortage of water. With regard to cost of agro-chemicals and hired equipment, the coefficients were insignificant and substantially low, which indicates a slight increase in paddy output when the stated inputs are increased in the cultivation.

According the empirical studies, land, labour, fertilizer, animal, cost of agro-chemicals and hired equipment were considered as important factors in deriving the paddy production function, though the selection of inputs differs from one researcher to another. Also, it is evident that regional and seasonal differences exist in findings when estimating the production function to different country scenarios. Therefore, the present study estimates a production function for paddy in Sri Lanka by employing land, fertilizer and animal inputs. The other inputs were excluded from the model due to unavailability of data at the national level. The empirical studies and their findings on factors affecting paddy production is of great importance to the present study, as it can be used as the basis for the regression analysis used in analysis.

Furthermore, empirical studies reveal many facts about the material fertilizer subsidy scheme which prevailed before the policy change. Weerahewa (2010) emphasised that the material fertilizer subsidy scheme has many inefficiencies, especially in the fertilizer distribution channel and a lot of bureaucracies exist too. Thus, she claims that although the material subsidy is politically and socially acceptable it is not economically efficient. In her, policy recommendations she suggests a voucher system which could transform the material subsidy into a cash transfer.

Having examined both theoretical and empirical studies on this study area, it can be stated that barely any research has been done on the new agriculture policy; cash transfer instead of material fertilizer. At the same time, equivalent variation theory too has not been used anywhere, as such a policy change has not taken place before in Sri Lanka. Even in the international context, barely any scholar has used the theory for a production related scenario. This establishes a clear research gap and highlights the present study's potential worth.

METHODOLOGY

The primary objective of the study is to investigate whether the cash subsidy equivalently compensates the fertilizer requirement in paddy production. In this regard the study focuses on paddy farming in Meegalewa Grama Niladhari Division of Mahaweli H System. This section has been devoted to explain the research method used, selection of the study area, sampling procedure, methods of data collection and tools of data analysis applied in achieving the stated research objectives.

Study Area

The study area is Mahawali System H. The major part of the area of the system falls within the Anuradhapura district where small areas falling within the Matale and Kurunegala districts (see Figure 3). It consists of seven (7) blocks namely Galkiriyagama, Meegalewa, Mahailuppallama, Nochchiyagama, Tambuttegama, Talawa and Eppawala. In 2010, system H was populated with 28,156 households and 175,975 individuals (Annual Report of Mahaweli Authority of Sri Lanka, 2010).

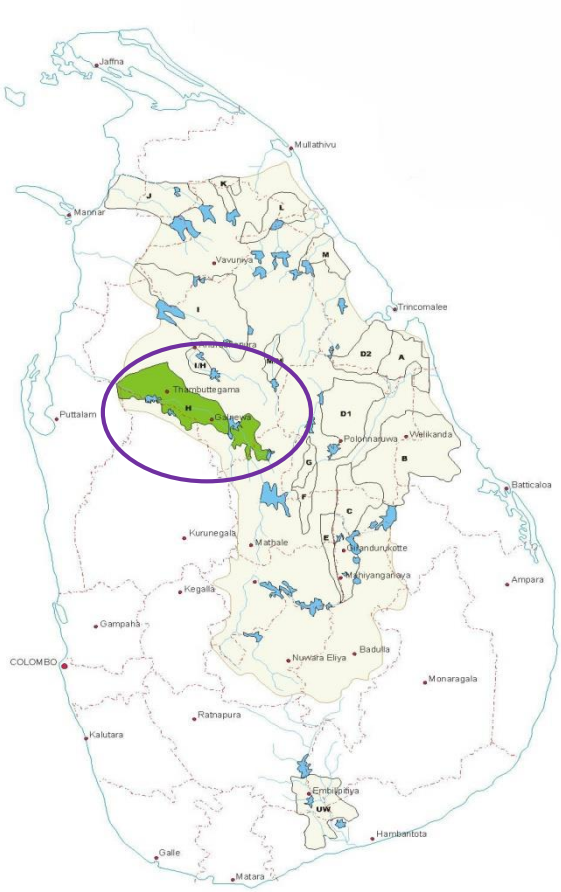

Figure 3: Location of Mahaweli System H

Source: www.mahaweli.gov.lk (2016)

According to the recent statistics from 2002 to 2011, system H was the largest paddy cultivating system among the Mahaweli Systems i.e., System B, C, G, H, L and Udawalawe in terms of total paddy production (in both *Maha* and *Yala* seasons) (see Figure 4). Additionally, Table 1 shows that system H has had the largest paddy cultivated land extent during the period excluding 2004. Therefore, Mahaweli System H was selected as the study area due to the extensive paddy production compared to the other Mahaweli Systems.

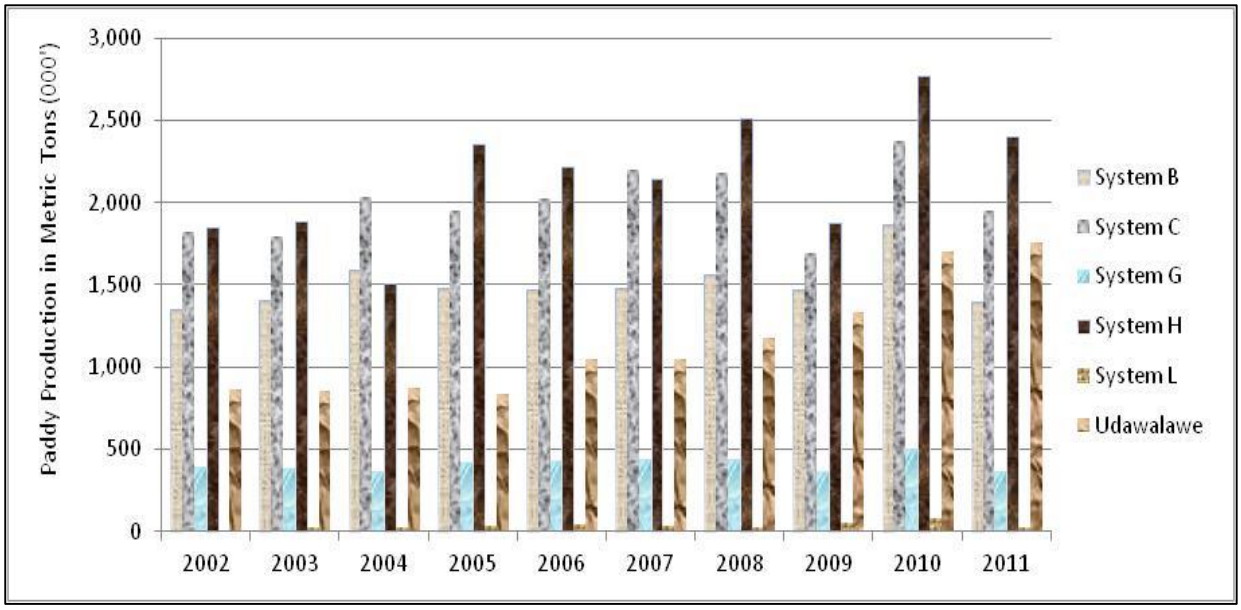

Figure 4: Total Paddy Production in Mahaweli Systems (2002-2011)

Source: Mahaweli Authority (n.d.)

Table 1: Total Paddy Cultivated Land Extent in Mahaweli Systems (2002-2011)

(Hectares)

Year	System B	System C	System G	System H	System L	Udawalawe
2002	31,036	40,227	8,588	**41,502**	297	17,759
2003	33,226	41,165	9,518	**42,843**	861	17,331
2004	34,095	41,733	8,131	34,991	936	17,154
2005	33,980	41,309	9,497	**48,566**	1,038	16,208
2006	31,512	42,294	9,580	**48,767**	1,160	19,388
2007	31,269	43,187	9,235	**44,156**	951	18,911
2008	33,875	43,184	9,727	**51,263**	777	20,147
2009	30,370	31,949	7,641	**36,729**	1,121	21,583
2010	38,512	44,702	10,132	**50,508**	1,557	27,081
2011	38,039	45,645	9,356	**53,119**	999	27,956

Source: Mahaweli Authority (n.d.)

Research Methods

The study has utilized a quantitative approach where regression and mean difference techniques have been employed in the analysis. The relationship between fertilizer input and paddy output was investigated adopting a regression analysis. Thereafter, a mean difference

test was employed to check whether the cash subsidy was equivalent to compensate cost on fertilizer.

Sampling Procedure

A cluster sampling technique has been applied in selecting the sample. The characteristics of 7 Mahaweli blocks can be assumed heterogeneous in terms of land extent under cultivation, average production per hectare, weather conditions, rain fall, soil quality and water sufficiency. Water sufficiency is one of the major determinants of the paddy production. Therefore, Meegalewa block was selected where the water sufficiency is above the average. The second clustering was done at the village level and Meegalewa Grama Niladhari Division was chosen assuming the homogeneity of farming related dimensions in all the villages situated in the block. From the village data was obtained from 94 farm households whose information was available for both 2015 and 2016 Yala seasons.

Data Collection

Secondary sources were used to gather macro and micro data for the analysis. The regression was run using national level data from 1961 to 2013 which were obtained from International Rice Research Institute (IRRI), Phillipines.

The mean difference technique was applied on micro level data of 94 farm households. Data such as cultivated land extent, amounts of fertilizer consumed, received cash subsidy, market prices of fertilizer and recommended fertilizer amounts for the two subsidy programmes were collected from Mahaweli Divisional Office-Meegalewa and Agrarian Service Center-Galgamuwa.

The cash sudsidy system was firstly introduced in 2016 Yala season. Thus, the comparison was done with 2015 Yala season during which material subsidy was prevailed in the country.

Data Analysis

A multiple regression model was run to test the relationship between fertilizer input and paddy output assuming a linear relationship. Land and draft animal were incorporated to the model as controlling variables totaling three independent variables. Paddy output was treated as the dependent variable. Fertilizer and paddy output were measured in thousand tones. Land was measured in thousand hectares and draft animal in thousand animals.

After the derivation of regression model, significance was tested for each independent variable. And the estimated coefficient of fertilizer along with other inputs was interpreted. Using regression results, the research investigated whether fertilizer input significantly affects on paddy production and to what extent.

Fertilizer amounts (Uria, MOP and TPS separately) required by each farmer to cultivate in 2016 Yala season were calculated based on the fertilizer recommendations prevailed in 2015 Yala season. At that time, 215 kg of Uria, 50 of TSP and 55 of MOP were distributed for a farm of 1 Ha land extent. Then, the cash values of each fertilizer type were calculated by multiplying fertilizer amounts by regulated fertilizer prices. One kg of Uria, TSP and MOP costed Rs. 50, Rs. 59.8 and Rs. 55 in 2016 Yala season. The cash values of each fertilizer type were converted to per Ha values. The calculated cash values were summed and interpreted it as the cash required by a farmer to purchase fertilizer to cultivate a land of 1 Ha. On the other hand, cash amounts received by each farmer under the cash subsidy programme were obtained and converted to per Ha values.

These two values were used to test the mean difference and the significance was tested under 5 per cent significance level using the following hypotheses.

H_0: There is no significant difference between two mean values
H_1: There is a significant difference between two mean values

According to the theory of equivalent variation, output should increase if a farmer receives compensation in cash instead of materials. However, cash transfer should be equivalent to the value of material transfer. The objective of this study is to check whether the cash subsidy equivalently compensates the fertilizer amounts received under the material transfer. Therefore, the fertilizer requirements were estimated and they were valued based on the current market prices. If an equivalent compensation was not found the deficiency of fertilizer would be calculated. The difference between the mean values of cash required by a farmer to purchase fertilizer to cultivate a land of 1 Ha and the cash transfer received for 1 Ha would be taken as the deficient cash amount. Fertilizer amounts that can be additionally purchased with that cash deficiency were calculated and understood as the deficiency of fertilizer. Thereafter, the loss in harvest would be calculated with the help of the regression results. The regression derives an estimated coefficient for fertilizer input and it can be interpreted as the unit change in paddy output as a result of a unit change in fertilizer.

Analysis

A regression analysis has been undertaken to check the contribution of fertilizer to the paddy production. The derived regression function is as follows,

Q = -1536.006 + 4.325 L + 3.715 F - 0.386 A

where, Q is paddy production, L is land extent in Ha, F is fertilizer in tones and A in draft animal input.

Table 2: Results of Regression Analysis

	Unstandardized Coefficients		t	Sig.
	B	Std. Error		
Constant	-1536.006	338.242	-4.541	0.000
Land	4.325	0.302	14.323	0.000
Fertilizer	3.715	0.858	4.330	0.000
Animal	-0.386	0.206	-1.874	0.067

Source: Compiled by the authors

According to the regression analysis, it was evidenced that fertilizer and land inputs significantly contribute to the paddy production in contrast animal input has recorded an insignificant relationship at 5% significant level. Fertilizer has a coefficient of 3.715 and it implies an increase of 3.715 units in paddy output when increasing fertilizer by 1 unit.

Mean difference tool was employed in order to check whether the cash subsidy provides an equivalent compensation to the farmers. The results have recorded a significant value of 0.000 which implied a difference between two mean values which is significant even at the 1% significant level. In other words, the cash required by a farmer to purchase fertilizer to cultivate a land of 1 Ha and the received cash amount for 1 Ha under the cash subsidy were significantly different. Thus, it is clear that this policy reform is not in line with the equivalent vitiation theory stated in the literature review. As discussed in the literature review, an economical benefit can only be generated through this policy change, only if an equivalent amount of cash is transferred to the farmers, however the reality shows otherwise.

Table 3: Results of Mean Difference Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Actual	45.744	93	.000	16051.595	15354.774	16748.417
Allocated	30.291	93	.000	12300.531	11494.135	13106.928

Source: Compiled by the authors

The mean value of the cash required to purchase fertilizer in 2016 was Rs. 16051.59 per Ha where the mean value of the cash subsidy was Rs. 12300.53 per Ha (exact value should be Rs. 12500 per Ha). Therefore, it can be evidenced that the cash subsidy has not provided an equivalent compensation to farmers. The deficiency was Rs. 3551.59. If the cash subsidy was equivalently compensated farmers would be able to purchase additional 71.9 kg of fertilizer (50.4 kg from Uria, 9.8 kg form TSP and 11.7 kg from MOP).

As per the regression results, if fertilizer input is reduced by 1 unit, the paddy output will fall by 3.715 units. Based on this result, it can be expected a significant reduction in paddy output in Yala season 2016 which can be amounted to 267.1 kg per Ha.

CONCLUSION AND RECOMMENDATIONS

The study attempted to investigate whether a cash transfer equivalent to the material subsidy has been provided under the new subsidy scheme or not, in year 2016 by the government. The findings indicate that an equivalent cash transfer has not been granted by the government. Hence, the expected benefits of this policy reform have not been reaped. Moreover, the results estimated through the regression model showed that there is a reduction in the fertilizer usage which caused a decrease in the paddy production. This creates an overall negative impact on farmers as well as the national paddy harvest.

The government provided the cash transfer with the intention that the farmers would utilize the full amount of the cash subsidy to purchase fertilizer. However, according to the observations and interviews held with agricultural officials, it is revealed that farmers also

use this cash for unproductive activities. Thus, leading to a reduction in the expected paddy harvest.

In situation where the farmers are unable to purchase the equivalent amount of fertilizer from the cash transfer, it can be recommended that the famers can substitute organic fertilizer, in order to maintain the same level of paddy harvest as during the previous subsidy scheme. If organic fertilizer is to be encouraged, it can be recommended that the government should initiate steps to educate the farmers on the production and usage of organic fertilizer, with the support of agricultural training centers. Alternatively, government can regulate the fertilizer prices, which would enable the farmers to purchase the same amounts of fertilizer under the cash subsidy scheme. This prevents any potential reduction in the paddy harvest. If both these options; encouraging organic fertilizer and regulating fertilizer prices fail, at least the government should take measures to increase the amount of cash transfer, so as to match the purchasing power of the farmers.

In respect to the unproductive use of the cash, it could be suggested that the cash subsidy should be made into a conditional cash transfer rather than the current unconditional transfer system. Then, the government will be able to prevent farmers from using the cash for unproductive uses.

Finally, it can be said that all efforts would fail, if the government doesn't possess a strong monitoring process on this fertilizer subsidy. Therefore, it is recommended that the government establishes and strengthens the monitoring systems and processes so as to ensure that the expected benefits of the policy reform are reached.

REFERENCES

Bardhan, P. K. (1973), "Size, Productivity, and Returns to Scale: An Analysis of Farm-Level Data in IndianAgriculture", *Journal of Political Economy* , Vol. 81, No. 6, pp. 1370-1386.

Central Bank of Sri Lanka, (2014), Annual Report 2014, Central Bank of Sri Lanka, Colobmo.

Chandrasiri, W.A.C.K. and Karunagoda, K.S. (2008), "Technical Efficiency of Paddy Production in the North Central and NorthWestern Provinces of Sri Lanka", *Second Annual Research Forum of Sri Lanka Agricultural Economics Association,* Sri Lankan Agricultural Economics Association.

Idiong, I. (2007), "Estimation of Farm Level Technical Efficiency in Smallscale Swamp Rice Production in Cross River State of Nigeria: A Stochastic Frontier Approach", *World Journal of Agricultural Economics and Extension,* Vol. 3, No. 5, pp. 653-658.

Karunaratne, M.A.K.H.S.S. and Herath, H.M.G. (1989), "Efficiency of Rice Production Under Major Irrigation Conditions: a Frontier Production Function Approach", *Tropical Agricultural Research,* Vol. 1, pp. 142-158.

Mahaweli Authority of Sri Lanka (n.a.), *Agricultural Statistics,* Retrieved March 15, 2016, from Mahaweli Authority: www.mahaweli.gov.lk.

Mahaweli Authority of Sri Lanka (n.a.), *Maps*, Retrieved March 15, 2016, from Mahaweli Authority: http://www.mahaweli.org

Mishra, B. L. and Marothia, D. K. (1975), "Possibilities of Fertilizer Substitution for Land in Paddy Production", *The Bangaladeh Development Studies* ,Vol. 3, No. 2, 239-244.

Nicholson, W. and Snyder, C. (2007), *Intermediate Microeconomics and It's Applications,* (10 ed.), Thompson South, Western USA, pp. 96-97.

Weerahewa, J. Kodithuwakku, S. S. and Ariyawardana A. (2010), "*The Fertilizer Subsidy Program in Sri Lanka",* Cornell University, New York.