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Economic and Social Cost of Fertilizer Subsidy on Paddy Farming in Sri Lanka

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Abstract: ***The main objective of this paper is to examine the effectiveness of fertilizer subsidy on paddy cultivation. ANCOVA model was fitted in order to accomplish this objective. Accordingly, it was found that there is a statistically significant positive relationship between fertilizer subsidy and average yield of paddy farming. Marginal Analysis was employed in order to assess the efficiency of fertilizer usage. According to the analysis, private benefits of fertilizer usage are higher than private cost; hence, fertilizer usage is inefficient; more precisely fertilizer is underutilized. On the contrary, as evidence shows social cost of fertilizer usage is higher than social benefits; fertilizer usage is inefficient but over utilized. Hence, appropriate measures should be taken up in order to reduce fertilizer usage. This dilemma should be handled very carefully. Since evidence has established that fertilizer usage is encouraged by fertilizer subsidy, it is suggested to reconsider the mechanism of fertilizer subsidy instead of removing it.***

Keywords: Fertilizer subsidy, marginal analysis, social cost and benefits, efficiency and effectiveness

1. Introduction

As in many Asian countries, paddy farming plays a greater role in socioeconomic development in Sri Lanka. Paddy is cultivated as a wetland crop in almost all parts of the country. It contributes to the socioeconomic development of the country in many ways. According to the food culture, rice is the staple food of the inhabitants of Sri Lanka. Providing rice requirement of the nation is the first and foremost role of the domestic paddy farming. It is one of the major sources that provide employment opportunities directly for the rural labor force. It also generates employment opportunities through its forward and backward linkages, considerably. Moreover, it provides inputs for the related industrial products. Indeed, it is not just an economic activity but also the way of life particularly of the rural inhabitants. Even within the rapid transformation of the socioeconomic structure with the effects of market friendly economic policy framework, still, it is the livelihood of many of the rural households. Rituals, cultural practices as well as the traditions of rural society and the institutional framework of the rural sector are affiliated the paddy farming.

As a strategically important economic activity, successive governments since independence have given highest priority within their development policy framework to expand the paddy sector. Public policies towards the progress of paddy sector were three-fold, i.e. expansion of the paddy land area, increasing land productivity and minimizing the uncertainty of paddy farming.

Paddy cultivation in Sri Lanka depends largely on subsidies though they are not highlighted in policy discussions. Supply of water free of charge, fertilizer for subsidized price, extension services free of charge, concessionary loans etc. are among them. Fertilizer subsidy is the major as well as most controversial input subsidy program provided for paddy farming sector. It was initiated in 1962 with the introduction of High Yielding Varieties (HIVs) as an effect of the Green Revolution. These HIVs are highly inorganic fertilizer responsive. Hence, it was needed to stimulate paddy farmers to use fertilizer sufficiently and to verify the availability of fertilizer at an affordable price. By use of fertilizer with HIVs, it was expected that land productivity would enhance and cost of paddy production would reduce resulting in more profitable paddy farming (Weerahewa *et al*., 2010). Since 1962, except in few years in early 1990s, fertilizer subsidy is continuing though it was revised from time to time. Since 2006, as a promise of the 'Mahinda Chintana', fertilizer is provided for paddy farmers at a subsidized rate of Rs 350 per 50kg bag. Even amidst the huge increases of the price of fertilizer in the international market, and subsidy cost making immense pressure on the government recurrent expenses, fertilizer subsidy is continuing as pledged. As many claims, fertilizer subsidy is one of the main factors that contributed to the recent progress of paddy sector in terms of total production as well as productivity[1]. Land area under paddy cultivation has increased. The country is now achieving self-sufficiency in rice. Rate of self-sufficiency of rice in 2010 was 113.9 percent. In spite of these achievements, there are some indications that fertilizer subsidy is becoming a controversial issue. The concern of the policymakers is mainly on the burdens of subsidy cost on the government budget. Fertilizer subsidy cost increased by 200 percent from SLRs 11867 million (1.66 percent of government total expenditure) in 2006 to SLRs 36 500 million (2.27 percent of government total expenditure) in 2012. However, politicians fear to intervene the subsidy due to the political sensitivity accompanying with the fertilizer subsidy. The most contentious concern, which goes beyond these economic elements is the external cost of high fertilizer usage. As disclosed by the researchers, environmentalists, professionals, health practitioners etc. high usage of agrochemicals and fertilizer in paddy farming has produced numerous adverse effects on the society such as health issues, water pollution, environmental pollution (Weerahewa

[1] Expansion of the usage of HIVs and the extension services are the other factors that contributed to increase the yield of paddy farming.

et al., 2010; Tibbotuwawa, 2010; Bandara, 2009; Jayasuman *et.al*, http://www.biomedcentral.com/1471-2369/15/124). Under these circumstances, the questions arisen are, is fertilizer subsidy for paddy farming efficient? Should it be revised? What are the alternative measures that can be employed? Is fertilizer used efficiently in paddy farming? The broad objective of this paper is to examine the effectiveness of fertilizer subsidy and the effectiveness of fertilizer usage in paddy farming in Sri Lanka.

2. Data and Methodology

The present analysis is based on the secondary data published mainly by the Department of Census and Statistics (DCS) and the Central Bank of Sri Lanka related to the paddy cultivation. A part of the analysis is descriptive and the other is analytical. ANCOVA model is formulated in order to evaluate the effectiveness of fertilizer subsidy on average paddy yield. In the model, fertilizer subsidy is taken into account by dummy variables. Marginal analysis is used to examine the efficiency of the usage of fertilizer in paddy cultivation. A production function technique is used as the main analytical tool. The production function is formulated based on the Cobb-Douglas production function.

3. Effect of Agricultural Input Subsidies

Agricultural inputs subsidies are a common attribute of the agricultural policy framework in many developing countries in Asia, Africa and also in some high income OECD countries, even though the aims and objectives of the subsidies differ between developing countries and high income countries. Input subsidies were initiated in many Asian countries with the expansion of the elements of Green Revolution. The input subsidies take different forms such as price subsidies, cash grants and vouchers. The overall objectives of the input subsidies are to stimulate farmers for the optimum usage of inputs economically and technically.

Orthodox economic policy does not advocate any kind of subsidies for private goods due to several reasons including distorting the resources allocation, high cost and difficulty to sustain without cutting expenditure on public goods and investments etc. and also as a way of transferring resources, subsidies are inefficient and often inequitable (Steve Wiggins and Jonathan Brooks, 2010). In spite of these converse views, many countries increasingly practice input subsidy policy.

The aims of agricultural input subsidies in different countries are diverse. Many of the subsidy policies are induced by economic factors while some others are motivated by social equity and political patronage. Broadly, increasing productivity, self sufficiency of essential food items, reducing cost of farming and convert it into a profitable production process, maintain price stability of food items, increasing income of the farming families whereby uplifting their living standards are among the end objectives of the agricultural input subsidies (Ellis, 1992; Vijay Paul Sharma and Hrima Thaker, 2009). Chirwa and Dorward (2013) suggest a number of potential contributions that input subsidies can make to economic development in poor agrarian economies. In addition to reducing food insecurity, ameliorating soil fertility problems, and increasing land and agricultural labor productivity, they can also drive wider, dynamic processes of pro-poor growth, structural change, economic diversification, and market thickening and development.

According to Steve Wiggins and Jonathan Brooks, (2010) though the entire benefit of subsidy do not reach the target groups, many countries provide agricultural subsidies because those help farmers to overcome the difficulties of applying new technology and improved inputs which are possibly hindered alleviating poverty and sustaining food security. As pointed out by Crawford, Jayne & Kelly (2008) subsidies cannot be restricted due to several reasons such as political attractiveness of the subsidies, simplicity of implementation, and the issues which are attempting to address by subsidies are the phenomenon that acquire highest attention nationally as well as internationally.

The views on the effects of agricultural input subsidies are diverse. While some evidence support for the input subsidy policies, some do not do so. It is believed that agricultural input subsidies contributed directly or indirectly to economic and social development of the respective countries. However, since subsidies on fertilizer, agrochemicals, irrigation water etc. naturally induce farmers to over use; they may produce negative externalities to the society (Vijay Paul Sharma and Hrima Thaker, 2009). As per Steve Wiggins and Jonathan Brooks (2010) input subsidies distort the relative prices of inputs as such farmers tend to use subsidized inputs for non-subsidized inputs resulting inefficient usage of inputs.

Even though, some studies on the effects of agricultural subsidies in India revealed a positive impact on paddy farming, some others have not revealed such impact. As in Sri Lanka, agricultural subsidies in India were initiated in 1960 as a result of the influence of the Green Revolution. Although grain production increased in the initial phase of agricultural subsidy policy where by reduced poverty incidence, it is difficult to observe such effect afterward (Dorward *et al.*, 2004; Smith & Urey, 2002: Fan et al., 2007). On the contrary, a study conducted by Sharma and Thaker (2009) concluded that fertilizer subsidy in India is more equitably distributed among farm sizes. Same study has found that small and marginal farmers have a large share in fertilizer subsidy in comparison to their share in cultivated area. Thus, they believe that a reduction in fertilizer subsidy is likely to have an adverse impact on farm production and income of small and marginal farmers and un-irrigated areas (about 60%) as they do not benefit from higher output prices but do benefit from lower input prices.

A study conducted by Nurul Nadia Ramli *et al.* (2012) in order to assess the impact of fertilizer subsidy on Malaysian paddy and rice industry using system dynamic model concluded that fertilizer subsidy has made a significant impact on paddy and rice industry. It has contributed on increase in the yield and the paddy production. As they pointed out, the removal of fertilizer subsidy will decrease the paddy production and consequently, decrease the self-sufficiency level. Their view is that fertilizer subsidy is essential to sustain the Malaysian paddy farming because farmers are not willing to buy fertilizer from their own money.

Ekanayake (2006) has attempted to analyze the impact of fertilizer subsidy on paddy cultivation in Sri Lanka. In this endeavor researcher has estimated three separate demand functions for major fertilizers i.e. namely, Urea, Muriate of Potash (MOP), and Triple Super Phosphate (TSP), by using simple regression model. Estimated model has revealed that changes in the prices of fertilizer and paddy do not have a significant effect on fertilizer usage. Thus, the demand for fertilizer is not affected by its own price. This implies that the fertilizer subsidy is not a key determinant of the use of fertilizer in paddy cultivation. Further, the results have also revealed that own price elasticity of demand for fertilizer was smaller than cross price elasticity between demand for fertilizer and paddy price. Therefore, increasing paddy price would increase demand for fertilizer at a faster rate than the decreasing of fertilizer prices. Another study conducted by Chandrasiri and Karunagoda (2008) in order to investigate the relationships between paddy yield and land, agrochemicals, machinery, and fertilizer have concluded that there are regional differences in the technical efficiency of fertilizer use. As estimate revealed, technical efficiency was higher in the North Central Province than in the North Western Province. A study conducted by Wijetunga, Thiruchelvam, and Balamurali (2008) in order to evaluate the impact of fertilizer usage on the paddy yield in major irrigation schemes during 2005-2008 concluded that increases of fertilizer usage resulted in an increases of the yield. During the period in concern, use of fertilizer has increased by 32 percent as result of the changes in the subsidy scheme, yield has increased by 17 percent. As per Rajapaksa and Karunagoda (2008), paddy yield is more responsive to output price than to fertilizer price.

According to Wickramasinghe, Samarasinha, and Epasinghe (2009), fertilizer subsidy introduced in 2005 has produced a number of benefits to the paddy farming sector. Average yield increased in all water regimes by 4 percent and 11 percent in 2006 and 2007, respectively. The fertilizer input cost of paddy decreased from about 15 percent to only 6 percent of the average cost of production. Farmers' dependence on credit for purchasing fertilizer fell. Fertilizer subsidy has produced more benefits to the small farmers holding less than three acres of paddy land.

As Weerahewa et al. (2010) pointed out, although the fertilizer subsidy helps to reduce the cost of production, some paddy farmers who bought fertilizer at the subsidized price resold it to vegetable farmers at a higher price. Further, based on the stakeholder's opinion, researchers disclosed that about 20 percent of the fertilizer given to paddy farmers under the subsidy program leaks out in this manner.

This brief literature review reveals that there are different experience on the impact of agricultural input subsidies particularly fertilizer subsidy not only in Sri Lanka but also in many other countries. What huge literature shows is that fertilizer subsidy has become a most popular research area among many parties including researchers and policymakers.

4. Fertilizer subsidy policy in Sri Lanka: initiation and evolution

Even though certain subsidies for domestic paddy farming sector have been provided since well before the independence in 1948, as mentioned earlier price subsidy for fertilizer was initiated in 1962. HIVs introduced into the domestic paddy farming sector as a result of the influence of the Green Revolution in early 1960s were highly fertilizer responsive. Because of this it was needed to stimulate paddy farmers to use inorganic fertilizer in paddy farming. As per Ekanayake (2006) the main objective of the subsidy scheme was to make fertilizer available as cheaply as possible in order to encourage its wider use. Implicitly, it was expected to make paddy farming a profitable economic activity by increasing yield by means of using inorganic fertilizer sufficiently on the one hand, and cutting down a part of the cost of paddy farming by providing fertilizer for lower price on the other. Meanwhile with the gradual increase of the demand for rice in the domestic market, increasing average yield was seen as the most feasible solution to meet the increasing demand. Also, it was considered as the mean of achieving self-sufficiency of rice and maintaining food security. In addition, the most impressive feature which existed at this time was the political sensitivity of fertilizer subsidy. As a result of these circumstances fertilizer subsidy has to be continued. Except a very short spell from 1990 to 1994, fertilizer subsidy is continuing throughout the past six decades at different levels. Several fertilizer subsidy regimes of paddy farming could be marked during this period according to the nature of the subsidy as follows (Ekanayake 2006; Weerahewa, 2010; Central Bank of Sri Lanka, 2007–2012):

Phase I – Subsidy provided for three main fertilizers (1962–1989, 1995–1996)
Phase II – Period of Subsidy removal (1990–1994)
Phase III – Subsidy provided only for Urea (1997–2005)
Phase IV – Subsidy provided for all three main fertilizers at a fixed price (Rs. 350 per 50 kg bag) from 2005

The main attribute of the fertilizer subsidy in Phase IV is that subsidy is given to all three main fertilizers i.e. urea, TSP and MOP. In addition to that subsidy has been continuing throughout past decades without change even amidst the sharp increases of fertilizer price in the international market. Moreover, there is no proper targeting mechanism; subsidized fertilizer is provided not only for small scale or marginal farmers but also for large scale farmers without any discrimination.

5. Impact of fertilizer subsidy on fertilizer usage

As mentioned earlier one of the key objectives of introducing fertilizer subsidy is to encourage paddy farmers to apply fertilizer sufficiently thereby increasing production and yield. As data reveals, this objective has been achieved as expected. Use of fertilizer in paddy farming has increased significantly after introducing subsidy. The total fertilizer usage in main four agricultural crops i.e. tea, rubber, coconut and paddy in 1961 was 279 000 MT. The share of fertilizer usage of paddy sector was only about 10 percent. It has increased to 53 percent by 1996. Average use of urea at the national level in 1965 was about 4.36 kg/ha. By 2005, it increased to 284 kg/ha (Wickramasinghe, Samarasinha, and Epasinghe (2009). During the period 1990-94 that the fertilizer subsidy was not available average usage of fertilizer was about 225 kg/ha. After re-introducing the subsidy, the usage has increased to 457 kg/ha during 2006-2012. This implies that the average use of fertilizer has increased significantly at the subsidized fertilizer prices.

6. Impact of fertilizer subsidy on average yield

Average yield of domestic paddy farming has increased remarkably during the past decades. During the 1950s it was about 1230 kg/ha. By 1980s it has increased to 2735 kg/ha. At present average yield is about 4500 kg/ha (CBSL, 1998; 2012). This improvement is caused by a number of factors including use of inorganic fertilizer, HIVs, agrochemicals, extension services and more crucially on the availability of water for paddy farming.

ANOVA regression model can be used in order to evaluate the impact of fertilizer subsidy on average yield of paddy cultivation. Data of 23 years from 1990 to 2012 was used in the analysis. Fertilizer subsidy was taken into account by a dummy variable in the model. As explained above, during the first five years since 1990 no subsidy was given to the paddy cultivation. In between 1998 and 2005 subsidy was given only for the Urea. Between 1995 and 1997 and again since 2005 to 2012 subsidy was given for all three fertilizers. The impact of these three modes of fertilizer subsidy can be taken into account by two dummy variables. In addition to that, Average yield (Y_t) was used as dependent variable. It is a scale variable. The general form of the model is as follows:

$$Y_t = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + u_t$$

Where, Y = average yield

$$D_1 = \begin{cases} 1, \text{if susidy was available only for Urea} \\ 0 \ \text{Otherwise} \end{cases}$$

$$D_2 = \begin{cases} 1 \ \text{if subsidy was available for all fertilizers} \\ 0 \ \text{Otherwise} \end{cases}$$

In the model 'absence of the subsidy' is the benchmark. Average yield of the years when fertilizer subsidy was not existed is given by parameter β_0. OLS estimates of the parameters are given in Table 1.

As estimates reveal, there are statistically significance differences of the average yields between different level of fertilizer subsidy. Average yield in the years of fertilizer subsidy is not existed was 3430.6 per/ha. Average yield is 3851.75 (= 3430.6+421.15) per/ha in the years of which subsidy was given only for Urea. It is 4074.90 (= 3430.6+644.3) per/ha in the period of which subsidy was given for all three types of fertilizers. What these evidences prove that fertilizer subsidy contributes to produce relatively a higher average yield in the paddy cultivation. In terms of economic viewpoint, this finding justifies the fertilizer subsidy of paddy cultivation in Sri Lanka. However, this finding is not much sensible because it just says that average yield is higher when the fertilizer subsidy is available. It does not provide any other information related to fertilizer subsidy and average yield. Thus this finding is less supportive for the decision makers.

7. Efficiency of the usage of fertilizer

Effectiveness of fertilizer subsidy in terms of economic viewpoint can be assessed by evaluating the efficiency of the usage of fertilizer in paddy cultivation. This is because one of the prime objectives of the fertilizer subsidy is to encourage farmers to use fertilizer sufficiently. Marginal analysis provides appropriate tools to evaluate the efficiency of the use of inputs in a process of production. According to the marginal analysis efficient point of the utilization of a given input is the point that the value of the marginal product (MVP) of the input equals to its marginal cost (MC). Symbolically this condition can be expressed as $MVP_i = MC_i$. Since the difference between these two components is the marginal benefit (MB), at the equality point marginal benefit of the input become zero. Any input utilization point that deviates from this condition, i. e. if $MVP > MC$ or $MVP < MC$, indicates the inefficient utilization of the given input. At the optimum input utilization point marginal benefit of the particular input must be equal to zero (*MB = 0*).

For the evaluation of the efficiency of input utilization based on the above analysis, production function technique can be tested. Among the various types of standard production functions, Cobb-Douglas production function is appropriate for this analysis because in addition to its theoretical relevance, it provides the necessary tools for the above analysis. In this analysis yield of each year (Y) is taken as the explained variable while extent of harvested land (X_1) and quantity of fertilizer used (X_2) in each year are taken as explanatory variables. The effects of other factors on the variation of yield are to be taking into account by the error term.

The general form of the production function is

$$Y_t = \beta_0 X_{1t}^{\beta_1} X_{2t}^{\beta_{2t}} e^{u_t}$$

The log-linear form of this function is

$$\ln Y_t = \ln \alpha + \beta_1 \ln X_{1t} + \beta_2 \ln X_{2t} + u_t$$

If 'lnα' of the model is defined as β_0, we can re-write the above model as

$$\ln Y_t = \beta_0 + \beta_1 \ln X_{1t} + \beta_2 \ln X_{2t} + u_t$$

Where,

$\ln Y_t$ = log value of yield in t^{th} year

$\ln X_{1t}$ = log value of land extent in t^{th} year

$\ln X_{2t}$ = log value of fertilizer used in t^{th} year

β_0, β_1 and β_2 are parameters.

Data pertain to the years between 1995 and 2012 were used to estimate the function and OLS estimates are given in Table 2.

The value of coefficient of determination is 0.858 and p-value of ANOVA is 0.000 implying that the overall model is statistically significant. Further p-values of slop coefficients are less than 0.05 imply that those are also statistically significant at 5 percent significance level. Positive slop coefficients indicate that there is a positive relationship of yield with two inputs i.e. land and fertilize. D-W statistic is 1.65; implies that though there is a positive autocorrelation it is not strong so as to harmful to the parameter estimates.

The estimates reveal that production elasticity of land (X_1) and fertilizer (X_2) inputs are 0.606 and 0.451, respectively. These imply that 1 percent increase of the extent of land and fertilizer lead to an increase in the yield by 0.606 percent and 0.451 percent respectively. The sum of the production elasticity of two inputs shows the constant returns to scale. This means that yield increases proportionately to the increase of both inputs. However, it should be noted that there are some other factors which are not included implicitly in the model which explain 14 percent of the total variation of the yield.

In order to evaluate the efficiency of input usage based on the above framework, value of marginal products and marginal cost of each input should be computed[2]. Computed values of marginal product, marginal cost and marginal benefit of each input are given in Table 3.

Marginal benefits of land and fertilizer have deviated from zero implying. This implies that the utilization of both inputs is economically inefficient. Negative marginal benefit of land implies that the average land size of paddy farming is larger than the optimum size. For the efficiency of land utilization, average land size should become smaller than the existing size. In practice, it is accepted that larger the land size input utilization is more efficient; hence produce higher yield. Thus, this result is contradicted with the practical situation. However, on the other hand, one can argue that a small plot produce higher yield because when land size is small farmers make their every efforts to get maximum yield and they can utilize inputs more economically hence producing higher yield.

Positive marginal benefit of fertilizer indicates that the fertilizer is used less than the optimum level. Thus, for more benefits, usage of fertilizer must be increased. However, it should be noted that the quantity of fertilizer used in paddy farming does not depend on the subsidy because the quantity of fertilizer obtained by each farmer is determined exogenously by government officials on the recommendation of the Department of Agriculture[3]. Hence, it is needed to reconsider these recommendations.

Overall, the analysis reveals that the usage of fertilizer in paddy farming is economically inefficient. Fertilizer is used less than the optimum level. However, there is no evidence to suggest that it is linked directly with the fertilizer subsidy.

8. Social costs and benefits of fertilizer usage

The above analysis was based purely on the private cost and benefits of paddy farming and did not taken into account the social cost and social benefits. For the realistic evaluation, social cost and benefits must be compared rather than merely private cost and benefits. Private cost of production consists only of the cost encountered directly by the producer. But, efficiency of the production process is determined not only based on the private cost and benefits but on the entire cost and benefits experienced/enjoyed by the society as a whole. So-called 'social cost' includes the entire cost encountered by the society including private cost and external cost of the production. Similarly, social benefits include the entire benefits of the production process including private benefits and external benefits enjoyed by the producer and society.

Quantifying social costs and benefits is not an easy task. Thus, in this evaluation, an attempt was made to examine the social cost and benefits based on the experiences and published facts and information instead of quantifying them.

9. Fertilizer subsidy and private benefits

As explained earlier, usage of fertilizer significantly contributes to increases the average yield of paddy farming. Increase of average yield increases the paddy production directly and the farmers' income indirectly. On the other hand, while increasing farmers' income, direct cost of paddy farming is reduced significantly by the fertilizer subsidy. This in turn leads to make paddy cultivation a profitable economic activity. The increase of paddy production contributes to food security of paddy farming families. These are the private benefits of fertilizer subsidy.

10. Contribution of fertilizer usage to food security and social benefits

Self-sufficiency of essential food item and food security are the crucial factors that affect the stability of key aspects including social, economic, cultural and political of any country. If the supply of essential food items depends on imports, it will be adversely affected on the stability of these aspects. Because of this, every country make efforts not only to achieve self-sufficiency in essential food items but also to sustain food security. Only then a country can face the unexpected disasters and challenges effectively.

As a result of the efforts made by the successive governments for over past five, six decades since

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[2] MPP of i^{th} input can be estimated by using the formula $MP_i = \hat{\beta}_i \frac{\bar{Y}}{\bar{X}_i}$. MVP of each input can be computed multiplying MPP of each input by the price of output. The price of a metric ton of paddy was used as the price of output. Value of the rent of a hectare of paddy land was taken as the marginal cost of the land input while subsidy price of a metric ton of fertilizer was considered as the marginal cost of fertilizer input.

[3] The Department of Agriculture developed its latest fertilizer recommendations for paddy in 2001. These recommendations are based on productivity levels (7, 6, 5, and 4 metric tons per ha), agro climatic zones (low country dry and intermediate zones, low-country wet zone, and up-country and mid-country wet and intermediate zones), and the age of the plant (3, 3½, 4, and 4½ months) (Weerahewa et al. (2010).

independence, Sri Lanka has almost achieved self-sufficiency in rice at present. In 1950, we have imported 0.482 million metric tons of rice. The domestic rice production was only about 0.185 metric tons. By 2012, rice import has declined to about 0.36 million metric tons. It is undoubted that the usage of fertilizer is one of the key contributors to this success. Applying fertilizer together with High Yielding Varieties involve in increasing average yield of paddy cultivation as such total paddy production of the country. This progress is hard to achieve without the use of inorganic fertilizer. This is one of the benefits experienced by the entire society as a result of the usage of fertilizer. Moreover, increase of paddy production of the country as a result of the usage of fertilizer contributes to increase the Gross Domestic Product (GDP) of the country. This is another external benefit enjoyed by the society due to the fertilizer subsidy.

It is, now, clear that fertilizer subsidy generates benefits to the paddy farmers directly and to the entire nation, indirectly. These are the arguments in favor of the fertilizer subsidy.

11. Social cost of Fertilizer Subsidy

Though fertilizer subsidy produces benefits significantly to the nation, as evidences prove, it generates a huge cost, too. As explained above, considerable amount of government income is devoted for fertilizer subsidy, annually. Opportunity cost of the subsidies in the countries like Sri Lanka, which has a very low government income base, is immense because they restrict public expenditure on other productive investments. Accordingly, expenditure on fertilizer subsidy constrains the public investments in other productive sectors making adverse impacts for the long term sustainability of the economy. This is one of the indirect costs of fertilizer subsidy encountered by the society. Apart from this, the most critical social cost generated by the usage of fertilizer is the damage made by it to the environment and human lives. It is believed that unusual chronic kidney disease reported among paddy farmers in the dry zone is a consequence of huge usage of inorganic fertilizer and agrochemicals. Although the debate over the effects of fertilizer on the human health is not over and experiments are continuing, the reports based on several experiments have suggested that the root cause of unusual spreading of kidney disease in agricultural areas in dray zone is the use of inorganic fertilizer (Jayasuman *et.al*, http://www.biomedcentral.com/1471-2369/15/124). With the increases of the number of kidney patients, on the one hand, the government has to bear a huge cost for the treatments because the cost of dialysis and transplantation is very high. On the other hand, the families with kidney patients also have to spend much of their little income for the treatments. Moreover, informal inquiries revealed that some of the families have lost their income base since the patient is head of the household or the main income earner of the family. Therefore, they have become poorer. Meanwhile, some argue that the improper and excessive application of inorganic fertilizer may cause pollution of waterways by heavy metals such as cadmium, which they believe has resulted in increased occurrence of chronic renal failure. Deposition of nitrates and phosphates in water bodies causes excessive algae growth resulting in oxygen depletion, water contamination and fish mortality (Bandara, 2009; Tibbotuwawa, 2010). With the pollution of waterways, providing quality drinking water has become a big issue. The government has to bear an additional cost to provide drinking water.

It is clear that the usage of fertilizer has produced a huge cost for the individual families as well as for the society. Although fertilizer subsidy produces substantial social benefits too, the problem is much critical since the social cost is not only in terms of physical resources but in terms of human lives. Thus, the usage of inorganic fertilizer must be reconsidered seriously. However, it does not mean that fertilizer subsidy should be completely removed. In fact, removing fertilizer subsidy is not an easy task because on the one hand, fertilizer subsidy is a highly politically sensitive phenomenon and on the other hand, removing fertilizer subsidy will decrease profitability of paddy farming since it is the only relief that farmers get within gradual increase of other costs of paddy farming. Moreover, it will adversely affect the self-sufficiency of rice. Thus, instead of removing fertilizer subsidy policymakers should reconsider the fertilizer recommendation for paddy farming and substitute for inorganic fertilizer.

12. Conclusions and Policy Discussions

As theoretically expected, there is a significant positive relationship between fertilizer subsidy and average yield of paddy farming. Fertilizer subsidy has contributed largely to increase the average yield. As a result, at present, paddy production has increased largely and the country has achieved self-sufficiency in rice.

In purely economic point of view fertilizer usage is inefficient; it is less than the optimum level. For the efficiency, fertilizer usage must be increased. When take into account the social costs, fertilizer usage is inefficient, too. In this point of view, fertilizer usage is higher than the optimum level. This implies that social cost can be decreased by decreasing fertilizer usage. Hence, policymakers should handle this dilemma very sensibly. Undeniably, fertilizer subsidy has encouraged farmers to use fertilizer increasingly. Hence, making appropriate revisions to fertilizer subsidy such as introducing targeting mechanism, incorporate it into the market mechanism are some policy options that can be applied in order to decrease fertilizer usage. Reconsideration of fertilizer standard for paddy farming is another policy option. Furthermore, in the long run, concentration on the alternatives for and the quality of inorganic fertilizer is some other policy options. However, undoubtedly there may be a trade-off between self-sufficiency of rice and human health and environmental safety.

Table 1: Coefficients of the ANOVA model

Variables	Coefficient	Std. Error	t	Sig.
Constant	3430.600	126.820	27.051	0.000
D_1	421.150	161.664	2.605	0.017
D_2	644.300	155.322	4.148	0.000

Table 2: Coefficients of the production function

Model	B	Std. Error	t	Sig.
Constant	1.334	.962	1.386	.186
X_1	.606	.181	3.356	.004
X_2	.451	.094	4.785	.000

Table 3: Marginal values of Land and Fertilizer inputs

Input	Marginal product (Mt'000)	Value of marginal product (SLRS)	Marginal cost (SLRS)	Marginal benefit (SLRS)
Land	0.726	21780	29820	-8040
Fertilizer	0.619	18570	7000	11570

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