Modelling the Dynamic Impact of Fertilizer Subsidy on Paddy Production: Empirical Evidence from Sri Lanka

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Abstract: Rice is the main staple food in Sri Lanka. There will be a potential increase in demand for rice due to the high population growth in the years to come. As the cultivable area is limited, the only way to increase required supply is to improve the yield level. However, there are a limited number of district level studies, which examined the factors that influence the paddy production in Sri Lanka. Hence, this study aims to identify the factors, which increase the paddy production in Sri Lanka with particular reference to fertilizer usage, guaranteed paddy price, temperature and rainfall. District-wise data were collected over the period from 1979 to 2019. An autoregressive distributed lag (ARDL) model was used to examine the short-run and long-run relationships between the paddy production and explanatory variables. According to the estimated model, the temperature has both significant positive and negative long-run relationships with paddy production in several districts. Furthermore, results reveal that paddy production in many districts had positive long-run relationships with the usage of the mixture of organic and chemical fertilizer. Hence, the findings of this study provide valuable policy insight for decision makers to redesign the chemical fertilizer subsidy in Sri Lanka. Our results also reveal that the use of organic fertilizer contributes to an increase in paddy production in both short-run and long-run. Hence, it is our opinion that sustainable agricultural practices combined with the removal of market distortions will lead to establishing an economically efficient paddy production system in Sri Lanka.

Keywords: Cointegration, Fertilizer usage, Guaranteed paddy price, Long-run relationship.

1. INTRODUCTION

According to the central bank, the contribution of the agricultural sector to the country's GDP in the last five years is around 10 per cent (Central Bank of Sri Lanka (CBSL), 2019). However, in the 1980's it has been nearly 25 per cent. This indicates that, during the previous 40 years, the contribution of the agricultural sector to the country's GDP has declined. This is also evident from the decline in the number of total employment during the last decade, there has been 30 per cent contribution from the agricultural sector and in 2018 it was 25.5 per cent (Sri Lanka Labour Force Survey, Annual Report 2018). The paddy sector makes a significant contribution to the agricultural GDP as it has been the staple food in the country throughout the history (Economic and Social Statistics in Sri Lanka (CBSL), 2006 – 2019). At the same time the recent mediation of the present government to introduced maximum retail prices for several rice varieties with effect from 10th April 2020 to emphasizes the extent at which rice has been an integral part in the life of the Sri Lankans as a staple food.

Weerahewa (2010) reveals that the paddy sector provides a direct and indirect livelihood for more than 1.8 million farmers engaged in paddy farming. Though the country has been self-sufficient in rice over the last few years, it is notable that the demand for rice will increase more than 1.1 percent per year due to the expected average population growth of Sri Lanka in the future (CBSL, 2019). Rice research and development institute at Bathalagoda in Sri Lanka indicates that the rice production should grow at a rate of 2.9 percent per year to meet that demand (Sri Lanka, Department of Agriculture, 2020). Samaratunga (2011) points that the it is possible to meet the demand with area expansion, yield improvement, or both. As the cultivable area is limited in Sri Lanka, the only ways to increase the production is through the improvement of the yield level. Despite the increasing trends in yield, this is still a challenge as the yield growth is not in line with the growth rate of the population in Sri Lanka. According to the data available in Food and Agriculture Organization (FAO) the average yield level in Sri Lanka over the last few decades is less and inconsistent compared to other south Asian countries (FAOSTAT, 1980 – 2019).

Since independence in 1948, almost all the governments in Sri Lanka has shown their interest in improving the performance of agricultural sector. To increase paddy production several policies such as fertilizer subsidy, guaranteed paddy rice prices schemes, loans, etc. have been implemented (Henegedara 2002). The present government is not an exception to this. They also continue with the policy such as fertilizer subsidy on inorganic fertilizer and guaranteed price to achieve self-sufficiency in paddy

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through improving productivity. Herath (2013) argues that the use of inorganic fertilizer has weekly contributed to paddy production. On the other hand, Jayasumana *et al.* (2013) argue that the application of chemical fertilizer in Rajarata and other dry zone paddy farming areas has been the root course for the chronic kidney disease (CKD).

Therefore, in the present context, there is an ongoing policy debate in Sri Lanka about the role of government intervention in improving resource efficiency in paddy production. In this scenario, in our district-wise study sheds light to the ongoing debates. The current research cover fourteen districts in Sri Lanka that contribute more than 80 per cent of the total paddy production and 60 per cent of them belong to the dry zone, as depicted in Figure **1**. About 55 to 60 per cent of paddy production is supplied by six districts, and all six districts belong to dry zone, namely Anuradhapura, Ampara, Batticaloa, Hambantota, Kurunegala and Polonnaruwa. In addition to these six districts, other districts covering both dry and wet zones are selected for the study.

Moreover, according to the authors, it is noted that there is no disaggregated study relevant to the district-wise research conducted to investigate the factors contributing to the paddy production in Sri Lanka. Hence the objectives of this study are two folds. Firstly, this paper aims to identify the factors that influence paddy production at the district level in Sri Lanka with particular reference to fertilizer usage and guaranteed paddy price. Secondly, the paper intends to examine the impact of environmental factors such as rainfall and temperature on increasing paddy production. This study also examines the impact of different methods of sowing and broadcasting, and improved variety, on the paddy production.

The organization of the paper is as follows. Section 2 is the literature-review and section 3 is the methodology with data sources. Section 4 provides data analysis and empirical findings. The concluding remarks and the policy implications are included at the final section.

2. LITERATURE REVIEW

There are number of studies that examined the impact of socio-economic and environmental factors on paddy production in Sri Lanka. Amerasinghe and Mahendrarajah (1974/75) in their research on the area and yield response estimate, that there are separately two seasons, which are statistically insignificance both area and yield wise to changes in the guaranteed price. Bogahawatta (1983) applied the same method, under the same method, notes that there is a positive and significant effect on yield for dry and wet zones separately when irrigation and hybrid varieties are used. In a similar study, Sandika and Dushani (2009) evaluate the growth performance of the rice sector in Sri Lanka and find that there is no significant relationship between cultivated and harvested extent with total production and productivity of rice over year 1977 to 2008.

At the same time, Karunasena (1985); Jayatissa and Weerahandi (1981) build econometric models to explain the Sri Lankan Economy from 1950 to 1980. They used sets of behavioral equations and identities to develop those models. Cooray (1998) developed an econometric model to analyze the agricultural policies and the paddy/rice market of Sri Lanka throughout 1970 to the late 1990's and employed yield and area approach to develop that production model. Further, that study indicates the yield is another crucial factor that profoundly affects paddy production more than the harvested area.

The trans log profit function was used by Rajapaksa and Karunagoda (2009) to estimate the factor demand for paddy cultivation in Sri Lanka. In this model labour, seed, and fertilizer were included as factors of production of paddy. Sivapathasundaram and Bogahawatte (2012) state that even though the country reached self-sufficiency in rice, to promote and support paddy production government expenditure has been increased. They used autoregressive integrated moving average (ARIMA) methods to forecast the paddy production in the country. Shantha *et al*. (2012) used a stochastic frontier production function, considering the technical efficiency effect model to estimate the technical efficiency of paddy farmers who are farming in a minor irrigation scheme in Sri Lanka by taking Trincomalee district only. When considering previous studies done related to the paddy sector in Sri Lanka over the last few decays, there was no such study done to identify the factors such as temperature and methods of sowing and broadcasting, which effect paddy production at the district basis in Sri Lanka.

Most of the researchers have applied the autoregressive distributed lag (ARDL) approach to examine the existence of cointegration and to estimate long-run and short-run parameters in their studies (De Silva and Cooray 2020; Appiah-Konadu *et al*. 2016;

Maiadua *et al*. 2016; Tiwari and Shahbaz 2013; Ahmed, Muzib, and Roy 2013) as this model is appropriate for the stationary at a level form and first difference. Darbandi (2018) also used ARDL approach to assess the price linkage between wholesale and retail prices in Nigerian rice market and found that it has been asymmetric between the two sectors.

Economists argue that the change in any econometric variable may result in the change in another econometric variable beyond time. Yet this change is not at once noted but runs over the future. As such the ARDL model plays an important part when there is a need to analyze an econometric scenario. It suggests that ARDL deals with single cointegration and is first introduced by Peasaran and Shin (1999) and expanded by Peasaran *et al*. (2001).

In contrast to other single co-integration procedures ARDL models have gained popularity as this method introduces several econometric advantages Halicioglu (2004) views that the use of ARDL is avoided as it creates endogeneity problems and its inability to test hypothesis on the estimated coefficients in the long-run in line with the Engle's granger method. Furthermore, the long-run and short-run parameters of the model are simultaneously asses. At the same time all variables are considered to be endogenous, and the econometric methodology gets out of the burden that establishes the integration order among the variables and that supports the pretesting for unit root. As highlighted by the authors above, most of the other methods except ARDL demand that the variables in time series regression equations be integrated at a level while it is possible to implement the method developed by Peasaran *et al*. (2001) irrespective of variables that are integrated at level or first difference.

3. DATA SOURCES AND METHODOLOGY

As mentioned earlier, this study investigates the long-run and short run impact of socio-economic and environmental factors namely; fertilizer usage, guaranteed paddy price, temperature and rain fall, and technological factors such as a method of sawing, method of land preparations, seed varieties on paddy production in Sri Lanka covering fourteen districts. We have taken time series data relevant to both seasons Maha and Yala, from 1979 to 2019 is used to estimate the production functions for each district separately. The variable notations are displaying in Table **1**. The data sources include Various Annual Reports of Central Bank of Sri Lanka, National Fertilizer Secretariat of Sri Lanka, Department of Agriculture and the Department of Census & Statistics of Sri Lanka.

Before proceeding with the ARDL approach, we applied the Augmented Dickey-Fuller (ADF) unit root test (Enders 1995) to test the properties of all-time series variables. After that, we employed the ARDL bound testing approach for each district to find the long-run and short-run linkage between variables. Next, to test the validity and stability of the ARDL models, series of diagnostics tests such as serial correlation LM test (Breusch-Godfrey Test), normality test (Jarque-Bera Test), heteroskedasticity test (Breusch-Pagoan-Godfrey Test) and cumulative sum of recursive residuals (CUSUM test) were used.

Theoretical Model: Auto Regressive Distributed Lag Model

As mentioned in the literature review, ARDL bound testing approach was used to study the existence of long run and short run relationships among variables irrespective of whether the underline regressors are

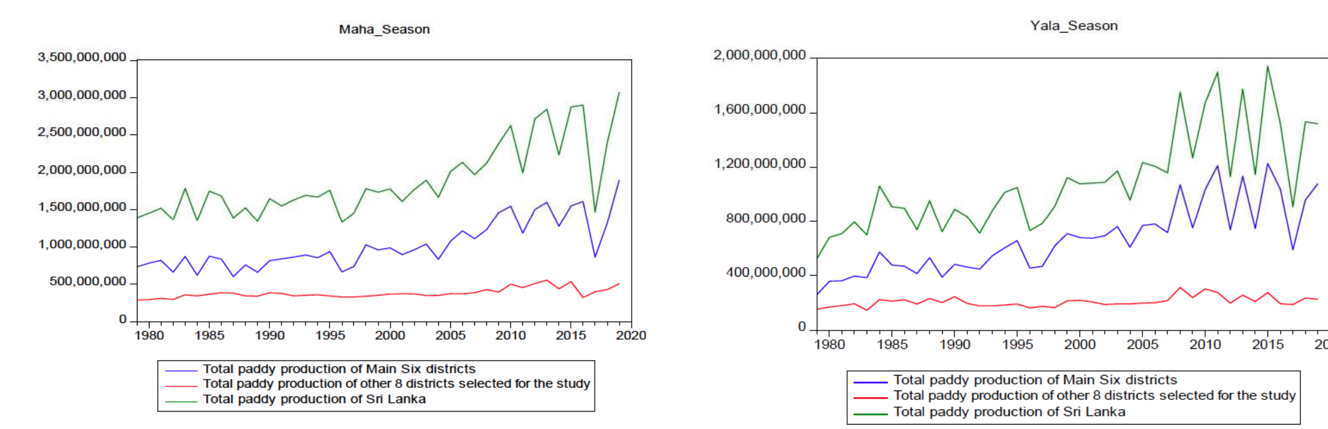


Figure 1: Paddy production.

Table 1: Variable Notations

Variable	Maha Season	Yala Season	Variable	Maha Season	Yala Season
Paddy Production (Kg)	QPMT	QPYT	Average Temperature (C)	TEMPA	TEMPA
Credit Granted (Rs /Ha)	CRGM1	CRGY1	Average Paddy Price(Rs/Kg)	PPA	PPA
Land Sown Area under Chemical Fertilizer Application (Ha)	LSCFA_M	LSCFA_Y	Rainfall (mm)	RF	RF
Land Sown Area under Organic Fertilizer Application (Ha)	LSOFA_M	LSOFA_Y	Cost of Paddy Cultivation	TCOC_M	TCOC_Y
Land Sown Area under Bothe Chemical and Organic Fertilizer Application (Ha)	LSBFA_M	LSBFA_Y	Land Sown Area under Method of Sowing Transplanted in Rows (Ha)	LSMSTR_M	LSMSTR_Y
Land Sown Area under Method of Land Preparation by Tractor (Ha)	LSMPT_M	LSMPT_Y	Land Sown Area under Method of Sowing Transplanted not in Rows (Ha)	LSMST_M	LSMST_Y
Land Sown Area under Method of Land Preparation mainly by Buffaloes (Ha)	LSMPBM_M	LSMPBM_Y	Land Sown Area under Method of Sowing Row seeded (Ha)	LSMSRS_M	LSMSRS_Y
Land Sown Area under Method of Land Preparation by Buffaloes, Mammotied and Tractor (Ha)	LSMPTBM_M	LSMPTBM_Y	Land Sown Area under New Improved Variety (Ha)	LSNI_M	LSNI_Y
Land Sown Area under Method of Sowing Broadcasting (Ha)	LSMSB_M	LSMSB_Y	Land Sown Area under Old Improved Variety (Ha)	LSOI_M	LSOI_Y
Land Sown Area under Traditional (Ha)	LSTR_M	LSTR_Y			

Source: Compiled by the authors.

I(0), *I(1)*, or mutually co-integrated. After that, the following ARDL representation was exploited separately for the fourteen districts selected for the study to investigate the factors that contribute to the paddy production in Sri Lanka.

$$\Delta QPMT_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta QPMT_{t-i} + \sum_{i=0}^{q} \delta_i \Delta FEA_{t-i} + \sum_{i=0}^{r} \gamma_i \Delta PPA_{t-i} + \phi_1 QPMT_{t-1} + \phi_2 FEA_{t-1} + \phi_3 PPA_{t-1} + \mu_t$$

Where, *QPMT* represents the paddy production of a particular district, β_0 is the constant, β_i, δ_i and γ_i represents the short-run coefficients, ϕ_i denotes the coefficient of long-run and μ_t the error term.

4. EMPRICAL MODEL AND DATA NALYSIS

Even though the ARDL co-integration approach does not require stationarity of time series data at level, according to Ahmed *et al*. (2013) the bound test will make no sense if some of the variables are stationary at 2nd difference. Thus, as a starting point of the econometric analysis stationarity of time series data were tested by using Augmented Dickey-Fuller (ADF) unit root test (Enders 1995). Results as shown in Table **2**, all the time series data belonging to each district satisfy the condition of stationarity at first difference or at ensuring that none of the variables are in I (2). Therefore, it is evident that the ARDL bound testing approach is very much applicable when compared with other methods.

Co-Integration with Auto Regressive Distributed Lag (ARDL) Approach

At the completion of the testing of the validity of data, the ARDL bound testing approach is employed for each district to find the long-run and short-run linkage between factors toward the paddy production. Results of the ARDL bounds testing approach to co-integration relating to the Maha and Yala seasons are summed up in Tables **3** and **6** respectively. Results

Table 2: Estimation of Unit Root Tests

	ADF Test											
District	Variable	T-statistics	Variable	T-statistics	Variable	T-statistics	Variable	T-statistics	Variable	T-statistics	Variable	T-statistics
	PPA	0.315	CRGM1	1.022	CRGY1	3.237	ΔCRGY1	-10.762**	ΔCRGM1	-5.850**	ΔPPA	-6.003**
Anuradhapura	QPMT	-1.158	LSOFA_M	-5.015**	QPYT_AP	-1.296	LSNI_M	-3.085*	LSBFA_Y	-1.005		
	Δ QPMT	-8.465**	LSMSTR_M	-3.436*	Δ QPYT_AP	-8.744**	LSNI_Y	-3.988**	Δ LSBFA_Y	-3.671*		
Ampara	QPMT_AM	1.337	QPYT_AM	-2.467	LSCFA_M	-4.807**	LSOI_Y	-5.365**	TEMPA	-5.298**	LSCFA_Y	-3.332*
	Δ QPMT_AM	-7.084**	Δ QPYT_AM	-7.096**								
Badulla	QPMT_BD	-2.351	Δ QPYT_BD	-6.763**	LSBFA_M	-1.445	LSNI_M	-2.468	LSMSB_Y	-2.926	LSBFA_Y	-1.902
	Δ QPMT_BD	-5.392**	LSMSB_M	-2.257	ΔLSBFA_M	-6.918**	ΔLSNI_M	-8.865**	Δ LSMSB_Y	-6.005**	Δ LSBFA_Y	-5.532**
	QPYT_BD	-2.720	Δ LSMSB_M	-5.170**	TEMPA	-4.261**	LSNI_Y	-5.361**				
Batticaloa	QPMT_BT	-4.646**	Δ QPYT_BT	-10.53**	ΔLSCFA_M	-3.914**	ΔLSBFA_Y	-5.512**	LSNI_M	-1.399		
	QPYT_BT	-1.303	LSCFA_M	-2.336	LSBFA_Y	-1.045	TEMPA	-5.327**	ΔLSNI_M	-5.235**		
Gampaha	QPMT_GP	-1.243	QPYT_GP	-2.709	LSOFA_M	-1.996	LSMSB_Y	-2.756	TEMPA	-6.277**	LSOI_M	-2.664
	ΔQPMT_GP	-7.218**	ΔQPYT_GP	-8.688**	ΔLSOFA_M	-10.798**	ΔLSMSB_Y	-5.625**	LSMSB_M	-3.204*	ΔLSOI_M	-4.389**
	LSOI_Y	-5.689**										
Hanbantota	QPMT_HT	-2.973*	ΔQPYT_HT	-8.271**	LSBFA_Y	-0.447	TCOCM	4.116	LSMSB_M	-1.196	LSNI_M	-4.917**
	QPYT_HT	-0.570	TEMPA	-5.503**	ΔLSBFA_Y	-8.226**	Δ TCOCM	-3.856*	ΔLSMSB_M	-6.00**		
Kandy	QPMT_KD	-2.737	QPYT_KD	-1.752	LSNI_M	-1.704	LSBFA_M	-2.209	LSMSRS_M	3.244	LSBFA_Y	-2.683
	ΔQPMT_KD	-6.799**	ΔQPYT_KD	-12.65**	ΔLSNI_M	-4.535**	ΔLSBFA_M	-7.699**	ΔLSMSRS_M	-8.055**	ΔLSBFA_Y	-5.896**
	LSNI_Y	-4.718**	LSMSB_Y	-4.459**	RF_10	-5.050**						
Kurunagala	QPMT_KU	-5.511**	TCOC_M	5.635	LSOFA_M	-3.689*	LSOFA_Y	-2.828	LSMSB_M	-3.521*	LSNI_Y	-4.171**
	QPYT_KU	-6.039**	ΔTCOC_M	-3.642**	TEMPA	-5.179**	ΔLSOFA_Y	-5.307**				
Kalutara	QPMT_KT	-3.731**	LSMSB_M	-0.750	LSCFA_M	-1.01	LSMPT_Y	-3.438*	TEMPA	-5.381**	LSCFA_Y	-1.546
	QPYT_KT	-2.793	ΔLSMSB_M	-5.735**	ΔLSCFA_M	-5.547**	LSNI_Y	-3.308*	RF_05	-4.543**	ΔLSCFA_Y	-6.489**
	ΔQPYT_KT	-8.478**										
Matale	QPMT_MT	-1.555	QPYT_MT	-0.782	LSNI_M	-2.8	LSCFA_Y	-4.797**	ΔLSMSRS_Y	-6.28**	LSCFA_M	-4.449**
	ΔQPMT_MT	-12.12**	ΔQPYT_MT	-4.676**	ΔLSNI_M	-5.929**	LSMSRS_Y	2.331	TEMPA	-6.501**	RF_01	-6.278**
Matara	QPMT_MA	-6.071**	LSNI_M	-1.357	LSNI_Y	-4.139**	LSMSB_Y	-2.583	RF_08	-5.782**		
	QPYT_MA	-4.959**	ΔLSNI_M	-5.417**	TEMPA	-5.514**	ΔLSMSB_Y	-7.514**				
Monaragala	QPMT_MO	-0.592	QPYT_MO	-0.559	LSMSRS_M	-0.669	LSOI_M	-0.907	LSNI_Y	-3.037*	LSOFA_Y	-3.952**
	ΔQPMT_MO	-13.27**	ΔQPYT_MO	-6.942**	ΔLSMSRS_M	-5.741**	ΔLSOI_M	-9.331**	LSOFA_M	-3.212*	TEMPA	-5.335**
Polonnaruwa	QPMT_PO	-0.466	LSMSB_M	-1.887	QPYT_PO	-0.825	LSMSB_Y	-3.698*	LSCFA_M	-2.213	LSBFA_Y	-1.866
	ΔQPMT_PO	-5.426**	ΔLSMSB_M	-6.331**	ΔQPYT_PO	-6.832**	RF_01	-5.803**	ΔLSCFA_M	-6.204**	ΔLSBFA_Y	-5.169**
									LSNI_Y	-4.795**		
Rathnapura	QPMT_RT	-4.08**	TEMPA	-5.381**	LSCFA_M	-0.498	LSMSB_Y	-2.161	LSMSB_M	-2.178	LSMPBM_Y	-11.62**
	QPYT_RT	-4.425**	LSOI_M	-3.334*	ΔLSCFA_M	-6.051**	ΔLSMSB_Y	-6.877**	Δ LSMSB_M	-5.886**		

Source: Compiled by the authors.
Note: * and ** denote the significant at 5% level and 1% level respectively.

Table 3: Cointegration Test for Maha Season (ARDL Long Run Form and Bound Test)

Panel I: ARDL Long Run Form and F Bounds Tests														
Districts	Ampara	ANURADHA PURA	Badulla	Batticalo	Rathnapura	Hambantota	Kandy	Kurunagala	Matale	Kalutara	Matara	Monaragala	Polonnaruwa	Gampaha
Estimated model	LSCFA_M TEMPA	LSNI_M LSOFA_M PPA LSMSTR_M	LSMSB_M LSBFA_M TEMPA LSNI_M	LSNI_M, LSCFA_M CRGM1 TEMPA	LSMSB_ML SOI_M LSCFA_MT EMPA	TCOC_M LSMSB_ LSNI_M TEMPA	RF_10, LSMSRS_M LSNI_M LSBFA_M	LSOFA_M, LSMSB_M TCOC_M TEMPA	LSNI_M, LSCFA_M TEMPA RF_01	LSCFA_M LSMSB_M RF_05	LSNI_M RF_08 TEMPA	LSOI_M, LSMSRS_ M LSOFA_M	LSCFA_M, LSMSB_MR F_01	LSOI_M, LSMSB_ M LSOFA_M
ARDL	(3,4,2)	(1,0,2,2,1)	(1,0,0,0,0)	(1,1,3,3,2)	(2,2,1,2,2)	(3,2,0,2,2)	(1,2,2,2,0)	(1,0,0,0,0)	(3,1,1,1,0)	(2,0,2,3)	(1,3,3,3)	(2,1,1,0)	(3,2,3,0)	(2,3,3,3)
F-statistics	3.88	92.48	4.54	14.77	9.19	8.66	3.49	27.6	3.44	9.26	5.81	9.31	43.4	22.75
Cointegration	present	Present	Present	present	Present	Present	present	present	Not present	present	Present	present	present	present
Critical Values														
	Lower bound					Upper bound			Lower bound			Upper bound		
5percent level	2.26					4.85			2.45			3.63		
2.5 percent level	2.62					3.9			2.87			4.16		
Panel II: Diagnostic Tests														
R^2	0.90	0.98	0.66	0.96	0.92	0.97	0.88	0.79	0.87	0.92	0.97	0.91	0.98	0.97
TEST[1]	0.82(0.47)	0.65(0.54)	0.14(0.87)	0.50(0.63)	1.56(0.27)	0.41(0.67)	4.55(0.09)	1.04(0.38)	0.78(0.49)	0.42(0.68)	9.68(0.22)	0.62(0.55)	0.88(0.45)	0.52(0.66)
TEST[2]	0.76(0.67)	0.18(0.99)	1.68(0.19)	0.11(0.99)	2.34(0.11)	0.88(0.60)	0.26(0.97)	0.36(0.87)	2.33(0.09)	0.27(0.97)	0.63(0.76)	0.87(0.55)	0.43(0.91)	0.93(0.61)
TEST[3]	1.04(0.59)	1.09(0.58)	3.88(0.15)	0.96(0.62)	0.14(0.93)	0.52(0.77)	1.37(0.51)	6.53(0.40)	0.77(0.68)	1.63(0.44)	3.67(0.16)	0.97(0.61)	3.32(0.19)	1.36(0.51)
TEST[4]	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable

Source: Compiled by the authors
1 – Breusch-Godfrey Serial Correlation LM test
2 – Heteroskedasticity Test: Breusch-Pagon-Godfrey
3 – Normality test: Jarque-Bera test
4 – CUSUM Test (See Appendix 1)
Note: The parenthesis () is the probability values of diagnostic tests

reported that F-statistics for all the districts except Matale in Maha season and Ampara and Kurunagala in Yala season are higher than the upper critical bound at 1% level of significance.

The serial correlation LM test, normality test, heteroscedasticity test were the series of diagnostic tests in use to check the validity of models for both seasons and are given in Tables **3** and **6**. It justifies that the models developed district-wise are free from the issues of serial auto correlation, heteroscedasticity and normality of residuals. Figure **1** in appendix confirms the stability of the models using the plot of the cumulative sum of recursive residuals (CUSUM test).

At the same time Tables **5** and **8** provide the error correction represent of the selected models of the district for both seasons. One of the most important value in the tables is that the error correction term with negative sign and coefficient less than one belonging to each district confirmed that there is a validity of expected convergence process in the long-run (Banerjee, Dolado, and Mestre 1998). It is also evident that there is a high model adequacy for all models as they all have indicated a high R-squared and adjusted R-squared values. In line with this most of the models show Durbin Watson value around 2 suggesting the model validity further.

In this discussion we have included long-run results in the Table **4** and the short-run results in the Table **5** pertaining to the Maha season. But in our discussion, we refer to both tables where necessary.

Table 4: Estimated Long Run Coefficients Using the ARDL Approach – Maha Season

District	Variable	Coefficient	P- value	District	Variable	Coefficient	P- value
AMPARA	LSCFA_M	5950.37	0.028	KURUNAGALA	LSOFA_M	22378..42	0.076
	TEMPA	-10332293	0.000		LSMSB_M	5087.8	0.000
ANURADHAPURA	LSNI_M	3553.86	0.000		TCOC_M	-802.6	0.028
	LSOFA_M	104866.9	0.010		TEMPA	-1770375	0.000
	PPA	-1229296	0.019				
	LSMSTR_M	-17605.51	0.003	KALUTARA	LSCFA_M	1496.64	0.103
BADULLA	LSMSB_M	2583.45	0.028		LSMSB_M	654.14	0.596
	LSBFA_M	1711.413	0.045		RF_05	-28882.7	0.006
	TEMPA	2675368	0.004	MATARA	LSNI_M	462.03	0.119
	LSNI_M	-2084.712	0.152		RF_08	553.65	0.965
BATTICALOA	LSNI_M	1419.46	0.706		TEMPA	363280.5	0.208
	LSCFA_M	1571.92	0.619	MONARAGALA	LSOI_M	5545.58	0.381
	CRGM1	6122.63	0.862		LSMSRS_M	150562.8	0.003
	TEMPA	-966555.2	0.000		LSOFA_M	51061.26	0.003
GAMPAHA	LSOI_M	-521910.4	0.003	POLONNARUWA	LSCFA_M	-800.15	0.005
	LSMSB_M	3123.874	0.018		LSMSB_M	3219.54	0.000
	LSOFA_M	23679.72	0.118		RF_01	-175600.3	0.000
HAMBANTOTA	TCOC_M	545.6408	0.003	RATHNAPURA	LSMSB_M	2772.99	0.027
	LSMSB_M	3917.335	0.000		LSOI_M	6265.83	0.000
	LSNI_M	-206.194	0.209		LSCFA_M	-379.06	0.358
	TEMPA	-951516.5	0.062		TEMPA	-259811.5	0.396
KANDY	RF_10	-13154.7	0.471				
	LSMSRS_M	16179.82	0.054				
	LSNI_M	1722.29	0.040				
	LSBFA_M	583.75	0.302				

Source: Compiled by the authors.

Table 5: Error Correction Representation of the Selected Model – Maha Season

District	Variable	Coefficient	P-value	District	Variable	Coefficient	P-value
AMPARA	D(QPMT_AM(-1))	-0.657	0.000	KANDY	D(RF_10)	20547.16	0.001
	D(QPMT_AM(-2))	-0.198	0.136		D(RF_10(-1))	18329.32	0.002
	D(LSCFA_M)	3501.5	0.010		D(LSMSRS_M)	-985.7	0.741
	D(LSCFA_M(-1))	-4957.8	0.064		D(LSMSRS_M(-1))	-9733..6	0.051
	D(LSCFA_M(-2))	-6721.6	0.004		D(LSNI_M)	2798.3	0.003
	D(LSCFA_M(-3))	-5200.1	0.003		D(LSNI_M(-1))	1826.03	0.006
	D(TEMPA)	-32152082	0.000		ECT(-1)	-0.59	0.001
	D(TEMPA(-1))	-47580123	0.000	KURUNAGALA	ECT(-1)	-0.96	000
	ECT(-1)	-0.035	0.003	KALUTARA	D(QPMT_KT(-1))	0.483	0.006
ANURADHAPURA	D(LSOFA_M)	22690.04	0.007		D(LSMSB_M)	-3903.35	0.004
	D(LSOFA_M(-1))	-24571.59	0.024		D(LSMSB_M(-1))	-6228.74	0.000
	D(PPA)	-7352928	0.000		D(RF_05)	-9472.56	0.000
	D(PPA(-1))	-1271323	0.222		D(RF_05(-1))	6560.8	0.028
	D(LSMSTR_M)	-9928.33	0.000		D(RF_05(-2))	17146.8	0.000
	ECT(-1)	-0.91	0.000		ECT(-1)	-0.54	0.000
BADULLA	ECT(-1)	-0.98	0.000	MATARA	D(LSNI_M)	2570.8	0.001
BATTICALOA	D(LSNI_M)	-1265.08	0.118		D(LSNI_M(-1))	-1583.25	0.006
	D(LSCFA_M)	3325.51**	0.000		D(LSNI_M(-2))	1906.8	0.001
	D(LSCFA_M(-1))	686.589	0.091		D(RF_08)	25313.0	0.005
	D(LSCFA_M(-2))	-1871.339	0.000		D(RF_08(-1))	10597.7	0.072
	D(CRGM1)	6274.993	0.168		D(RF_08(-2))	26861.8	0.004
	D(CRGM1(-1))	242.892	0.959		D(TEMPA)	-209997.7	0.826
	D(CRGM1(-2))	37895.2	0.002		D(TEMPA(-1))	-2028452	0.117
	D(TEMPA)	-10276157	0.000		D(TEMPA(-2))	-5214366	0.010
	D(TEMPA(-1)	-35532755	0.000		ECT(-1)	-0.37	0.006
	ECT(-1)	-0.98	0.000	MONARAGALA	D(QPMT_MO(-1)	-0.973	0.000
GAMPAHA	D(LSOI_M)	35155.43	0.015		D(LSOI_M)	16162.54	0.000
	D(LSOI_M(-1))	558508.4	0.000		D(LSMSRS_M)	204852.8	0.000
	D(LSOI_M(-2))	2697228.8	0.000		ECT(-1)	-0.23	0.000
	D(LSMSB_M)	-2883.92	0.005	POLONNARUWA	D(QPMT_PO(-1))	-0.39	0.000
	D(LSMSB_M(-1))	-5227.75	0.000		D(QPMT_PO(-2))	-0.27	0.000
	D(LSMSB_M(-2))	-1569.61	0.016		D(LSCFA_M)	380.11	0.466
	D(LSOFA_M)	41925.31	0.004		D(LSCFA_M(-1))	3886.49	0.000
	D(LSOFA_M(-1))	28279.29	0.024		D(LSMSB_M)	4422.91	0.000
	D(LSOFA_M(-2))	55831.58	0.001		D(LSMSB_M(-1))	1525.27	0.007
	ECT(-1)	-0.91	0.000		D(LSCFA_M(-2))	3431.17	0.000
HAMBANTOTA	D(QPMT_HT(-1))	-0.062	0.542		ECT(-1)	-0.51	0.000
	D(QPMT_HT(-2))	0.375	0.051	RATHNAPURA	D(QPMT_RP(-1))	-0.303	0.008
	D(TCOC_M)	-1162.84	0.000		D(LSMSB_M)	1103.21	0.018
	D(LSNI_M)	-23.72	0.612		D(LSMSB_M(-1))	-1638.07	0.018
	D(LSNI_M(-1))	212.01	0.000		D(LSOI_M)	3450.02	0.016
	D(TEMPA)	1010285	0.000		D(LSCFA_M)	1554.12	0.002
	D(TEMPA(-1))	7662873	0.000		D(LSCFA_M(-1))	1491.4	0.008
	ECT(-1)	-0.89	0.000		D(TEMPA)	3035455	0.001
					D(TEMP(-1)	4720816	0.000
					ECT(-1)	-0.65	0.000

Source: Compiled by the authors.

Table 6: Cointegration Test Results for Yala Season (ARDL Long Run Form and Bound Test)

Panel I: ARDL Long Run Form and F Bounds Tests														
Districts	**Ampara**	**Anuradhapura**	**Batticalo**	**Gampaha**	**Hambantota**	**Kandy**	**Matale**	**Matara**	**Monaragala**	**Polonnaruwa**	**Badulla**	**Kalutara**	**Kurunagala**	**Rathnapura**
Estimated model	LSCFA_Y LSOI_Y TEMPA	LSNI_Y LSBFA_Y LSMSB_Y	LSBFA_YTEMPA RF_03	LSMSB_YTEMPA LSOI_Y	LSMSB_MLSBFA_Y RF_11	LSMSB_YLSNI_Y LSBFA_Y	LSCFA_Y LSMSRS_Y TEMPA	TEMPA LSNI_Y LSMSB_Y	LSNI_Y LSOFA_Y TEMPA	LSMSB_YLSBFA_YLSNI_Y	TEMPA, LSMSB_Y LSNI_Y LSBF_Y	LSNI_Y LSMPT_Y LSCFA_Y TEMPA	LSNI_Y LSCFA_Y TCOC_M TEMPA	LSMSB_Y LSMPBM_Y
ARDL	(3,1,3,2)	(1,2,3,2)	(2,1,1,3)	(1,0,0,2)	(1,0,0,0)	(2,3,2,1)	(4,3,3,2)	(1,0,0,2)	(1,2,3,1)	(1,2,3,2)	(2,3,3,0,3)	(3,3,3,3,3)	(3,3,1)	(1,0,0)
F-statistics	1.39	8.09	5.28	121.34	13.51	3.79	3.93	4.88	8.66	12.34	5.71	172.7	1.96	5.90
Cointegration	Not present	Present	Present	present	present	present	Present	present	present	present	present	present	Not present	present
Critical Values														
	Lower bound					Upper bound					Lower bound	Upper bound	Lower bound	Upper bound
5percent level	2.45					3.63					2.26	3.48	2.72	3.83
2.5 percent level	2.87					4.16					2.62	3.9	3.22	4.5
Panel II: Diagnostic Tests														
R^2	0.79	0.99	0.90	0.98	0.86	0.89	0.96	0.85	0.97	0.98	0.97	0.99	0.88	0.60
TEST[1]	0.67(0.53)	0.70(0.52)	0.76(0.49)	0.23(0.79)	0.39(0.68)	0.51(0.61)	0.08(0.93)	0.34(0.72)	0.50(0.62)	2.20(0.15)	1.27(0.33)	0.62(0.55)	1.74(0.22)	0.15(0.86)
TEST[2]	0.81(0.64)	0.41(0.92)	0.48(0.87)	0.41(0.86)	1.40(0.27)	1.11(0.42)	0.22(0.99)	0.99(0.46)	0.67(0.74)	1.15(0.40)	0.28(0.98)	0.87(0.55)	0.49(0.85)	2.17(0.12)
TEST[3]	0.28(0.87)	2.97(0.23)	5.65(0.06)	0.73(0.70)	0.56(0.76)	1.45(0.48)	1.33(0.51)	0.16(0.92)	0.17(0.92)	1.39(0.50)	6.72(0.06)	2.52(0.28)	4.53(0.11)	0.20(0.91)
TEST[4]	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable	Stable

Source: Compiled by the authors
1 – Breusch-Godfrey Serial Correlation LM test
2 – Heteroskedasticity Test: Breusch-Pagon-Godfrey
3 – Normality test: Jarque-Bera test
4 – CUSUM Test (See Appendix 1)
Note: The parenthesis () is the probability values of diagnostic tests

Long-run results in the Table **4** shows us about the environmental factors such as temperature and rainfall which had a significant long-run relationship with the paddy production for Maha season with respect to several districts. Here, the Badulla district indicate a significant long-run effect of temperature on paddy production whereas Hambantota and Kurunagala districts are of a significant negative effect in the long-run. In further analysis, for Ampara and Baticalo Districts, temperature has negative impact on paddy production both in long-run and short-run. This suggest that the negative impact is on the districts in the dry zone. Moreover, the districts of Ratnapura and Matara belonging to the wet zone reveled that temperature has a negative short-run impact on paddy cultivation. In further discussion, it is also noted that for the districts Polonnaruwa and Kalutara, there is a significant negative long-run relation on paddy production by rainfall. In the short-run the Kandy district had a positive relationship with rainfall when Kalutara indicated negative effect.

In relation to the chemical fertilizer applications regarding the Maha season, the Tables **4** and **5** bring out the point that there is a positive long-run relationship at Ampara and a negative long-run impact on paddy production at Polonnaruwa by contrast. Also, with the short-run analysis the districts such as Ampara, Batticaloa, Rathnapura and Polonnaruwa show a positive impact. What is notable here is that the district of Anuradhapura adjacent to Polonnaruwa has indicated a positive effect of organic fertilizer application both in long-run and short-run. Furthermore, the Monaragala district also shows that there is a significant positive long-run relationship with organic fertilizer application though it has been a positive short-run relationship in Gampaha. It also reveals that districts such as Badulla and Kandy records a positive impact on paddy with the usage of a mixture of organic and chemical fertilizer. even though it is interesting to note that there has been no short run relationship on paddy production with the usage of both at all districts.

The use of the newly improved paddy varieties has developed a significant long-run relationship in relation to Anuradhapura and Kandy districts, as depicted by the Tables **4** and **5**. But this explanatory variable shows negative impact in the context of Badulla and Hambantota districts in Maha season. In the short-run, Kandy, Matara and Hambantota districts also show positive impact in this regard on paddy production. Similarly, the use of the old improved varieties has also brought out a significant positive and negative long-run relationship when the Rathnapura and Gampaha districts are in concern respectively.

When compared, the districts of Gampaha, Monaragala and Rathnapura point outs a positive short-run effects on the use of old improved seed on paddy production. Anuradhapura district become exceptional as it has shown a negative long-run and short-run impact on paddy production pertaining to the average paddy price. The average paddy price means the prices that explain the process of paddy purchasing including the guaranteed paddy price average paddy producer price and paddy market price. No district is observed with a significant impact on paddy production with the credit grant for paddy. Paddy sowing methods too bears a significant and positive long-run relationship with respect to Badulla, Gampaha, Hambantota, Kurunagala and Polonnaruwa. However, this has shown negative short-run results reporting from Kalutara and gampaha districts. Added to this, it is the district of Polonnaruwa which is also a positive short-run relationship in this regard.

This includes a further discussion related to the Yala season based on Tables **7** and **8**.

According to the ARDL bound testing long-run and short-run results in Tables **7** and **8**, it is indicated that there is a significant positive long-run effect on temperature on paddy production in Matara. However negative results show at Matale and Gampaha districts. Badulla, Batticaloa, Matale and Kalutara indicate a positive short-run effect with temperature. Monaragala is the only district that has shown a negative short-run relationship toward paddy production. The explanatory variable, the rainfall does not show much effect on paddy production both in long-run and short-run. With regard to the fertilizer usage there is a positive long-run impact on the mixture of organic and chemical fertilizer usage in Polonnaruwa, Anuradhapura and Hambantota districts were as the Kandy district has shown a negative long-run relationship at this. In our further analysis of these tables we would like to highlight that, for the usage of both chemical and organic fertilizer, the two districts Anuradhapura and Batticaloa indicates a significant and positive short-run impact on paddy production.

With respect to the usage of chemical fertilizer positive long-run impact is the results for Kalutara in the wet zone and Matale districts in the intermediate zone. This confirms that the results run in consistent in the short-run as well. Only the district of Monaragala

Table 7: Estimated Long Run Coefficients Using the ARDL approach – Yala Season

District	Variable	Coefficient	P-value	District	Variable	Coefficient	P-value
ANURADHAPURA	LSNI_Y	0.188	0.635	MATARA	TEMPA	406921.9	0.016
	LSBFA_Y	2.911	0.042		LSNI_Y	91.788	0.491
	LSMSB_Y	2.456	0.000		LSMSB_Y	690.83	0.093
BADULLA	TEMPA	423130.5	0.326	MONARAGALA	LSNI_Y	2172.528	0.003
	LSMSB_Y	2195.295	0.204		LSOFA_Y	-173.915	0.992
	LSNI_Y	-1150.125	0.005		TEMPA	118006.8	0130
	LSBFA_Y	933.825	0.331	MATALE	LSCFA_Y	3834.904	0.012
BATICALO	LSBFA_Y	1604.234	0.122		LSMSRS_Y	-37280.92	0.035
	TEMPA	-57078.71	0.925		TEMPA	-544672	0.041
	RF_03	634308.2	0.006	POLONNARUWA	LSMSB_Y	4188.18	0.000
GAMPAHA	LSMSB_Y	2923.67	0.000		LSBFA_Y	988.82	0.001
	TEMPA	-85949.24	0.001		LSNI_Y	-830.16	0.039
	LSOI_Y	12142.54	0.079	RATHNAPURA	LSMSB_Y	2091.907	0.000
HAMBANTOTA	LSMSB_M	2740.528	0.000		LSMPBM_Y	130.03	0.528
	LSBFA_Y	2727.735	0.000	KANDY	LSMSB_Y	2342.394	0.009
	RF_HT11	-24715.12	0.192		LSNI_Y	-140.01	0.701
KALUTARA	LSNI_Y	1048.326	0.015		LSBFA_Y	-2146.538	0.011
	LSMPT_Y	1062.793	0.028				
	LSCFA_Y	630.07	0.046				
	TEMPA	-86557.86	0.094				

Source: Compiled by the authors.

Table 8: Error Correction Representation of the Selected Model – Yala Season

District	Variable	Coefficient	P-value	District	Variable	Coefficient	P-value
ANURADHAPURA	D(LSNI_Y)	0.45	0.008	MONARAGALA	D(LSNI_Y)	1649.326	0.000
	D(LSNI_Y(-1))	0.958	0.000		D(LSNI_Y(-1))	-1310.971	0.000
	D(LSBFA_Y)	2.026	0.073		D(LSOFA_Y)	44262.02	0.000
	D(LSBFA_Y(-1))	3.279	0.025		D(LSOFA_Y(-1))	-27601.58	0.001
	D(LSBFA_Y(-2))	2.826	0.005		D(LSOFA_Y(-2))	-24388.53	0.009
	D(LSMSB_Y)	2.874	0.000		D(TEMPA)	-8048624	0.000
	D(LSMSB_Y(-1))	-0.938	0.000		ECT(-1)	-0.70	0.000
	ECT(-1)	-0.92	0.000	MATALE	D(QPYT_MT(-1))	-0.737**	0.001
BADULLA	D(QPYT_BD(-1))	-0.402	0.003		D(QPYT_MT(-2))	0.021	0.915
	D(TEMPA)	2557266	0.001		D(QPYT_MT(-3))	0.555**	0.001
	D(TEMPA(-1))	-3065675	0.000		D(LSCFA_Y)	2496.36**	0.000
	D(TEMPA(-2))	-2589649	0.003		D(LSCFA_Y(-1))	261.49	0.795
	D(LSMSB_Y)	3964.691	0.000		D(LSCFA_Y(-2))	1365.39	0.035
	D(LSMSB_Y(-1))	3272.83	0.000		D(LSMSRS_Y)	37706.11*	0.037
	D(LSMSB_Y(-2))	2240.367	0.001		D(LSMSRS_Y(-1))	79562.28**	0.000
	D(LSBFA_Y)	255.899	0.353		D(LSMSRS_Y(-2))	36462.66	0.114
	D(LSBFA_Y(-1))	-826.018	0.012		D(TEMPA)	3062227**	0.000
	D(LSBFA_Y(-2))	-1213.399	0.000		D(TEMPA(-1))	3529434**	0.000
	ECT(-1)	-0.55	0.000		ECT(-1)	-0.179	0.001

(Table 8). Continued.

District	Variable	Coefficient	P-value	District	Variable	Coefficient	P-value
BATTICALOA	D(LSBFA_Y)	3789.147	0.001	POLONNARUWA	D(LSMSB_Y)	3929.26	0.000
	D(TEMPA)	11216725	0.000		D(LSMSB_Y(-1))	-738.74	0.024
	D(RF_03)	124977.3	0.001		D(LSBFA_Y)	364.91	0.324
	D(RF_BT03(-1))	-308595.6	0.003		D(LSBFA_Y(-1))	447.83	0.285
	D(RF_BT03(-2))	-59646.83	0.281		D(LSBFA_Y(-2))	-801.38	0.044
	ECT(-1)	-0.83	0.000		D(LSNI_Y)	121.92	0.292
GAMPAHA	D(LSOI_Y)	1788.932	0.419		D(LSNI_Y(-1))	829.42	0.000
	D(LSOI_Y(-1))	-5622.354	0.014		ECT(-1)	-0.85	0.000
	ECT(-1)	-0.89	0.000	KALUTARA	D(QPYT_KT(-1))	-0.05	0.068
HAMBANTOTA	ECT(-1)	-0.93	0.000		D(QPYT_KT(-2))	0.389	0.007
KANDY	D(QPYT_KD(-1)	-0.650**	0.000		D(LSNI_Y)	-1115.23	0.005
	D(LSMSB_Y)	2661.217**	0.000		D(LSNI_Y(-1))	-374.727	0.012
	D(LSMSB_Y(-1))	-400.88	0.403		D(LSNI_Y(-2))	-919.348	0.003
	D(LSMSB_Y(-2))	-935.564**	0.009		D(LSMPT_Y)	1340.039	0.004
	D(LSNI_Y)	730.862**	0.000		D(LSMPT_Y(-1))	1533.264	0.006
	D(LSNI_Y(-1))	270.46	0.094		D(LSMPT_Y(-2))	866.248	0.010
	D(LSBFA_Y)	-269.072	0.615		D(LSCFA_Y)	4890.293	0.002
	ECT(-1)	-0.12	0.000		D(LSCFA_Y(-1))	1654.936	0.005
RATHNAPURA	ECT(-1)	-0.68	0.000		D(LSCFA_Y(-2))	2195.632	0.003
MATARA	D(LSMSB_Y)	2951.84	0.000		D(TEMPA)	218194	0.006
	D(LSMSB_Y(-1))	908.86	0.003		D(TEMPA(-1))	-2961211	0.008
	ECT(-1)	-0.59	0.000		D(TEMPA(-2))	7812865	0.003
					ECT(-1)	-0.82	0.003

Source: Compiled by the authors.

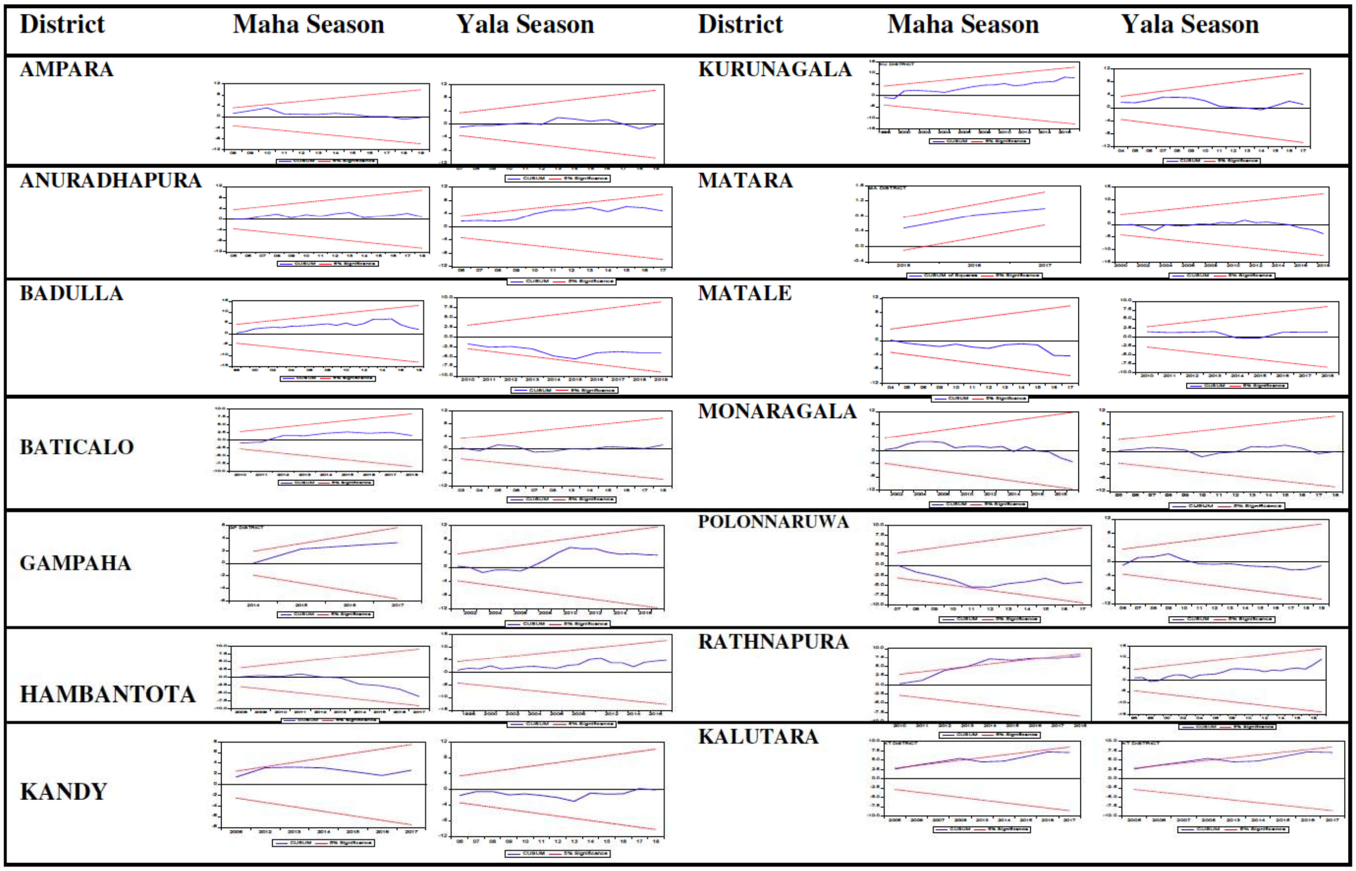
shows a short-run relationship in the usage of organic fertilizer.

When the sowing methods consisting of broadcasting, row seeded, transplanted in rows, are taken into consideration, with close reference to the Tables **7** and **8**, it is evident that the sowing method of broadcasting too had a positive impact on paddy production in Gampaha, Hambantota, Polonnaruwa, Rathnapura and Anuradhapura in the long-run. The similar positive effect is also seen in Anuradhapura, Badulla and Matara Districts in the short-run also. However, in the few districts, it means Kandy and Polonnaruwa, shows this impact negative relating to the sowing method in the short-run. Land preparation method, that is with the help of the tractor too indicate a positive long-run and short-run impact on the paddy production in the Kalutara district.

5. CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of our research, we wish to conclude that the results generated by the ARDL bound testing approach gives us a wealth of information regarding long-run and short-run district-wise impact of policies on paddy cultivation. In line with the main objective of the study there is an impact of the environmental factors such as temperature and rainfall on the production of paddy. We found significant positive impact of the temperature and rainfall on paddy yield. Our results confirm the finding of Seo et. *al* (2005). We also identified that the districts such as Ampara, Batticaloa, Hambantota and Kurunagala have a negative relationship between temperature on paddy production while such districts as Baddula and Matara have a positive impact. What is notable here is that most of the districts in the dry zone are more temperature sensitive than that of the districts in the wet zone.

Based on the overall results it is recommended that the supply of water for paddy during the first few weeks after sowing is an essential factor for high yields but the supply of water during the period of land preparation do not indicate much significance. Further it is notable that almost all the major paddy producing districts, especially in the dry zone districts such as Ampara, Anuradhapura, Kurunagala etc. bears evident that



proper irrigation networks have been very much useful to promote high yields. What is interesting to note is that, despite the lower rainfall, cultivations with tank water too has shown an increase in paddy production. Therefore, it is difficult to capture the actual effect in relation to the rainfall.

In previous study by Cooray (1998), found a positive link between, the use of fertilizer in paddy cultivation and production. The current study went further step and tested the impact of both chemical fertilizer and organic fertilizer on paddy cultivation. We found a positive link in Badulla, Anuradhapura, Monaragala and Gampaha districts in the Maha season. Similar results were found in Anuradhapura, Hambantota, Batticaloa and Polonnaruwa in Yala season. Further it is observed that the use of chemical fertilizer in the Polonnaruwa district indicates a negative long-run impact on paddy production. Overall results illustrate that the use of a mixture of chemical and organic fertilizer creates the positive impact in more districts in contrast to the districts using only chemical fertilizer.

In relation to the performance of the paddy production, the districts that use only the chemical fertilizer is lower than the districts that use a mixture of both chemical and organic fertilizer. This suggest that there should be a programme to encourage the farmers to use organic fertilizer where necessary discourage the use of chemical fertilizer alone. In order to make this a success it is the responsibility of the successive governments to gradually minimize and then avoid the chemical fertilizer subsidy. As evident from research of Rajapaksha and Karunagoda (2009) in Sri Lankan context, 80 percent of total fertilizer subsidy used for paddy could be avoided if the successive government pay more attention on the use of organic fertilizer. This, no doubt, will save huge amount of foreign exchange that every government incur for fertilizer import. But under the government subsidiary schemes, still 65 per cent of cultivable areas use imported chemical fertilizer whereas only 0.2 per cent of cultivable areas used organic fertilizer. At the same time, as reveled by results the factors such as the guaranteed paddy price, the average paddy price, the average producer price and the market price of rice are insignificant explanatory variables which explain the paddy production. The inability of those variables to explain the paddy production is because of the distortion of market of rice and paddy by the interventions of respective governments since the independence. In this scenario, it is advisable that the government not engaged in controlling rice price and leave it to be determined by the market forces supply and demand if we still expect paddy to be cultivated as the staple food of Sri Lanka.

The only possible remedial step that any government in power should take is to have policy decisions. In order to developed a system that promotes the applications of organic fertilizer. And also, there is a practical role in the activities of the regional agricultural centers towards this destination. They are expected to organize and conduct workshops and practical sessions in order to convince the farmers how easy it is for them to prepare organic fertilizer with the raw materials available with no price in their home gardens and increase harvest saving their money for chemical fertilizer. As such there is need to regularly monitor these programmes till farmers are convinced by the advantages of eco-friendly low budget paddy cultivation methods and habits.

One of the limitations that we had to encounter in our study is that the inability to consider the irrigated and the rain-fed areas as two conditions and also the omission of the soil condition. With these conditions future researchers may get the opportunity to determine the real effect more broadly and accurately.

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