
GROWTH PERFORMANCE AND STRUCTURAL CHANGE IN THE PADDY SECTOR IN SRI LANKA: COMPARISON BETWEEN PRE AND POST LIBERALIZATION PERIODS

M.T. Padmajani

Abstract

The present situation of the paddy sector has been attributed to the past development strategies adopted by successive governments. In spite of the significant advances in the rice production in the past few decades, there is a rising concern about declining profitability and restricted scope for expansion of future rice production in Sri Lanka. The purpose of this study is to examine the growth performance of area, average yield and production of paddy sector during the last 50 years and examine whether there is a structural change in area, average yield and production in paddy sector with the economic reforms in 1977. Growth rates were estimated using exponential growth function and structural change was analyzed using dummy variable technique. Results indicated better performance of rice production in pre liberalization period than in the post liberalization period with a higher growth rate of area, average yield and total production. Comparison of growth rates in maha and yala season always shows better performance in maha season. With the introduction of open economic policy in 1977, area under paddy cultivation, average yield and production in maha season and annual total paddy production has shown a structural change.

1. Introduction

Agriculture has been considered as the most important pursuit of the people in Sri Lanka. It has greatly conditioned the socio-economic environment of the country and continued to dominate every sphere of the economy. Although the relative contribution of agricultural sector to the total GDP has gone down to 12% (Central Bank of Sri Lanka, 2009), it must be noted that more than 70 per cent of the rural population in the country still make their livelihood directly or indirectly on agriculture. Paddy occupies the largest land area under agriculture, and in the year 2009 the annual gross extent sown was 978,000 ha. Generally, paddy occupies about 45 per cent of the total permanent agriculture land holdings

(Central Bank of Sri Lanka, 2009). Given the significance of the paddy sector in the Sri Lankan economy, all successive governments have placed greater emphasis on increasing paddy production in order to achieve self-sufficiency. Therefore, a larger amount of investments were geared towards the improvement of the paddy sector. Large scale irrigation projects, land development and settlement schemes, free provision of irrigation water, fertilizer subsidies and guaranteed prices were some of the investments made in order to improve the sector performance. These have improved paddy cultivation in the country and total rice production had increased rapidly and reached 3.87 million Mt in 2008 recording the highest ever production. Furthermore country is enjoying self-sufficiency level of about 95 per cent

The economic reforms introduced in 1977 reversed the food and agricultural policies pursued from independence, and are considered a sharp break from past economic regimes. The inward looking development strategy was changed to outward looking development strategy making the economy free from controls. However, trade liberalization and country's commitments to various trade agreements have forced the domestic rice sector to shift towards free market orientation exposing it to competitive global rice market (Jayasinghe Mudalige 2005).

There was stagnant rice production and average yield during the two decades of 1980 and 1990. But there was an increasing trend starting from 2000. The average yield which remained at 3.5mt per hectare is increased up to 4.3mt/ha in year 2009(Central Bank of Sri Lanka, 2009). Sri Lanka annually produced an average of 3.5 million metric tons of rice which almost satisfied the requirement of the nation. A publication on rice sector development in Sri Lanka 2007-2010 done by *Api Wawmu Rata Nagamu* programme revealed that to cater to the growing population, the rice production has to be increased by 30 per cent in 2010.

On the contrary, yield stagnation, increased input costs and declining profitability of rice production pose the question whether the performance of rice sector in future is progressive enough and if not what kind of policy interventions are required to enhance its competitiveness. Given this setting, this paper attempt to examine the growth performance of area, average yield and production of paddy sector during the last 50 years and examine whether there was a structural change in area, average yield and production in paddy sector following the economic reforms in 1977.

2. Methodology

2.1 Sources of Data

The present study utilizes time series data (1961 to 2008) on area (ha), production (MT) and average yield (kg/ha) of paddy. The data were collected from paddy statistics, published by the Department of Agriculture in Sri Lanka. For arriving of meaningful conclusions, data were gathered season wise (*Maha* and *Yala*) and annually as a whole. The periods were considered as a whole as well as by sub dividing into two; pre-liberalization period (1961-1977) and post-liberalization period (1978-2009). These periodic classification is useful to asses the changes in growth rates in each era and to search whether there is any change in cultivated land area, total production and average yield after the introduction of open economic policy in 1977.

2.2 Analysis of Data

2.2.1 Compound growth rate analysis

The linear, log linear, exponential and power functions were employed to study the growth rates. Among these, the exponential form of the function $Y_t = ab^t$ was most frequently used and literature suggest that in a biological production process like agriculture a compound growth rate is the most appropriate (Borthakur, Bhattacharyya, 1999). With this understanding in the present study, compound growth rates in area, production and average yield of paddy were estimated by specifying the following relationship;

$$Y_t = ab^t \quad \text{-----} \quad (1)$$

Where;

Y_t – the variable for which growth rate is calculated (Area, production and average yield of paddy)

t - Year which takes value 1, 2,.....n

b – the regression coefficient of Y on ' t '

a – Intercept

After transforming the model (1) into a linear form by taking logarithms, we get;

$$\log Y = \log a + t \log b \quad \text{-----} \quad (2)$$

Which is a linear relationship between Y and t , hence, can be fitted by the method of Ordinary Least Square (OLS) technique. The compound growth rate (r) was then estimated by the given equation (3).

$$\text{CGR} (r) = (\text{antilog } b - 1) * 100 \quad \text{-----} \quad (3)$$

Student's ' t ' test was used to test the significance of the CGR;

$t = r / \text{s.e.} (r)$ (with $(n-2)$ degree of freedom)

s.e. (r) = [(100*b)/log₁₀ e]* s.e. (log b)

Where;

r is the compound growth rate

n is the number of years

s.e. is the standard error and 'n' is number of years considered under the study

log₁₀ e = 0.43429

Residual analysis and model adequacy checking were also carried out by considering the adjusted R² and Durbin-Watson statistics.

2.2.2 Structural change analysis

Structural change analysis is needed to find out whether the introduction of open economic policy to the country in 1977 has led to a structural change in paddy sector. Chow test and dummy variable approach are the two available econometric techniques to analyze the structural change. Among these two techniques, Gujarati, (1989) suggest that although the overall conclusions derived from the Chow and dummy variable test in any given application are the same, there are some advantages of using dummy variable approach, and, this study has employed the dummy variable approach to test the structural change.

The distinct advantage of dummy variable approach is, it not only tells if two regressions are different but also pinpoints the sources of the difference, whether it is due to the intercept or slope, or both (Gujarati, 1995). The coefficient α_2 attached to the dummy variable D, which called as differential intercept coefficient tells how much the value of the intercept term of the category that receives the value of 1 differs from the intercept coefficient of the base category.

In regression function, years 1961-1977 (closed economic period) were coded as 0 and years 1978-2009 (open economic period) code as 1.

Following regression function is defined;

$$Y_i = \alpha_1 + \alpha_2 D_i + \beta_1 X_i + \beta_2 (D_i X_i) + u_i \quad \text{-----} \quad (1)$$

Where;

Y_i = Area, production and average yield of paddy

X_i = time variable

$D_i X_i$ = product of dummy variable* time variable

α_1 = intercept

α_2 = differential intercept

β_1 = slope coefficient of variable X_i

β_2 = differential slope coefficient

To see the implications of model (1), and assuming that $E(u_i) = 0$, following regression functions were obtained;

Mean area/ production/ average yield function for pre liberalization period

$$E(Y_i \mid D_i = 0, X_i) = \alpha_1 + \beta_1 X_i \quad \text{_____} \quad (2)$$

Mean area/ production/ average yield function for post liberalization period

$$E(Y_i \mid D_i = 1, X_i) = (\alpha_1 + \alpha_2) + (\beta_1 + \beta_2) X_i \quad \text{_____} \quad (3)$$

3. Results and Discussion

3.1 Growth Trends in Paddy Sector

Production, area and average yield trends in paddy sector described in this section illustrate the growth pattern of the sector with the time. The annual total paddy extent cultivated during 1960s which was around 514 thousand hectares increased to about 723 thousand hectares during the end of the 1970s. At the end of the 2000s the total extent under paddy cultivation was around 842 thousand hectares with lot of fluctuations.

Seasonal trends in the cultivation area are different from the trend observed in total area. The increase of cultivated area achieved in 1980s during the *maha* season has shown some decline in the 1990s, but *yala* season shows an increase in the average cultivated area in 1990s with lot of fluctuations (Figure 1).

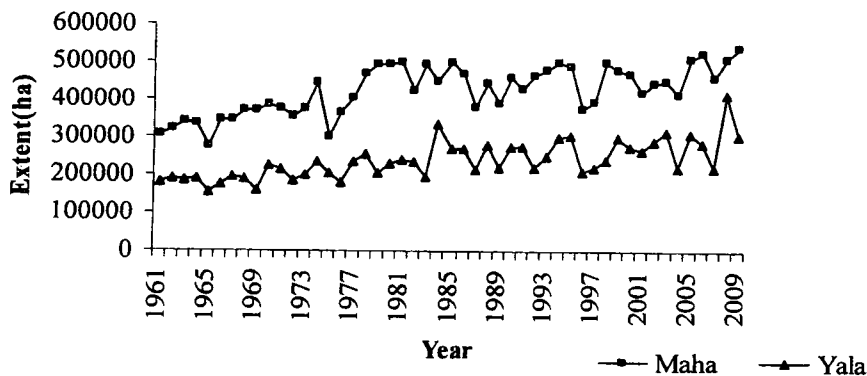


Figure 1: Paddy Extent Cultivated during *Maha* and *Yala* Seasons, 1961-2009

Total paddy production had increased rapidly during the first part of the 1980s both in *maha* and *yala* seasons. Later part of the 1990 both in *maha* and *yala* season shows decline in paddy production (Figure 2).

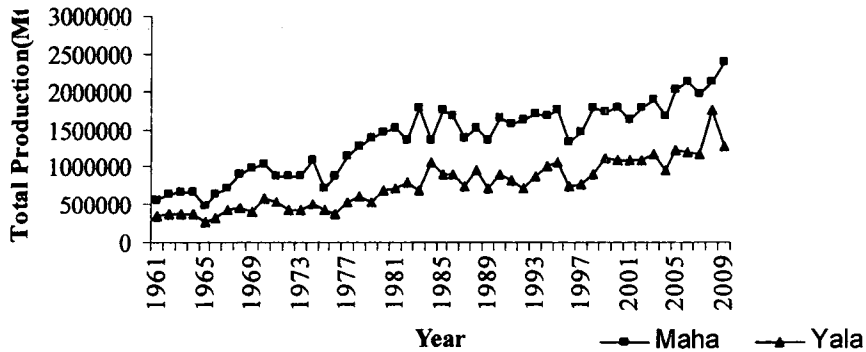


Figure 2: Total Paddy Production during *Maha* and *Yala* Seasons, 1961-2009

Figure 3 shows the trend in average paddy yield over the period of 1961 to 2009. Average yield began to increase with the introduction of old improved varieties over the traditional varieties at the beginning of the 1960s and then the introduction of new improved varieties over the old improved varieties during the late 1960s. Rice breeding programmes were given the first priority in the research and development programmes were conducted by the Department of Agriculture. With the full adoption of these new varieties in mid 1980s paddy yield at national level reached to a plateau around 3,500kg/ha. Again during the latter part of the 1990s paddy yield shows an increasing trend owing to the introduction of many new varieties by regional research stations from time to time (Wickramasinghe, 2005).

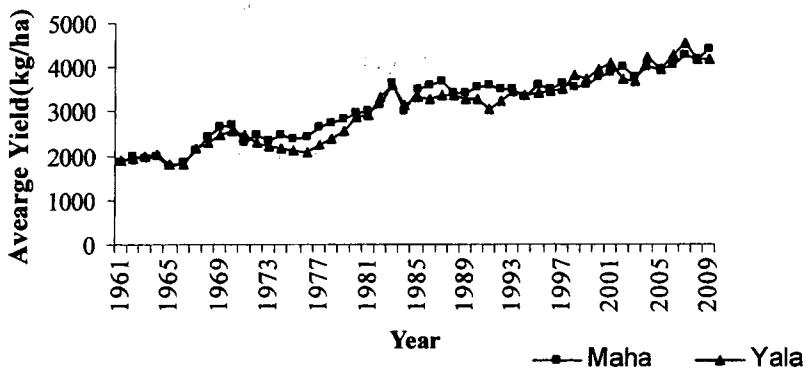


Figure 3: Average Paddy Yield during *Maha* and *Yala* Seasons, 1961-2009

Generally, the yield during *maha* season is higher than the *yala* season at the national level due to adequacy of water during *maha* season. But figure 3 shows that this seasonal variation between *yala* and *maha* has now narrowed down and in some years *yala* yields are higher than *maha* yields.

After independence, the increase in public investment in irrigation came to a peak and it contributed positively to paddy cultivation. Largest ever multipurpose irrigation project called Mahaweli was undertaken during 1979-1985. The Mahaweli development project was initially planned for 30 years and was later accelerated to be completed within 6 years. This project largely influences the paddy sector in Sri Lanka. Under this project some 128,250ha of lands in the dry zone were brought under cultivation with irrigation water by settling down 98,300 families.

3.2 Compound Growth Rate in Paddy Sector

The estimated annual compound growth rates of area, production and average yield are presented in the table 1. Growth rate in area under paddy cultivation showed 1.287 percent increase during the closed economic period, and in open economic period it was 0.357 percent per annum. The overall period area shows 0.953 percent annual growth.

At the same time, studying the average yield of paddy showed 1.938 percent growth rate per annum in closed economic period and 1.211 percent annual growth rate in open economic period. As a result the growth rate in the average yield for the overall period was 1.75 percent per year only.

Table 1: Annual Compound Growth Rates Percentages of Area, Production, and Average Yield for the Period 1961-2009

Particulars	Compound Growth Rate Percentage		
	Closed economic period 1961-1977	Open economic period 1978-2009	Overall period 1961-2009
Area	1.287*	0.357*	0.953*
Average yield	1.938*	1.211*	1.750*
Production	3.251*	1.572*	2.718*

*Significant at 1% probability level

Considering the above mentioned two components that affect the total production, average yield showed higher growth rate than area. Production increased by 3.251 percent annually during closed economic period as compared to 1.572 percent during the open economic period. The overall growth in production was 2.718 percent per annum.

Considering the two paddy cultivation seasons *Maha* has most favourable environmental conditions for paddy compared with the *Yala* season. Therefore growth rates in area, average yield and production was analyzed separately for the two seasons. The estimated compound growth rates of area, production and average yield for the *Maha* season are presented in the table 2.

Table 2: Compound Growth Rates Percentages of Area, Average Yield and Production in *Maha* Season for the Period of 1961-2009

Particulars	Compound Growth Rate Percentage		
	Closed economic period 1961-1977	Open economic period 1978-2009	Overall period 1961-2009
Area	1.308*	0.099*	0.841*
Average yield	2.222*	1.111*	1.711*
Production	3.691*	1.243*	2.580*

* Significant at 1% probability level

As annual compound growth rate results indicate, in *Maha* season closed economic period showed higher growth rates than open economic period. In this period the growth rates in area, average yield and production were 1.308, 2.222 and 3.691 percent per annum respectively and these were positive and significant at 1% probability level. In *Maha* season open economic period compound growth rates in area, average yield and production were, 0.099, 1.111 and 1.243 respectively and found to be positive and significant. For the overall period (1961-2009), the compound growth rates of paddy area, average yield and production of *Maha* season were 0.841, 1.711 and 2.58 percent per annum, respectively and these were positive and significant at 1 per cent level of probability.

Table 3: Compound Growth Rates Percentages of Area, Average Yield and Production in Yala Season for the Period of 1961-2009

Particulars	Compound Growth Rate Percentage		
	Closed economic period 1961-1977	Open economic period 1978-2009	Overall period 1961-2009
Area	1.223*	0.752*	1.098*
Average yield	1.147*	1.379*	1.812*
Production	2.384*	2.201*	2.966*

*Significant at 1% probability level

The computed compound growth rate of area, average yield and production of paddy during the *Yala* season were presented in the table 3. In closed economic period compound growth rates in area, average yield and production were 1.223, 1.147 and 2.384 respectively. In the open economic period, area under paddy cultivation shows 0.752 percent annual growth rate and average yield and production shows 1.379 and 2.201 percent growth rates per annum. For the total period in *Yala* season area, average and production showed 1.098, 1.812 and 2.966 growth rates correspondingly and all these values are positive and significant at 1% probability level.

3.3 Structural Change Analysis

Sri Lankan economy has been undergoing significant changes due to the implementation of the new economic reforms in 1977. With those reforms, paddy sector has undergone structural changes both in production and marketing (Rupasena *et al*, 2008). This study has only focused on production side of the paddy sector. Structural change can occur on all three components, i.e. area, average yield and production or may be in one or two of them. Therefore separate analysis was done for area, average yield and production. On the other hand *Maha* and *Yala* seasons were considered separately and both were considered together as annually.

Three separate regressions were run for area under paddy cultivation in *Maha* season, *Yala* season and annual. In *Maha* season regression function the differential intercept coefficient α_2 and differential slope coefficient β_2 were statistically significant. Therefore only in *Maha* season, area under paddy cultivation showed a structural change after the introduction of open economic policies. Differential slope coefficient β_2 was -0.00521 . It implies that in open economic period area under paddy cultivation has shown 0.00521ha decline in

every year compared with the closed economic period. Equation 1, 4 and 5 shows the estimated regression functions for *Maha* Season, *Yala* season and annual, area under paddy cultivation respectively. Equation 2 shows the derived regression function for area under paddy cultivation in *Maha* season closed economic period and Equation 3 shows the derived regression function for *Maha* season during open economic period.

Estimated Pooled regression function in *Maha* season area under paddy cultivation;

$$Y_i = 5.50 + 0.155D_i + 0.00564X_i - 0.00521DX_i \quad \text{_____} \quad (1)$$

$$t = (259.12^*) (4.42^*) \quad (2.73^*) \quad (-2.35^{**}) \quad [R\text{-Sq (adj)} = 6.1\%]$$

Derived regression function for pre liberalization period

$$Y_i = 5.50 + 0.00564 X_i \quad \text{_____} \quad (2)$$

Derived regression function for post liberalization period

$$Y_i = 5.50 + 0.00043 X_i \quad \text{_____} \quad (3)$$

Estimated pooled regression function for *Yala* season area under paddy cultivation

$$Y_i = 5.24 + 0.0688D_i + 0.00528X_i - 0.00202DX_i \quad \text{_____} \quad (4)$$

$$t = (167.55^*) (1.33^{ns}) \quad (1.73^{ns}) \quad (-0.62^{ns}) \quad [R\text{-Sq (adj)} = 54.4\%]$$

Estimated pooled regression function for annual area under paddy cultivation

$$Y_i = 5.69 + 0.123D_i + 0.00556X_i - 0.00401DX_i \quad \text{_____} \quad (5)$$

$$t = (266.30^*) (3.48^*) \quad (2.67^*) \quad (-1.79^{ns}) \quad [R\text{-Sq (adj)} = 68.6\%]$$

As same as in area, *Maha* season only showed the structural change in average yield of paddy after the introduction of open economic policies. β_2 and α_2 both coefficients get statistically significant and β_2 was -0.00475 and it implies that in open economic period average yield shows 0.00475kg/ha decline in every year compared with the closed economic period. The estimated regression functions related to the average yield of paddy in annual, *Maha* and *Yala* seasons given follow.

Estimated pooled regression function for *Maha* season average yield in paddy

$$Y_i = 3.26 + 0.128D_i + 0.00955 X_i - 0.00475DX_i \quad \text{_____} \quad (6)$$

$$t = (220.15^*) (5.24^*) \quad (6.60^*) \quad (-3.06^*) \quad [R\text{-Sq (adj)} = 93.1\%]$$

Derived regression function for pre liberalization period

$$Y_i = 3.26 + 0.00955 X_i \quad \text{_____} \quad (7)$$

Derived regression function for post liberalization period

$$Y_i = 3.388 + 0.00048X_i \quad \text{_____} \quad (8)$$

Estimated pooled regression function for Yala season average yield in paddy

$$Y_i = 3.28 + 0.0591D_i + 0.00496X_i + 0.00099DX_i \quad (9)$$

$$t = (192.13^*) (2.10^{**}) (2.97^*) (0.56^{ns}) \quad [R-Sq (adj) = 91.8\%]$$

Estimated pooled regression function for annual average yield in paddy

$$Y_i = 3.27 + 0.106D_i + 0.00834 X_i - 0.00311DX_i \quad (10)$$

$$t = (218.37^*) (4.31^*) (5.71^*) (-1.992^{ns}) \quad [R-Sq (adj) = 93.2\%]$$

Equation 11, 14 and 17 shows the estimated regression functions for the total annual paddy production and *Maha* season and *Yala* season productions respectively. In *Maha* season annual production equations, differential intercept coefficient α_2 and differential slope coefficient β_2 both were statistically significant indicating that there is a structural change with the introduction of open economic policies. In annual production function β_2 was -0.00712 and it implies that there is a 0.00712 mt reduction in each year after the year 1977.

Analysis revealed that *Maha* season total production has decreased by 0.0104 mt annually in post liberalization period in Sri Lanka. On the other hand there is no change in *Yala* season total production with the policy change. When there is structural change, we cannot pool the two time periods and estimate as one regression function, therefore for those situations separate functions had to be derived and those are presented as derived functions for closed economic period and open economic period.

Estimated pooled regression function for Annual paddy production

$$Y_i = 5.95 + 0.229D_i + 0.0139 X_i - 0.00712DX_i \quad (11)$$

$$t = (220.97^*) (5.15^*) (5.28^*) (-2.52^{**}) \quad [R-Sq (adj) = 91.2\%]$$

Derived regression function for pre liberalization period

$$Y_i = 5.95 + 0.0139X_i \quad (12)$$

Derived regression function for post liberalization period

$$Y_i = 6.179 + 0.00678X_i \quad (13)$$

Estimated pooled regression function *Maha* season production in paddy cultivation

$$Y_i = 5.76 + 0.283D_i + 0.0157 X_i - 0.0104DX_i \quad (14)$$

$$t = (206.24^*) (5.78^*) (6.15^*) (-3.55^*) \quad [R-Sq (adj) = 90.1\%]$$

Derived regression function for pre liberalization period

$$Y_i = 5.76 + 0.0157 X_i \quad (15)$$

Derived regression function for post liberalization period

$$Y_i = 6.043 + 0.0053X_i \quad (16)$$

Estimated pooled regression function *Yala* season production paddy cultivation

$$Y_i = 5.52 + 0.122D_i + 0.0102X_i - 0.00078DX_i \text{ ————— (17)}$$

$$t = (161.67^*) (2.17^{**}) (3.07^*) (-0.22^{ns}) [R-Sq (adj) = 88.1\%]$$

Analysis shows that the performance in paddy sector in Sri Lanka is remarkable during the closed economic period from 1960 to 1980 that is because of the impact of green revolution. In this period state support continued in research, extension, input supply and marketing activities and parallel with this developments governments adopted macro economic policies that were favourable for agricultural sector and in particular paddy. Main contributory factor for increase paddy production in this period was the use of high yielding varieties, by mid 1970s, 30% of the total area cultivated with paddy was under Newly Improved Varieties.

Comparison of estimated growth rates in *Maha* and *Yala* seasons clearly illustrates that *Yala* season open economic period and overall period has shown higher growth rates than *Maha* season open economic period and overall period. This difference was due to the fact that, in green revolution period more emphasis was given to the development of physical infrastructure facilities in the dry zone and the continuation of rehabilitation of major and minor irrigation schemes. The uncultivated lands in dry zone were distributed among farmers. This give the solution for the most limiting factor i.e. water in dry zone, hence, farmers were able to get higher yield in *Yala* season as well.

Jayawardhane (2003) concluded that, with the introduction of open economic policies in 1977, the state involvement in paddy marketing has been scaled-down leaving the private sector to perform those activities. Farmers did not have bargaining power and, there was no government institute to oversee the activities related to paddy marketing. Because of those reasons farmers were not able to sell paddy at a reasonable price during the harvesting season. As a result farmers had moved away from paddy farming. The major drive to expand paddy production up to 1980s was to achieve self sufficiency. But with the adoption of open economic policy since 1977 the policy of achieving self sufficiency in rice was changed to crop diversification and this was another reason for the decline of the paddy sector in open economic period.

Rafeek and Samarathunga, (2000), have found that in 1960s and 1970s rice production has grown at 18% and 4% per annum respectively. The increase of the area under cultivation has contributed equally to the increase in rice production in those decades. However, the increase in average yield has decelerated and become stagnant at 3.5Mt/ha level in 1990s. During last decades,

an increase in yield has just compensated for decrease in area keeping the total production at a stagnant level. Average paddy yield in 2009 is 4.3Mt/ha and within the year 75,752ac of lands were brought under cultivation and added about 91,000Mt of paddy to the total production. This reveals that in response to the supportive measures and remunerative price resurgence can be seen in the paddy sector in Sri Lanka (Central Bank of Sri Lanka, 2009). A recent study done by Rupasena *et al* (2008) has found similar results related to the paddy sector growth performance. Results have revealed that rice sector has shown considerable growth performance in pre liberalized period than post liberalization period.

4. Conclusion

Area under paddy cultivation has shown a positive and significant annual growth in pre-liberalization period than post-liberalization period as well as in *Maha* season, and as in *Yala* season. On the other hand growth rate of average yield was high in post liberalization period than in pre liberalization period only in *Yala* season. In *Maha* season and annual average wise it was the other way. Paddy production had substantial growth rate in pre liberalization period as compared to slow growth observed in post liberalization period in all three categories.

With the introduction of open economic policy in 1977, area under paddy cultivation, average yield and production in *Maha* season and annual total paddy production had undergone a structural change. Pre liberalization period had shown better performance than post liberalization period. Economic liberalization had not led to structural change in *Yala* season related to area under paddy, average yield and production, as well as to annual area under paddy cultivation and average yield.

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