

## The Impact of “Kethata Aruna” Fertilizer Subsidy Programme on Fertilizer Use and Paddy Production in Sri Lanka

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**ABSTRACT:** “Kethata Aruna”, is the existing fertilizer subsidy programme for paddy sector, which was implemented in 2005 in Sri Lanka. Under this subsidy programme, the three major fertilizers, i.e. Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MOP), have been heavily subsidized for paddy farmers with the intention of promoting the use of fertilizer to increase national paddy production. This paper investigates the impact of the price of paddy fertilizer on the level of fertilizer application and national level paddy production for the period 1981 to 2009. Secondary data obtained from the relevant government institutions were graphically and statistically analyzed to determine the trends and relationships of different parameters on national paddy production. The results revealed that the subsidized fertilizer prices promoted the use of recommended rates of fertilizer by farmers in their paddy crops. It also revealed that the “Kethata Aruna” fertilizer subsidy programme has triggered the paddy farmers to use more fertilizers per unit area than what they used previously. However, the imbalanced fertilizer use in the past, particularly the overuse of urea compared to TSP and MOP, was controlled by the present subsidy programme by making TSP and MOP available at the same price as of urea. About 88% of the variation of the national paddy production is explained by combined effect of total fertilizer, sown extent and the technological improvement. Results showed that a 1% increase of the input of total fertilizer has resulted in a 0.109% increase in the total national paddy production, while an increase in 1% of sown extent resulted in a 0.85% increase in the national paddy production.

**Keywords:** Fertilizer subsidy programme, fertilizer use, paddy

### INTRODUCTION

A fertilizer subsidy programme was first implemented in Sri Lanka in 1962. This initiation was coincided with the onset of Green Revolution and the main intension of the provision of fertilizer subsidy was to encourage farmers to switch to new high yielding varieties which are highly responsive to chemical fertilizers (Weerahewa *et al.*, 2010 and Kikuchi & Aluwihare, 1990). Since 1962, there have been a number of changes to the fertilizer subsidy policy in Sri Lanka in terms of the price, type of fertilizers subsidized, crops that received the subsidy and the method of subsidy, i.e. fixed or variable subsidy. The existing “Kethata Aruna” fertilizer subsidy programme, introduced in 2005 is given only for paddy farmers under certain criteria.

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Provision of fertilizers at lower cost along with the assistance to use fertilizers according to recommended rates, would expect to increase the national crop production through the wide use of plant nutrients. One of the main intentions of the existing fertilizer subsidy programme is to increase the rice crop productivity (as per the “*Mahinda Chinthana*”) to attain self sufficiency in terms of rice (MADAS, 2007). In turn, it is targeted to reduce the cost of food importation, help farmers to reduce the cost of production and channel this benefit to the consumer through reduced cost of rice. Under this subsidy programme, the three major paddy fertilizers namely, Urea, Triple Superphosphate (TSP) and Muriate of Potash (MOP) are given at a price of Rs. 350 per 50 kg, subsidizing approximately 91.5% of the total cost of fertilizer (Ministry of Finance & Planning, 2008 & 2009).

Many studies have been carried out in different parts of the world to study the variation in application of chemical fertilizers as a response to their price (Heady & Yeh, 1959, Sidhu & Sidhu, 1985 & Quddus *et al.*, 2008). Economics of fertilizer use in major crop sectors of Sri Lanka was studied by Chandrapala & De Silva (1988). The crop sectors focused in the study were tea, rubber, coconut and paddy. Regression models indicated that the relative price ratio of fertilizer and the output has a significant effect on fertilizer use. Furthermore, the results suggest that the removal of fertilizer subsidy will worsen the situation with respect to fertilizer use in these sectors. From the results of an investigation on the impact of fertilizer subsidy on paddy cultivation in Sri Lanka, Ekanayake (2006) has reported a relatively high correlation between fertilizer use and paddy price compared to the fertilizer use and fertilizer price. Wijetunga *et al.* (2008) investigated the effects of “*Kethata Aruna*” fertilizer subsidy programme in the Minipe irrigation project. The results showed that during the period from 2005 to 2007 the fertilizer use has increased by 32% while the yield and the cultivation extent have increased only by 17% and 10% respectively. However, there has not been any information as to how the present subsidy programme has affected the fertilizer use, the use of relative proportions of different fertilizers and total paddy production.

Therefore, present study was conducted to identify the general trend of fertilizer use in the paddy sector as a response to the introduction of the “*Kethata Aruna*” fertilizer subsidy programme. Furthermore, the impact of fertilizer price on the use of different fertilizers, the impact of fertilizer subsidy on the use of recommended amount of fertilizers, and factors which are assumed to affect the paddy production at the national level were investigated.

## MATERIALS AND METHODS

The study focuses on the fertilizer consumption in paddy sector and the fertilizer price available for the paddy farmers from 1979 to 2009. In order to explain the variation of fertilizer consumption pattern, national paddy cultivation extent, weather patterns prevailed in the country and secondary data from previous studies, reports and relevant government departments were used for the analysis. Department of Agriculture (DOA), Department of Census and Statistics (DCS), National Fertilizer Secretariat (NFS), Department of Meteorology, the Ministry of Finance and Planning, and the Central Bank are the main institutes from which secondary data were obtained. The data obtained were both graphically and statistically analyzed using Microsoft Excel 2007 to determine the trends in paddy sector total fertilizer use, fertilizer use per unit area and use ratio of Urea: TSP: MOP with respect to fertilizer price.

A multiple regression analysis was done to find the relationship between total national paddy productions with the amount of fertilizer used, sown extent and technological improvements (Herath, 2011).

## RESULTS AND DISCUSSION

### Impact of fertilizer subsidy on use of fertilizers

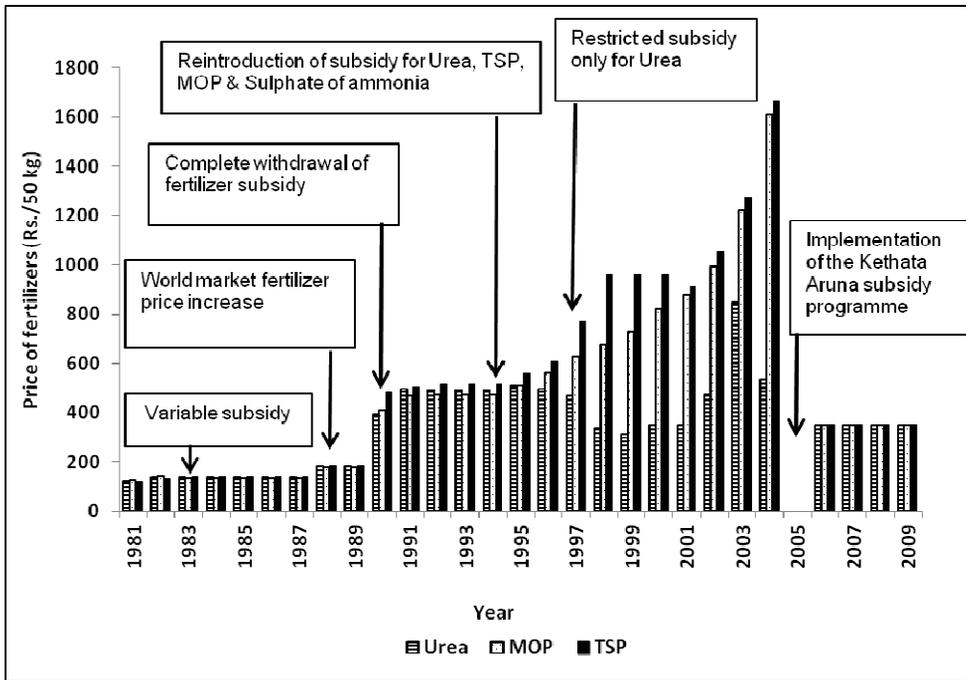
A fertilizer subsidy policy was first introduced in Sri Lanka in 1962. From 1962 to 1975 different fertilizer types were subsidized at different rates and the subsidy level varied with crop as well. In the period from 1975 to the end 2005, the fertilizer subsidy had been uniform for all the crops even though the subsidized rates varied (Table 1). Towards the end of 2005, the government implemented the present fertilizer subsidy programme. This subsidy programme was implemented only for the paddy sector, in which nearly 75% of the imported fertilizer was utilized (NFS, 2008).

**Table 1. Fertilizer subsidy history in Sri Lanka**

Year	Description of fertilizer subsidy
1962	Introduction of the fertilizer subsidy for the first time in Sri Lanka
1983	Introduction of variable subsidy programme – under this the fertilizer price is kept fixed
	Significant increase of the fertilizer prices in the world market
1988	Removal of subsidy for Sulphate of Ammonia and Rock Phosphate leaving the subsidy only for Urea, TSP and MOP
1990	Fertilizer subsidy was removed from all sectors of agriculture
1994	Re-introduction of the fertilizer subsidy for Sulphate of Ammonia, Urea, TSP and MOP
1997	Removal of subsidy from all other fertilizers except for Urea
2005	Implementation of the “ <i>Kethata Aruna</i> ” fertilizer subsidy programme only for paddy farmers under certain criteria – under this Urea, TSP and MOP are given at a price of Rs. 350 per 50kg each

A fixed fertilizer price (variable subsidy policy) was continued from 1983 to 1987 until the cost on fertilizer subsidy had to be reduced due to the significant increase of fertilizer prices in the world market in 1988 (Fig. 1). The subsidy for Sulphate of Ammonia and Rock phosphate was removed in 1988 leaving the subsidy only for Urea, TSP and MOP. Since the fertilizer subsidy was a heavy burden on the government budget, it was completely removed from all the sectors of agriculture in 1990. A clear reduction in the paddy sector fertilizer use, in terms of Urea, TSP and MOP, was observed immediately (Fig. 2). This acts as an evidence for the fact that the fertilizer consumption by the paddy sector depends on the price of fertilizers. However, the gradual increase in fertilizer consumption from 1991 to 1994 (Fig. 2) could be interpreted as adjustment of farmers to the situation. Various reasons led to the re-introduction of the fertilizer subsidy as a variable subsidy for Sulphate of Ammonia, Urea, TSP and MOP in 1994. Although the fertilizer use was expected to rise due to the implementation of the subsidy, it was slightly less than the consumption figures of 1994 (Fig. 2). Two reasons could be put forward to explain this situation. First, the price being almost the same as the previous year, the fertilizer consumption in 1995 would have been

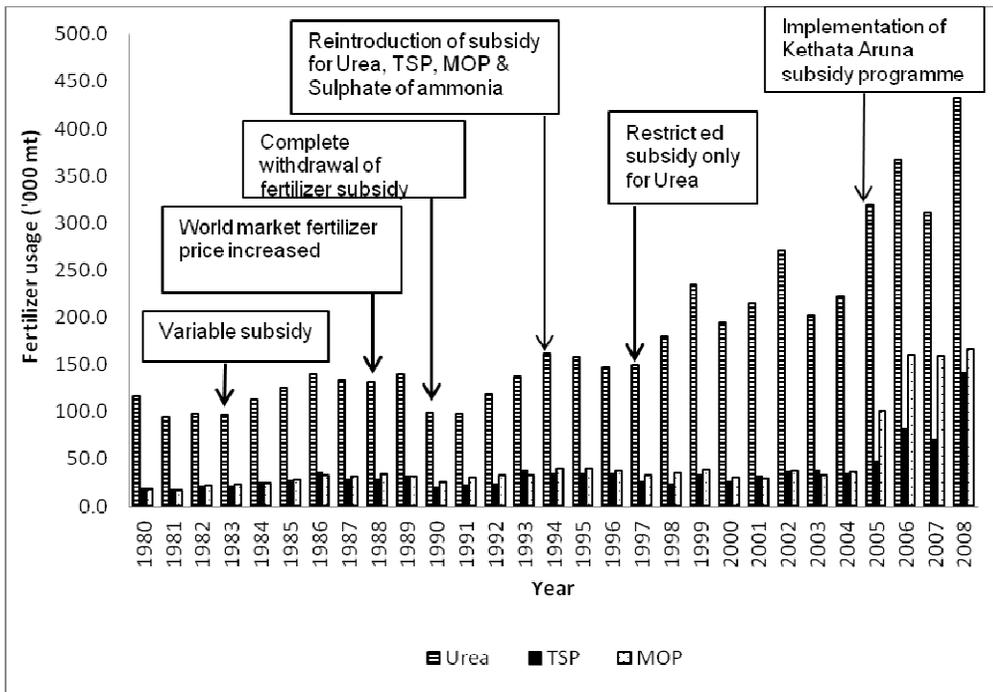
independent of the fertilizer price. The second possibility is the decrease in fertilizer use due to the decrease in paddy cultivation (Fig. 3) in 1995 and 1996 as a result of the severe drought condition prevailed in the country (Anon., 1997).



**Fig. 1. Annual average prices of Urea, TSP and MOP from 1981 to 2009**  
(Source: Department of Agrarian Development)

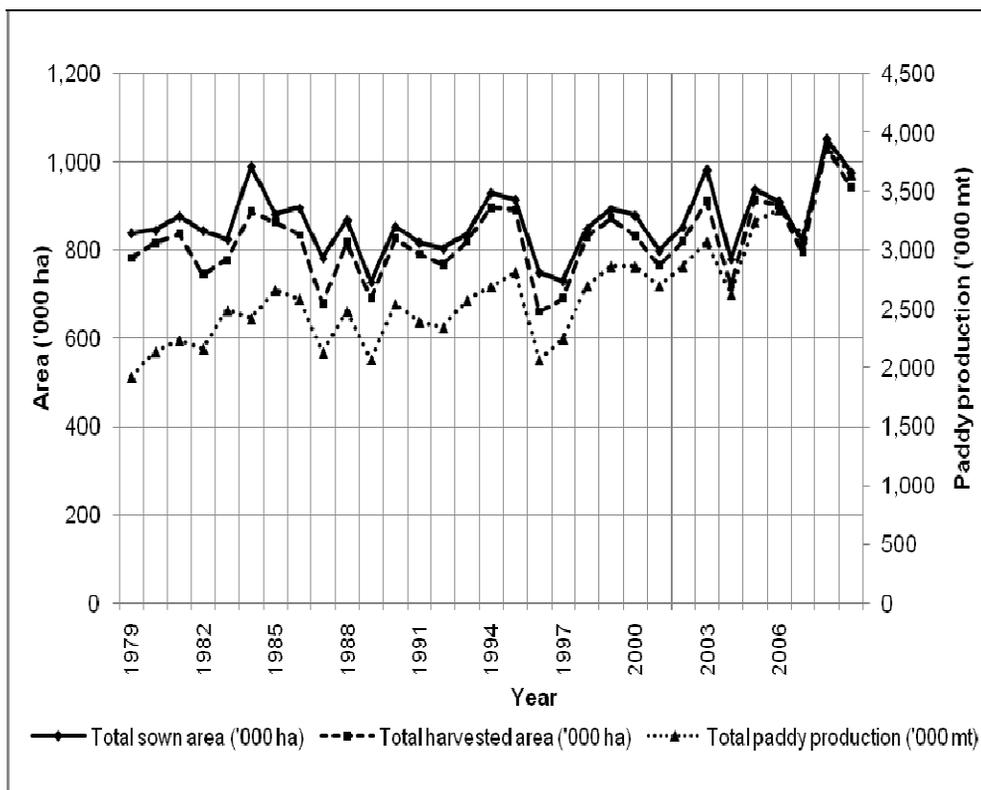
(Note: 2005 average fertilizer prices are not available as the subsidy was introduced in November)

In 1997 the fertilizer subsidy was restricted to Urea. The fertilizer use respond was very clear in this situation where a jump in Urea use was observed while TSP and MOP consumption figures remained more or less unchanged (Fig. 2). The sudden decrease in Urea consumption in the years 2000 and 2001 relative to the consumption in 1999 could be attributed to the reduced paddy cultivation (Fig. 3) in some of the major rice growing areas of the island in 2000 due to the floods (Central Bank of Sri Lanka, 2000) and in early 2001 due to the drought (Anon., 2009).



**Fig. 2. Annual consumption of Urea, TSP and MOP in paddy sector from 1980 to 2008**  
(Source: Department of Agrarian Development)

Since 2002 was a good crop year (Fig. 3) it could be pointed out that the use of Urea had increased with the extended cultivation area, regardless of the increase in the price of Urea. There had been a significant increase in the Urea price from 2002 to 2003. Although the sown extent in 2003 was about 130,000 ha, a 15% greater than that of 2002 (Fig. 3), Urea use in 2003 has reduced by 35% of that of 2002 (Fig. 2). Higher price of fertilizer was again the reason for this reduction. Even though Urea price was reduced in 2004, its use had only increased slightly, due to the reduction in paddy cultivation as a result of the drought prevailed in this year (Anon., 2009). From November 2005, Urea, TSP and MOP were available for the paddy farmers at a price of Rs. 350 per 50 kg under the “Kethata Aruna” fertilizer subsidy programme. Over 850,000 paddy farmers were estimated to be benefitted by this subsidy programme in 2009 (Ministry of Finance and Planning, 2009).



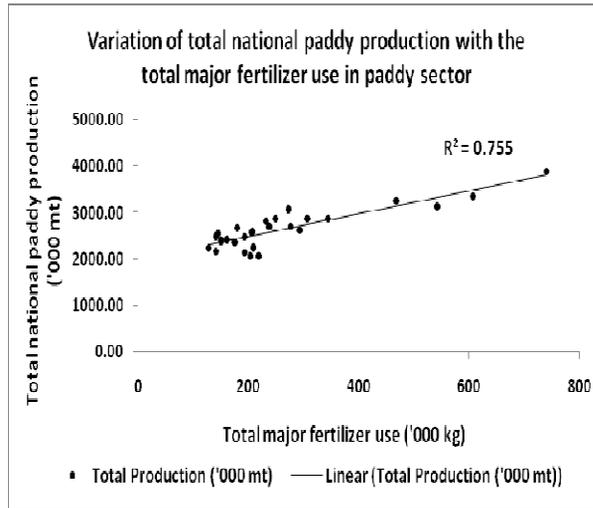
**Fig. 3. National paddy production (mt), total paddy sown area (ha) and total harvested area (ha) of paddy from 1979 to 2009**

(Source: Agriculture and Environmental Statistics Division, Department of Census and Statistics)

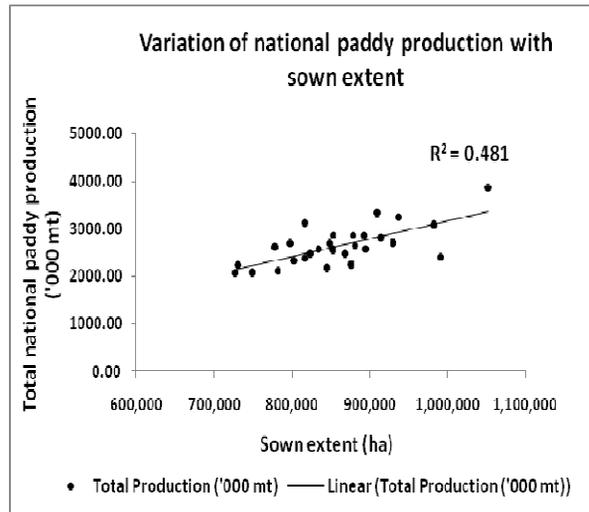
The Fig. 2 shows the obvious increase in Urea, TSP and MOP use with the implementation of fertilizer subsidy in 2005. All the fertilizers recorded their highest use values since 1980. This clearly indicates that the fertilizer use by the farmers of the paddy sector depend on the price of fertilizer.

**Factors affecting paddy production**

The impact of amount of fertilizer used, sown extent and technological improvements on the paddy production were analyzed under this study. Fig. 4 indicates individual linear relationships between total fertilizer use and national paddy production, and sown extent and national paddy production.



(a)



(b)

**Fig. 4. Variation of national paddy production with (a) the fertilizer used (Urea, TSP & MOP) in the paddy sector and (b) sown extent of paddy at the national level from 1981 to 2008**

A third independent variable, which is the technological improvement was incorporated as time trend considering that it has changed at a constant rate throughout the period referred (varies from 1 to 28 consecutively from 1981 to 2008). Taking these variables, several functions were tested to select the best function based on  $R^2$  value and the resultant equation is given below. The coefficients, standard errors and probability values are given in Table 2.

$$\text{Log (T)} = c + \beta_1 \text{Log (TF)} + \beta_2 \text{Log (SE)} + \beta_3 \text{(TT)}$$

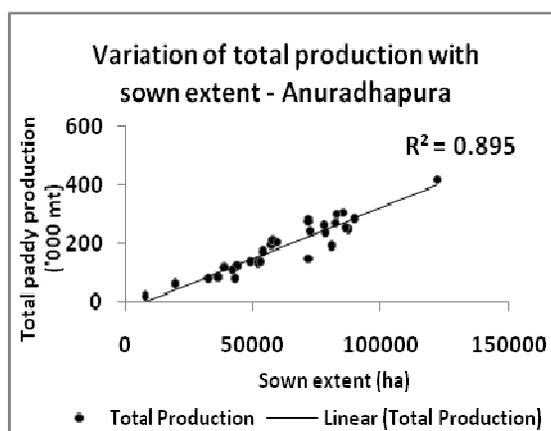
Where; T = Total national paddy production ('000 mt), TF =Total fertilizer use (mt), SE = Sown extent (ha), TT = Technological improvement as a time trend,  $\beta_1$  = coefficient of variation of total fertilizer use,  $\beta_2$  = coefficient of variation of sown extent,  $\beta_3$  = coefficient of variation of technological improvement.

**Table 2. Multiple regression analysis determining the effect of total fertilizer, sown extent and the technology on total national paddy production**

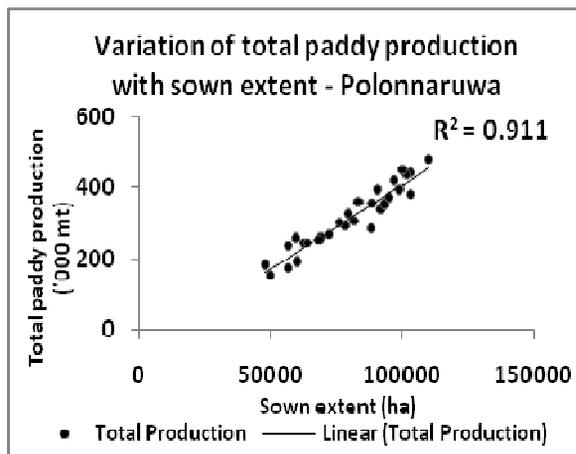
	Coefficient	Standard error	Probability >t	95% confidence interval
Log total fertilizer ('000 kg)	0.1092753	0.0551104	0.059	-0.004467 0.2230176
Log sown extent (ha)	0.8508577	0.1268375	0.000	0.5890778 1.112637
Time trend	0.0031484	0.0012443	0.018	0.0005803 0.0057165
Adjusted R <sup>2</sup>	0.88			
Probability	< F = 0.0000			
Number of observations	28			

The results indicate that 88% of the variation of the national paddy production is explained by combined effect of total fertilizer, sown extent and the technological improvement. The relationship is significant at 5% probability level. Since this is a log-log function, the coefficients represent the elasticity. Therefore, 1% increases of the input of total fertilizer results a 0.109% increase in the total national paddy production. Similarly, increase in 1% of sown extent results a 0.85% increase in national paddy production.

Data of paddy production and sown extent in two major rice grown areas of the dry zone, namely Anuradhapura and Polonnaruwa show that there is a strong relationship between total paddy production and the sown extent (Fig. 5 a and b). This verifies the results of the model indicating the strong contribution of the sown extent on increase in the national paddy production.



(a)



(b)

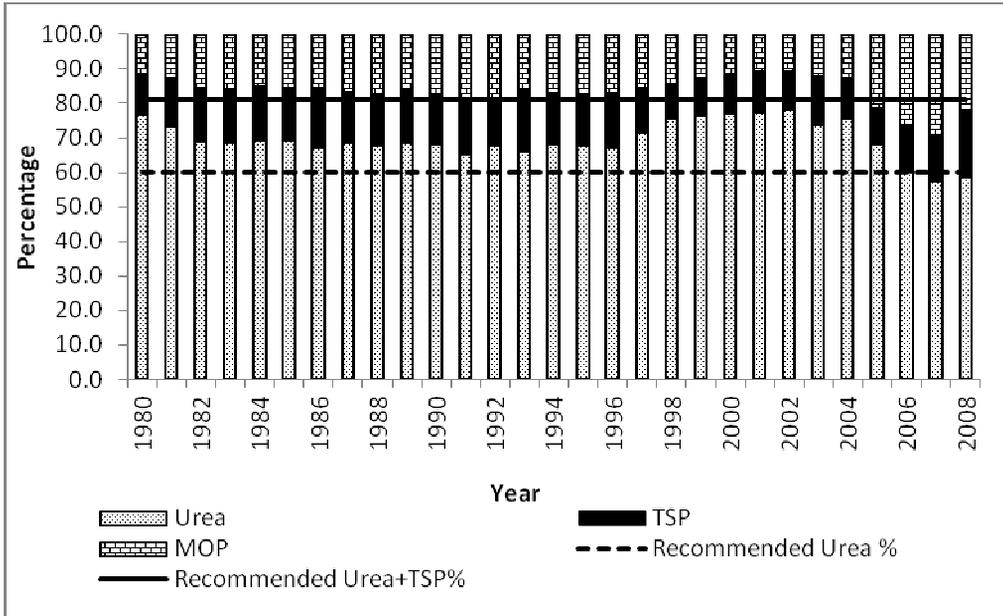
**Fig. 5. The relationship between the sown extent and the total paddy production in (a) Polonnaruwa and (b) Anuradhapura from 1980 to 2008**

The effect of the use of individual fertilizers along with the sown extent and technological improvements was tested similarly as above, to determine the individual effect of fertilizer. However, the results indicate that the effects of individual fertilizers are not significant at 5% probability while sown extent and technological improvements show the same effect as above. This indicates that the synergetic effect of the three types of fertilizers has a significant effect on paddy production rather than the individual use. Therefore, it suggests the necessity of balanced nutrient application in crop production.

#### **Impact of price on the use of recommended quantities of fertilizers**

The application of fertilizer in correct proportion of N (Urea): P (TSP): K (MOP) is required to achieve the highest productivity. Except for years 2006, 2007 and 2008, the relative proportions of Urea:TSP:MOP (approximately 60:20:20) has not been used for the paddy sector in Sri Lanka as shown in Fig. 6. It is clear that Urea has been used extensively compared to other two types of fertilizers (TSP and MOP) until the introduction of “*Ketata Aruna*” subsidy programme.

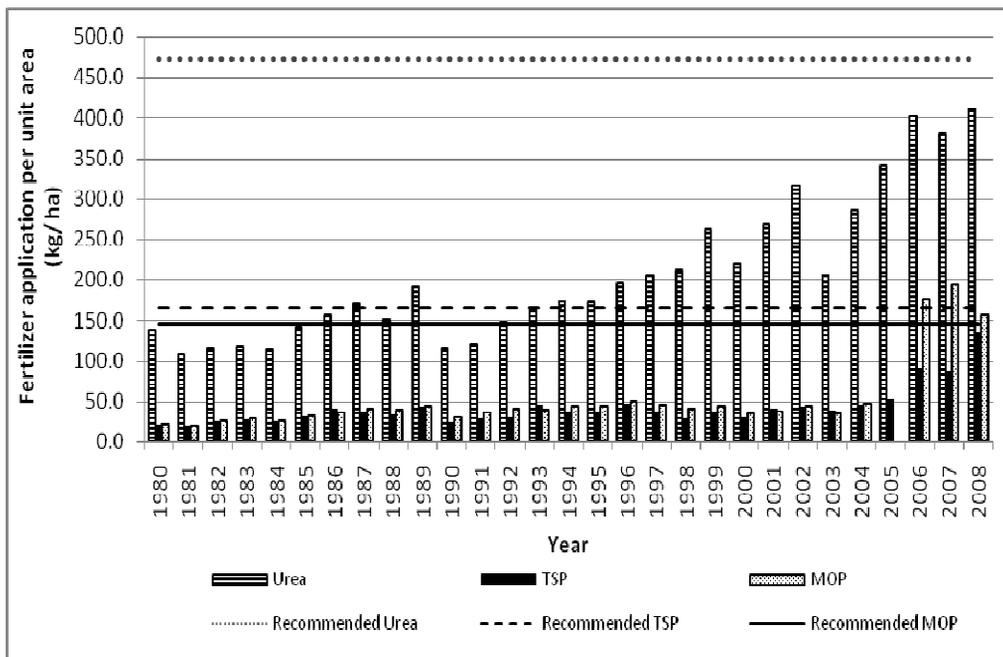
The largest discrepancy was observed during the period from 1997-2004 when subsidy was given only for Urea which had indirectly encouraged the farmers to use Urea in excessive proportions to other two fertilizers. With the implementation of the fertilizer subsidy programme in 2005, the percentage use of TSP and MOP has increased while the percentage of Urea used decreased to reach the recommended rate. This indicates the requirement of having a price balance in all three types of fertilizers in order to maintain the appropriate fertilizer use. Therefore, this result further consolidates the earlier finding that the use of fertilizer depends on the fertilizer price.



**Fig 6. Percentage of Urea, TSP and MOP used in the paddy sector of Sri Lanka for the period from 1980 to 2008\***

\*Note: Recommended percentages of Urea, MOP and TSP were calculated based on the dry & intermediate zone fertilizer recommendation for 3 month paddy with an expected yield of 120 bushels/ Acre and wet zone fertilizer recommendation for 3 month paddy with an expected yield of 80 bushels/ Acre (DOA, 2009). The national paddy extent in Dry & Intermediate zones is considered as 79% while wet zone is considered as 21% (Silva, 2001).

Fig. 7 shows the annual fertilizer use (kg) per unit sown area (ha) at national level for the period under study. Three horizontal lines indicate the recommended quantities of each fertilizer to be used for paddy cultivation. It is clear that all three fertilizer types have been applied at a much lower quantities than the recommended values. The discrepancy between the recommended and the applied quantities were lowest only after the introduction of the "Kethata Aruna" fertilizer subsidy programme in 2005. It is also apparent that the application of fertilizers, on average at the national level, has not yet exceeded the recommended quantity.



**Fig. 7. Annual fertilizer use (kg) per unit of sown area (ha) at national level from 1980 to 2008\***

\*Note: Annual recommended amounts of Urea, MOP and TSP were calculated based on the dry & intermediate zones fertilizer recommendation for 3 month paddy with an expected yield of 120 bushels/ acre and wet zone fertilizer recommendation for 3 month paddy with an expected yield of 80 bushels/ acre (DOA, 2009). The national paddy extent in Dry & Intermediate zones is considered as 79% while wet zone is considered as 21% (Silva, 2001).

### CONCLUSIONS

Based on the results of the study, it can be suggested that the fertilizer application in the paddy sector of Sri Lanka is dependent on the fertilizer price. In other words, subsidized fertilizer prices promote the farmers to use recommended rates of fertilizer for their paddy crops. The excessive use of Urea when compared to TSP and MOP, prevailed in the paddy sector over the period of 1997 to 2005, was rectified by implementation of the “*Kethata Aruna*” fertilizer subsidy programme in 2005. This fertilizer subsidy programme has also promoted the paddy farmers to use more fertilizers per unit area than they have been using since 1980, though not exceeded the recommended rates at the national level on average.

The results indicate that 88% of the variation of the national paddy production is explained by the combined effect of total fertilizer, sown extent and the technological improvement (at 5% probability level). Based on the results of multiple regression analysis, it can be stated that 1% increase in of the input of total fertilizer results a 0.109% increase in the total national paddy production. Similarly, increase in 1% of sown extent results a 0.85% increase in national paddy production.

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