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FOREWORD

Rice – the staple food in Sri Lanka provides around 60 percent of the carbohydrate requirements of the population. The production of paddy sustains the livelihood of nearly 2 million farmers in the country. However, the increase of the cost of production and stagnated yield has made paddy farming a non-viable enterprise during the last few years.

This research report describes the current situation of paddy farming in Sri Lanka and highlights the current problems that hinder the improvement of paddy farming under different agro-climatic and water regime conditions. The study results evolved from descriptive and econometric approaches of analyses provide insights into the economic, social and institutional issues of paddy cultivation in Sri Lanka.

The yields of existing paddy varieties in research stations are much higher than the present average paddy yields obtained by the farmers. The study discusses the means of reducing the gap between research yield and actual yield while reducing the cost of cultivation. The major issue highlighted in the report, which needs immediate attention of the policy makers, is the importance of addressing institutional issues related to paddy farming in order to increase the farm level yield. The labour cost incurred as high as 60 percent of total cost in major irrigation is another area, which needs attention to reduce the cost of cultivation.

The findings of the study are valuable for the academics and policy makers in making paddy farming a profitable enterprise in Sri Lanka. As it has been noted in this report further investigation on suitability of paddy farming in minor irrigation conditions, and the possible socio economic consequences of farm mechanization are needed.

I wish to congratulate the research team consisting of Mr. M.M.M. Aheeyar, Dr. G.M. Henegedara and Mr. L.P. Rupasena for their commitment and the valuable output.

V.K. Nanayakkara
Director
26.1.06

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We appreciate the services and cooperation provided by the officials of the Departments of Agrarian Services and Agriculture in conducting field surveys in Rambukkana, Dedigama, Nikeweratiya, Hettipola, Pannala and Ibbagamuwa Agrarian Services Centre areas. We are grateful to Ms. Ruvini Manjula and Ms. Shayama Ranasinghe for the excellent job of typesetting, layout and designing of the cover page of the report. We also thank Ms. Shashika Ariyapperuma, the former Editor for the expert editorial assistance provided and to Mr. S. Rameswaran, Acting Head, Publication Unit and his staff for the support extended in preparing the final version of the report for printing and publishing. Finally, we would like to pay our tribute to the paddy farmers in study areas who trusted us and provided all the valuable information for the success of the study.

Authors

EXECUTIVE SUMMARY

The study provides a detailed investigation on the cost of production of paddy farming in Kegalle and Kurunegala districts of Sri Lanka. The main focus of the investigation was to analyze the factors affecting the variation in cost of production of paddy in Sri Lanka with a special reference to different agro-climatic zones and water regimes.

The study sites were selected from the above two districts in order to represent the dry, intermediate and wet zone climates and major, minor and rainfed production areas. The primary objective of the study was to diagnose the main socio-economic factors affecting the cost of production of paddy cultivation in Sri Lanka. The specific objectives are: (i) to measure the technical and economic efficiency of paddy farming in accordance with different agro-ecological and source of water conditions, (ii) to identify and analyze the factors which influence production of paddy and their costs, (iii) to determine the average amounts and cost of inputs involved in the production of one kg of rice and (iv) to study institutional aspects and transfer of technology, in the paddy sector.

The research methodology was based on literature reviews, questionnaire survey and participatory research techniques. The questionnaire survey was conducted using multistage stratified random sampling techniques. Sample size was 120 farm families from the Kurunegala district, which represented 40 farm families each from major irrigation (Ridibendi ela), minor irrigation (Udagama and Bandara Koswatta minor irrigation systems in Hettipola area) and rainfed areas (Pannala). Ninety farm families were selected from the Kegalle district (Dedigama and Rambukkana areas), which represented only rainfed areas. The study was conducted during the period of *maha* 2000/01 and *yala* 2001. The data was analyzed through descriptive analysis and statistical analysis such as frontier production function and multiple regression.

Secondary information obtained suggests that paddy yield has stagnated but, slowly showing little increase during last few years and the question of viability of paddy farming has arisen. The cost of paddy farming has increased, while paddy price has decreased in recent times, hence farmers are faced with a very serious cost-price squeeze. The study findings reveal that, the average paddy yield per hectare in major irrigation, minor irrigation and rainfed farming in the Kurunegala district during *maha* 2000/01 was 4.6 tons, 3.2 tons and 3.7 tons respectively. The yield obtained from major irrigation condition was 30 percent and 110percent higher than that of minor irrigated and rainfed cultivation areas.

According to the frontier production analysis, mean technical efficiency is not closer to 1 in any study location indicating that paddy cultivation is technically not fully efficient in all locations. Nevertheless, paddy cultivation is relatively efficient in major irrigation areas (0.76) compared to the minor irrigation (0.61) and rainfed areas (0.68) of Kurunegala district. However, average technical efficiency in the rainfed areas of Kegalle district is only 0.54.

The multiple regression analysis indicates that land size has a significant impact on increasing production in all areas. Though there is no clear relationship between labour use and the level of production, it has a positive effect in rainfed areas of both districts. In the meantime, return for labour was low in rainfed areas and high cost incurred for animal drought power indicates the potential of mechanization, but feasibility of mechanization in smalls landholdings needs to be studied. The findings also show that use of animal draught power, especially in Kegalle district is another reason for the increased cost of production.

The study findings indicate that the cost of production in major irrigated, minor irrigated and rainfed areas of Kurunegala district vary indicating relatively high costs in rainfed areas and lowest costs in minor irrigation. Cost in Kegalle district also shows a similar situation. Labour cost represents over 50percent of the total cost in all locations for both seasons, but labour cost exceeds over 65percent in rainfed areas of Kegalle district. Harvesting of paddy alone accommodates 36-46percent of the total labour cost. Therefore, the study strongly recommends to investigate the pros and cons of adopting mechanization in rice harvesting. Fertilizer cost amounts to 45-60percent of total material cost of paddy cultivation. However, it was found that, there is an imbalance in fertilizer application, which leads to inefficiency in fertilizer use. Although, use of straight fertilizer reduces fertilizer cost and increases efficiency of fertilizer use, majority of the farmers have not adopted straight fertilizers. The cost for producing one kg of paddy varied from Rs 9.38, 13.25 and 13.27 in major irrigation, minor irrigation and rainfed areas respectively in Kurunegala district during *maha* 2000/01. The average cost for producing one kg of paddy in Kegalle district is around Rs 15.23 in the same season.

The average yield per acre in major irrigation areas during *maha* 2000/01 was above 90 bushels and it was around 60 bushels and 55 bushels in minor irrigated and rainfed areas respectively. Thus, yields in major irrigated areas is significantly higher than in minor and rainfed areas due to water availability, better management practices and commercial cultivation practices, but yields in rainfed areas have gone down mainly due to lack of water, especially during the maturing phase of the plant, small size of land holdings, tenant cultivation and inefficient cultivation practices. The yield gap between research yield and actual yield is high in all areas, especially a big gap exists under rainfed conditions. The factors affecting the existing yield gap are associated with high risk of crop failures in rainfed and minor irrigated areas, poor extension services and constraints in social and institutional factors.

Considering the existing yield level between efficient farmers and less efficient farmers, the yield level of less efficient farmers could be increased by 24percent, 39percent and 32percent respectively in major, minor and rainfed areas without adding any additional cost. This can be achieved by use of production factors in an efficient manner, especially by paying attention on use of quality seed paddy, correct amount and combination of fertilizers and timely application of suitable agro-chemicals. In rainfed areas, labour use efficiency is also very low. Results obtained from stochastic frontier production function analysis shows that, farmers' age, farming experience and level of education are the significant factors causing inefficiency among farmers in minor irrigation systems. Therefore, it is necessary to enhance the farmers' knowledge, skills and entrepreneurship in order to improve productivity, through training, demonstration and field level research programmes.

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LIST OF ABBREVIATIONS

AI	-	Agricultural Instructors
ARPA	-	Agricultural Research and Productivity Assistants
ASC	-	Agrarian Services Centre
CWE	-	Co-operative Wholesale Establishment
DO	-	Divisional Officers
DRC	-	Demotic Resources Cost
EPC	-	Effective Protection Coefficient
EPR	-	Effective Protection Rate
FO	-	Farmer Organization
GDP	-	Gross Domestic Production
GURAA	-	GATT and Uruguay Round of Agreement on Agriculture
IMD	-	Irrigation Management Division
NIVs	-	New Improved Varieties
NPC	-	Nominal Protection Co-efficient
NSF	-	National Science Foundation
R&D	-	Research and Development
SAPTA	-	South Asia Preferential Trade Agreement

CHAPTER ONE

INTRODUCTION

1.1 Background

Rice, as the staple food of Sri Lankans provide calories, protein and other nutrient requirements of people. The total extent under paddy cultivation in Sri Lanka is about 983,000 ha and it accounts for 16 percent of the total land extent of the country in 2003 (Central Bank of Sri Lanka, 2003). At present, about 700,000 farm families are directly involved in paddy farming. The annual paddy production had been 3.07 million metric tons with an average of 3,761 kg per hectare harvested from a total of 1 million hectares of lands in two cropping seasons in 2003. Paddy accounted for 3 percent of the GDP and 21.6 percent of agricultural GDP in year 2003 at the constant factor price of 1996 (ibid).

The total extent of paddy cultivation in Sri Lanka is classified under three categories namely major irrigation, minor irrigation and rainfed areas[1]. About 55 percent of cultivable lands are under major irrigation and 24 percent and 21 percent of lands are cultivated under minor and rainfed conditions respectively.

Rice, as the main staple food crop in Sri Lanka was given the highest priority by various governments in agricultural policy formulations. All the successive governments since independence in 1948, made massive investments to promote the paddy sector through many development projects such as creation of new irrigation settlement schemes, investment on research and extension and other support services. Nevertheless, the country still imports around 13 percent of the national rice requirement in order to cater to the per capita consumption of 93.5 kg of rice per year.

Area under cultivation increased from 759,000 ha in 1970 to 983,000 ha in 2003. According to the statistics published by the Department of Census and Statistics, the extent of paddy cultivation has increased by 109 percent from 1951/52 to 2002/2003. Paddy production has increased from 1.7 million metric tons in 1970 to 3.16 million metric tons in 2003 representing 86 percent increase within the period of three decades. Both increases in area under cultivation and average yield have contributed to this increase. The notable current issues in rice production are summarized below:

i. Stagnation in Yield Levels

According to the past records, the average paddy yield has reached a plateau level by 1995. Though the average yield has increased by 67 percent during 1960-80 period, it has increased only by 8 percent during 1980-2000 period. The average yield stagnated around 3.5 t/ha during the last decade, but it has shown a slight increase during the last few years.

It is accepted that the average research yield of paddy, deviates based on major, minor and rainfed conditions. According to the research station results the average research yield was reported as 7.3 t/ha, 4.3 t/h and 3.5 t/ha in major, minor irrigated and rainfed areas respectively. According to the Department of Agriculture, however, farmers' yield levels in all areas are lower than these figures at present, indicating a more than 40 percent gap between research and actual yields.

ii. Viability of Rice Production

On the other hand, paddy farming has been severely affected by the rapid increase of cost of production and the low farm-gate prices. Presently, the average cost of production of paddy has

[1] According to classification of Irrigation Department, the paddy lands that are cultivated under irrigated reservoirs and tanks of which capacity is 80 ha or above were considered as major irrigation and those with less than 80 ha considered as minor irrigation. Paddy lands which fully depended on rainfall are considered as rainfed farming.

been recorded as Rs 7.00 to Rs 13.00 per kg, while the farm-gate price remains at Rs 11.00 per kg. According to present production practices and the average yield, paddy cultivation is economically viable in major irrigated areas, while paddy cultivation in minor irrigation and rainfed areas are below the break even yields (Department of Agriculture, 2000). Though gross income for paddy cultivation has increased in all areas in the past ten years, net income and returns to capital have increased only in selected major irrigated areas.

iii. Food Security

Like in many other countries, Sri Lanka also adopted various polices to maintain food security of the country. But, still its 40 percent of the total grain requirement is fulfilled by imports. Though the extent of rice cultivation and the total production have increased over the period, per capita rice consumption has decreased from 174.5 kg/year (1980/81) to 101.9 kg/year (1995/96), while per capita wheat consumption has increased from 30.4 kg (1980/81) to 40.5 kg (1995/96) during the same period. It indicates the level of dependency on food imports in order to maintain the country's food security.

Therefore, the study was intended to be a review of the current economic circumstances faced by paddy growers in Sri Lanka reflecting irrigated and rain-fed production conditions. The study is designed with a view to capture the major trends emerging as well as to highlight the current and potential problems that would hinder the improvements in the paddy farming sector in Sri Lanka. The study would provide a descriptive account of the key issues affecting paddy production. Thus, main areas of investigation were based on three factors namely, methods of increasing the yield level of inefficient farmers, factors affecting yield gaps between research yield and actual yield and possible ways and means to reduce cost of production.

1.2 Objectives

The prime objective of the study is to identify the current technical and socio-economic factors affecting paddy farming in Sri Lanka. Specific objectives are;

i. *To measure the technical and economic efficiency of paddy farming in respect to different agro- climatic and water regime conditions.*
ii. *To identify and analyze the factors which influence production of rice and their costs including marketing under different water regimes.*
iii. *To study issues pertinent to institutional aspects and transfer of technology in paddy cultivation.*

1.3 Research Methodology

The methodology was designed to measure the relationship of various production factors of paddy cultivation in accordance with different water regimes and climatic conditions. The methodology was designed to capture necessary information in line with the study objectives mentioned in Section 1.2.

Objective i: *To measure technical and economic efficiency of paddy farming in respect to different agro-climatic and water regime conditions.*

This objective relates to technical efficiency of rice production under various physical and climatic conditions. Additional land availability for extensive cultivation is very limited and once the frontier for extensive cultivation is reached, further increase in production has to come from improvement in productivity of the crop. In this context, technical efficiencies and its determinants in rice production assume a paramount importance to overcome the problem of production.

Technical efficiency is most frequently associated with the role of management in the production process. It is assumed that the difference in efficiency is attributable to the difference in

entrepreneurial skills of the farmers. Probing into the reasons for variation in efficiencies will give further impetus to the production of rice by appropriate policy prescriptions.

Frontier production function analysis was used to measure technical and economic efficiency of different farmers under various agro-climatic conditions.

Objective ii: *To identify and analyze the factors influencing the production of rice and their costs including marketing.*

This objective involves identifying factors that influence paddy production, thus it is expected to carry out a detailed comprehensive examination of the use of inputs in paddy production such as land, labour (family and hired labour), imputed as well purchased inputs and support services. More specifically, the research team investigated the share of each input in the paddy production process. In addition, land size, land tenure, type of labour used, cultural practices, levels of education, farming experience, use of agrochemicals and their availability and marketing of output were also investigated. Thus, a detailed examination of farm inputs was carried out considering the socio-economic characteristics of the farm households, production methods and output. The investigation of farm supporting services such as credit, extension and insurance services were examined and analyzed in order to see their contribution to the production process.

Objective iii: *To study the issues pertinent to institutional aspects and transfer of technology in paddy cultivation.*

The Institutional aspects such as farm support services, credit facilities, farmer organizations and research and extension services have made an enormous impact on paddy production. Therefore, it's necessary to assess the available quality and responsiveness of farm support services and institutional support on increasing farm outputs and also to evaluate the impact of institutional aspects on production efficiency under various conditions.

1.4 Data Collection

Since the study aims to measure the production efficiency both in terms of economic and technical factors, the study should be based on a very comprehensive database. The necessary data were collected through secondary sources, questionnaire survey, key informant discussions and other participatory data collection tools.

a. Primary Data

An in-depth questionnaire survey was conducted to collect primary data in relation to factors of production of rice cultivation and other information pertaining to general socio-economic status of farmers.

b. Secondary Information

A comprehensive literature review was undertaken to understand the existing policy scenarios, production trends and cost factors of paddy cultivation. The review of literature includes collection of data and information from past research reports, journal articles, newspaper articles and other forms of publications.

c. Participatory Data Collection Methods

Focus group interviews and key informants interviews were used as participatory data collection techniques. The research team visited the sites and conducted focus group interviews, which includes farmers, FO representatives, state officials, traders, middlemen and other private sector individuals. The discussions focused on exploring the field situation of paddy production, particularly problems related to paddy cultivation, support services provided, input supply, marketing and various other aspects of the enterprise.

1.5 Study Sites

As proposed in terms of reference given by NSF, the study was conducted in eight districts by four research teams. HARTI conducted the study in Kurunegala and Kegalle districts and the report is based on the findings in these districts. The rest of the districts studied by other research teams are Matara, Hambantota (University of Ruhuna), Anuradhapura, Polonnaruwa (University of Peradeniya) Ampara and Batticaloa (Eastern University of Sri Lanka). The sample sites were based on two main criterions:

i. Differences in Agro-climatic zones
The selected districts represent the Wet Zone (WL_1, WM_1), Intermediate Zone (IL_1, IL_3) and Dry Zone (DL_1, DL_2).

ii. Differences in Water Regimes
Study locations were selected considering three water regimes of major irrigation, minor irrigation and rainfed areas.

Considering the financial and time constraints, the total sample size was limited to 210 farm families from two districts. The selection of sample size between the two districts was determined on distribution of total paddy extent and production of paddy in major and minor irrigation and rain fed areas. Thus, 120 farm families from Kurunegala district, which represents 40 farm families each from major, minor, and rainfed areas were selected. Ninety farm families were selected from Kegalle district, which represented only rainfed areas. The existing paddy land registry was used as a sample frame and farmers were selected randomly. The specific study sites in each district and their respective sample sizes are given in table 1.1.

Table 1.1: Distribution of Sample

District	Study Site	Water Regime	Sample Size
Kurunegala	Ridibendiela (Nikaweratiya)	Major Irrigation	40
	Hettipola (Udagama & Bandarakoswatta minor irrigation)	Minor Irrigation	40
	Pannala	Rainfed	40
Kegalle	Dedigama	Rainfed	50
	Rambukkana	Rainfed	40

1.6 Data Analysis

A descriptive analysis was applied to examine the socio-economic characteristics of sample sites and statistical analysis was followed to analyse the cost of production, yield and income level. The stochastic frontier production function was used to measure the technical efficiencies of rice production. The model uses gross margin analysis to find out the cost and benefits with different practices. The efficiency levels cannot be explored using the normal Cobb-Douglas production function.

The frontier production function measures efficiency against the best production farmer. The analysis estimates the maximum output obtainable with given inputs and it enables the measurement of farm specific technical efficiency as the vertical deviation of the farm specific output from the frontier output.

The distribution function of the standard normal variable as specified by Aigner, Lovell and Shemidt (1977) is

$$\sigma^2 = \sigma^2_u + \sigma^2_v$$

According to Battese and Corra (1977), the variance ratio parameter γ can be calculated in the following manner:

$$\gamma = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2}$$

Maximization of the relevant likelihood function by numerical techniques provides the maximum likelihood estimates of the production function parameters including intercept, σ^2 and γ. If the value of γ equals zero, the difference between farmers yield and the efficient yield is entirely due to statistical noise. The value of γ equal to 1 indicates technical inefficiency.

The following model specializations were used in the analysis:

Aigner, Lovell and Shemidt (1977) and Meeusen and van den Broeck (1977) proposed the stochastic frontier production function. The original specification involved a production function specified for cross-sectional data, which had an error term, which had two components, one to account for random effects and another to account for technical inefficiency. This model can be expressed in the following form:

(1) $Y_i = x_i\beta + (V_i - U_i)$ $\quad i=1,\ldots N$

where Y_i is the production (or the logarithm of the production) of the i-th firm;
x_i is a $k\times1$ vector of (transformations of the) input quantities of the i-th firm[2];
β is a vector of unknown parameters;
V_i is random variable, which IS assumed to be iid. $N(0,\sigma_V^2)$, and independent of the U_i which are non-negative random variables which are assumed to account for technical inefficiency in production and are often assumed to be iid.

$$|N(0,\sigma_U^2)|.$$

The frontier production function was fitted to paddy output. The model was constructed considering production as a function of land size, cost of fertilizer, cost of seed, cost of farm power and labour use.

$$\text{Ln } Y_1 = \beta_0 + \beta_1 \text{Ln}X_{1i} + \beta_2 \text{Ln } X_{2i} + \beta_3 \text{Ln } X_{3i} + \beta_4 \text{Ln } X_{4i} + \beta_5 \text{Ln}X_{5i} + V_i - U_i$$

Ln denotes logarithms to base e

Y_1 = Output (kg of paddy)
X_1 = Extent of land (ac)
X_2 = Labour cost (Man days)
X_3 = Seed cost (Rs)
X_4 = Fertilizer cost (Rs)
X_5 = Cost of power (Rs)

The inefficiency model specified by Battese and Coelli (1995) was,

$$U_i = \delta_0 + \sum_{i=1}^{k} \delta_i Z_i + W_i$$

where,
U_i = Non-negative random variables

[2] For example, if Y_i is the log of output and x_i contains the logs of the input quantities, then the Cobb-Douglas production function is obtained.

δ	=	Vector of unknown parameter to be estimated
Z_i	=	Vectors of explanatory variables associated with technical inefficiency effects namely age of farmers (years), experience of farmers (years), education (dummy) and occupation (dummy)
W_i	=	Unobservable random variables

The efficient production frontiers for the farmers in different locations were estimated separately in both *yala* 2001 and *maha* 2000/01. Factors influencing the technical inefficiencies were measured both in terms of direct and indirect factors related to paddy production.

1.7 Scope of the Study

The investigation focused on studying five major issues. Firstly, it measured technical efficiency of paddy farming under different agro-climatic and water regime conditions. Secondly, it highlights the level of influence made by various factors of production in rice cultivation. Thirdly, it deals with the farm incomes, costs and net returns reflecting food security and self-sufficiency of paddy production. Fourthly, it highlights institutional and technical aspects pertinent to paddy farming and finally suggests appropriate recommendations to increase paddy production.

The study component concerning factors influencing paddy production will reflect a detailed examination of the use of farmer owned inputs such as land, labour, household assets as well as purchased inputs and services for farming purposes. Some of the key issues that need to be investigated in this regard are: (a) relationship between land tenure status of operational land holdings (b) ownership patterns and distribution of land and other assets (c) nature of the family labour force and employment patterns and (d) the nature of farming practices and production technologies adopted by the farmers. This will help in establishing the actual input intensities associated with the current production. A detailed examination of farm inputs was made with a view to ascertain the underlying inter-relationships between the socio-economic characteristics of the farm households, production methods and output. The investigation on farm support services was analyzed considering both formal and informal services available to farmers. Among the major services that were examined in this regard are input distributions, credit supply, disposal of produce, extension and crop insurance.

The second objective of the analysis was centered on costs and returns of paddy cultivation. This section is expected to provide detailed insights of the operational status of the farm economy with a view to establish details of the costs incurred and incomes received. The analysis on the production costs will help to identify the relative significance of the cost components, patterns of cost changes in the recent past and their influences on net farm returns. The investigation on household expenditure on agricultural production would indicate the liquid cash requirement for farming and the demand for credit facilities at farm level. This particular investigation will help to identify the relationship between farm income and expenditure and to relate these to the socio-economic variables of the households.

1.8 Rationale

In view of the policy and infrastructure changes that have taken place in the agrarian sector during the past few years, a detailed investigation of the production efficiency and the economic viability of paddy cultivation are timely and relevant. Such a study based on farm level data, would provide insights into the economics of paddy cultivation with special reference to production inputs, farm management practices, farm supporting services, cost and returns, disposal of outputs and food security. Un-profitability of paddy farming, non-viability of paddy farming and farmers moving out from paddy cultivation have been discussed in the recent past (Sandaratne, 2001). Therefore, a study to provide an insight to paddy farming and a detailed account on constraints, trends and potential of paddy farming in Sri Lanka is an important measure for policy makers.

1.9 Limitations of the Study

Like many other socio-economic and cost of production surveys, the study had to face some limitations. They are:

i. Paddy cultivation in Sri Lanka heavily relied on family owned resources such as family labour, draught power, and seed paddy. These difficulties emerged in making a realistic assessment of these production inputs

ii. The existing paddy lands register was used as the sample frame. However, the paddy lands register has not been updated regularly. Therefore, the sample frame used for the study may not include recent inclusions of cultivators.

iii. Farmers in the village level in the various parts of the country use various traditional measurement units. For instance, one locality in the study district uses *kuruni* as the paddy measurement unit, while another uses *laha* or *bera*. These measurements were not identical even within the two districts.

iv. As in the case of many other social science research studies, some responses on past activities related by farmers from recalling the past, may not be very reliable.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 Economics of Paddy Cultivation in Sri Lanka

A comprehensive body of literature is available on economics of paddy cultivation in Sri Lanka and it could be broadly classified under three categories:

a. Cost of production surveys conducted annually by the Department of Agriculture and paddy statistics collected by the Dept. of Census and Statistics:

   These surveys are conducted island wide using representative samples from each district. Cost of production information is available both in terms of production inputs and operational activities. Thus, a detailed set of information is published annually both at district and national levels.

b. Descriptive analysis of paddy cultivation and cost of production conducted in the past (Central Bank of Ceylon, 1969; Abeyratne, 1991; Henegedara 2000; Rupasena, 1999).

c. Analytical studies focused on variation in cost of production of paddy in terms of factors of production, Nominal Protection Co-efficient (NPC) and Effective Protection Co-efficient (EPC) (Gunawardena, 1987; Sirisena, 1986; Edirisinghe 1991; Wickramarachchi, 1993; Samarathunga and Rafeek, 2000).

There has been an apparent dilemma in the rice production sector in Sri Lanka during the last couple of decades. The view is largely based on the poor performance of paddy in recent years in terms of stagnant yields, low market prices, contraction of extent cultivated, part-time occupation with more lucrative off-farm employments and comparison of domestic rice price with the international market.

According to the cost of production data published by the Department of Agriculture from 1978 to 2001, paddy production has become an unprofitable enterprise over the years, except in major irrigated areas and some minor irrigation schemes. The situation in rainfed areas has been deteriorating drastically. The descriptive and analytical studies show that rice production and yield have increased over the past 50 years and it has reached a plateau level since 1995 (Sandaratne, 2001). The increase of production and yield was attributed mainly due to the introduction of high yielding varieties in the 1960s and expansion of the area cultivated in the 1970s to 1980s. Having analyzed the overall impact of intensive programmes implemented during the past 50 years, several research studies conducted in the past by analyzing comparative advantage of rice production showed the technical and economic efficiency levels of rice in Sri Lanka. Abeyratne et al (1991), Edirisinghe (1991), Wickramarachchi (1993), Samarathunga and Rafeek (2000) have estimated DRC for the respective years showed some contrasting results. These studies gave mixed and contrasting findings. The reason was the estimates were one-time point estimates of yield, which fluctuate, significantly year-to-year. Kikuchi et-al (2002) overcomes these defects by dealing with a long-term trend in rice production (1980-1997). They showed that rice production in Sri Lanka had a comparative advantage around 1980 and advantage has been eroded in the last two decades. But, they emphasized that rice production under the major irrigation regime, that shares about 70 percent of total rice production of the country is still profitable, as long as the investment costs of constructing these major irrigation schemes are treated as a sunk cost. They also highlighted that the major factor that has been pushing down the comparative advantage of rice production is the increasing agricultural wage rate.

Several methods were followed to determine the most efficient production frontier by different researchers (Farrell, 1957; Aigner and Chu, 1968; Timmer 1970 and Aigner, 1977). Battese (1992) proved that the econometric modeling of frontier production functions provides useful insights into best practice technology and measures by which the productivity efficiency of different firms may be compared. Despite its well-known limitations, the Cobb-Douglas functional form has been widely used in farm efficiency analysis for both developing and developed countries. Ekanayake and Jayasooriya (1987) and Karunaratne and Herath (1989) estimated the technical efficiencies for rice and other field crops in the Mahaweli System H using the stochastic frontier model.

Having considered the cost of production, disposals, tenure and net value under rainfed and irrigated conditions, Henegedara (2000) shows that paddy cultivation is economically viable only in major irrigated areas. Intensive cultivation and commercial farming practices were major causative factors for the viable productive situations in major irrigations. It was also found that more than 45 percent of total production costs were accounted for labour and it varies from 45 percent- 54 percent in some rainfed areas. Efficiency of paddy cultivation was measured both in terms of technical and economical efficiencies. These analyses were based on cost benefit analysis.

Wijeratne and Hemakeerthi (1992) reported that, the production costs have increased over the years in the districts with better water conditions. This indicates that uncertainty of water supplies has decreased the level of investment on rice production to a large extent. Tudor Silva et-al. (2000) found a trend towards diversification or rotation of paddy with commercially oriented crops mainly in the areas outside the predominant paddy growing areas.

Sanderatne (2001) identified three main issues in paddy farming i.e. stagnant yields, viability of paddy farming and evolution of paddy farming as a part-time occupation. He emphasized the vital importance of increasing the average national yield up to 5 metric tons per hectare within the coming decades in order to maintain paddy farming in economically and socially viable enterprise. He also recommended that Research and Development (R&D) policies and institutional issues needed to be addressed immediately to achieve the expected targets. Panabokke and Punyawardena (2000) recommend to regionalize the paddy cultivation to more potential areas of the country rather than spreading across the whole country. In this regard Gamage (2000) investigated the water use efficiency in agriculture and suggested to identify the best rice producing areas and to restrict paddy cultivation to areas with imperfectly drained and poorly drained soils under major irrigation projects.

2.2 Agricultural Policy Reforms

Domestic agricultural policies had undergone various changes, in line with macro economic policy reforms made after 1948. The policies that followed by various political regimes after the independence (1948-1970) focused mainly on increasing rice production through expanding the cultivated area and improving productivity. The six year development plan (1951-1957), the six year program of investment (1954-1959) and the ten year development plan (1959-1968) emphasized the need of enhancing the efficiency of the non plantation crop sector in Sri Lanka (Athukorala and Jayasooriya, 1994). Programs during the 1948-1970 period centered around five activities (Chandrapala, 1986) namely:

i. Increase the extent of paddy land cultivated through developing irrigation infrastructure and land settlement programs
ii. Increase the production and productivity through research and improved production technology
iii. Develop institutions for farmers such as the establishment of cultivation committees and rural banks etc
iv. Change land and land tenure policies and

v. Provide subsidies for production inputs and credit facilities

The policies implemented during the period of 1970-1977 provided greater emphasis on farm support services such as credit, marketing and crop insurance. Rural Banks, Paddy Marketing Board and Crop Insurance Board were established during this period. Programs for the development of irrigation, research and extension services, land settlements and rural institutions were also implemented.

Agricultural policy reforms implemented after 1977 were executed with the intension of achieving four major objectives (Ministry of Finance and Planning, 1984). The policies adopted during this period were in line with the government structural adjustment programs and the liberal market economic policies.

i. Achievement of self-sufficiency in rice
ii. Expansion of exports to increase the contribution of agriculture to the balance of payments situation
iii. The creation of new employment opportunities and the consequent enhancement of incomes in the rural sector.
iv. The improvement of the nutritional status of the people.

Agricultural policy reforms implemented in the past fifty years in Sri Lanka irrespective of policy regimes could be categorized under seven headings as follows (Sirisena, 1986; Abeyratne, 1991):

a. Development of irrigation and agricultural infrastructure
b. Guaranteed price schemes
c. Production subsidies
d. Research and development
e. Trade policy reforms
f. Institutional development programs
g. Agricultural credit programs

Every successive government provided production subsidies to protect and encourage small producers. The various production incentives took the form of low prices, low interest rates, loans and trade incentives (Abeyratne, 1991). There were two main input subsidies given to the farmers i.e. the fertilizer subsidy and the irrigation subsidy. The fertilizer subsidy had a positive effect on productivity and total production of paddy (Annual Reports, Department of Agriculture). The impact was very significant in the case of high yielding varieties, which required the use of inorganic fertilizers for a better yield. However, the impact of reducing total production cost was marginal due to the fact that fertilizer accounted for only12 percent of total cost though it helped to increase fertilizer application among small producers who were not able to bear the high production costs (Henegedara, 2000).

Out of total fertilizer subsidy allocation, more than 60 percent of the subsidy was utilized for paddy compared to tea, rubber and coconut. The average fertilizer usage for paddy has increased from 155kg/ha in 1978 to 308 kg/ha in 1997 despite the decrease of the total extent cultivated from 876,000 ha (1978) to 729,815 ha (1997).

Along with the effects of green revolution in 1960s, the importance of Research and Development (R&D) on improved high yielding varieties was stressed. The paddy variety usage statistics indicate that, the adoption of high yielding varieties increased from 71percent in 1972 to almost 100percent in the late 1980s. New seed varieties have shown a greater yield response to fertilizer use, method of cultivation i.e. transplanting and broadcasting and the use of herbicides, pesticides and fungicides.

In order to achieve a number of objectives of the liberal policy reforms introduced since 1977, the quantitative restrictions (QRs) on imports were replaced in 1978 by introducing a six-band tariff system ranging from 0 percent tariff for essential consumer items to 500 percent tariff for luxury items. The Presidential Tariff Commission on Trade and Tariff altered this system in 1992 and a three-band tariff structure was introduced with the rates of 10, 20 and 45 percent in order to relax the rigidity and to rectify the distortions in domestic agricultural sector. The introduction of the three-band tariff structure in 1992 helped to reduce market distortions in the non-plantation agricultural sector (Gunawardena and Somaratna, 1996).

The new trade agreements on agriculture with the GATT/Uruguay Round Agreement on Agriculture (GURAA) and the South Asian Preferential Trade Agreement (SAPTA) have opened new horizons and avenues for non-plantation agricultural commodities. In compliance with GURAA, Sri Lanka is bound to have all tariffs on imports of agricultural products at a uniform rate of 50 percent (Gunawardena and Somaratna, 2000). Thus, approximately 700 agricultural products will benefit under the GURAA and SAPTA agreements.

The import duty rates imposed by the government on paddy were changed from time to time considering the local production and internal political pressures. According to table 2.3, the tariff on the import of rice was 25 percent in 1980 and it remained unchanged until 1989. The rate was reduced to 8 percent in 1990 for two years. It was, however increased from 12 to 16 percent in 1992 and again to 35 percent or Rs 7/kg in 1994. Even though it was reduced to zero in 1995/96 *maha* and 1997 *yala* seasons due to a severe drought, which resulted in low production, the tariff was increased again to 35 percent in 1998 with another 4.5 percent charge as the national security levy. It, however, dropped to 10 percent in 1999 and increased to 35 percent in January 2000 (Table 2.1).

Table 2.1: Variation of Duty Rates for Rice Imports

Period	Rate of Duty
1986 – 1989	25%
1990	08%
1992 July 30	12%
1992 Dec. 01	16%
1993 July 26	20%
1993 Aug. 17	35%
1994 Dec. 13	20%
1995 Feb. 01	31%
1996 April 15	0%
1997 Jan. 31	35%
1997 Nov. 20	0%
1998 Feb. 01	35%
1999 Nov. 22	10%
2000 Jan. 01	35%

Source: Sri Lanka Custom Notifications (Various Issues)

Though there has been a degree of flexibility in regard to tariff rates, no rational policy has been adopted in this regard (Rupasena, 2000). However, the impacts of these changes were very effective in determining domestic market prices. Until 1990, the CWE held a monopoly on rice imports. After August 1990, the private traders were allowed to import and to maintain buffer stocks subject to import duties when stocks were released to the local market.

The impact of tariff rates on local producers and consumers is negligible when compared to the Nominal Protection Coefficient [3](NPC) and the Effective Protection Coefficient (EPC)[4]

According to HARTI statistics based on 1991/92 survey data in four major rice producing areas, the NPC or the NPR was -8.2 at the official exchange rate and -16.8 at the shadow exchange rate (Wickramarachchi, 1993). It implies that rice was negatively protected or local producers were taxed. According to the same estimates, EPC or the Effective Protection Rate (EPR) was -9.8 and -21.6 respectively in newly irrigated and rehabilitated irrigated areas at the official exchange rate. The rate was -23.2 and -32.0 respectively in newly and rehabilitated areas in terms of the shadow exchange rate (Wickramarachchi, 1993). This implies again that protection policies had a negative effect on the local producers.

Following the agricultural policy reforms, the agricultural delivery system was also improved through strengthening the institutional mechanism of the state services and the participation of beneficiary groups. Thus, Agrarian Services Centres (ASCs') were established in 1971 to provide farm support services such as extension services, credit and marketing through the Department of Agrarian Services, Department of Agriculture, Paddy Marketing Board and Agricultural Development Authority. Under the Agricultural Productivity Act of 1971, farm support services were strengthened through promoting the participation of beneficiary groups. Thus, Agricultural Productivity Committees were formed in every ASCs' representing farmer representatives and line agency officers. However, after 1988, the role of the Agrarian Services Centers was limited to training and extension services, and the private sector was encouraged to provide fertilizer, chemicals and seeds.

[3] NPC is the ratio of domestic market price of a given commodity to its border price. Thus:
$NPC = P^d/P^b$ where P^d – domestic price of given commodity
P^b – border price of the commodity

[4] The EPC is defined as the ratio between the value added in domestic market prices to the value added in world prices for a particular production process.
$EPC = V^d/V^b$ where V^b – value added in border prices
V^d – value added in domestic prices

CHAPTER THREE

ECONOMIC ASPECTS OF PADDY FARMING

3.1 Cost of Production

Theoretically, costs are divided into two parts: 1) fixed cost 2) variable cost. Fixed cost includes expenditure incurred before production commences. This implies that fixed cost does not vary with the quantity of production; an example is the cost of purchasing or renting of paddy lands, while variable cost varies with production, an example being the cost of labour. In this study, only the variable costs are taken into account and divided into three components, namely labour, power and material cost. Power cost includes expenditure incurred for hiring machinery and equipment. The major cost component of this category is the tractor charges. Material cost includes expenditure on fertilizer and agro chemicals. The information related to cost was collected on an operational basis. In addition to the hired inputs, information on family inputs such as labour was gathered. Data was analyzed on an operational, component and cash/non-cash basis. Imputed values for family owned inputs based on the market rates were placed in the non-cash category. Percentages were calculated to show the importance of major cost items. Results are presented in a tabular form.

3.1.1. Total Cost

Table 3.1 presents the total cost of production per acre in the study locations. As shown in the table, the cost of production during the 2001 *yala* season exceeded Rs 19, 000 per acre except in Hettipola where the cost was Rs 17, 171 per acre. Lowest cost was reported in Hettipola even for the *maha* season. The reason for low cost in Hettipola was due to low wage rates prevailing in the area and lesser use of fertilizer. The above reason is evident in table 3.2 where the cash cost was separated in order to get an idea of cash requirement for paddy cultivation. Farmers at Ridibendiela and Pannala required about Rs 12,000 in cash to cultivate one acre of paddy land. The cash cost represents about 65 percent of the total cost at Ridibendiela where paddy is grown under major irrigation. However, cash cost at Hettipola was about 50 percent of the total cost because of the low-level fertilizer application. As regard to Kegalle district where paddy is grown under rain-fed conditions, cash cost per acre was about Rs 8,800, which was about 45 percent of the total cost of production, where once again there is a low fertilizer application.

Table 3.1: Cost of Cultivation per acre of Paddy during *yala* 2001 and *maha* 2000/01

District/ Location	Mode of water supply	*Yala* 2001			*Maha* 2000/01		
		Total Cost (Rs/acre)	Cash Cost (Rs/acre)	% of Cash Cost to Total Cost	Total Cost (Rs/acre)	Cash Cost (Rs/acre)	% of Cash Cost to Total Cost
KURUNEGALA DISTRICT							
Ridibendiela	Major Irrigation	19,057	12,295	65	18,311	11,823	65
Hettipola	Minor Irrigation	17,171	8,141	47	17,233	8,844	51
Pannala	Rainfed	19,217	11,704	61	20,224	12,352	61
KEGALLE DISTRICT							
Dedigama & Rambukkana	Rainfed	19,077	8,840	46	18,988	8,813	46

Source: Survey data, HARTI, 2001

The breakdown of the cash cost is given in table 3.2 for both seasons. The situation varies by location. At Ridibendiela, labour cost represents about 45 percent of the total cash cost followed by about 40 percent for material cost. The remaining 15 percent was spent on farm power. In Kegalle district, farm power and material costs consisted of about 30 percent each. The farm power cost was considerably higher than that of Ridibendiela. The total farm power cost in

Kegalle district was 35 percent higher than that in Ridibendiela during the 2001 *yala* season. One of the reasons for the higher level of farm power cost in the Kegalle district was use of animal draught power for land preparation and threshing.

Table 3.2: Composition of Cash Cost for Paddy Cultivation during *yala* 2001 and *maha* 2000/01

District/ Location	Mode of Water Supply		*Yala* 2001				*Maha* 2000/01			
			Labour Cost (Rs)	Power Cost (Rs)	Material Cost (Rs)	Total Cost (Rs)	Labour Cost (Rs)	Power Cost (Rs)	Material Cost (Rs)	Total Cost (Rs)
KURUNEGALA DISTRICT										
Ridibendiela	Major Irrigation	(Rs/ac)	5,585	1,930	4,779	12,295	5,516	1,665	4,642	11,823
		%	45.4	15.7	38.9	100.0	46.7	14.1	39.3	100.0
Hettipola	Minor Irrigation	(Rs/ac)	3,161	1,811	3,169	8,141	3,517	1,672	3,655	8,844
		%	38.8	22.2	38.9	100.0	39.8	18.9	41.3	100.0
Pannala	Rainfed	(Rs/ac)	3,654	4,593	3,457	11,704	5,385	3,181	3,786	12,352
		%	31.2	39.2	29.5	100.0	43.5	25.7	30.6	100.0
KEGALLE DISTRICT										
Dedigama & Rambukkana	Rainfed	(Rs/ac)	3,779	2,580	2,481	8,840	3,855	2,439	2,519	8,813
		%	42.8	29.2	28.1	100.0	43.7	27.7	28.6	100.0

Source: Survey data, HARTI, 2001

In the study, importance of each cost item was examined by calculating the percentage contribution to the total cost. Results are presented in table 3.3. Cost of labour is the highest component representing over 50percent of the total cost in all localities for both seasons. In Kegalle district, labour cost exceeded over 65 percent and the amount was around Rs 13,000 per acre compared to Rs 10,500 at Ridibendiela in Kurunegala district. In major irrigation areas, the second most important cost item is the material cost. The study found that material cost at Ridibendiela represented 26 percent followed by 18 percent for farm power.

Table 3.3: Composition of Total Cost of Cultivation of Paddy during *yala* 2001 and *maha* 2000/01

District/ Location	Mode of Water Supply		*Yala* 2001				*Maha* 2000/01			
			Labour Cost (Rs)	Power Cost (Rs)	Material Cost (Rs)	Total Cost (Rs)	Labour Cost (Rs)	Power Cost (Rs)	Material Cost (Rs)	Total Cost (Rs.)
KURUNEGALA DISTRICT										
Ridibendiela	Major Irrigation	(Rs/acre)	10,590	3,480	4,986	19,057	10,413	3,060	4,838	18,311
		%	55.6	18.3	26.2	100.0	56.9	16.7	26.4	100.0
Hettipola	Minor Irrigation	(Rs/acre)	9,302	4,211	3,658	17,171	9,608	3,723	3,903	17,233
		%	54.2	24.5	21.3	100.0	55.8	21.6	22.6	100.0
Pannala	Rainfed	(Rs/acre)	10,002	5,585	3,627	19,214	12,028	4,247	3,950	20,224
		%	52	29	18.9	100.0	59.5	20.4	19.5	100.0
KEGALLE DISTRICT										
Dedigama & Rambukkana	Rainfed	(Rs/acre)	12,712	3,498	2,866	19,076	13,075	3,076	2,837	18,988
		%	66.6	18.3	15.0	100.0	68.9	16.2	14.9	100.0

Source: Survey data, HARTI, 2001

Labour Use

As explained above, since the labour cost contributes the highest share in the total cost, labour requirement for paddy farming was examined in the survey. As shown in table 3.4, the number of man-days per acre varies from 38 days at Hettipola to 60 days at Dedigama/Rambukkana. In Kegalle district, exchange labour (*attam*) is widely used, while in Kurunegala, hired labour is widely used under major irrigation. As indicated by the total number of labour days, farmers in the rainfed areas use the highest number of labour days to cultivate a unit area. Although the total number of labour days utilized in rainfed areas recorded the highest amount of exchange labour compared to other water regimes, but in economic terms the labour use efficiency is very low. Therefore, the highest of labour use and low return from paddy cultivation in the rainfed areas have led to the lowest rate return to labour, which is lower than the prevailing market wage rate in the rainfed areas. Farmers in the major irrigated areas have to carry out the land preparation simultaneously, considering the water issue from the irrigation schemes. Consequently, harvesting of all fields takes place at the same time. Also land preparation and harvesting require a greater number of labour days. These two reasons attributed to the high demand for hired labour for cultivation of paddy under major irrigation. Average wage rate per day was around Rs 200 per man and Rs 125 per woman without meals. Due to scarcity of female labour at Pannala, the cost was around Rs 150 per day.

Table 3.4: Labour Requirement for Paddy Cultivation during *yala* 2001 and *maha* 2000/01

Season	District/ Location	Mode of Water Supply	Family Labour (Md/acre)	Hired Labour (Md/acre)	Exchange Labour (Md/acre)	Total	*Wage rate (Rs/day)	
							Male	Female
YALA 2001	**KURUNEGALA DISTRICT**							
	Ridibendiela	Major Irrigation	23.77	23.25	1.58	48.61	210	121
	Hettipola	Minor Irrigation	26.87	9.75	1.85	38.47	220	128
	Pannala	Rainfed	24.65	14.33	8.97	47.94	183	148
	KEGALLE DISTRICT							
	Dedigama & Rambukkana	Rainfed	31.45	12.89	12.31	56.65	214	137
MAHA 2000/01	**KURUNEGALA DISTRICT**							
	Ridibendiela	Major Irrigation	24.34	23.66	1.24	49.23	202	122
	Hettipola	Minor Irrigation	28.83	12.30	1.74	42.88	211	126
	Pannala	Rainfed	27.39	19.61	6.58	53.57	203	151
	KEGALLE DISTRICT							
	Dedigama & Rambukkana	Rainfed	31.58	13.24	15.13	59.95	210	134

* Wage rate (Excluding Food)

Source: Survey data, HARTI, 2001

Fertilizer Application

Use of fertilizer varies by location and type of farming as depicted in table 3.5. With regard to locations, the highest usage of fertilizer was observed at Pannala, while the lowest application was reported at Dedigama and Rambukkana for both seasons. In both locations, farming is carried out under rain-fed conditions. There is an imbalance in application of fertilizer. For instance, farmers at Ridibendiela use more than the recommended dosage of urea and under use V-mixture and TDM. Fertilizer cost amounts to about 45-60 percent of the total material cost. Since the Department of Agriculture is promoting the use of straight fertilizers, farmers' adoption of this practice was examined. Findings show that application of straight fertilizers was not in practice in the study locations except in Kegalle, where only a few farmers used straight fertilizers. The findings indicate that, farmers are continuously depending on fertilizer mixtures, although straight fertilizers are recommended by the Department of Agriculture. As pointed out by Nanayakkara (1989), the use of straight fertilizers reduces the fertilizer cost and increases the efficiency of fertilizer use. However, farmers in the study locations are reluctant to use straight fertilizers due to lack of awareness, difficulties in mixing fertilizers and non-availability of straight fertilizers at village level.

Table 3.5: Fertilizer Application by Type, Quantity (kg/ac) and Cost (Rs/ac) during *yala* 2001 and *maha* 2000/01

Season	District/ Location	Mode of Water Supply	V Mixture Basal	Urea	TDM	Straight Fertilizers	Total kg	Fertilizer Cost (Rs/ac)	Fertilizer Cost as % of material cost
YALA 2000	**KURUNEGALA DISTRICT**								
	Ridibendiela	Major Irrigation	60	86	44	0	190	2,264	45
	Hettipola	Minor Irrigation	34	66	46	2	148	1,583	43
	Pannala	Rainfed	56	66	40	5	167	1,925	55
	KEGALLE DISTRICT								
	Dedigama & Rambukkana	Rainfed	40	30	32	27	129	1,742	60
MAHA 2000/01	**KURUNEGALA DISTRICT**								
	Ridibendiela	Major Irrigation	63	79	46	0	188	2,179	45
	Hettipola	Minor Irrigation	34	66	47	3	150	1,609	41
	Pannala	Rainfed	56	61	44	2	163	1,912	48
	KEGALLE DISTRICT								
	Dedigama & Rambukkana	Rainfed	38	31	33	31	133	1,743	61

Source: Survey data, HARTI, 2001

Cost of Cultivation by Operations

In this study, information on cost of production was obtained on an operational basis. As shown in the annexes (annexes I-VIII) paddy farming was divided into 14 operations from nursery preparation to transportation of paddy to the farmhouse. Labour is deployed in all operations. Nevertheless, peak demand for labour prevailed in two stages, i.e., planting stage (nursery preparation,transplanting/broadcasting) and harvesting stage (harvesting, threshing and transporting of products to homestead). The analysis of cost of production at Ridibendiela shows that cost for these two stages amounted to Rs 3,370 and Rs 4,345 respectively totaling to Rs 7,715 per acre. This represents 75 percent of the total labour cost of the entire cultivation process. When the machinery cost was added to the labour cost, the cost for the first stage amounted to Rs 5,292 and the second stage was Rs 5,330 totaling Rs 10,622. This means that 58 percent of the total cost of production was spent at the initial as well as final stages of cultivation.

3.2 Profitability and Yield

Profitability of paddy farming was worked out on a per acre basis. Gross return or income was calculated by multiplying production and average producer price. Net return is a subtraction of production cost from the gross return. Net return was calculated by two methods: including imputed costs and excluding imputed cost, which is called cash cost. In addition, return to labour, and return to capital were calculated. Return to labour means the amount that could be earned for a labour day. This is a value of the labour in respect to net income of paddy. Similarly, return to capital means the amount that could be earned by investing one rupee in paddy farming. It is worked out by dividing the net return by total cash cost investment. Results are presented in table 3.6.

Table 3.6: Yield, Producer Price and Revenue: Paddy during *yala* 2001 and *maha* 2000/01

Season	District/ Location	Mode of Water Supply	Yield (kg/ac)	Farm gate Price Rs/kg	Gross Return Rs/ac	Net Return (Rs/ac)		Return to Labour Rs/day	Return to Capital (Rs/one rupee of investment)
						1	2		
Yala 2001	**KURUNEGALA DISTRICT**								
	Ridibendiela	Major Irrigation	2,216	12.15	26,924	7,868	14,630	301	1.18
	Hettipola	Minor Irrigation	1,712	12.65	21,657	4,486	13,516	351	1.66
	Pannala	Rainfed	1,259	13.80	17,374	-1,840	5,670	118	0.47
	KEGALLE DISTRICT								
	Dedigama & Rambukkana	Rainfed	1,070	13.66	14,616	-4,461	2,399	42.34	0.27
Maha 2000/01	**KURUNEGALA DISTRICT**								
	Ridibendiela	Major Irrigation	1,953	12.22	23,860	5,549	12,037	245	1.02
	Hettipola	Minor Irrigation	1,301	12.08	15,715	-1,518	6,870	160	0.78
	Pannala	Rainfed	1,524	13.23	20,159	-65	7,807	146	0.88
	KEGALLE DISTRICT								
	Dedigama & Rambukkana	Rainfed	1,248	11.93	14,888	-4,100	6,075	101	0.69

(1) - Including imputed cost of farmer owned inputs (2) - Excluding imputed cost of farmer owned inputs

Source: Survey data, HARTI, 2001

As expected, the highest yield per acre was recorded from major irrigated areas, the second highest from minor irrigated areas and the lowest was from rain-fed areas. For example, average yield at Ridibendiela under major irrigation was 2,216 kg per acre in 2001 *yala* season, which was 29 percent higher than that of minor irrigation and 107 percent higher than that of rain-fed condition. This is mainly due to the differences in water availability. When these yields are compared to research level yield, a big disparity exists at all locations (table 3.7). This will be explained in detail under the section of technical efficiency (Section 3.3).

Table 3.7: Disparities between Research yield and, Actual yield among different varieties (*maha* 2000/01)

Type of varieties	KURUNEGALA DISTRICT			KEGALLE DISTRICT	Recorded Highest Yield in the Research Station*Bu/ac
	Major Irrigation (Bu/ac)	Minor Irrigation (Bu/ac)	Rainfed (Bu/ac)	Rainfed (Bu/ac)	
BG 304		40.0			143.5
BG 352	89.9	75.0	92.0	55.1	116.3
BG 358	98.4		104.0		184.2
BG 400/1	77.8		65.0		164.8
LD 355	80.0				87.3
BG 357	100.2		100.0	110.0	184.2
BG 450	78.7				116.3
BG 300		48.3			135.7
BG 379/2	91.6		65.0	69.6	164.8
BG 403	130.0	80.0			155.1
LD 252	110.0				87.3
BG 350		40.0			126.0
BG 11/11	100.0			68.0	126.0
AT 354		91.7			97.0
BG 345		46.7			97.0
BG 90/2				72.0	164.8
Not Known	98.3	58.7	68.2	59.5	

* Source: Research Officer in Charge at Rice Research Station, Ambalantota

With regard to gross return, the maximum amount obtained was Rs 26,924 at Ridibendiela and the lowest was Rs 14,616 per acre at Dedigama/Rambukkana area in the 2001 *yala* season. Compared to crops like onions, potatoes and chillies, gross income obtained from paddy farming is low. Due to this situation, the private sector is reluctant to invest in paddy farming and the youth are unwilling to enter into paddy farming. As mentioned earlier, net income was calculated including and excluding the cost for family labour. Accordingly, net income per acre varied from Rs 14,630 at Ridibendiela to Rs 2,399 at Dedigama/Rambukkana. As shown in the table 3.6, net return under rain-fed conditions is considerably low, but farmers are still willing to continue rainfed paddy farming due to two reasons: 1) food security at household level and 2) absence of suitable alternative crops for rainfed paddy lands. Farmers in the rainfed areas use the highest number of labour days to cultivate a unit area. Although the total number of labour days utilized in rainfed areas included the highest amount of exchange labour compared to other water regimes, in economic terms, the labour use efficiency is very low. Therefore, highest amount of labour use and low return from paddy cultivation in the rainfed areas has lead to the lowest return for labour, which is lower than the prevailing market wage rate in the rainfed areas.

Harvesting of paddy (including harvesting, threshing and winnowing) alone accommodate 36-40 percent of the total labour cost of paddy farming. The cost of labour plus machinery cost involved in harvesting of paddy is around 25-30 percent of the total paddy production cost (Annex I-IV). Therefore, with a diminishing return for labour, an increasing cost for harvesting, further investigation on potential, constraints and feasibility of adopting mechanization in harvesting of paddy is vital. Maharouf and Rafeek (2003) found that, use of combine harvester for paddy harvesting reduces the cost of production by 10-15 percent, increases paddy output by about 5 percent and reduces post harvest losses and enhances the incorporation of straw in soil.

They also describe that although combine harvester has a negative effect on employment opportunities of harvesting labourers, gross social return of using combine harvester is higher than the net social return.

The findings from major irrigation areas of the study show that, investing one rupee in paddy farming has generated more than one rupee in return. Return of capital in rainfed areas is less than 1 and it is lower in *yala* season compared to *maha* season. In this study, an attempt was made to calculate the unit cost and break-even yield. The results are presented in table 3.8. Under the condition in which farmer own input is valued at market rate in calculating the cost of production, the market price of paddy is lower than the unit production cost of rainfed paddy. In major and minor irrigated areas, actual yield is higher than the break-even yield and the market price of paddy is higher than that of unit cost.

Table 3.8: Unit Cost and Break-even Yield: Paddy during *yala* 2001 and *maha* 2000/01

District/ Location	Mode of Water Supply	*Yala* 2001				*Maha* 2000/01			
		Unit Cost Rs/kg		Break-even yield kg/ac		Unit Cost Rs/kg		Break-even yield kg/ac	
		1	2	1	2	1	2	1	2
KURUNEGALA DISTRICT									
Ridibendiela	Major Irrigation	8.60	5.55 (12.15)	1,568	1012 (2,216)	9.38	6.06 (12.22)	1498	967 (1,953)
Hettipola	Minor Irrigation	10.03	4.76 (12.65)	1,357	644 (1,712)	13.25	6.80 (12.08)	1427	732 (1,301)
Pannala	Rainfed	15.26	9.29 (13.80)	1,392	882 (1,259)	13.27	8.10 (13.23)	1529	960 (1,524)
KEGALLE DISTRICT									
Dedigama & Rambukkana	Rainfed	17.83	8.26 (13.66)	1,397	647 (1,070)	15.22	7.06 (11.93)	1592	739 (1,248)

1 - Including imputed cost of farmer owned inputs
2 - Excluding imputed cost of farmer owned inputs

Figures in parentheses under the unit cost column indicates the farm gate price of paddy and figures in the parentheses under the break-even yield column shows the average paddy yield prevailed in the area.
Source: Survey data, HARTI, 2001

3.3 Technical Efficiency

Technical efficiency was measured using the maximum likelihood - frontier production function. In this model, each farmer efficiency level was measured based on the best farmer's efficiency level. The value of the technical efficiency coefficient varies between zero and one. A value closer to one indicates an increase in efficiency, while a closer figure closer to zero means an increase in inefficiency. The value of the mean technical efficiency provides the average situation. Results are presented in table 3.9.

As shown in the table, the values of the technical efficiency coefficient varies significantly, indicating that there is a vast difference of production efficiency among farmers, though they operate under similar conditions. This may be due to different farming practices adopted by farmers and their entrepreneurship. For instance, some farmers used old seeds, which were used in the their fields repeatedly for several seasons, while others used new certified seeds. Similarly, application of fertilizer and use of agro-chemical varies by farmers. According to the results of the

mean technical efficiency, there is room to increase the production without increasing the input level. For instance, value of the mean technical efficiency in Kurunegala was 0.76 for major irrigation, which indicates that, production could be increased by another 24 percent if all the farmers achieve the technical efficiency of the best farmers. This does not demand an increase in input levels. With regard to *yala* season, technical efficiency is high in major and minor irrigation areas, while it is very low in rain-fed areas as indicated by the low mean efficiency value of less than 0.50.

Table 3.9: Technical Efficiency

Maha **2000/2001**	**KURUNEGALA DISTRICT**			**KEGALLE DISTRICT**
	Major	**Minor**	**Rainfed**	**Rainfed**
Variation	0.99-0.19	0.98-0.24	0.98-0.22	0.95-0.16
Mean Efficiency	0.76	0.62	0.69	0.54

Yala **2001**	**KURUNEGALA DISTRICT**			**KEGALLE DISTRICT**
	Major	**Minor**	**Rainfed**	**Rainfed**
Variation	0.99-0.55	0.95-0.21	0.99-0.12	0.99-0.11
Mean Efficiency	0.83	0.84	0.47	0.47

Source: Survey data, HARTI, 2001

Based on the mean and the standard deviation of technical efficiency, farmers were grouped into three categories: high efficiency (TE < 91percent), average efficiency (61percent < TE < 90percent) and low efficiency (TE < 60percent). Table 3.10 compares farming practices of each group. As shown in the table, the number of low efficiency farmers in the sample is high in minor irrigated and rain-fed areas compared to that of the major irrigated area. Out of 123 rain-fed paddy farmers in the two sample districts, 71 or 57 percent belongs to the category of low efficiency; where as the figure for major irrigation is only 6 out of 39 farmers, representing only 15 percent. The cost for fertilizer and labour are considerably higher for low efficiency farmers compared to high efficiency farmers. In other words low efficiency farmers are over using fertilizer input which is one of the factors leading to inefficiency (Table 3.10). Another important point is that yield is substantially high among high efficiency farmers as against the low efficiency farmers but there is hardly any variation in cost. Average yield of high efficiency farmers was 110 bushels per acre compared to 55 bushels of low efficiency farmers under major irrigation. The same condition prevails in areas under minor irrigation and rain-fed conditions.

Table 3.10: Farming Practices of Paddy Cultivation by Level of Efficiency of the Farmers during 2000/01 *maha* season

Important measurements in related to Paddy	KURUNEGALA DISTRICT									KEGALLE DISTRICT		
	MAJOR IRRIGATION			MINOR IRRIGATION			RAINFED			RAINFED		
	High Efficiency	Average Efficiency	Low Efficiency	High Efficiency	Average Efficiency	Low Efficiency	High Efficiency	Average Efficiency	Low Efficiency	High Efficiency	Average Efficiency	Low Efficiency
Average Land Cultivated (ac)	1.35	1.17	1.29	1.20	1.01	0.87	0.84	0.88	0.70	0.58	0.66	0.66
Yield per Acre (Bu/ac)	110	93	55	97	64	47	85	81	55	102	78	47
Seed Rate (Bu/ac)	2.19	2.01	1.94	2.17	2.85	2.55	1.85	2.45	2.22	1.77	1.68	1.83
Seed Cost (Rs/ac)	256	319	283	270	322	422	492	458	550	562	575	594
Fertilizer Rate (kg/ac)	199	178	207	118	165	170	155	212	198	118	110	143
Fertilizer Cost (Rs/ac)	2,209	2,082	2,464	1,231	1,706	1,659	1,840	2,410	2,370	1,652	1,435	1,895
Agro-Chemicals Cost(Rs/ac)	1,591	2,073	1,856	1,088	1,354	1,541	768	1,296	1,289	173	236	501
Power (Rs/ac)	2,973	3,147	2,907	3,361	3,754	3,831	3,836	4,550	4,185	3,527	2,886	3129
Labour including FL (Rs/ac)	10,005	10,588	10,511	6,732	8,759	11,530	11,706	11,602	12,657	13,260	12,817	13,182
Labour excluding FL (Rs/ac)	5,377	5,529	5,708	1,763	2,760	4,922	6,013	5,332	5,058	2,773	3,539	4,088
Man days including FL (md/ac)	48.25	52.92	50.16	34.81	40.39	53.73	52.98	54.74	55.23	64.72	61.24	60.31
Man days excluding FL (md/ac)	25.46	27.60	26.56	8.76	12.59	22.83	26.99	28.93	25.38	30.32	30.67	28.48
Cost per kg (Rs/kg)	7.62	9.58	21.64	6.53	12.32	19.79	10.30	12.36	18.46	8.99	11.00	20.48
No. of Farmers included for FP*	10	23	6	5	15	18	8	13	16	5	26	55
Percentage of Farmers	26	59	15	13	39	47	22	35	43	6	30	64
Cost per Acre (Rs/ac)	17,543.03	18,665	18,412	13,170	16,505	19,493	18,923	20,819	21,329	19,217	17,997	19,436

* Frontier Program

Low efficiency = less than 60% of technical efficiency

Average efficiency = 60 – 90% of technical efficiency

High efficiency = above 90% of technical efficiency

3.4 Stochastic Frontier Production Function Results

Coefficient of variables obtained from the regression analysis directly provides elasticity of the respective variables in terms of production. Results are presented in tables 3.11 and 3.12. In case of major irrigation, only land and agro chemical usage has a significant relationship with production during *maha* season. In *maha* season, farm size is the highest co-efficient of elasticity. It shows that doubling the farm size, under major irrigation while maintaining the other inputs at a constant level would increase the production by about 56 percent, which is significant even at 1 percent level. With regard to minor irrigation, if land elasticity with respect to production is greater than one, it indicates that one percent increase in land leads to more than one percent increase in production during the *maha* season.

In Kurunegala district, there is no strong relationship between labour use and production under the irrigated condition. However, labour has a significant and positive elasticity under rainfed conditions in both Kegalle and Kurunegala districts during *maha* season. The scarcity of labour in Kegalle district was observed during the field survey, and return to labour was found to be low in rainfed areas, which might indicate the potential for mechanization of paddy cultivation.

The relationship with fertilizer use, which is the key material, cost of paddy cultivation (over 45 percent of total material cost) shows no significant relationship in any of the study locations. This may be due to application of improper dosages of fertilizers as discussed earlier in section 3.1.1.

Table 3.11: Maximum Likelihood Estimates for Parameters of the Stochastic Frontier Production Function for Paddy Cultivation in Kurunegala and Kegalle Districts during *maha* 2000/2001

Variables	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major irrigation		Minor irrigation		Rainfed		Rainfed	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Intercept	1.5848	*1.6220	15.1352	***11.9246	-2.9924	**-2.5687	-0.2634	-0.2174
Land (ac)	0.5689	***3.0189	1.9227	***13.5634	-0.3697	*-2.0542	0.0851	0.4457
Labour (Man days)	0.0367	0.1110	0.1422	1.4558	0.8553	***3.0278	0.5825	***3.1042
Seed (Rs)	-0.1498	-1.1056	-0.5835	***-9.6346	-0.0158	-0.2362	0.1724	1.2864
Fertilizer (Rs)	-0.1043	-0.9466	-0.5454	-1.1745	0.1837	0.8820	0.0910	0.8736
Agro-chemicals (Rs)	0.1224	*2.1001	-0.0860	-1.5043	-0.0299	-0.4103		
Power (Rs)	0.4949	1.5702	-0.3161	***-3.7921	0.3698	***3.87149	0.1001	1.5710
Sigma squared	**0.2615**	***3.8774**	**0.5270**	***5.5271**	**0.2152**	***3.8991**	**0.2262**	***2.6835**

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level

Table 3.12: Maximum Likelihood Estimates for Parameters of the Stochastic Frontier Production Function for Paddy Cultivation in Kurunegala and Kegalle Districts during *yala* 2001

Variables	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major irrigation		Minor irrigation		Rainfed		Rainfed	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Intercept	2.3625	**2.3899	-3.3062	***-2.6964	-7.9347	-4.1263	1.33053	0.7659
Land (ac)	0.5775	1.0899	0.0320	0.1723	-0.7717	-2.5296	0.3347	1.1677
Labour (Mandays)	0.1841	0.2207	0.1988	1.1558	2.0259	8.0345	0.2504	0.9344
Seed (Rs)	0.0660	0.0790	0.5653	***3.6535	-0.4997	-2.1502	0.1159	1.1568
Fertilizer (Rs)	0.0090	0.0133	-0.0427	-0.3035	0.1304	1.0470	0.1521	1.2748
Agro-chemicals	0.0750	0.4787	0.0358	0.5465	0.2981	2.6865		
Power (Rs)	0.0873	0.1096	0.3828	***2.8372	-0.5173	-0.9300	0.0149	0.1094
Sigma squared	**0.0580**	**0.4581**	**0.3161**	**2.1789	**0.6567**	**3.1161**	**1.0661**	**1.1260**

*** Significant at 1% level, ** Significant at 5% level

The factors influencing the technical inefficiencies were analyzed using the model specified by Battese and Coelli (1995). Age of farmers (years), experience of farmers (years), occupation (full time/part time farmers, dummy) and education level (dummy variable) were taken as causing variation in technical inefficiency. The results are given in tables 3.13 and 3.14.

Age coefficient in minor irrigation during *maha* season is positive and significant, which indicates that younger farmers are more efficient than older ones. Negative and significant coefficients among minor irrigation farmers of Kurunegala district with education and occupations (part time/full time) in *maha* season indicates that, increasing education and experience has led to higher efficacy. When farmers are full time farmers, they devote more time on cultivation, which leads to increase of farm efficiency. However, findings from *yala* season data (Table 3.14) indicate a low level of association between these variables (age, experience and occupation) and their technical efficiency.

Table 3.13: Results of the Inefficiency Model, *maha* 2000/01

Variables	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	Coefficient		Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Age (years)	0.2316	0.5900	2.1769	***4.9045	-0.7219	-1.5508	0.1984	0.6153
Experience (years)	0.0205	0.0724	-0.7228	***-3.6266	0.4523	1.2645	-0.1556	-0.8035
Education (dummy)	1.5215	**2.2816	-2.7048	***-3.4692	-0.0246	-0.0444	-0.5002	-1.6082
Occupation (dummy)	0.4552	*0.7716	-0.4667	-1.3224	0.0945	0.2015	-0.1866	-0.6482

*** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level

Table 3.14: Results of the Inefficiency Model, *yala* 2001

Variables	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Age (years)	0.0511	0.0922	0.6214	0.6731	-0.1936	-0.3311	-0.9372	-0.5622
Experience (years)	-0.0618	-0.1383	-0.1283	-0.7692	0.2750	0.3814	0.2609	0.4286
Education (dummy)	0.0138	0.0144	4.4530	*1.9056	-0.0053	-0.0062	-1.1591	-0.9726
Occupation (dummy)	0.0126	0.0134	3.5961	1.5193	-0.3629	-0.4503	-0.8304	-0.8197

* Significant at 10% level

CHAPTER FOUR

INSTITUTIONAL ASPECTS OF PADDY CULTIVATION

4.1 Farm Support Services

This section deals with various farm support services such as purchased inputs, irrigation water, extension system credit and marketing system that influenced the present paddy production process and productivity.

4.1.1 Purchased Inputs

Purchased inputs of paddy production include chemical fertilizers, agro-chemicals and seed paddy which are integral components of green revolution technology.

a. Seed Paddy

Use of New Improved Varieties (NIVs) was the main reason for the success in paddy grain production programme. The findings of the study reveals that almost 100 percent of the farmers use NIVs for paddy cultivation irrespective of water regimes. Over 65 percent of farmers in minor irrigated and rainfed cultivations and 50 percent of farmers under the major irrigation system obtain seed paddy from private farmers or use their own seed stocks (Tables 4.1 and 4.2), while the rest of the farmers obtain seeds from private traders, Agrarian Development Centres and Co-operatives. One of the important sources of seed paddy for Ridibendiela (major irrigation) farmers, was a farmer company established in the scheme recently by the Irrigation Management Division (IMD) of the Ministry of Irrigation and Power. The findings also indicate that, the role of government departments like Department of Agrarian Services and Department of Agriculture is considerably higher in rainfed areas with regard to the seed paddy supply compared to the irrigated areas, due to lack of access to alternative sources.

When analyzed in depth, use of seed paddy from neighbouring farmers and farmers' own paddy fields, it was revealed that, most of these high yielding seed varieties have not been replaced for many years. However, it is recommended by the Department of Agriculture to renew seed paddy with certified seed preferably every season or at least once in 4-5 seasons in order to maintain the seed quality. Otherwise, poor quality seeds would lead to low levels of yield. The main reasons for the use of poor quality seeds were unawareness among the farmers about the repercussions of using uncertified seed for a longer period, high price of certified seed paddy and difficulties in obtaining certified seeds of right quality at the required time and quantity.

Table 4.1: Sources of Seed Paddy – *yala* 2001

Source	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No. of respondents	%	No. of respondents	%	No. of respondents	%	No. of respondents	%
Own seed	10	25	14	35	9	24	41	46
Neighbour Farmers	13	32.5	14	35	17	46	26	29
Private Traders	1	2.5	5	12.5	2	5.5	2	2
Agrarian Development Centre	1	2.5	2	5	6	16	14	16
Department of Agriculture	1	2.5	3	7.5	2	5.5	5	5.5
Landlord	-	-	1	2.5	1	3	1	1
Co-operative	1	2.5	1	2.5	-	-	-	-
Farmer Company	13	32.5	-	-	-	-	-	-

Source: Source: HARTI Survey, 2001

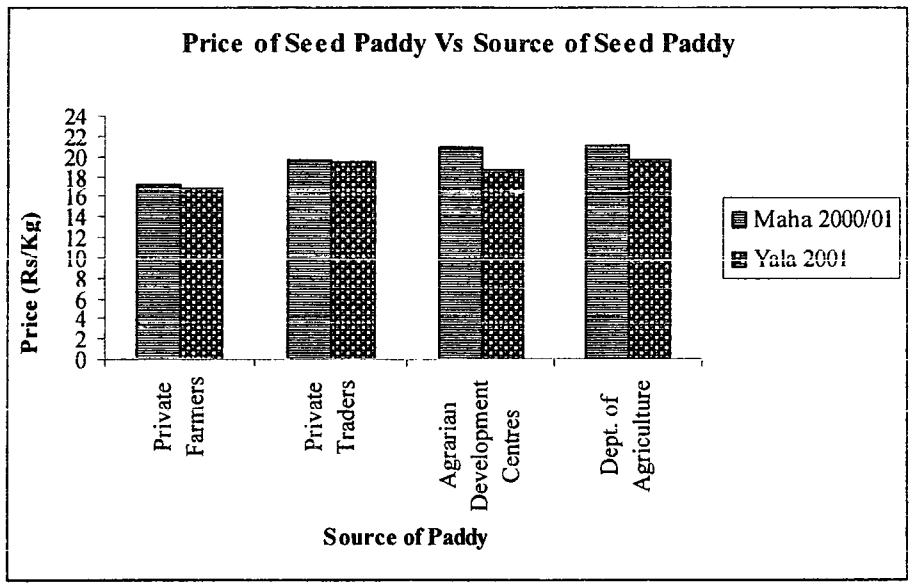
Table 4.2: Sources of Seed Paddy -*maha* 2000/01

Source	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No. of respondents	%	No. of respondents	%	No. of respondents	%	No. of respondents	%
Own seed	7	17.5	9	22.5	3	8	45	52.5
Private Farmers	13	32.5	17	42.5	13	34	18	21
Private Traders	2	5	5	12.5	5	13	2	2
Dept. of Agriculture	3	7.5	3	7.5	8	21	4	4.5
Agrarian Development Centre	-	-	4	10	9	24	15	17.5
Land lord	-	-	1	2.5	-	-	1	1
Co-operative	-	-	1	2.5	-	-	1	1
Farmer Company	15	37.5	-	-	-	-	-	-

Source: HARTI Survey, 2001

Figure 4.1 illustrates the average price of seed paddy among different sources during *maha* and *yala* seasons. According to the information, the cheapest source of seed paddy is the private trader, where the quality of seed is not assured. The overall seed paddy price is comparatively higher in rainfed areas, mainly due to poor infrastructure and transport cost.

Figure 4.1: Price of Seed Paddy Vs Source of Seed Paddy



b. Fertilizers

Application of the correct amount of fertilizer is the most convenient and simplest method of increasing yield. Therefore, availability of proper fertilizer at the correct time is a very important aspect in increasing the productivity of paddy. Tables 4.3 and 4.4 describe the main sources of fertilizer during *yala* 2001 and *maha* 2000/01 respectively in the study locations. The findings show that, private traders are the major source of fertilizer providers for farmers under the minor irrigation schemes. In Ridibendiela (major irrigation), the bulk of the fertilizer was handled by the farmer company, while the Agrarian Development Centres and Co-operative stores were the major suppliers of fertilizer in rainfed areas.

Majority of the sample farmers (95 percent) under major and minor irrigation systems, and farmers in rainfed areas in Kurunegala district declared that they have no difficulties in obtaining the required amount and type of fertilizer at the right time. However, 31 percent of rainfed farmers in Kegalle district stated that, they have experienced problems in obtaining the required amounts of quality fertilizer on time at a reasonable price.

Table 4.3: Sources of Fertilizer – *yala* 2001

Source	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No. of Respondents	%	No. of Respondents	%	No. of Respondents	%	No. of Respondents	%
Private Traders	17	42.5	32	80	12	32.5	38	43
Farmer Company	19	47.5	-	-	-	-	-	-
Agrarian Development Centre	-	-	5	12.5	12	32.5	47	47
Farmer Organization	04	10	-	-	1	2.5	1	1
Co-operatives	-	-	3	7.5	12	32.5	8	9

Source: HARTI Survey, 2001

Table 4.4: Sources of Fertilizer – *maha* 2000/01

Source	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No. of Respondents	%	No. of Respondents	%	No. of Respondents	%	No. of Respondents	%
Private Traders	18	45	34	85	11	29	35	41
Farmer Company	17	42.5	-	-	-	-	-	-
Farmer Organization	5	12.5	-	-	1	2.5	1	1
Agrarian Development Centre	-	-	2	5	13	34	40	46.5
Co-operatives	-	-	4	10	12	31.5	10	11.5

Source: HARTI Survey, 2001

c. Agro-chemicals

The study findings reveal that private traders were the major source of providing agro-chemicals in all locations, except in rainfed areas of Kurunegala district. The farmer company in Ridibendiela also performs an equal role as private traders, in supplying agro-chemicals. However, 57 percent of farmers in the sample rainfed areas of Kurunegala district declare that, their major agro-chemical sources are Co-operatives and Agrarian Development Centres.

About 95 percent of farmers in major irrigated (Ridibendiela), minor irrigated and rainfed areas of Kurunegala district revealed that they have not experienced difficulties in regard to availability of agro-chemicals. Nevertheless, the farmers in rainfed areas of Kegalle district stated that, they had various problems in obtaining agro-chemicals as previously described in the case of supply of fertilizers.

4.1.2 Non-purchased Inputs

a. Extension

Agricultural education and awareness creation play an important role in reducing the existing yield gap between research yield and farmers yield and also minimize the yield differences between farmers at various efficiency levels. However, over 50 percent of sample farmers in all locations were not satisfied with the existing extension and knowledge creation system (Table 4.5). Inefficiency in the present extension system and lack of enthusiasm among extension officers was the major reason given by about 70 percent of the farmers for their dissatisfaction on the present extension system (Table 4.6).

Table 4.5: Degree of Farmers' Satisfaction on Present Agricultural Extension Services

Level of Satisfaction	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No	%	No	%	No	%	No	%
Not Satisfied	23	57.5	29	72.5	19	50.0	50	55.6
Satisfied	17	42.5	11	27.5	18	47.4	40	44.4
Undecided	0	0.0	0	0.0	1	2.6	0	0.0
TOTAL	**40**	**100.0**	**40**	**100.0**	**38**	**100.0**	**90**	**100.0**

Source: HARTI Survey, 2001

Table 4.6: Reasons for the dis-satisfaction over present agricultural extension system (As perceived by farmers)

Reason	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	N = 23		N = 29		N = 19		N = 50	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No	%	No	%	No	%	No	%
1. Lack of efficiency/enthusiasm among extension officers	16	69.6	23	79.3	14	73.7	37	74.0
2. Lack of proper relationship between officials and farmers	6	26.1	4	13.8	2	10.5	10	20.0
3. Inadequacy of knowledge among extension officers.	2	8.7	3	10.3	3	15.8	6	12.0
4. Lack of awareness among farmers about present extension services.	1	4.3	3	10.3	2	10.5	4	8.0

Source: HARTI Survey, 2001

There are mainly two sets of officers attached to the present agricultural extension system, namely Agricultural Instructors (AI) and Agricultural Research and Productivity Assistants (ARPA). The area covered by AIs, who are the trained agricultural extension officers is extensive and therefore it is practically not possible for them to approach each farmer individually. About 60-80 percent of farmers declare that, extension officers (AI) have never visited their fields during the last *maha* and *yala* seasons. The number of visits made by extension officers during *maha* 2000/01 and *yala* 2001 is given in tables 4.7 and 4.8. The study team realized that, the level of necessary knowledge of the grass root level extension-linking officers such as ARPA is very low.

Also since ARPAs' are under the supervision of Divisional Officers (DO), AIs' have difficulties in utilizing the ARPA cadres for grass root level extension work. Poor level of knowledge of ARPAs' on the relevant subject and lack of capacity and the low level of recognition given to them in the present village set up, are main constraints of the present extension system. The farmers presented this situation by stating their lack of confidence in ARPA cadres for agricultural extension work.

One of the major problems of present extension services is obtaining correct guidance for pest and disease management. Farmers were questioned about sources that provide advice on pest and disease control during the past season. The results are shown in table 4.9. The findings indicate that a majority of the farmers have relied on agro-chemical traders, neighbouring farmers and farmer organizations for advice on pest and disease management. However, over 50 percent of sample farmers have not received any advice on this matter and they have used their own methods.

Table 4.7: Frequency of visits made by the Extension Officers to farmers' fields - *maha* 2000/01

Frequency of Visits	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No.	%	No.	%	No.	%	No.	%
No visits	24	60.0	28	70.0	23	60.5	60	66.7
Once in the season	8	20.0	3	7.5	7	18.4	5	5.6
Twice in the season	5	12.5	2	5.0	6	15.8	12	13.3
Thrice in the season	2	5.0	2	5.0	1	2.6	4	4.4
Four times in the season	0	0.0	3	7.5	0	0.0	0	0.0
More than 4 times	1	2.5	2	5.0	1	2.6	9	10.0
TOTAL	**40**	**100.0**	**40**	**100.0**	**38**	**100.0**	**90**	**100.0**

Source: HARTI Survey, 2001

Table 4.8: Frequency of visits made by the Extension Officers to farmers' fields - *yala* 2001

Frequency of Visits	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No.	%	No.	%	No.	%	No.	%
No visits	32	80.0	29	72.5	25	65.8	60	66.7
Once in the season	1	2.5	2	5.0	5	13.2	5	5.6
Twice in the season	3	7.5	2	5.0	5	13.2	9	10.0
Thrice in the season	2	5.0	6	15.0	2	5.3	9	10.0
Four times in the season	0	0.0	1	2.5	1	2.6	2	2.2
More than 4 times	2	5.0	0	0.0	0	0.0	5	5.6
TOTAL	**40**	**100.0**	**40**	**100.0**	**38**	**100.0**	**90**	**100.0**

Source: HARTI Survey, 2001

Table 4.9: Source of Information for Pest and Disease Control - *yala* 2001

	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	N = 15		N = 16		N = 16		N = 36	
	No.	%	No.	%	No.	%	No.	%
AI	6	40	9	50	8	50	27	75
ARPA	6	40	3	19	6	37	13	36
Neighbours	2	13	3	19	2	13	2	6
Traders	4	27	6	38	5	31	5	14
FOs	2	13	2	12	1	6	2	6

* Some farmers have given multiple responses on sources of information

Source: HARTI Survey, 2001

b. Irrigation/Water

As other inputs, water is also a crucially important factor to maintain a high level of yield for high breed paddy. Under irrigated agriculture, a sufficient amount of water at the latter stage of cultivation of paddy is not always issued due to scarcity of water. However, supply of sufficient water during the maturing phase is critically important to maintain a high level of yield. The low

level of irrigation at the maturing phases of the season was common in minor irrigation schemes, especially during *yala* season.

Figures 4.2 and 4.3 illustrate the percentage of farmers who received an inadequate water supply during *maha* 2000/01 and *yala* 2001 season respectively. According to the findings, about 42 percent and 32 percent of farmers in the minor irrigation schemes have received inadequate supply of irrigation water during *yala* 2001 and *maha* 2000/01 respectively. The study team made an attempt to analyze the impact of an inadequate water supply on yield during the respective seasons.

Farmers' perception on impact of inadequate water issues on yield reduction clearly indicates that yield reduction due to water shortage is comparatively higher under minor irrigation system during both *maha* and *yala* seasons. 47 percent and 25 percent of farmers under minor irrigated condition in Kurunegala district have perceived that, they have experienced a yield reduction due to inadequate water issues during *yala* and *maha* respectively.

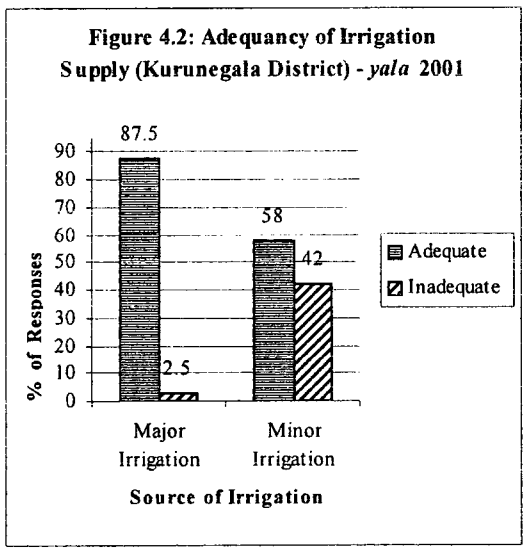


Figure 4.2: Adequancy of Irrigation Supply (Kurunegala District) - *yala* 2001

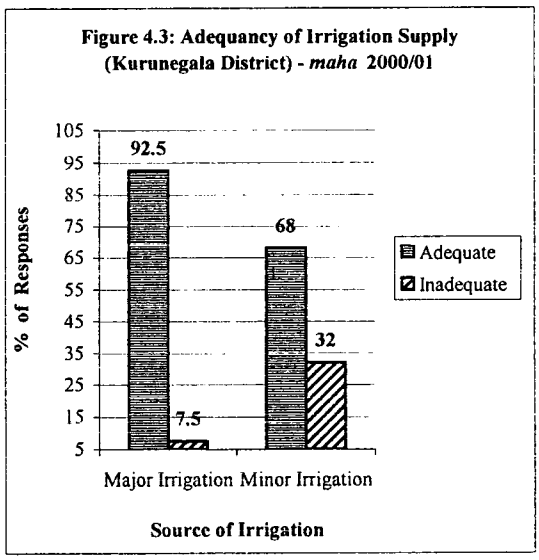


Figure 4.3: Adequancy of Irrigation Supply (Kurunegala District) - *maha* 2000/01

Irrigation water management is mainly handled by the farmer company under the major irrigation scheme (Ridibendiela) and by Farmer Organizations (FO) under minor irrigation schemes. The sample farmers were asked, as to who should handle the irrigation management activities at distributory level, in order to increase the efficiency of irrigation management from the present level. According to the farmers perception, 25 percent of the farmers under major irrigation and 13 percent of farmers under minor irrigation believe that, irrigation management task should be handed over to the relevant government institutions in order to increase their efficiency but, a majority preferred community organizations. The details of the findings are given in table 4.10.

Table 4.10: Appropriate institution to manage irrigated water at distributory channel level (As perceived by farmers in Kurunegala district)

Name of Institution	Major Irrigation		Minor Irrigation	
	No.	%	No.	%
Farmer Company	30	75	-	-
Dept. of Irrigation	10	25	-	-
Farmer Organization	-	-	33	87
Dept. of Agrarian Services	-	-	05	13
Total	**40**	**100**	**38**	**100**

Source: HARTI Survey, 2001

c. Credit

As discussed earlier, credit has strong linkages with the use of green revolution technologies, since they rely heavily on purchased inputs. The survey findings indicate that, 75-80 percent of farmers in rainfed cultivation areas, and 60 percent of minor irrigation and major irrigation farmers belong to the annual income category of less than Rs 180,000. The existing income level elaborates the subsistent nature of the farmers who are engaged in paddy cultivation and also their credit necessity. During the *maha* 2000/01 season, 72 percent of major irrigation farmers, 32 percent of minor irrigation farmers, 37 percent of rainfed farmers in Kurunegala district and 16 percent of rainfed farmers in Kegalle district have obtained agricultural credit. Moreover, majority of the farmers who have obtained credit have done so by borrowing from informal and semi-formal credit sources. Only 17-35 percent of the farmers have obtained loans from formal credit sources (Government and private banks).

There are various constraints in obtaining agricultural credit as perceived by farmers in various water regimes. The major constraints are listed below:

1. Difficulties in obtaining loan at the required time;
2. High level of interest rate;
3. Problems in finding guarantors to obtain credit from formal sources;
4. Long processing time taken by formal credit sources;
5. Credit given is not sufficient to do paddy cultivation;
6. Credit in kind given by government authorities is some times not matching with the farmers' requirement at the given time; eg: Fertilizer
7. Default of previous loans

4.1.3 Other Support Services

a. Agricultural Marketing

Marketing is an important aspect in paddy production, especially under the irrigated condition. Farmers' knowledge on various aspects of marketing was tested. The results are given in table 4.11. According to these findings, a majority of the farmers irrespective of water regimes were unaware of the wholesale price of paddy. Only 17-26 percent of farmers have a sufficient knowledge on wholesale prices of paddy. It should to be noted that, only about 22 percent of farmers in rainfed areas of Kegalle district have sufficient knowledge on various aspects of market information, which are listed in table 4.11, although sufficient knowledge on these aspects is important to increase the farmers' income level.

The study findings reveal that, as paddy crop is cultivated on the full extent of land available under major irrigation schemes during both *maha* and *yala* seasons, the marketing aspect is important for all farmers. But, in rainfed cultivation, only about 12-14 percent of the farmers have marketable surplus of paddy during *yala* season. Table 4.12 provides details of the number of farmers who had marketed their paddy production during *maha* and *yala* seasons.

Table 4.11: Farmers Knowledge on Selected Aspects of Market Information of Paddy

Type of Market Information/Level of Knowledge	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No.	%	No.	%	No.	%	No.	%
1. Consumer Preference on Rice								
No knowledge	8	20	5	12.5	9	24.0	24	27.0
Some knowledge	19	47.5	20	50.0	20	52.0	48	53.0
Sufficient knowledge	13	32.5	15	37.5	9	24.0	18	20.0
2. Wholesale Price of Rice								
No knowledge	17	42.5	17	42.5	16	42.0	51	57.0
Some knowledge	16	40.0	14	35.0	12	32.0	21	23.0
Sufficient knowledge	7	17.5	9	22.5	10	26.0	18	20.0
3. Knowledge on various marketing channels and the purchase price of paddy								
No knowledge	1	2.5	4	10.0	16	16.0	49	55
Some knowledge	16	40	17	42.5	18	47.0	21	23
Sufficient knowledge	23	57.5	19	47.5	14	37.0	20	22

Source: HARTI Survey, 2001

Table 4.12: Production of Surplus Paddy for Marketing (Number of Farmers)

Category of Farmers	*Maha* 2000/01		*Yala* 2001	
	No.	%	No.	%
Major Irrigation (Kurunegala)	40	100	40	100
Minor Irrigation (Kurunegala)	31	82	28	73
Rainfed (Kurunegala)	24	60	3	12.5
Rainfed (Kegalle)	30	33	13	14

Source: HARTI Survey, 2001

Tables 4.13 and 4.14 show the quantity of surplus paddy produced by farmers under different water regimes in *maha* and *yala* seasons respectively. According to these tables, over 50 percent of the farmers under major irrigation schemes produce more than 100 kg of marketable surplus in both seasons. Under rainfed cultivation, majority of the farmers, who produced marketable surplus, have less than 40 kg of surplus paddy.

Table 4.13: Quantity of Surplus Paddy Production – *maha* 2000/01

Quantity (kg)	KURUNEGALA DISTRICT (Number of Farmers)						KEGALLE DISTRICT (Number of Farmers)	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No.	%	No.	%	No.	%	No.	%
No surplus	0	0	9	22.5	13	35.1	55	64
01-20	1	2.5	5	12.5	5	13.5	12	14
21-40	4	10	3	7.5	9	24.3	12	14
41-60	5	12.5	6	15.0	6	16.2	3	3.5
61-100	9	22.5	6	15.0	3	8.1	3	3.5
> 101	21	52.5	11	27.5	1	2.7	1	1.0

Source: HARTI Survey, 2001

Table 4.14: Quantity of Surplus Paddy Production – *yala* 2001

Quantity (kg)	KURUNEGALA DISTRICT (Number of Farmers)						KEGALLE DISTRICT (Number of Farmers)	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No.	%	No.	%	No.	%	No.	%
No surplus	0	0	10	25	32	86.5	77	86
01-20	0	0	4	10	2	5	7	8
21-40	3	7.5	3	7.5	2	5	3	3
41-60	2	5.0	4	10	0	0	2	2
61-100	10	25.0	6	15	1	3	0	0
> 101	25	62.5	13	32.5	0	0	1	1

Source: HARTI Survey, 2001

Farmers mostly sell their paddy to the private traders, especially to the paddy collectors living within the village. Rice millers are the major paddy purchasers under minor irrigation schemes in Kurunegala district. It is interesting to note that no one has marketed their paddy to CWE or co-operatives during *maha* 2000/01 at any of the study locations. During *yala* 2001, only 4 farmers (9 percent of total major irrigation farmers) have chosen CWE/Co-operatives as their surplus paddy buyers. Tables 4.15 and 4.16 describe the status of paddy purchasing by various buyers during *maha* 2000/01 and *yala* 2001 respectively.

Table 4.15: Main Paddy Purchasers – *yala* 2001

Paddy Purchaser	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No.	%	No.	%	No.	%	No.	%
Collectors within the Village	21	49	5	33	3	100	2	50
Collectors outside the Village	7	16	1	7	0	0	0	0
Rice Millers	7	16	7	47	0	0	0	0
CWE	3	7	0	0	0	0	0	0
Co-operative	1	2	0	0	0	0	0	0
Farmer Organization	0	0	0	0	0	0	0	0
Neighbours (for household consumption)	4	9	2	13	0	0	2	50

Source: HARTI Survey, 2001

Table 4.16: Main Paddy Purchasers – *maha* 2000/01

Paddy Purchaser	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No.	%	No.	%	No.	%	No.	%
Collectors within the Village	20	50	15	48	8	40	15	50
Collectors outside the Village	7	17.5	0	0	6	30	8	26
Rice Millers	10	25	11	35	6	30	2	7
CWE	0	0	0	0	0	0	0	0
Co-operative	0	0	0	0	0	0	0	0
Farmer Organization	1	2.5	0	0	0	0	0	0
Neighbours (for household consumption)	2	5	5	16	0	0	5	17

Source: HARTI Survey, 2001

The reasons for choosing private traders as the main paddy purchaser are given in tables 4.17 and 4.18. Some of these reasons were, higher prices offered by private traders, lack of transport cost in carrying paddy from the field site and loans obtained for cultivation at the beginning of the season from private traders.

Table 4.17: Reasons for selecting Private Traders to Sell Surplus Paddy, during *yala* 2001

Reason	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	N = 35		N = 13		N = 3		N= 2	
	No.	%	No.	%	No.	%	No.	%
Payment of higher price	24	68.6	8	61.5	2	66.7	0	0.0
Conditional loans borrowed for cultivation	5	14.3	2	15.4	0	0.0	0	0.0
Provision of transport	0	0.0	1	7.7	0	0.0	1	50.0
Paying ready cash	2	5.7	1	7.7	0	0.0	1	50.0
Less quality controlling	2	5.7	0	0.0	0	0.0	0	0.0
Closeness to the farm gate	1	2.9	1	7.7	1	33.3	0	0.0
Better relationship with private traders	1	2.9	0	0.0	0	0.0	0	0.0

Note: N denotes the number of farmers who sold their paddy to private traders

Table 4.18: Reasons for selecting Private Traders to Sell Surplus Paddy, during *maha* 2001

Reason	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	N = 37		N = 26		N = 20		N= 25	
	No.	%	No.	%	No.	%	No.	%
Payment of higher price	22	59.5	13	50.0	10	50.0	8	32.0
Conditional loans borrowed for cultivation	5	13.5	5	19.2	0	0.0	2	8.0
Provision of transport	1	2.7	1	3.8	2	10.0	4	16.0
Less quality controlling	5	13.5	0	0.0	0	0.0	0	0.0
Closeness to the farm gate	1	2.7	4	15.4	3	15.0	6	24.0
Better relationship with private traders	1	2.7	0	0.0	4	20.0	4	16.0

Note: N denotes the number of farmers who sold their paddy to private traders

The major difficulties faced by the farmers under major irrigation schemes, in marketing surplus paddy were, expectation of high quality standards of paddy by the purchasers and lack of transport facilities. The problem experienced by minor irrigation farmers in selling their paddy is lack of proper marketing channels. The rainfed farmers encounter problems of malpractices in weighing paddy, maintenance of a high quality standard of paddy and non-payment of ready cash for the sold paddy stocks. However, about 25 percent, 50 percent and 15-30 percent of farmers in major irrigation, minor irrigation and rainfed cultivation respectively were willing to stock the surplus paddy (fully or partially) in order to seek a higher price during off seasons.

4.2 Role of Institutions in Providing Farm Support Services

4.2.1 Public Institutions

A number of public institutions are involved in providing farm support services in the study area at varying levels of effectiveness and efficiency. State Banks, Private Banks Agrarian Development Centres, Agricultural Development Authority, Irrigation Department, Samurdhi

Authority of Sri Lanka, and Government Farms play a major role. Among the sample areas, the role of government institutions was very prominent in the rainfed areas, where functions of private organizations were very minimal due to poor infrastructure and subsistent nature of the produce. Agricultural Development Authority has given loans and subsidies in order to construct agro-wells and also to install micro-irrigation equipment. Samurdhi Authority of Sri Lanka has provided loans to poor farmers for cultivation and to start rice-processing industries.

Although, there are a number of state institutions involved in providing farm support services, farmers were not satisfied with the reliability and timeliness of the services provided by them. In addition, long procedural delays and malpractices in government institutions were the other major problems perceived by farmers.

4.2.2 Private Institutions

Role of private institutions in providing farm support services was prominent in major irrigation areas. Private sector institutions and private traders largely handled the supply of credit, seed paddy, fertilizers and agro-chemicals. The private sector also provides necessary instructions and advices for farmers regarding crop management. Wayamba Seed Company and CIC are two private institutions which are involved in seed paddy production in Ridibendiela area.

4.2.3 Farmer Organizations

Farmer Organizations (FOs') exist in all sample locations and a majority of the farmers have become members of the FOs'. Farmers contribute to FOs by contributing their labour for volunteer work (*Shramadhana*). However, the provision of cash and materials for the organizational activities were comparatively low. The main reason for the situation as explained by farmers was lack of transparency in financial matters of the FOs'.

Farmers were asked about the services provided by FOs' for their agricultural activities. The results are depicted in table 4.19. The major activities of FOs' in all locations were, organizing *Shramadhana* works, supplying agricultural inputs (fertilizers and agro-chemicals) and helping to obtain the cultivation loans from Agrarian Development Centres. Nevertheless, majority of the farmers were not satisfied with the performance of FOs' activities except in Ridibendiela (major irrigation) (Table 4.20). In the meantime, FOs' leadership explained that, a majority of their members are of passive nature.

Table 4.19: Type of Services Provided by FOs

Services	KURUNEGALA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No.	%	No.	%	No.	%	No.	%
Organizing Shramadana Works	26	67	22	59	9	32	25	33
Supply of Agric. Inputs	16	41	9	24	12	43	26	34
Assisting to Obtain Loans from ASC	9	23	4	11	11	39	3	4
Managing the Water Distribution among Farmers	0	0	21	57	0	0	0	0
Preparing a Cropping Calendar	1	2.5	7	19	10	36	2	3
Farmers' Conflict Resolution	4	10	0	0	1	3.5	5	6.5
No Services	5	13	4	11	0	0	27	36

Source : HARTI Survey, 2001

Table 4.20: Farmers' Satisfaction on FOs' Activities

	KURUNEGLA DISTRICT						KEGALLE DISTRICT	
	Major Irrigation		Minor Irrigation		Rainfed		Rainfed	
	No.	%	No.	%	No.	%	No.	%
Satisfied	33	85	17	42.5	17	49	30	36
Not satisfied	6	15	23	57.5	18	51	54	64
Total	**39**	**100**	**40**	**100**	**35**	**100**	**84**	**100**

Source: HARTI Survey, 2001

CHAPTER FIVE

CONCLUSIONS AND POLICY IMPLICATIONS

1. The average yield per hectare under major irrigation, minor irrigation and rainfed condition in Kurunegala district during *maha* 2000/01 was 4.6 t, 3.2 t and 3.7 t respectively, while in the Kegalle district the yield under rainfed condition was 2.9 t/ha. Therefore, the yield obtained from major irrigated areas is about 30 percent higher than that of minor irrigated areas and over 100 percent higher than that of rainfed farming. The yield obtained from various water regimes indicates that, there are significant yield gaps existing between actual yield and the yield achieved under the *Yaya* demonstration programmme, implemented by the Department of Agriculture. Under the *Yaya* block demonstration programme, the yield level has been over 7.6 t/ha in dry zone conditions under major and minor irrigations. It was around 6 t/ha under rainfed conditions during *maha* season. Therefore, there is a strong possibility of increasing the average national paddy yield significantly, by promoting and adopting the components implemented by the *Yaya* programmes national wide. The findings implicate the importance of more attention, in addressing the institutional issues related to paddy farming in Sri Lanka.

2. In paddy cultivation, cash cost represents about 50 percent of the total cost on average. However, labour cost is over 60 percent of the total cost in major irrigated areas because of high wage rates and high level of fertilizer application. Labour and material cost contributes to nearly 80 percent of the cash cost. With regard to the total cost, which includes both cash, and imputed cost for family labour, labour cost is the highest cost representing over 50 percent of the total cost and 40 percent of the cash cost. Labour requirement for cultivation per acre, varies from 38 to 60 man-days depending on farming practices. The amount of labour used is high when the exchange labour is used because of low productivity. On average the labour requirement is around 50 man-days per acre. Harvesting of paddy accommodate 36-40 percent of the total labour cost and 25-30 percent of the total paddy production cost. Further, it is timely to study the feasibility of adopting mechanization in paddy farming, especially for harvesting with special attention to the land size topography, soil condition, labour opportunities and gross social return.

3. Paddy farming under rain-fed conditions is not profitable when the imputed cost is added to the cash cost. Return to labour is lower than the wage rate mainly due to the use of higher number of labourers to cultivate a unit area. Similarly, unit cost is higher than the value of unit output. Nevertheless, return to investment is profitable, meaning that, investing one rupee generates more than one rupee.

4. Technical efficiency values indicate that farmers in major and minor irrigation areas are more technically efficient in *yala* season than in *maha* season. However, rainfed farmers are more technically efficient in *maha* season compared to *yala* season. The mean technical efficiency of Kurunegala district, under irrigated condition ranges from 62 percent to 84 percent. The same values in Kurunegala district under rainfed condition vary from 47 percent to 69 percent. It is 54 percent to 47 percent under the rainfed situation in Kegalle district. The technical efficiency values indicate that, there is a tremendous scope for increasing technical efficiency without any addition to the present input level. For instance, present technical efficiency level of irrigation farmers could be increased by 16 percent to 38 percent without any additional cost.

5. Under rainfed farming and minor irrigation about 57 percent and 47 percent of paddy farmers respectively belong to the category of low efficiency, where as, the figure for major irrigation is only 15 percent. Average yield per acre is about 110 bushels for high efficiency farmers compared to 55 bushels for low efficiency farmers, under major

irrigation. However, there is not much of a variation in the cost of production. The findings again highlight the necessity of institutional intervention in order to enhance the technical efficiency levels.

6. Regression analysis shows that further increase in fertilizer usage has no impact on production in irrigated areas. The findings also show that there is an imbalance in fertilizer application, specially irrigated farmers use more urea than other fertilizers. Farmers' adoption of straight fertilizers is very minimal in all locations, although it was introduced to increase the fertilizer use efficiency and to reduce the fertilizer cost. The government has to make actions to create awareness on the importance of using straight fertilizers and to ensure the availability of straight fertilizers at village level.

7. Age, farming experience and level of education are major factors contributing to the inefficiency among farmers under minor irrigation. Therefore skills, knowledge, entrepreneurship of the farmers need to be enhanced through awareness creation and demonstration in order to improve farming efficiency.

8. Farmers mainly use seed paddy produced from their own paddy field or neighbouring fields, mainly due to high cost and difficulties encountered in obtaining the required quantity of certified seeds at the required time. The major drawback in use of seed paddy in the current context is, non-replacement of seed paddy by certified seed at least once in 4-5 seasons. This has been one of the reasons for the low level of productivity in paddy production, especially in rainfed areas.

9. The main source of fertilizer and agro-chemicals provision for the farmers in major irrigated areas was private traders, but for farmers in rainfed areas state institutions like Agrarian Development Centres were the main suppliers. Problems with regard to supply of fertilizer and agro-chemicals (quantity and quality) were experienced by rainfed farmers, which implicate the inefficiency of delivery mechanism of the state institutions.

10. More than 50 percent of sample farmers in all study locations were not satisfied with the present extension system. Lack of enthusiasm and morale among trained extension officers (Agricultural Instructors), poor knowledge of grass root level officers such as Agricultural Research and Productivity Assistants and wideness of the field area to be covered by the limited number of Agricultural Instructors were the major reasons for the existing inefficiency of the present extension system.

11. Limited irrigation water issues at the maturity phase of paddy crop under minor/rainfed irrigation schemes have led to reduction than expected level of yield. Yield reduction due to water shortages was significantly higher during *yala* season.

12. About 72 percent, 32 percent and 37 percent of farmers in major irrigated, minor irrigated and rainfed areas respectively in Kurunegala district and 16 percent of rainfed farmers in Kegalle district are dependent on agricultural credit for paddy cultivation. However, only 17-35 percent of farmers have obtained their loan from formal credit lenders.

13. Farmers' knowledge on the wholesale paddy market was very poor irrespective of the study locations. Further, the level of knowledge on various aspects of paddy marketing was not sufficient among rainfed farmers, since they are not producing a considerable amount of surplus for marketing.

REFERENCES

Abeyratne, F. (1991) Agricultural Taxation and Subsidies Related to the Irrigation Sector, a paper presented to the Irrigation Management Policy Support Activity (IMPSA) Colombo.

Abeyratne, F., Edirisinghe N., Somaratne W.G. and P. Wickramarachchi (1993) "Efficiency of Rice Production and Issues Relating to Protection", *Sri Lankan Journal of Agricultural Economics, Vol. 1* No. 1.

Abeyratne, F., et-al. (1991) "The Issues of Self-sufficiency and Comparative Advantage of Growing Rice in Sri Lanka", Paper presented at the Annual Session of Sri Lanka Association of Advancement of Science, December 1991 Colombo.

Aigner, D. (1977) Formulation and Estimation of Stochastic Frontier Production Function Models, *Journal of Econometrics Vol 1* : 21 – 37.

Aigner,D..J., Lovell, C.A.K., and P. Shemidt (1977) Formulation and Estimation of Stochastic Frontier Production Function Models. *Journal of Econometrics, 6*:21-27

Aigner, D.J and S.F. Chu (1968) On Estimating the Industry Production Function. *American Economic Review, Vol. 58*, No. 4: 826 – 839.

Aluwihare, P.M. and M. Kikuchi (1990) *Irrigation Investment Trend in Sri Lanka: New Construction and Beyond,* International Irrigation Management Institute, Colombo.

Athukorala, P. and S. Jayasuriya (1994) *Macro-economic Policies, Crisis and Growth in Sri Lanka, 1969-90* The World Bank, Washington, D.C.

Barker R. and D. Dawe, (2000) "The Asian Rice Economy in Transition", Paper presented at the Symposium on Rice Research and Production in the 21st century. PGRC, Peradeniya 2000

Battese, G.E and T.J. Coelli (1995) A Model for Technical Inefficiency in a Stochastic Frontier Production Function for Panel Data. *Empirical Economics 20*: 325-332.

Battese, G.E and G.S. Corra. (1977) Estimation of a Frontier Model: With Application to the Pastoral Zone of Eastern Australia. *Australian Journal of Agricultural Economics 21*: 169-179.

Battese, G.E. (1992) Frontier Production Function and Technical Efficiency: A Survey of Empirical Applications in Agricultural Economics, *Agricultural Economics, 7* (2): 185 – 208.

Central Bank of Ceylon (1969) Survey on Cost of Production of Paddy, Colombo.

Central Bank of Sri Lanka (2003) Annual Report, Central Bank of Sri Lanka, Colombo.

Chandrapala, H.A. (1986) "Performance in the Agricultural Sector", Facets of Development in Independent Sri Lanka, Felicitation Volume to commemorate the 10th Successive Budget of Hon. Ronnie de Mel, Ministry of Finance and Planning, Colombo, pp 219-277.

Edirisinghe, N., et-al (1991) "Efficiency and Policy Incentives in Rice Production in Sri Lanka". Agrarian Research and Training Institute, Sri Lanka and International Food Policy Research Institute, Washington.

Ekanayake, S.A.B. and S.K.W. Jayasuriya (1987) Measurement of Firm Specific Technical Efficiency: A Comparison of Methods. *Journal of Agricultural Economics, Vol. 38*, No. 1; 115 – 22.

Farrell, M.J. (1957) The Measurement of Technical Efficiency. *Journal of Royal Stat. Soc. Part III,* 120: 253 – 280.

Gamage, H. (2000) "More Crop per Drop: Increasing Water Use Efficiency of Rice to Face Impending Water Scarcity in Sri Lanka", Rice Symposium, 14 – 15 December, PGRC Gannoruwa, Peradeniya.

Gunawardena, P.J. (1987) Rice Pricing and Marketing Policies in Sri Lanka, 1952-1984: A Welfare Evaluation, PhD. thesis submitted to School of Agriculture, Latrobe University, Australia.

Gunawardena, P.J. and W.G. Somaratne (1996) "Economic Reforms since 1977 and their Impact on Domestic Agriculture in Sri Lanka", Paper presented at the conference of Economists, Australian National University, Canberra, 23-25, September.

Gunawardena, P.J. and W.G. Somaratne (2000) "Non-Plantation Agricultural Economy of Sri Lanka: Trends, Issues and Prospects", Sri *Lanka Journal of Agricultural Economics, Vol. 3 No. 1.*

Henegedara, G.M. (2000) Economics of Paddy Cultivation in Sri Lanka with Special Reference to Resource Use and Profitability Based on 1987/88 Maha season, Research Study No: 106, Hector Kobbekaduwa Agrarian Research and Training Institute, Colombo.

Karunaratne, M.A.K.H.S.S. and H.M.G. Herath (1989) Efficiency of Rice Production under Major Irrigation Conditions: a Frontier Production Function Approach, *Tropical Agricultural Research Vol.* 1: 139 – 158.

Kikuchi, M., Barker, R., Samad, M. and Weligamage. P (2002) "Comparative Advantage of Rice Production in an Ex-rice Importing Country: The case of Sri Lanka. (In), Acharya, S.S. Singh, S. Sagar, V. (eds.). *Sustainable Agriculture, Poverty and Food Security*, Jaipur, India; Rawat Publishers.

Mahrouf, A.R.M., and M.I.M. Rafeek (2003) "Mechanization of Paddy Harvesting: the Economic Perspective", (In) H.B.Kotagama et-al, *ASDA 2003Annals of Department of Agriculture Vol. 5*, Department of Agriculture, Sri Lanka.

Meeusen and van den Broeck (1977) Efficiency Estimation from Cobb-Douglas Production Function with Composite Error. *International Economic Review 18*(2): 435-444.

Ministry of Finance and Planning, (1984) National Agriculture, Foods and Nutrition Strategy: A Change in Perspective, Ministry of Finance and Planning, National Planning Division, Colombo, Sri Lanka.

Panabokke, C.R. and B.V.R. Punyawardena, (2000) "Towards a Rational Utilization of the Land and Water Resources Base for Sri Lanka's Rice-Paddy Lands", Paper presented at the Rice Symposium-2000 14 – 15 December, PGRC, Gannoruwa, Peradeniya.

Ranaweera, N.F.C., Samaratunga P.A, and A.A.B. Hafi (1990) Economics of Paddy Cultivation: Past, Present and Future. (In) Amarasiri et-al (ed), *Rice Congress- 1990* Proceeding of the Symposium, 3-4 September 1990 Department of Agriculture, Peradeniya.

Rupasena L.P. (2000) Review of Paddy / Rice Marketing for the First Half of the Year 2000 A Report submitted to the Ministry of Finance & Planning (mimeo).

Rupasena, L.P (1999) A Review of Paddy Production and Rice Consumption, Economic Review, Vol. 12, Peoples Bank, Colombo.

Samaratunga, P.A., Rafeek M.I.M. and R.M. Herath Banda (2000) "Future Rice Production Policy in Sri Lanka: Global and National Perspectives", Paper presented at the Rice Symposium 2000 PGRC, Peradeniya, 14-15 December.

Sandanayake, C.A, Pathinayake, B.D. and R-Peiris (1995) "New Approaches for Varietal Improvement to Meet Future Challenges", (In) Amarasiri et-al (ed). *Rice Congress 1990* Department of Agriculture, Peradeniya.

Sanderatne, N. (2001) "The Rice Economy: Challenges in the Next Decade", Paper presented at the seminar organized by the Institute of Policy Studies, Colombo, 17 August.

Sirisena, N.L. (1986) "An Evaluation of Agricultural Policy on the Paddy Sector, 1950-1985 Sri Lanka Economic Journal, 1: 66-67.

Timmer, C.P. (1970) On Measuring Technical Efficiency. Food Research Institute Studies, *Agricultural Economics, Trade Development Vol. 9*, No. 12: 99-271.

Tudor Silva, K. et-al (2000) "No Future in Farming? The Potential Impact of Commercialization of Non-plantation Agriculture on Rural Poverty in Sri Lanka", Center for Intersectoral Community, Health Studies (CICHS) Kandy, Sri Lanka – German Technical Co-operation (GTZ).

Weerahewa, J. and P. Abeygunawardena (1987) "Diminishing Profit of Paddy Production", Economic Review, Nov. Dec., Peoples Bank, Colombo.

Wickramaarachchi, P. (1993) Comparative Advantages of Food Crop Production in Sri Lanka, Hector Kobbekaduwa Agrarian Research and Training Institute, Colombo. (Unpublished Report)

Wickramarachchi, P. (1998) Institutional Farm Credit Survey, Asian Productivity Organization, Tokyo, Japan.

Wijayaratna, C.M. (1994) "Irrigated Rice in Sri Lanka: Recent Trends and Future Direction", Paper presented at the 6th Annual Congress of the Postgraduate Institute of Agriculture, University of Peradeniya, 29 – 30 November 1994.

Wijayaratna, C.M. and K. Hemakeerthi, (1992) "Production and Profitability of Rice Cultivation in Sri Lanka Under Different Water Regimes – A Trend Analysis: Advancement in IIMI's Research, 1991 International Irrigation Management Institute, Colombo.

ANNEXES

Annex: I

Cost of Cultivation per Acre of Paddy (Major Irrigation)

District: KURUNEGALA **Season: *Maha* 2000/01**

Operations	Labour Cost Rs/ac	Machinery & Equipment Cost Rs/ac	Material Cost Rs/ac	Total Cost Rs/ac
Preparation of Nursery	76.33			76.33
Cleaning Bunds and Canals	693.38			693.38
1st, 2nd Ploughing and Leveling	425.80	1960.62		2386.43
Plastering Bunds	809.38			809.38
Broadcasting/Transplanting	1365.08		754.77	2119.85
Weed Controlling	487.09	13.58	834.40	1335.07
Fertilizer Application	253.31		2179.17	2432.47
Pest & Diseases Controlling	210.24	136.27	1069.43	1415.94
Water Management	965.04	2.49		967.53
After Care	782.46			782.46
Harvesting	2337.34			2337.34
Threshing	1339.37	573.06		1912.43
Winnowing	516.82	203.47		720.29
Transport	150.95	170.78		321.73
TOTAL	**10412.60**	**3060.26**	**4837.77**	**18310.63**

Note:- Machinery and Equipment Cost

Weed controlling: Cost only for weeder

Annex: II

Cost of Cultivation per Acre of Paddy (Minor Irrigation)

District: KURUNEGALA **Season: *Maha* 2000/01**

Operations	Labour Cost Rs/ac	Machinery & Equipment Cost Rs/ac	Material Cost Rs/ac	Total Cost Rs/ac
Preparation of Nursery	20.35			20.35
Cleaning Bunds and Canals	602.25			602.25
1st, 2nd Ploughing and Leveling	467.43	2481.06		2948.48
Plastering Bunds	758.85			758.85
Broadcasting/Transplanting	1075.28		903.22	1978.50
Weed Controlling	485.57	4.19	709.47	1199.24
Fertilizer Application	288.27		1608.80	1897.07
Pest & Diseases Controlling	314.98	130.99	681.06	1127.02
Water Management	1285.61	27.06		1312.67
After Care	899.42			899.42
Harvesting	1619.45			1619.45
Threshing	1148.42	650.88		1799.30
Winnowing	522.31	167.93		690.24
Transport	119.58	260.62		380.20
TOTAL	**9607.76**	**3722.73**	**3902.54**	**17233.04**

Note:- Machinery and Equipment Cost

Weed controlling: Cost only for weeder

Annex: III

Cost of Cultivation per Acre of Paddy (Rainfed)

District: KURUNEGALA **Season: *Maha* 2000/01**

Operations	Labour Cost Rs/ac	Machinery & Equipment Cost Rs/ac	Material Cost Rs/ac	Total Cost Rs/ac
Preparation of Nursery	158.44			158.44
Cleaning Bunds and Canals	647.71			647.71
1st ,2nd Ploughing and Leveling	569.13	2957.44		3526.57
Plastering Bunds	685.12			685.12
Broadcasting/Transplanting	2547.22		866.30	3413.52
Weed Controlling	245.84	0.00	448.76	2509.47
Fertilizer Application	259.80		2263.63	2523.43
Pest & Diseases Controlling	194.01	163.94	723.32	1081.28
Water Management	966.29	0.00		966.29
After Care	944.59			944.59
Harvesting	2689.70			2689.70
Threshing	1366.43	611.17		1977.60
Winnowing	610.72	284.30		895.02
Transport	142.65	229.66		372.31
TOTAL	**12027.65**	**4246.51**	**4302.01**	**20576.17**

Note:- Machinery and Equipment Cost

Weed controlling: Cost only for weeder

Annex: IV

Cost of Cultivation per Acre of Paddy (Rainfed)

District: KEGALLE **Season: *Maha* 2000/01**

Operations	Labour Cost Rs/ac	Machinery & Equipment Cost Rs/ac	Material Cost Rs/ac	Total Cost Rs/ac
Preparation of Nursery	294.12			294.12
Cleaning Bunds and Canals	588.44			588.44
1st, 2nd Ploughing and Leveling	1431.34	2033.92		3465.26
Plastering Bunds	673.20			673.20
Broadcasting/Transplanting	2612.86		689.80	3302.66
Weed Controlling	404.56	0.02	203.16	2147.54
Fertilizer Application	270.37		1742.96	2013.33
Pest & Diseases Controlling	98.64	72.05	200.67	371.36
Water Management	741.70	0.00		741.70
After Care	976.46			976.46
Harvesting	2711.88			2711.88
Threshing	1316.05	739.05		2055.10
Winnowing	723.86	75.65		799.51
Transport	231.91	155.12		387.04
TOTAL	**13075.38**	**3075.81**	**2836.60**	**18987.79**

Note:- Machinery and Equipment Cost

Weed controlling: Cost only for weeder

Annex: V

Cost of Cultivation per Acre of Paddy (Major Irrigation)

District: KURUNEGALA **Season: *Yala* 2001**

Operations	Labour Cost Rs/ac	Machinery & Equipment Cost Rs/ac	Material Cost Rs/ac	Total Cost Rs/ac
Preparation of Nursery	44.25			44.25
Cleaning Bunds and Canals	635.41			635.41
1st, 2nd Ploughing and Leveling	381.23	2204.74		2585.97
Plastering Bunds	820.56			820.56
Broadcasting/Transplanting	1137.90		741.02	1878.92
Weed Controlling	568.40	9.47	868.61	1446.49
Fertilizer Application	240.79		2264.45	2505.24
Pest & Diseases Controlling	194.95	147.45	1111.92	1454.32
Water Management	1022.49	2.96		1025.45
After Care	820.39			820.39
Harvesting	2469.32			2469.32
Threshing	1410.54	661.76		2072.30
Winnowing	622.59	228.88		851.47
Transport	221.52	224.93		446.45
TOTAL	**10590.32**	**3480.20**	**4986.00**	**19056.53**

Note:- Machinery and Equipment Cost

Weed controlling: Cost only for weeder

Annex: VI

Cost of Cultivation per Acre of Paddy (Minor Irrigation)

District: KURUNEGALA **Season: *Yala* 2001**

Operations	Labour Cost Rs/ac	Machinery & Equipment Cost Rs/ac	Material Cost Rs/ac	Total Cost Rs/ac
Preparation of Nursery	20.89			20.89
Cleaning Bunds and Canals	641.91			641.91
1st, 2nd Ploughing and Leveling	474.56	2707.91		3182.47
Plastering Bunds	768.09			768.09
Broadcasting/Transplanting	996.42		968.49	1964.91
Weed Controlling	306.94	6.51	730.48	1043.93
Fertilizer Application	325.06		1583.25	1908.30
Pest & Diseases Controlling	177.72	119.26	375.38	672.36
Water Management	1212.81	199.36		1412.17
After Care	1112.52			1112.52
Harvesting	1569.47			1569.47
Threshing	1076.45	735.33		1811.78
Winnowing	529.71	147.32		677.03
Transport	89.48	295.41		384.88
TOTAL	**9302.03**	**4211.10**	**3657.60**	**17170.72**

Note:- Machinery and Equipment Cost

Weed controlling: Cost only for weeder

Annex: VII

Cost of Cultivation per Acre of Paddy (Rainfed)

District: KURUNEGALA **Season: *Yala* 2001**

Operations	Labour Cost Rs/ac	Machinery & Equipment Cost Rs/ac	Material Cost Rs/ac	Total Cost Rs/ac
Preparation of Nursery	39.48			39.48
Cleaning Bunds and Canals	557.49			557.49
1st, 2nd Ploughing and Leveling	461.26	3596.25		4057.50
Plastering Bunds	550.06			550.06
Broadcasting/Transplanting	1704.74		791.26	2496.01
Weed Controlling	188.53	0.00	405.80	2576.02
Fertilizer Application	290.28		2387.49	2677.77
Pest & Diseases Controlling	188.37	176.52	504.10	868.98
Water Management	839.54	812.29		1651.83
After Care	999.87			999.87
Harvesting	2315.16			2315.16
Threshing	1133.53	589.08		1722.61
Winnowing	560.22	237.20		797.42
Transport	173.97	173.72		347.69
TOTAL	**10002.49**	**5585.05**	**4088.65**	**19676.19**

Note:- Machinery and Equipment Cost

Weed controlling: Cost only for weeder

Annex: VIII

Cost of Cultivation per Acre of Paddy (Rainfed)

District: KEGALLE **Season: *Yala* 2001**

Operations	Labour Cost Rs/ac	Machinery & Equipment Cost Rs/ac	Material Cost Rs/ac	Total Cost Rs/ac
Preparation of Nursery	257.50			257.50
Cleaning Bunds and Canals	538.96			538.96
1st ,2nd Ploughing and Leveling	1434.09	2366.30		3800.39
Plastering Bunds	697.32			697.32
Broadcasting/Transplanting	2588.65		737.34	3325.99
Weed Controlling	253.62	1.59	140.40	1997.51
Fertilizer Application	260.43		1742.30	2002.73
Pest & Diseases Controlling	95.90	76.79	246.09	418.78
Water Management	818.79	0.00		818.79
After Care	927.20			927.20
Harvesting	2687.32			2687.32
Threshing	1264.81	798.53		2063.34
Winnowing	676.05	79.93		755.98
Transport	210.54	175.04		385.58
TOTAL	**12711.17**	**3498.18**	**2866.14**	**19075.49**

Note:- Machinery and Equipment Cost

Weed controlling: Cost only for weeder