

STABILITY AND COMPARATIVE ADVANTAGE OF PADDY CULTIVATION IN LOW COUNTRY WET ZONE OF SRI LANKA

B.R. WALISINGHE¹, S.W. ABEYSEKARA¹, D.B.T. WIJERATHNE², T.H.C.S. PERERA³,
G.M.N. SANJEEWANI¹, S.W.N.P. SENADHEERA¹ AND H.M.M.K. KUMARI¹

¹ *Rice Research and Development Institute, Department of Agriculture, Bathalagoda, Sri Lanka,*

² *Ministry of Agriculture, Battaramulla, Sri Lanka,*

³ *Socio Economics and Planning Centre, Department of Agriculture, Peradeniya, Sri Lanka,*

ABSTRACT

Adoption of New Improved rice Varieties and favourable policy regimes have paved way for achieving self sufficiency in rice. Maintaining Wet zone paddy production is of vital importance as a buffer zone in spite of major contribution by Dry zone which is highly vulnerable to adverse weather conditions. However, Wet zone is characterized by series of a biotic and biotic problems common to the region. Hence the primary objective of this study is to analyze the current status of production, extent and average yield of paddy and to estimate the comparative advantage of paddy production in Low Country Wet zone (LCWZ). A primary survey was conducted in LCWZ using a sample of 700 farmers. Coefficient of variation was used to analyse the instability of production, extent and average yield and Domestic Resource Cost was computed to assess the comparative advantage. Annual compound growth rates were also computed for the three climatic zones. Results revealed that, the percentage contribution of LCWZ to the national extent and production of paddy has lowered from 23 % and 20 % in 1990 to 12 % and 9 %, respectively by 2012. The total average cost of cultivation of one acre of paddy in LCWZ is Rs. 34,186 in 2012. The LCWZ Wet zone districts do not have a comparative advantage in rice production as at 2012. Average yield depicts a more stable condition whereas the production is characterized by the highest instability followed by the extent. In contrast to Intermediate and Dry zone, Wet zone paddy production is more stable based on the coefficient of variation. However, growth rates of extents cultivated were at a decreasing trend in the Wet zone. Therefore, a need is raised to revise the current policies to set priorities in order to LCWZ paddy production profitable.

KEYWORDS: Instability, Paddy, Low Country Wet zone

INTRODUCTION

Green Revolution has paved a way for Sri Lanka in achieving self sufficiency in rice production by 2010. As a result, in 2012, the country has achieved an annual paddy production of 3.84 million tons (CBSL, 2012) with an average yield of 4.3 t/ha creating a surplus of 300,000 t in production. The outstanding performance of the rice sector is mainly attributed to technological advancement and implementation of favourable policies by the government of Sri Lanka. Adoption of New Improved rice Varieties (NIV) is the major component of this achievement. The Rice Research and Development

Institute (RRDI) continue to develop New Improved rice Varieties (NIV) with multiple resistances to major biotic and abiotic stresses. RRDI has released approximately sixty rice varieties adaptable to varying agro-ecological conditions with wider adaptability during the last five decades.

Rice is grown predominantly in nine agro ecological regions out of 15 in the Wet zone. Out of the total rice extent in the Wet zone of Sri Lanka, approximately 80 % lies in the Low Country Wet zone (LCWZ). A significant proportion of rice lands in the Wet zone, particularly, in the LCWZ has been diverted to other uses and abandoning or long term fallowed due to seawater intrusion, water logging, development of soil related problems, poor drainage systems, prone to flooding etc (Bentota *et al.*, 2010). However, the Wet zone paddy production is essential as a buffer zone (Dhanapala, 2005) in spite of major contribution by Dry zone which is highly vulnerable to adverse weather conditions.

The Wet zone paddies with proper timing can be cultivated twice a year. The Wet zone receives ample water which is a scarce resource in Dry zone paddy farming, but the Wet zone is characterized by series of abiotic and social problems common to the region. The main abiotic problem in the Wet zone is poor drainage (Dhanapala, 2005). The situation is aggravated with soil related problems such as half bog and bog soils, iron toxicity, salinity, sandy soils, etc (Bentota *et al.*, 2010 and Dhanapala, 2005).

The paddy farming in the Wet zone is viable only in part time basis (Baddawalage and Karunagoda, 2010), because the paddy farming is not the major income generating activity in such farmers. Hence, the paddy production in the area operates at a subsistence level generating low farm income. Moreover, the percentage contribution of LCWZ to the national extent and production in 1990 was 23 % and 20 %, respectively which is a declining trend. Although the share of paddy production of Wet zone has declined, it gives stable production throughout the years. However, Wet zone is characterized by variety of problems and solving these problems would help to achieve the national food security. A review of growth and instability in the paddy sector is of vital importance in order to suggest suitable policy options for achieving optimal paddy production in the LCWZ. Hence, the primary objective of this study is to analyze the current status of production, extent and average yield of paddy and to estimate the comparative advantage of paddy production in the low country Wet zone. The specific objectives are to compare the status of production in Wet zone, Dry zone and Intermediate zone and to estimate the comparative advantage of paddy production in the low country Wet zone. Further, this study estimates the instability status and growth rates in terms of paddy production, extent and average yield in all the climatic zones.

MATERIALS AND METHODS

The study was conducted in seven districts in the LCWZ of Sri Lanka including Kalutara, Galle, Matara, Colombo, Gampaha, Kegalle and Rathnapura. Seven hundred paddy farmers were interviewed using a pre-tested and structured questionnaire following a stratified random sampling. Data were collected during May-August 2012 by trained enumerators. Details of cost of production of 2011/12 *maha* and 2012 *yala* seasons were also collected. In addition to the primary data collection, paddy statistics of Department of Census and Statistics from 1990-2012 (DCS, 199-2012) were also used to calculate instability and growth rates of the three climatic zones.

Measurement of comparative advantage

Domestic resource cost (DRC) ratio is widely used as a measure of comparative advantage in the context of resource use efficiency. DRC compares the social opportunity cost of domestic production of a particular commodity relative to the value added by the product (Pearson and Monke, 1989). In policy dialogue, DRC is a useful criterion in deciding whether a commodity should be produced domestically or to be imported. If DRC is greater than unity, economy loses foreign exchange through domestic production, hence, the importation is profitable. If DRC is less than unity and above zero, domestic production is efficient and cost is less than the opportunity cost. DRC can be defined as,

$$DRC = \frac{\sum_{j=k+1}^n a_{ij} V_j}{P_i^b - \sum_{j=1}^k a_{ij} P_j^b} \dots\dots\dots (i)$$

Where a_{ij} , 1 to k = coefficients for traded inputs

a_{ij} , k+ 1 to n = coefficients for domestic resources and non-traded intermediary inputs

V_j = shadow price of domestic resource or non-traded input

P_j^b = border price of traded input

P_i^b = border price of traded output

Instability and growth of paddy production

Many research studies have used coefficient of variation to measure instability in the production systems. Fernando *et al* (2009) has examined the instability and growth rates for paddy in different agro climatic zones using coefficient of variation and the

results have revealed that the highest production stability recorded in the Wet zone while higher risk in production of paddy involved in Intermediate zone. Hazell (1982) has also used coefficient of variation to measure the instability of Indian food grain market and results have revealed that grain production carried the highest instability followed by average yield and area. Chand and Raju (2008) have examined the sources of instability of crops in Andhra Pradesh in India. They have found that erratic rainfall distribution, irregular power supply for irrigation and extension of crops to non-traditional areas were the main causes for instability.

Co-efficient of variation (CV) was used to measure the magnitude of instability in extent, production and average yield of paddy, which measures the amount of variation of the response variable. The growth performance in production, extent cultivation and average yield of paddy is carried out by estimating Compound Annual Growth Rate (CAGR) for the period of 1990 to 2012 for paddy and the estimation was performed for national level under different climatic zone level and districts of Wet zone representing seasonal variations.

$$CAGR(t_0, t_n) = (V(t_n)/V(t_0))^{\frac{1}{t_n-t_0}} - 1 \quad (\%) \dots\dots\dots (iii)$$

Where,

Compound Annual Growth Rate (CGR) (%)

$V(t_0)$: Initial value,

$V(t_n)$: Finish value,

$t_n - t_0$: Number of years.

RESULTS AND DISCUSSION

The demographic profile of the surveyed farmers in LCWZ is given in Annex 1. Almost 80 % of the farmers were at or above 40 years in age. Sixty nine of the farmers had education level up to either ordinary level or advanced level. About 69 % of the respondents were engaged in farming as the primary occupation and 85 % had experience in farming more than 10 years. Of the total sample, 54 % farmers indicated that they are full-time farmers. About 46 % of respondents stated that the farming was the main income source.

The status of the paddy cultivation in *maha* season 2011/12 at selected districts is illustrated in Annex 2. Average land holding size is less than 1 ha conforming to the

small scale operation. Eighty percent of the lands were under rainfed and 20 % were cultivated with irrigated conditions. Field establishment is mainly done through direct seeding (80 %) while transplanting (20 %) is also practiced. The most preferred maturity class of paddy is 3 ½ months (75 %). Red rice varieties were mainly demanded in districts like Galle, Matara and Kalutara whereas the small grain white rice varieties had a greater demand in Gampaha (62 %) and Colombo (35 %). The average yield was 2.81 and 2.69 t/ha in *maha* and in *yala* seasons, respectively.

Annex 3 summarizes the cost of cultivation incurred for one acre of cultivation of rice during *maha* season 2011/12 in the selected area of LCWZ. Total cost was disaggregated to material cost, labour cost and power cost, of which more than 60 % spent on labour input. The total cost of cultivation was further analyzed with and without family labour component, because the family labour involvement is impressive in paddy cultivation in Sri Lanka. After valuation of family labour, the total cost of one acre of paddy cultivation was Rs 53,311/= whereas excluding the family labour, the total cost was Rs. 34,186/=. The high cost of cultivation is due to inclusion of marginal paddy lands in the sample. Similarly, the cost of cultivation for *yala* season was also derived using the survey data. The average unit cost of production in the sample was Rs. 31/= /kg in *maha* season whereas Rs. 33/= /kg in *yala* season. Based on the observations, the cost is high in *yala* season due to low productivity.

Domestic Resource Cost (DRC) calculation

DRC values were computed for the paddy production in the districts in LCWZ using shadow prices (Table 1). Conversion factors used to derive tradable and non-tradable components are depicted in Annex 4. The assumptions used in computing DRC values are: (i) market value of seed paddy was assumed to be the shadow cost of seed paddy; (ii) operation and maintenance cost (separately for major & minor irrigation) was taken as the irrigation cost (rehabilitation cost was excluded); (iii) shadow cost of land was calculated as 25 % of the gross return (yield x price/kg/ac) per acre; (iv) shadow cost of labour was calculated multiplying the market wage rate with a factor 0.722; (v) shadow cost of fertilizer was adjusted for 32 % subsidy; and (vi) the market prices for agrochemical were adjusted from 10 % tariff rate to derive shadow cost.

Table 1. Domestic Resource Cost (DRC) ratios at paddy production in low country Wet zone.

	<i>Galle</i>	<i>Matara</i>	<i>Kalutara</i>	<i>Colombo</i>	<i>Gampaha</i>	<i>Kegalle</i>	<i>Ratnapura</i>
DRC	1.12	1.01	1.04	1.26	1.08	1.07	1.09

All the districts recorded DRC greater than unity having comparative disadvantage in paddy production. The respective districts do not possess a comparative advantage, because the production cost exceeds the cost of importing the same amount of paddy. Colombo represents the highest disadvantage (DRC=1.26) among the selected districts, because the cost of production of one unit of paddy is the highest in the region in Colombo.

Instability of paddy production

The results revealed that the percentage contribution of LCWZ to the national extent and production of paddy has lowered from 23 % and 20 % in 1990 to 12 % and 9 % respectively by the year 2012. Coefficient of variation was calculated at disaggregated levels based on climatic zone and districts in the Wet zone of Sri Lanka (Table 2) to estimate the instability. Paddy production in *yala* season is more unstable compared to *maha* season in terms of average yield, production and extent. Usually 60 % of the annual paddy production is derived from *maha* season cultivation because of the year-round availability of rainfall in almost every part of the country. Meanwhile, *yala* season is characterized with water shortage compared to *maha* season and hence resulted in low production. Average yield depicts a stable condition (6.78, 7.6 and 10.2, respectively in Wet, Intermediate and Dry zones) whereas the production is characterized by the highest instability (10.8, 25.7, 25.5). Compared to average yield, paddy extent is also shown a higher instability in each of the agro-climatic zones.

Table 2: Coefficient of variance of average yield, production and extent of Wet, Intermediate and Dry zones (1990-2012).

	Average yield			Extent			Production		
	<i>maha</i>	<i>yala</i>	Annual	<i>maha</i>	<i>Yala</i>	Annual	<i>maha</i>	<i>yala</i>	Annual
WZ	5.93	10.19	6.75	11.42	22.78	14.86	8.27	19.66	10.78
IZ	7.52	9.99	7.63	17.25	26.8	17.04	21.79	40.72	25.74
DZ	15.06	12.43	10.23	33.87	26.19	19.49	25.22	32.9	25.53

Compared to Intermediate and Dry zone, Wet zone paddy production is more stable based on the coefficient of variations (CV in Wet zone of yield=6.8, production=10.8, extent=14.9). The stability is depicted in all the three parameters; average yield, production and extent, respectively. However, Dry zone is highly vulnerable to the drought and flood conditions characterizing a production risk. Instability was also computed at district level in the Wet zone districts in Sri Lanka (Table 3). Similarly, as in zonal level as well as at district level, the *yala* season shows a

greater instability compared to *maha* season. Prominently, the production is highly unstable (Colombo=63.7, Gampaha=69.6) followed by extent. Average yield shows a stable situation compared to extent and production.

Table 3: Coefficient of variation of average yield, production and extent at districts at disaggregate level (1991-2012).

District	Average Yield			Extent			Production		
	<i>maha</i>	<i>yala</i>	Annual	<i>maha</i>	<i>Yala</i>	Annual	<i>maha</i>	<i>yala</i>	Annual
Colombo	6.73	18.56	7.26	16.43	59.54	25.07	16.86	63.7	21.47
Gampaha	7.69	15.49	8.44	16.34	68.13	28.16	15.86	69.6	25.94
Kalutara	9.46	10.02	8.8	11.5	19.42	13.43	11.74	18.16	12.65
Galle	11.26	15.15	12.24	11.61	40.71	21.04	8	36.37	14.11
Matara	10.14	13.34	10.56	10.71	10.7	9.44	8.28	17.32	9.87
Rathnapura	7.55	11.8	7.93	10.3	13.25	10.71	11.95	11.66	10.05
Kegalle	7.42	9.23	5.96	17.41	28.11	18.83	17.44	29.63	19.23
Kandy	13.85	13.01	11.18	13.58	27.67	16.45	12.52	22.15	13.84
Nuwara Eliya	9.49	12.52	8.67	6.28	22.14	8.82	11.32	28.71	13.14

Among LCWZ districts, Kegalle has the most stable average yield due to its favourable climatic conditions (annual CV=5.96) while Galle is characterized by the highest instability because of production variability (annual CV=12.24). In case of production, Matara (CV=9.87) and Rathnapura (CV=10.05) are more stable where the irrigation is assured. Gampaha (CV=25.94) and Colombo (CV=21.47) districts have comparatively unstable production because the paddy lands are extensively used for other development tasks. In case of the paddy extent, Matara (CV=9.44) and Rathnapura (CV=10.71) crop cultivation is stable whereas Gampaha (CV=28.16) and Colombo (CV=25.07) show a greater instability in the extent cultivated as the cultivable lands are depleting due to urbanization. Matara district accounts for the most stable condition in paddy production in terms of yield and extent while Gampaha and Colombo show a greater instability among the low country Wet zone districts.

Compound Annual Growth Rate (%)

According to Table 4, the average yield has attained growth (annual) momentum by 1.12 %, 1.30 % and 1.78 %, respectively in Wet, Intermediate and Dry zones of Sri Lanka. Average yield in the Dry zone shows a higher growth compared to Wet and Intermediate zones. Interestingly, growth of production (-3.04%) and extent (-4.46%) were at a decreasing trend in the Wet zone. This phenomenon is mainly attributed to the declining significance to national contribution by the Wet zone paddy.

Five-year growth rates were estimated to capture the variations in growth momentum in average yield, annual production and sown extent in the Low Country Wet zone districts of Sri Lanka (Tables 5, 6 and 7). The annual growth rate of average yield has increased at 1.12 % in the Wet zone from 1990-2012 (Table 5). This is mainly due to the adoption of New Improved Varieties and the conducive government policies such as fertilizer subsidy and price support for the produce. The Wet zone paddy production shows a negative growth rate (-3.04) in the period concerned (Table 6). Except the growth periods in 1995-1999 and 2005-2009 where a bumper harvest reported, in general, the other periods recorded a negative growth in paddy production. This was mainly attributed to the adverse environmental conditions prevailed during the period.

Table 4: Compound Annual Growth Rates (%) for climatic zones (1990-2012).

Zone	Average yield	Annual Production	Sown Extent
Wet zone	1.12	-3.04	-4.46
Intermediate zone	1.30	2.09	1.75
Dry zone	1.78	5.82	4.08

Table 7: Compound Annual Growth Rate (%) for extent.

Time Period	Colombo	Gampaha	Kalutara	Galle	Matara	Rathnapura	Kegalle	Wet zone
1990-1994	-4.30	-6.66	-2.30	-1.53	-1.282	-0.771	-1.14	-2.33
1995-1999	2.46	-0.70	-0.93	1.40	-0.557	0.707	-3.02	-0.22
2000-2004	-1.65	-1.05	-5.39	-8.09	-4.412	-5.468	-0.18	-4.60
2005-2009	4.32	8.50	2.34	4.99	2.425	2.309	-1.37	3.17
2010-2012	13.69	-17.37	-11.65	-16.42	-6.25	-4.631	-19.87	-11.84
1990-2012	-5.77	-5.13	-3.86	-5.12	-2.48	-6.39	-6.39	-4.46

The land extent under paddy in the Wet zone of Sri Lanka is decreasing with a negative growth rate of -4.46 % (Table 7). The phenomenon is common to all the districts during the period concerned. Even though the period from 2005-2009 possess a positive growth due to favourable production environment, the rest of the districts illustrated a negative growth in extent. Matara (-2.48 %) and Kalutara (-3.86 %) have lower land depletion rate compared to Kegalle, Rathnapura (-6.39 %), Colombo (-5.77 %) and Galle (-5.12 %). As the farmers revealed, the reasons for this depletion is that paddy land is being occupied by the development process such as highway construction. On the other hand, a significant amount of paddy lands have being abandoned due to unprofitability in production.

Table 5. Compound annual growth rate (%) for average yield.

Time Period	Colombo	Gampaha	Katutara	Galle	Matara	Rathnapura	Kegalle	WZ
1990-1994	-1.02	0.68	0.82	-0.53	-1.199	-2.054	0.98	-0.35
1995-1999	2.26	-0.49	2.51	4.31	5.548	-1.603	1.24	1.91
2000-2004	1.99	0.06	-3.71	3.33	0.944	0.262	-0.28	0.47
2005-2009	2.64	0.98	3.53	-2.52	0.852	2.747	2.23	1.44
2010-2012	0.00	-1.97	1.02	3.29	-2.05	1.494	0.836	0.31
1990-2012	1.25	1.09	1.58	2.13	0.54	0.79	0.79	1.12

Table 6. Compound annual growth rate (%) for annual production.

Time Period	Colombo	Gampaha	Katutara	Galle	Matara	Rathnapura	Kegalle	WZ
1990-1994	-5.30	-6.01	-1.44	-2.08	-2.298	-2.805	-0.26	-2.57
1995-1999	4.94	-1.21	1.16	5.29	4.379	-0.978	-2.46	1.47
2000-2004	1.30	-1.25	-8.76	-3.98	-3.527	-4.716	-4.14	-4.38
2005-2009	7.07	9.50	5.97	2.74	2.996	5.232	0.72	4.44
2010-2012	-13.71	-18.86	-10.67	-13.77	-8.64	-4.54	-21.88	-12.18
1990-2012	-4.58	-4.05	-2.31	-3.10	-2.03	-6.18	-6.18	-3.04

CONCLUSIONS

The percentage contribution of LCWZ to the national extent and production has lowered to 12 % and 9 %, respectively by 2012. Paddy production in the Wet zone has no comparative advantage in terms of domestic production. Farm mechanization and increase the availability of suitable rice varieties are some possible options to reduce the cost of production. Comparably, Matara district accounts for the most stable condition in terms of paddy production, average yield and sown extent while Gampaha and Colombo depict a greater instability among the low country Wet zone districts. Dry zone is highly vulnerable to the environmental hazards like floods and drought, characterizing production instability. Compared to Intermediate and Dry zone, Wet zone paddy production is more stable. Therefore, a need for maintaining the Wet zone paddy as a buffer zone is evidently justified. The average yield has achieved a growth momentum in all the climatic zones of Sri Lanka and this is mainly due to the adoption of New Improved rice varieties released by RRDI. However, growth of paddy production and particularly the extent cultivated reported a negative growth in the Wet zone. Therefore, an urgent revision of land policies needs to adopt in order to utilize the paddy lands an effective manner.

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Annex 1. Demographic profile of the sample (farmer percentage).

	<i>Galle</i> (%)	<i>Matara</i> (%)	<i>Kalutara</i> (%)	<i>Colombo</i> (%)	<i>Gampaha</i> (%)	<i>Kegalle</i> (%)	<i>Rathnapura</i> (%)	<i>Average</i> (%)
Gender composition								
Male	92	92	86	99	94	90	99	93
Female	8	8	14	1	6	10	1	7
Age of the Farmers (Yrs)								
<40	15	11	14	13	12	4	18	12
40-60	57	52	52	47	55	61	48	53
>60	28	37	34	40	33	35	34	34
Education level of the farmers								
Primary	27	32	30	26	16	31	29	26
OL	50	36	48	53	49	42	46	46
AL	21	30	17	17	28	24	22	23
Degree /Post Graduate	2	2	5	4	7	3	3	4
Primary occupation of the farmer								
Government	19	17	15	14	18	9	5	14
Private Sector	2	5	5	8	9	3	6	5
Semi-Govt	3	2	0	1	0	4	2	2
Daily wages	8	10	11	9	5	7	16	9
Farming/Self employment	67	66	69	68	68	77	71	69
Experience in farming (Yrs)								
<10	17	8	18	17	20	6	17	15
10-30	55	66	50	35	53	38	37	48
>30	28	26	32	48	27	56	46	37
Monthly income of the farmer(Rs)								
<10,000	22	28	27	24	15	39	25	26
10000-20000	49	47	48	54	56	54	60	53
20,000-40,000	23	20	11	19	26	7	12	17
>40,000	6	5	4	3	3	0	3	3
Farming as a main income								
Yes	36	46	56	45	42	58	39	46
No	64	54	44	55	58	42	61	54
Farming status								
Full time	48	56	60	52	53	60	48	54
Part time	52	44	40	48	47	40	52	46

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Annex 2: Crop cultivation in the area - 2012.

	<i>Galle</i>	<i>Matara</i>	<i>Kalutara</i>	<i>Colombo</i>	<i>Gampaha</i>	<i>Kegallā</i>	<i>Rathnapura</i>	<i>Average</i>
Average size of Cultivated land (ha)								
<i>maha</i> season	0.93	0.74	0.54	0.54	0.86	0.37	0.49	0.64
<i>yala</i> season	0.91	0.66	0.45	0.53	0.82	0.35	0.43	0.59
Land holding size in ha (%)								
<1	72	70	83	86	78	93	84	81
1-3	23	23	17	14	18	7	16	17
>3	5	7	0	0	4	0	0	2
Ownership of low land (%)								
Own	71	53	57	75	70	75	42	63
Tenure	25	42	40	32	30	25	51	35
Leased	3	3	0	1	0	0	2	1
Encroached	1	2	3	0	0	0	5	1
Water source for low land (%)								
Rainfed	100	66	90	95	80	85	47	80
Irrigated	0	36	10	7	22	15	53	20
Field Establishment method (%)								
Direct seeding	100	67	90	95	80	85	47	80
Transplanting	0	36	10	5	20	15	53	20
Preferred maturity group of rice in months (frequency)								
2.5	3	1	0	3	0	1	0	1
3	28	9	34	8	5	3	10	14
3.5	73	85	60	80	73	64	93	75
4- 4.5	2	30	4	19	24	48	12	20
> 4.5	0	2	1	7	6	0	1	2
Preferred rice type (frequency)								
Red long	37	66	15	9	2	4	51	26
Red small	37	18	17	58	4	7	32	25
White long	11	27	44	16	36	76	23	33
White small	15	20	24	35	62	14	17	27
Paddy yield (t/ha)								
<i>maha</i>	2.2	2.8	3.0	2.9	2.9	3.0	2.9	2.81
<i>yala</i>	2.3	3.0	2.4	2.5	2.8	2.6	3.2	2.69

Annex 3: Cost of cultivation of paddy in *maha* season 2011/12.

	<i>Galle</i>	<i>Matara</i>	<i>Kaluthara</i>	<i>Colombo</i>	<i>Gampaha</i>	<i>Kegalle</i>	<i>Rathnapura</i>	<i>Average</i>
Cost on material inputs (Rs/Ac)								
Seed paddy	2618	2132	2845	2649	2236	2384	2667	2504
Fertilizer	834	1067	749	863	805	735	896	850
Insecticide	1015	1486	1260	919	1615	1392	1725	1344
Weedicide	1830	2971	1638	2298	1957	2252	1930	2125
Sub Total	6297	7656	6492	6729	6613	6763	7218	6824
Cost on labour (Rs/Ac)								
Family labour	14922	17430	18291	24096	18522	23940	16675	19320
Hired labour	19067	19090	12194	22088	14112	17556	12673	16800
Sub Total	33989	36520	30485	46184	32634	41496	29348	36120
Cost on power and machinery (Rs/Ac)								
Land preparation	4282	6793	8916	7569	6656	4959	7668	6692
Threshing	2264	4462	2611	3231	3313	3145	2872	3128
Combine harvester	3368	5169	4924	6230	7333	6409	9913	6192
Transport	643	910	1042	862	676	725	1151	858
Sub Total	7189	12165	12569	11662	10645	8829	11691	10678
Total cost of production excluding family members (Rs/Ac)								
Labour	19067	19090	12194	22088	14112	17556	12673	16683
Power and machinery	7190	12165	12569	11662	10645	8829	11691	10678
Material input	6297	7656	6492	6729	6613	6763	7218	6824
Total	32554	38911	31255	40479	31370	33148	31585	34186
Total Cost of production including family members (Rs/Ac)								
Labour	33989	36520	30485	46184	32634	41496	29348	35808
Power and machinery	7190	12165	12569	11662	10645	8829	11691	10679
Material input	6297	7656	6492	6729	6613	6763	7218	6824
Total	47476	56341	49546	64575	49892	57088	48257	53311
Unit cost of production (Rs/ kg)								
Maha	38	35	26	36	28	28	28	31

Annex 4: Conversion factors used to derive tradable and non-tradable components.

Item		Domestic (%)	Tradable (%)
Farm Power	Ploughing	55	45
	Threshing	55	45
	Spraying	28	72
Agro-Chemicals	Pesticides	45	55
	Weedicides	55	45
Transport	4WT	33	67
Fertilizer	Urea, TSP, MOP	2	98

Sources: Abeyratne *et al*, 1990; Shilpi, 1995.