Socio Economic Factors Affecting the Productivity of Green Gram

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FOREWORD

In Sri Lanka, green gram consumption has been increasing over the years as an alternative source of protein which complementary to our staple diet. Therefore, it has been identified as a high priority crop by the 'Mahinda Chinthana' Policy Framework. Though the government has taken various initiatives to increase the domestic production to reduce imports of green gram, the targets are yet to be achieved. Therefore, increasing the productivity of green gram has been identified as an imperative need in order to meet the country's requirement and assure self-sufficiency.

Benefits of increasing the green gram production would be two fold: boosting the income level of farmers and fulfilling the dietary needs of the people in the country. Comparatively, the production cost for green gram cultivation is low and higher consumer demand is fetching a premium market price for the green gram despite the high labour intensity. This has led to attracting farmers towards green gram cultivation. However, in Sri Lanka there is a large gap between the actual yield and the potential yield of green gram due to various issues prevailing in this sector. Hence, addressing these issues to evolve remedies in order to maintain food and nutrition security is timely.

This study has identified the extent and the level of the existing green gram yield gap in a more comprehensive manner. It also highlighted various socio-economic factors that affect the productivity of green gram in the country by estimating the relationship between the productivity and socio-economic factors.

I congratulate the research team for successfully completing this research project and hope the findings of this research and recommendations would be helpful for policymakers to achieve the targets of green gram production in the country and further development of the sector.

E.M. Abhayaratne
Director

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EXECUTIVE SUMMARY

In Sri Lanka the actual yield is far behind the potential yield of green gram. Thus the increasing productivity is an overriding need to meet the government's objective of self-sufficiency in green gram production. Therefore, this study attempted to examine the extent of yield gap of green gram and to identify the socio-economic factors affecting the productivity of green gram in major producing areas with a view to identify solutions to overcome major constraints in order to propose possible means of increasing the productivity of green gram. The study was carried out in three selected districts namely Hambantota, Monaragala and Kurunegala and the total sample comprised 352 farmers. Both primary and secondary data utilized for the study have been gathered through a questionnaire survey, focus group discussions, key informant interviews and a literature survey.

The study findings show that the yield gap existed for green gram in all three selected districts and compared to the mean value of the potential yield (648 kg/ac), the percentage of yield gap was 73%. The yield gap of green gram was 63% when compared to the lower limit of the potential yield of 486 kg/ac. After estimating the relationship between the productivity and various socio-economic factors, results described that the degree of using hired labour, fertilizer cost and seed rate have a significant relationship with the productivity of green gram. These are the factors on which the relevant parties place emphasis, in order to increase the productivity of green gram.

The productivity has increased with the increased seed rate up to the recommended level (12kg/ac) and decreased thereafter. Further, the increase in seed rate had shown a decrease in productivity which can be attributed to increased plant density that constrains weeding and stimulates rapid spread of pests and diseases. The model illustrates that the farmers with access to hired labour were more productive. Weeding and harvesting are the most labour consuming operations in green gram and carrying out these operations at the proper time may result in a higher productivity. Green gram does not require large quantities of fertilizer as it is a leguminous crop, and most farmers had neither used fertilizer nor complied with recommendations, however, recommendations show that application of fertilizer will help in obtaining a better yield from lands which are continuously used for cultivation, showing a significant relationship with the productivity.

According to the farmers, lack of a proper market and a reasonable price for their products were the major problems they face. Further, the lack of storage facilities force them to sell their products immediately after harvesting at low prices. The above reasons demotivate the farmers from engaging in cultivating this crop.

More than 50% of the farmers in the total sample have grown the recommended varieties and the average yield of the recommended varieties is higher than that of the other traditional varieties and lower than the yield of the Australian variety.

About 41 percent of respondents highlighted that it is necessary to introduce new machinery in most labour intensive operations such as harvesting, weeding and land preparation. The prevalence of an extension service is not adequate in case of green gram as about 62 percent of the total sample had not received even a single visit during the cropping season and therefore it needs to be improved.

The current scenario surrounding the low green gram productivity in Sri Lanka requires the government to improve and expand the existing seed distribution programme in order to provide every single farmer with an adequate amount of good quality seeds in time. Since the land is fixed, the government should encourage the use of fertilizer, and this can be done by providing incentives for the setting up of cooperative shops to provide fertilizer to households at an affordable price with the view to increase the productivity. On the other hand, it is essential to develop a variety which is suitable for mechanization for the operations such as harvesting and weeding that utilize more labour as green gram is a labour intensive crop. Furthermore, it is important to establish a stable price for green gram and also a proper mechanism to purchase products and involve the private sector in purchasing the produce through forward contracts. In addition, the government should improve its method of gathering and disseminating of information that is vital for households. This also requires the government to expand its current level of extension services to provide better awareness on proper cultural practices, control of pests and diseases and also about the current rainfall pattern to avoid crop damages which reduce the quality of the output. Further, it is important that the government gets involved in providing proper storage facilities to store the produce of green gram until the prices go up in the market.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AIs	-	Agricultural Officers
DOA	-	Department of Agriculture
DOs	-	Divisional Officers
HARTI	-	Hector Kobbakaduwa Agrarian Research and Training Institute
MI	-	Maha Illuppallama
SPSS	-	Statistical Package for Social Science

CHAPTER ONE

Introduction

1.1 Background of the Study

Green gram has been one of the most important grain legumes in the traditional farming systems of Sri Lanka. It has been one of the principal but cheap sources of protein and its importance as a component of the Sri Lankan diet has grown over the years. Green gram not only contains a high percentage of easily digestible protein, but its essential amino acid composition is also complementary to our staple diet, rice. In addition to being an important source of human food and animal feed, green gram also plays an important role in sustaining soil fertility by improving physical properties and fixing atmospheric nitrogen in the soil.

The local production of green gram shows a declining trend over the last two decades, where the production is 26931 mt in 1990 and only 11703 mt was produced in 2010. At present, around 9068 ha of land is utilized for green gram cultivation in Sri Lanka while around 10,535 mt is domestically produced (Department of Census and Statistics, 2011). However, to meet the domestic green gram requirement the country imported 10,447 mt spending around Rs. 1,523,454,623 in 2011 (Department of Customs, 2012). It reveals that 49.8% of the total green gram requirement is still being imported.

Green gram has been identified as a high priority crop in the *Mahinda Chinthana* policy document and with the aim to increase the domestic production of green gram the government has taken several measures to promote this sector. Under the "*Api wawamu*, *Rata nagamu*" programme, the target of the government was to reduce the import of green gram by 84% by the year 2009. However, still it has not been achieved and according to the *Mahinda Chinthana - Way Forward,* the target is to reduce the import of green gram to 200 mt by 2015.

In this context, it is clear that increasing the production of green gram is a must to achieve the target of the government. There are two strategies which can be adopted to increase the local production. One is to increase the extent of cultivation while the other is by increasing the productivity. Due to population growth and legal restrictions, land acts as a limiting factor for expanding the extent of cultivation. Thus a high yield per surface unit (high productivity) is the overriding need. Productivity increase among farmers requires a policy focus on several factors as there is a number of factors that affect the productivity of a crop. Therefore, this study attempted to find out the socio-economic factors affecting the productivity of green gram in the country.

1.2 Research Problem

The potential yield of green gram is ranging between 1.2 – 2 mt/ha (yield potential of MI 5 is 1200–1500 kg/ha and in MI 6 the value is 1800-2000 kg/ha) while the national average yield varied between 0.8 – 1.1 mt/ha in Sri Lanka during the period of year 1990 to 2011 (Department of Census and Statistics, 2011). Though it is well

understood that the potential yield is rarely achieved under farm conditions, the data shows that there is about a 50% gap between two parameters. On the other hand, a considerable variation in the actual yield among the major green gram producing districts can be observed. For instance, in 2011 the average yield of green gram in the Kurunegala district was about 500 kg/ha while the average yield of green gram in the Moneragala district was about 1200 kg/ha (Department of Census and Statistics, 2011). Both factors mentioned above, the yield gap and the yield variation across districts, adversely affect the national production of green gram as these factors directly affect the productivity of a crop. Therefore, identification of reasons for the yield gap and the yield variation across districts will be helpful towards planning and implementation of programmes and strategies that ensure an increased production of green gram in the country. There is a number of factors that affect the agricultural productivity, such as biophysical, technical and socio-economic condition. However, there is a dearth of knowledge relating to socio-economic factors affecting the productivity of green gram. Therefore, this study was an attempt to bridge the existing knowledge gap on socio-economic factors affecting the productivity of green gram in Sri Lanka.

1.3 Objectives of the Study

The overall objective was to identify the socio-economic factors affecting the productivity of green gram in major producing areas with a view to identify solutions to overcome major constraints in order to propose possible means for increasing the productivity of green gram.
More specifically the study attempted to:

i. Examine the nature and extent of yield gap in green gram.
ii. Identify the socio-economic factors accounting for the productivity of green gram.
iii. Propose possible means of overcoming constraints that lower the productivity.

1.4 Research Methods

1.4.1 Study Locations

Three districts were selected to collect information by analyzing the secondary data on the extent, production and productivity of green gram. These included Hambantota, Kurunegala and Moneragala districts. These three districts collectively account for more than 50 percent, both in terms of the total green gram production and the extent of cultivation. The highest average productivity in year 2011 is reported in Hambantota (1.483 mt/ha), while Kurunegala records the lowest in terms of productivity (0.501 mt/ha) in the country and the average productivity in Moneragala is much higher than that of Kurunegala and closer to the Figures of the Hambantota district (1.219 mt/ha).

1.4.2 Sample Selection

From the target population (Green gram farmers in Sri Lanka) respondents were selected using the multi stage sampling technique. At the first stage, three districts were selected based on the production, extent and productivity of green gram. In

the second stage, four Agrarian Development Centers (ADCs) were selected from each district based on the extent of cultivation of green gram. At the third stage, three Grama Niladhari (GN) Divisions that occupied the highest extent under green gram were selected. At the final stage, around 30 green gram farmers were selected from the three selected GN divisions proportional to the number of green gram farmers in each GN division. Accordingly, 352 farmers were included in the total sample.

Tables 1.1: Study Locations and Sample Size

District	Agrarian Development Centre	Agro-ecological Zone	Sample Size
Kurunegala	Nikaweratiya	Low Country Intermediate Zone	31
	Rasnayakapura		32
	Maho		20
	Ambanpola		22
Hambantota	Bandagiriya	Low Country Dry Zone	14
	Yodakandiya		22
	Weerawila		33
	Udayala		31
	Ambalantota		29
Monaragala	Sewanagala	Low Country Dry Zone	44
	Buttala	Low Country Intermediate Zone	41
	Telulla		33
Total Sample			**352**

Source: HARTI Survey Data, 2013

1.4.3 Data Collection

The study employed three different approaches and activities for data collection:

a. Sample Survey

A sample survey was conducted to collect relevant information from the sample farmers through a structured questionnaire designed to achieve the study objectives.

b. Key Informant Interviews

Interviews were held to gather information from the crop coordinator for green gram, breeders contributed to green gram breeding program, Director – Field Crops Research and Development Institute (FCRDI), District Directors, DOs of Agrarian Development Centers, and AIs of study areas.

c. Collection of Secondary Information

Data and information pertaining to green gram cultivation such as production, productivity, extent under cultivation, yield and yield potentials were gathered through the review of secondary sources of information. Further, information was reviewed from published and unpublished sources of information.

1.4.4 Data Analysis and Presentation

Data gathered from different sources were analyzed through SPSS 20 statistical package and have been presented in tabular and graphical forms. Both descriptive statistics and inferential statistics are presented in the report. To examine the extent and the nature of yield gap, primary information on actual crop yields which were collected from a sample survey has been compared with the potential yields of cultivated varieties. A regression analysis has been carried out with regard to upland cultivation of green gram in 2011/12 *Maha* season in order to understand the factors affecting the productivity. In order to identify such factors, yields of green gram were tested against some selected socio-economic aspects. Description of explanatory variables used in regression analysis is as follows:

$Y=f(FL, HL, F, M, A, G, D_1, D_2, D_3, D_4, D_5, D_6)$
Where,
Y = Productivity/Yield (kg/ac)
FL = Family/ unpaid Labour cost (Rs/ac)
HL = Hired Labour cost (Rs/ac)
F = Fertilizer cost (Rs/ac)
M = Machinery cost (Rs/ac)
A = Age of the farmer (years)
G = Level of education (years)
D_1 = Seed Rate; 1= greater 12 kg/ac 0= Otherwise
D_2 = District; 1= Kurunegala 0= Hambantota
D_3 = District; 1= Monaragala 0= Hambantota
D_4 = Extension visits; 1= at least one visit 0 = no visits
D_5= variety used; 1-Recommended varieties 0 = otherwise
D_6 = D6- variety used; 1= Australian variety, 0 = otherwise
α, β = Coefficient to estimate different variables
U = Error term

The model is specified as follows;

$$\ln Y=\ln\alpha_0+\alpha_1 \ln FL+\alpha_2 \ln HL+\alpha_3 \ln F+\alpha_4 \ln M+\alpha_5 \ln M+\alpha_6 \ln A+\alpha_7 \ln G+\beta_1 D_1+\beta_2 D_2+ \beta_3 D_{3+} \beta_4 D_4 + \beta_5 D_5+ \beta_6 D_6 + U$$

1.5 Chapter Organization

This report will be organized under six chapters. The first chapter gives a brief introduction about the study including the research problem, objectives and methodology. The second chapter discusses theoretical and empirical literature on agricultural productivity, factors affecting the productivity and the yield gap. The next chapter provides socio-economic characteristics of the sample population. The fourth chapter is devoted to the discussion of cultivation practices, marketing and support services of green gram. The fifth chapter describes factors affecting the productivity of green gram while the last chapter draws conclusions and proposes recommendations.

CHAPTER TWO

Literature Review

2.1 Theoretical Literature

2.1.1 Agricultural Productivity

According to Wong and Geronimo-kuch (1982), variations in crop productivity, whether measured in terms of value of production per hectare or output per unit of input is a common phenomenon among farmers. Within the same region, no two fields that employ the same inputs of land, labour and capital yield the same amount of output. Greater variations in output occur when comparisons are made among farms across a country or between countries. As mentioned by Wong and Geronmo-kuch (1982) these variations in output could be partly due to the supply of good quality land, farm size, or the variability of factor proportions in labour and capital inputs. They could be partly due to the level of technological acceptance of fertilizer and chemical input or the type of seed used. They said that agricultural economists have long noted that the effect of economic inputs to production has always been associated with a certain level of technology. But available land supply and technology are not sufficient conditions to provide an adequate explanation. Even if conditions of land supply, economic inputs and level of technological adoption are favourable, wide variations in productivity still arise as there are other social, political and institutional factors that need to be looked in to.

According to Mbam and Edeh (2011), farm productivity is the index of the ratio of the value of total farm output to the value of the total input used in farm production. They state that increasing agricultural productivity is a vital pre-requisite for rapid economic growth and development of a country, especially for developing countries.

As Mbam and Edeh (2011) mentioned agricultural productivity change is explained by such factors: climatic, agronomic, socio-economic, and farm management. Therefore productivity increase among farmers requires a policy focus on these factors.

According to the literature a number of different factors can cause agricultural productivity to increase or decrease. It is important to note that productivity is not an absolute measure, but rather a reflection of the ratio between inputs and outputs. So a field that produces twice as much as it did in a previous year is not necessarily twice as productive; if the farmer spent double the time on that field, the net change in productivity would be zero.

Some factors, like weather, are beyond the control of the farmer. Unusual weather patterns, such as drought, a prolonged rainy season, early or late frosts,

and other factors, can ruin crops and bring productivity down. The capacity of a given farm is also an important factor. Soil cannot be forced to produce beyond capacity, although there are methods that can be used to improve production capacity, such as fertilizing to add nutrients to the soil so that it can support more crops.

Pests can be another concern. In addition to affecting crops, pests can also add significantly to the costs of producing a crop. Controlling them may require measures such as fencing, chemical treatments, or companion planting-all of which change the ratio of inputs to outputs.

Available equipment is another factor. In regions where access to mechanized farm equipment is low, agricultural productivity can also be low as people handle their crops manually. This involves a huge investment of time, energy, and money, and also limits the total capacity of the land. Likewise, people with access to specialized seeds such as crop hybrids specifically developed to produce more can improve their productivity.

Innovation is a key factor for agricultural productivity. Farmers who can develop creative ways to farm smarter, as it were, will experience productivity increases. For this reason, many agricultural companies and nations invest in developing new farming techniques and in researching new approaches to farming. Studying ancient approaches to learn from prior generations can also play a role in agricultural innovation; sometimes the best method is already in use.

The supply and demand in the market may also play a role, because farmers will adjust their activities to meet the needs of consumers and this can have an impact on agricultural productivity. In some cases, governments even pay subsidies to farmers to compensate for not growing crops, which can skew productivity measures.

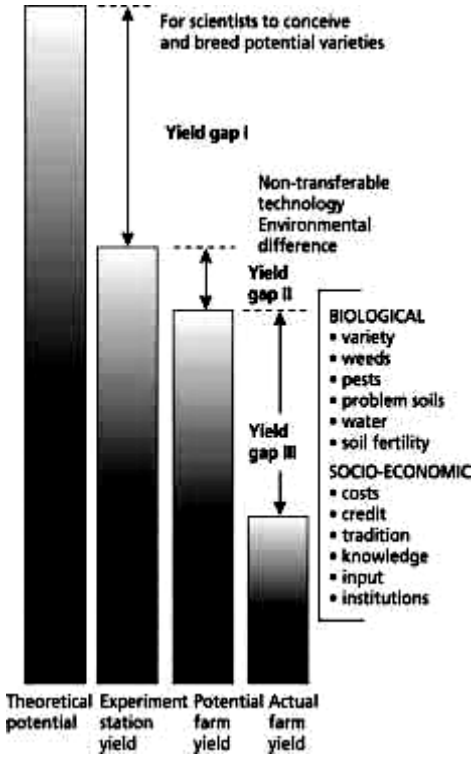
2.1.2 Yield Gap

According to Food and Agriculture Organization (FAO) (2004), the practical yield gap that can be achieved is the difference between the maximum attainable yield and the farm level yield, which are defined in the following ways:

- Maximum attainable yield: the crop yield of experimental/on-farm plots with no physical, biological or economic constraints and with the best-known management practices for given ecology.

- Farm-level yield: the average farmer's yield in a given target area at a given time, in a given ecology.

Yield gap can be broken down further into three components (FAO, 2004) (Figures 2.1).



Figures 2.1 Yield Gap Components

Component One -: Gap I: The difference between the theoretical potential and the experiment station yield which the scientists conceive and breed potential varieties.

Component Two -: Gap II: The difference between the experiment station yield and the potential farm yield, is caused mainly by factors that are generally not transferable, such as environmental conditions and some of the built-in component technologies that are available at research stations. It is therefore difficult to narrow this component, and Gap II is often not economically exploiTables.

Component Three -: Gap III: The difference between the potential farm yield and the actual farm yield, is mainly caused by differences in management practices. Gap III exists because farmers use sub optimal doses of inputs and cultural practices. This component is manageable and can be narrowed by increasing efforts in research and extension services, as well as by appropriate government intervention, particularly in institutional issues.

As per the FAO (2004), factors causing yield gaps can be classified according to their nature and the degree to which they contribute to the gaps is presented below:

1. Biophysical: climate/weather, soils, water, pest pressure, weeds.

2. Technical/management: tillage, variety/seed selection, water, nutrients, weeds, pests and post-harvest management.

3. Socio-economic: socio-economic status, farmer's traditions and knowledge, family size, household income/expenses/investments.

4. Institutional/policy: government policy, rice prices, credit, input supply, land tenure, market, research, development, extension.

5. Technology transfer and linkages: the competence and facilities of extension staff; integration among research, developments and extension; farmer's resistance to new technology; knowledge and skills; weak linkages among public, private and non-governmental extension staff.

2.2 Empirical Literature

Literature pertaining to productivity of green gram in Sri Lanka is scarce, however India has conducted many research on pulses as it is the world's largest producer of pulses. As much as 25 percent of the world's green gram output is from India. According to Patrik and Jeffry (2009) India's pulse yield can be brought to world-class level through a mix of good agronomic practices and farmer education. The low rates of pulse production in India can be traced to low yields per acre and the low acreage under pulses. There are several reasons why pulse production has not grown in India. Some of these are historic, and most can be directly traced to the poor connection between new research and development and the practitioner out in the field. Yet all these constraints are easily addressed. The challenges can be categorized as; agro-climatic, biological, socio-economic, knowledge-based, and infrastructural.

Several studies have been carried out on crop productivity and most of them were based on rice productivity. Mbam and Edeh (2011) in their paper quantify the productivity of rice farmers in Nigeria using total factor productivity. They have adopted Key and Mcbride (2003) approach to determine total factor productivity.

According to them, determinants of rice farmer's productivity (TFP) were modeled in terms of socio-economic variables of the farmers and other actors. The model is specified as follows:

$TFP_i = a_0 + a_1X_1 + a_2X_2 + a_3X_3 + a_4X_4 + a_5X_5 + a_6X_6 + a_7X_7 + e_i$

TFP_i = Total factor productivity for i^{th} farmer

X_1 = Farm size

X_2 = Cost of labour used

X_3 = Years of education

X_4 = Fertilizer used

X_5 = Improved varieties used

X_6 = Frequency of extension visit

e_i = Error term

a_{0-7} = Parameters to be estimated

In the paper of Mpaweinimana (2005) titled "Analysis of socio-economic factors affecting the production of banana in Rwanda" he used the specification of the production function model.

$Q = f(N, K_pL, F, P, E_d)$

Where,

Q = Total output of banana in terms of quantity of bananas (in tons) produced

N = Acreage in terms of acres under banana crop Kp = Physical capital

L = Labour

F = Fertilizer use

P = Price of bananas

E_d = Level of education attained by the respondent

A = Coefficient to estimate the relationship between the output and the different variables

u = Error term

The econometric model is specified as follows;

$$LnQ=ln\ \alpha_0+ \alpha_1\ lnN+ \alpha_2 lnKp+\alpha_3\ lnL+ \alpha_4 Fert+ \alpha_5 lnP+ \alpha_6 Ed+U$$

Hettiarachchi *et. al.,* (1998) in their study focused on the Kurunegala district have discussed factors such as cultivated varieties and sources of seeds, cultural practices, pest and disease problems, yields and selling prices as the main factors determining the productivity of food legumes.

CHAPTER THREE

Characteristics of the Social Environment of Green Gram Farmers

3.1 Socio-economic Characteristics

3.1.1 Family Size, Sex and Age Distribution of the Sample

Agricultural activities in Sri Lanka largely depend on family labour and at the same time, green gram cultivation is considered more labour consuming. Hence, the distribution of family size among the selected households is highly important. The survey indicated that the average family size of the sample households was four. Tables 3.1 shows that most of the households (58%) belong to the category of family size of 3-4 members and the survey did not show a considerable difference of family size among three districts.

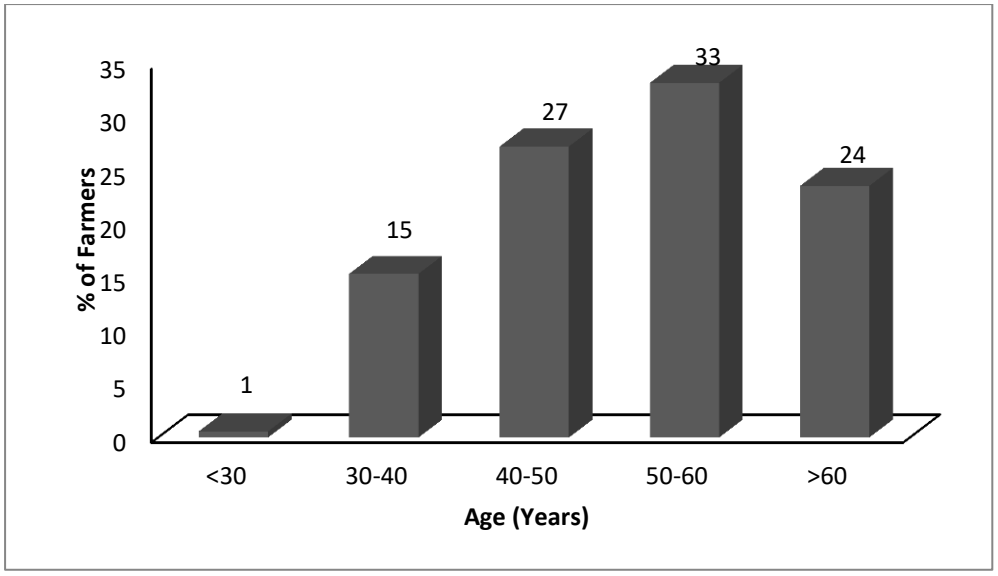
Tables 3.1: Percentage Distribution of Family Size of the Sample Households

Family Size	Kurunegala %	Hambantota %	Monaragala %	Total %
1-2	17	9	14	13
3-4	56	57	60	58
5-6	25	32	22	26
>6	2	3	3	3
Total	100	100	100	100

Source: HARTI Survey Data, 2013

The average sex ratio of male to female of the sample population is 0.91 and this is a slight deviation from the national average of 0.96.

Average age of the farmer in the sample population was around 50 years and the findings indicate that, majority of green gram farmers (about 60%) were between 40-60 years of age highlighting a less involvement of youth in green gram farming (Figures 3.1). Only 1 percent of the total number of farmers was below 30 years and only 15 percent of the total were between 30 – 40 years of age. These findings reveal that green gram cultivation is not an attractive venture for the younger generation.

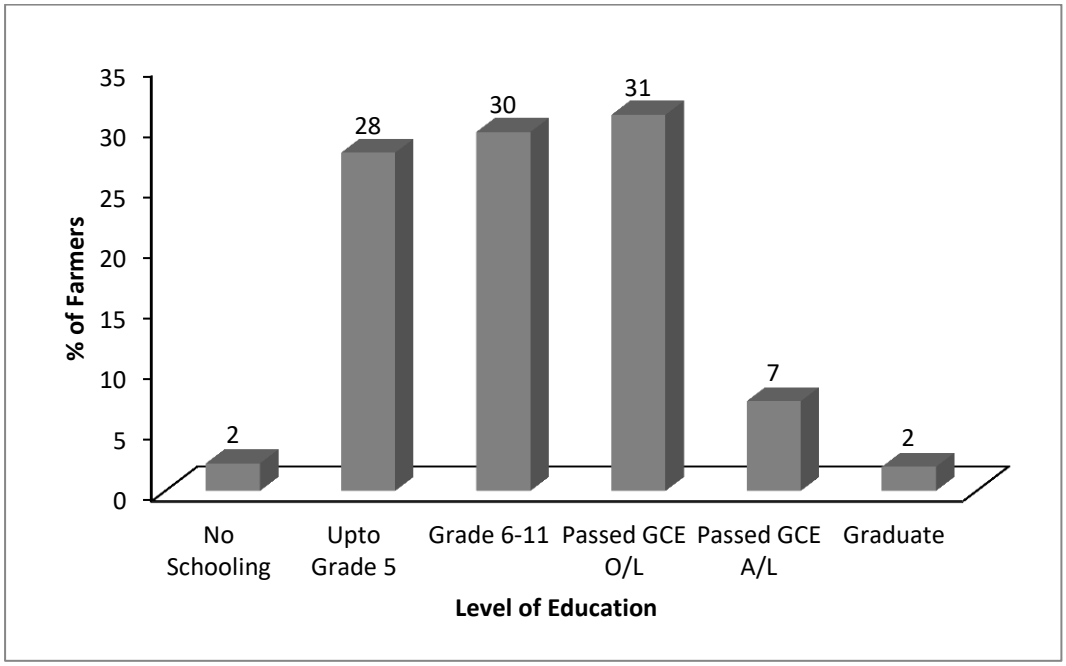


Source: HARTI Survey Data, 2013

Figures 3.1: Age Distribution of Farmers

3.1.2 Educational Background

The level of education of the farming community is important because, when the education level of farmers is at a satisfactory level, it will be an advantage for them to absorb new technology.



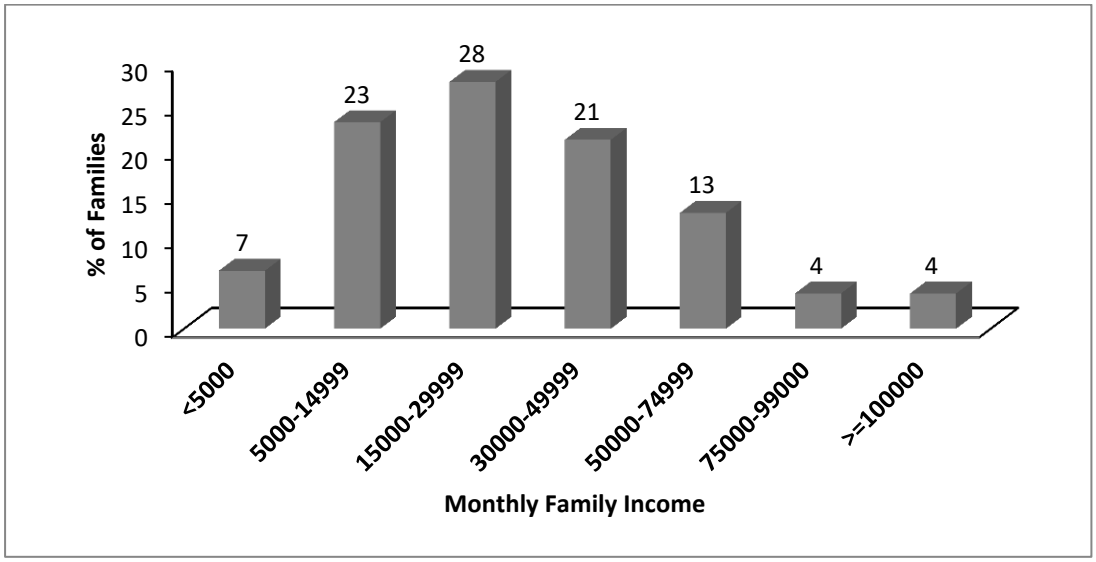
Source: HARTI Survey Data, 2013

Figures 3.2: Level of Education of Farmers

Figures 3.2 shows the level of education of the sample farmers and it reveals that the a higher proportion (31%) of the farmers had passed GCE O/L while the lowest percentage (2%) had been equally represented by two farmer groups: the graduates and those who had not received school education. According to the survey, 70 percent of the farmers had received secondary education or above. The major difference in the level of education which can be identified across districts was that in the Monaragala district where the majority of farmers were educated up to grade 5 and at the same time the number of farmers who had passed GCE (A/L) and educated above A/L were less, compared to other two districts.

3.1.3 Family Income and Income Earning Sources

To understand the total family income it is necessary to consider all the family income sources (both primary and secondary occupations) and the income of all family members. According to the survey, 92% of the respondents had selected farming as their primary income source. Out of the total sample, only 24% of the farmers had engaged in secondary level income earning activities.



Source: HARTI Survey Data, 2013

Figures 3.3 Monthly Family Incomes of the Sample Families

The Figures 3.3 illustrates the monthly gross family income. According to that, a larger proportion of households (28%) had received a gross monthly income between Rs. 15,000 and Rs. 30,000. Only 7% was recorded with a monthly income of less than Rs. 5,000. This showed that 70% of the farmers earn more than Rs. 15,000 per month indicating satisfactory levels of income.

It is evident from the results that there were significant correlations in hired labour cost and total land area with the total family income, indicating an indirect effect of the family income on the productivity of green gram.

Tables 3.2: District-wise Variation of Monthly Family Income

Monthly Family Income	% of Families		
	Kurunegala	Hambantota	Monaragala
<5000	6	3	11
5000-15000	25	19	26
15000-30000	27	22	35
30000-50000	22	24	18
50000-75000	13	18	8
75000-100000	11	5	3
>100000	4	8	0
Total	100	100	100

Source: HARTI Survey Data, 2013

When the family incomes of the three districts are considered separately the data showed a slight deviation in the Hambantota district as the larger proportion of farmers had received a monthly income between Rs. 30,000/= and Rs. 50,000/= while in the other two districts the majority have fallen into the category of Rs. 15,000/= – Rs. 30,000/= (Tables 3.2). At the same time, the number of farmers who had received the monthly income of more than Rs. 100,000/= were higher in Hambantota (8%). It was 4% in Kurunegala and no farmer in Monaragala district had received a monthly income above Rs. 100,000/=. The average monthly income of the three districts were Rs. 37,599/=, Rs. 47,751/= and Rs. 24,031/= in Kurunegala, Hambantota and Monaragala districts respectively.

3.1.4 Distribution of Land

The total land area owned by an individual farmer varied between 0.5-22.5 acres with an average land size of 4.6 acres among the total sample. When the average land sizes of three districts are separately considered, a large deviation from the average land size of the total sample could not be observed. The average land sizes were 4.8, 4.5 and 4.6 acres in Kurunegala, Hambantota and Monaragala respectively.

Tables 3.3: Land Distribution Pattern of the Sample

Land Size	% of Farmers
<1 ac	1
1-3 ac	24
3-5 ac	39
5-8 ac	26
8-10 ac	4
>=10 ac	5
Total	100

Source: HARTI Survey Data, 2013

As shown in the Tables 3.3 most of the farmers in the sample possessed a total land area between 3-5 ac (39% of the total sample) while 63 percent of the farmers have fallen into the category of 1-5 ac of land and only 5% of farmers possessed more than 10 ac of land. When the type of land taken into consideration, paddy lands formed 41% of the total extent while uplands and home gardens formed 30% and 29% respectively.

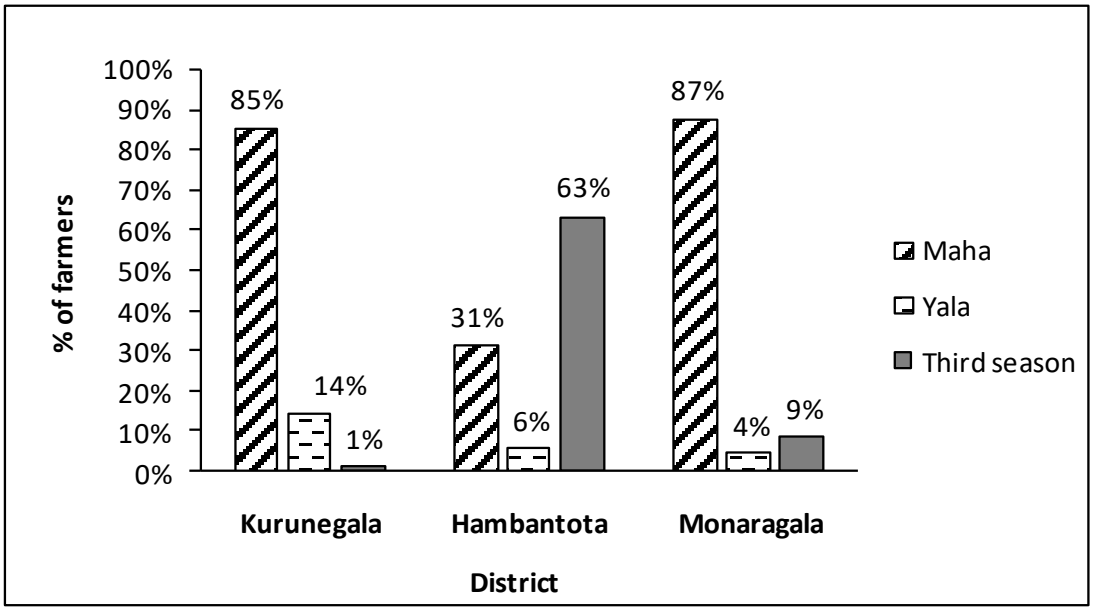
CHAPTER FOUR

Cultivation Practices, Marketing and Support Services of Green Gram

This chapter is mainly devoted to a discussion of prevailing cultivation practices, marketing and extension and other support services and their problems, and also of the preferences and opinions of farmers on these aspects.

4.1 Variation in Cultivation Season of Green gram

The findings revealed that the majority of farmers in the sample (66%) grow green gram in *Maha* season and 26% of the sample cultivate green gram in the 'Third Season' that follows the *Yala* season largely in the Hambantota district.



Source: HARTI Survey Data, 2013

Figures 4.1: Distribution of Farmers by Cultivation Season

According to the survey almost all the farmers who cultivated green gram in *Maha* season were confined to highlands while the cultivations in the third season and *Yala* season were mainly confined to lowlands.

4.2 Green Gram Varieties Used by Farmers

During the survey, farmers' awareness on available varieties of green gram was tested and according to the result only 40% of the total sample was well aware of the available green gram varieties.

Tables 4.1: Awareness of Farmers on Available Varieties

District	Aware of Available Varieties (%)	Not Aware of Available Varieties (%)
Kurunegala	12	88
Hambantota	72	28
Monaragala	30	70
Total Sample	40	60

Source: HARTI Survey Data, 2013

A great awareness of available varieties was reflected among the farmers from Hambantota (72%). At the other extreme was the Kurunegala district where only 12% of farmers were aware of available varieties. In the Monaragala district 30% of farmers were aware of available varieties. When farmers were requested to name the varieties known to them, some farmers mentioned only attributes of the varieties and therefore when there was a doubt, the variety was considered a traditional/local variety which had been saved by farmers and used for a longer time. Information was collected from the Agrarian Development Centres (ADCs) and retail shops of the area to obtain relevant data on cultivated varieties by the farmers as some farmers were not able to name the variety grown by them.

Tables 4.2: Use of Green Gram Varieties by District

Variety	% of Farmers			Overall (%)
	Kurunegala	Hambantota	Monaragala	
MI 5	51	41	50	47
MI 6	10	16	11	12
Australian Variety	6	36	3	16
Traditional & other consumption varieties	33	7	36	25
Total	100	100	100	100

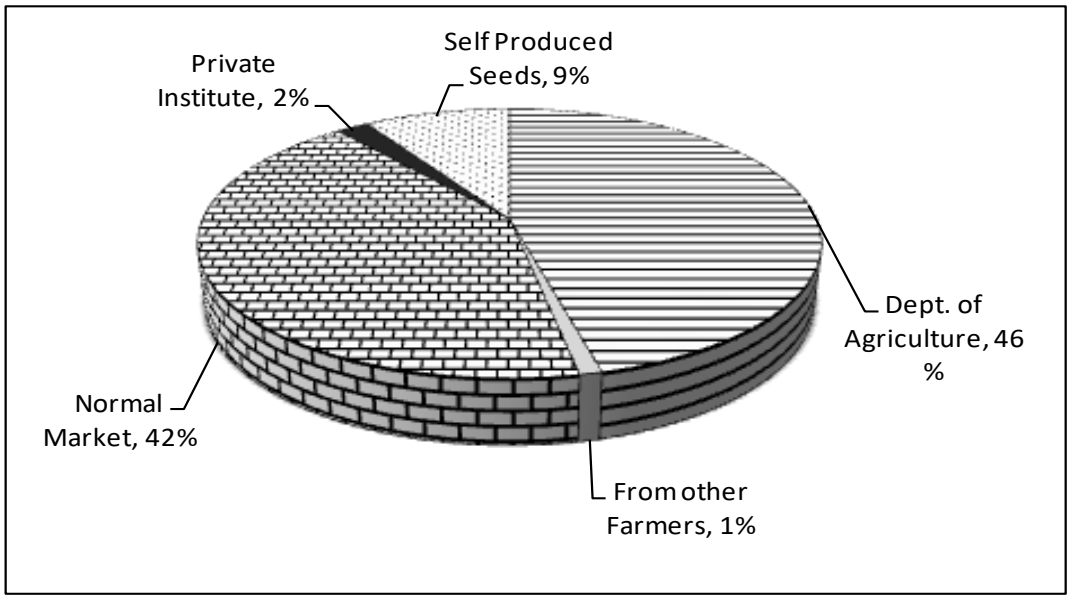
Source: HARTI Survey Data, 2013

According to the farmers, 59% of the total sample had grown recommended green gram varieties of MI 5 and MI 6 while the other 41% of farmers in the sample had used traditional and other consumption varieties (Tables 4.2). A considerable proportion of farmers can be identified (36%) in the Hambantota district who had grown Australian variety rather than using other traditional varieties. The analysis was done to identify the main criteria which had been used by farmers in selecting a variety and the result showed that the major concern among 33% of responses was a high yield and it was the quality of the output among 20% of the responses.

4.3 Use of Seeds in Green Gram Cultivation

Seeds, as one of the major inputs of agriculture play an important role in improving crop productivity. Therefore farmers' knowledge and awareness on seed usage and their practices are discussed here.

4.3.1 Sources of Seeds



Source: HARTI Survey Data, 2013

Figures 4.2: Sources of Seeds

Figures 4.2 shows that the majority of farmers (46%) have obtained required seeds for cultivation from the Department of Agriculture (DOA) and the open market (42%). Only about 9% of the farmers had used their own seeds. As per the responses of farmers, 41 farmers (11% of the total sample) who used recommended varieties had obtained seeds from the open market. There was evidence that the seed lots of contract seed growers, which failed from the certification test of the DOA, had been released to the open market and sold to the farmers. This may be the reason for the above situation.

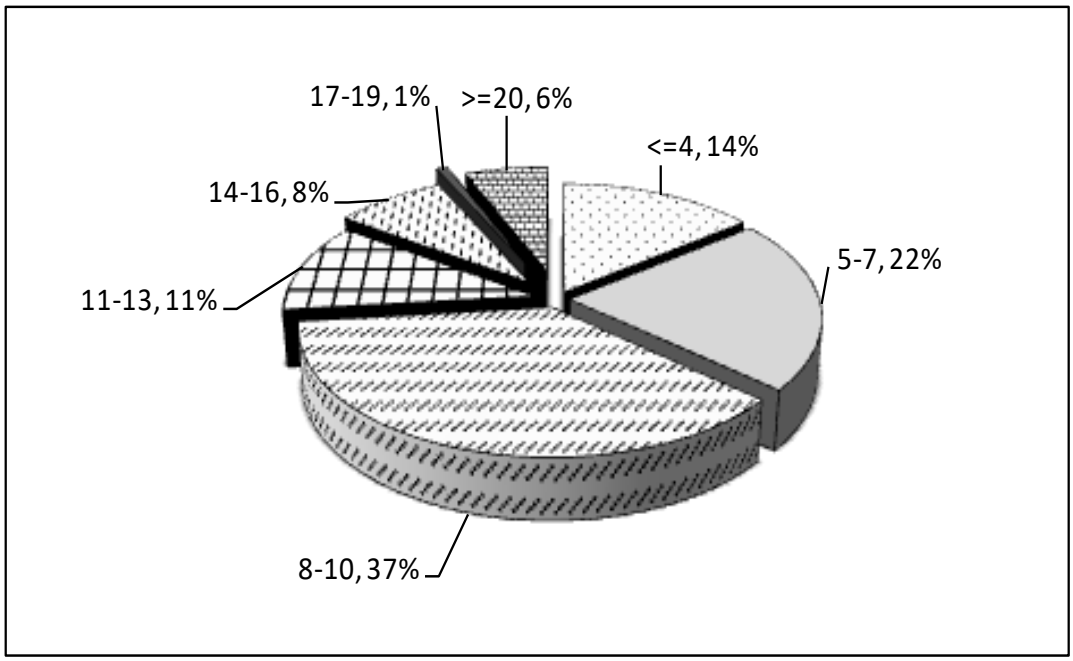
Among the farmers who obtained seeds from the DOA, 39% said that they used seeds of the DOA as they believe that DOA will provide good quality seeds. Another 27% of farmers obtained seeds from DOA because they received seeds at a 50% concessionary rate while 9% of them selected DOA as a source of seeds because of both reasons mentioned above. On the other hand, among the farmers who fulfilled their seed requirement from the market, 37% claimed that they bought seeds from the market as the DOA failed to supply good quality seeds at the required time.

Average seed price of the total sample was Rs.193/kg and the lowest average price of Rs.175/kg was recorded in the Monaragala district. The respective values for Hambantota and Kurunegala districts were Rs.200/kg and Rs. 205/kg respectively. In response to the question on the problems faced in obtaining seeds, 38 percent farmers stated that it was the lack of quality seeds, 21 percent said high price and 20 percent stated difficulty in obtaining at the required time. The farmers' views on problems they faced in obtaining required seeds were also obtained and from the total number of responses (199) 38% cited the lack of good quality seeds as the main problem while 21 percent stated that high price of seeds was the major problem. At the same time, 20% of the total responses identified the difficulty of obtaining seeds at the required time as their main problem.

4.3.2 Seed Rate

According to the (DOA) the recommended seed rate for green gram is 12 kg/ac. However, as it was evident from the key informant interviews, officers distribute recommended varieties among farmers through Agrarian Development Centres (ADCs) at the rate of 8 kg/ac. The reason for this decision as explained by field level officers was farmers do not practice thinning out after planting as recommended by the DOA and therefore the rate given by ADCs is adequate.

Farmers' awareness on recommended seed rate was questioned during the survey and the results revealed that 53% of the total sample was aware that there is a rate recommended by the DOA and 43% of farmers were totally unaware about the seed rate. However, there were some disparities in the quantity they stated as the recommended rate. Government Officers such as Agricultural Instructors (AIs), Agriculture Research and Production Assistants, Farmer Representatives were the information source for 59% farmers from the respondents who were aware of the seed rate. This could be considered as a good reflection of the extension service of the government.



Source: HARTI Survey Data, 2013

Figures 4.3: Seed Rate Used (kg/ac)

The survey responses indicated that the majority of the total sample (37%) had used 8-10 while only 7 percent of farmers used the recommended seed rate, 12 kg/ac. Another 37 percent used the rate less than 7 kg/ac and 7 percent of farmers used more than 16 kg/ac. As per the results of chi-square test and correlation test, there was a significant relationship between the seed rate and the method of planting and therefore over usage of seed could be observed as farmers who had practiced broadcasting as the method of planting followed a seed rate much higher than the recommended rate. However, this quantity varied across districts.

Tables 4.3: Seed Rate Used by Farmers by District

Seed Rate (kg/ac)	Kurunegala		Hambantota		Monaragala	
	No. of Farmers	% of Farmers	No. of Farmers	% of Farmers	No. of Farmers	% of Farmers
<= 4	34	32	4	3	13	11
5-7	35	33	16	13	26	22
8-10	27	25	59	46	44	37
11-13	4	4	22	17	14	12
14-16	3	3	17	13	9	8
17-19	0	0	1	1	2	2
>=20	3	3	9	7	10	8
Total	106	100	128	100	118	100

Source: HARTI Survey Data, 2013

The Tables shows that there is a considerable deviation in the Kurunegala district compared to that of the other two districts as the quantity of seeds used by the majority of farmers (65%) in Kurunegala was less than 8 kg/ac. Percentage of farmers who have used the recommended seed rate (12 kg/ac) in Hambantota was 9 percent while this was 8 percent in Monaragala and 3 percent in the Kurunegala district. A substantial percentage (25%) of farmers in the Hambantota district have used more than the recommended rate and this might be due to the practice of broadcasting of seeds as a planting method by most of them instead of row seeding.

4.4 Land Preparation and Crop Establishment

Of the farmers in the sample only about 10% used tractors in land clearing and only 28% of the total sample relied on machinery such as tractors and ploughs in land preparation. All the others did it manually using mammoties.

Majority of farmers in the sample commenced their land clearing and land preparation for green gram cultivation in August for *Maha* season. There was no significant difference among the three selected districts at the time of land preparation. For the cultivation in *Yala* season almost all the farmers commenced their land clearing and land preparation during February and March.

As per the recommendations of the DOA seeds should be planted during October for *Maha* season, during the last week of April to the second week of May for *Yala* season and in February for the third season. According to the survey results almost all the farmers who cultivated green gram in *Maha* season planted their seeds from the third week of September to end of November. Early planting could be seen mostly in the Kurunegala district whilst farmers of the Hambantota and Monaragala districts established their crop during the recommended period. A major decisive factor for planting of seeds is the rainfall and therefore farmers generally commence planting with the onset of the rain. This could be the reason for the deviation in the Kurunegala district. Mid February to Mid March was the most favourable period for planting the third season crop in the paddy fields in the Hambantota district.

According to the survey results 52% farmers of the total sample had practiced row seeding while the other 48% had broadcast their seeds. From upland farmers 73% had used row seeding as the method of crop establishment and invariably farmers who cultivated in paddy fields had broadcast their seeds. For a better crop, as recommended by the DOA, thinning out of unnecessary plants after 12 days of planting is needed as high plant density may increase the occurrence of pest and diseases. However, only a few farmers (9%) had adhered to this practice.

4.5 Use of Fertilizer

Being a leguminous crop, green gram does not require a large quantity of fertilizer to produce a good yield. However fertilizer application helps obtain a better yield from lands which are continuously cultivated. Therefore, DOA recommended to apply urea, Triple Super Phosphate (TSP) and Murate of Potash (MOP) at the rates of 12

kg/ Ac, 40 kg/Ac and 30 kg/Ac respectively before planting of seeds and applying urea 14 kg/Ac after 30 days of planting. As it was evident from the survey, 109 farmers (31% of the total sample) had applied some fertilizer but did not comply with the recommendation.

As per the Tables 4.4 fertilizer usage was minimal among Monaragala farmers and it was comparatively higher among Hambantota farmers. In the Hambantota district, the highest usage of fertilizer was reported among farmers who have engaged in green gram cultivation in the third season. Survey results revealed that most of the farmers use a form of liquid fertilizer at the flowering stage.

Tables 4.4: Pattern of Fertilizer Application across Districts

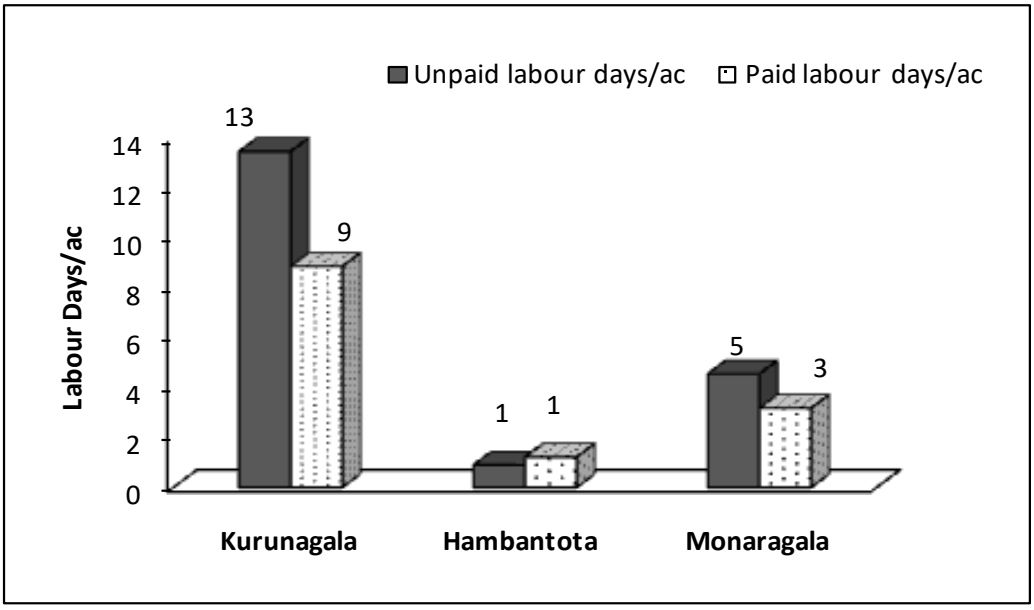
District	Season	Fertilizer Application			
		Applied		Not Applied	
		No. of Farmers	% of Farmers	No. of Farmers	% of Farmers
Kurunegala	*Maha*	26	29	64	71
	Yala	2	13	13	87
	Third	0	0	1	100
	Overall	**28**	**26**	**78**	**74**
Hambantota	*Maha*	18	45	22	55
	Yala	6	86	1	14
	Third	43	53	38	47
	Overall	**65**	**51**	**63**	**49**
Monaragala	*Maha*	13	13	90	87
	Yala	2	40	3	60
	Third	1	10	9	90
	Overall	**16**	**14**	**102**	**86**

Source: HARTI Survey Data, 2013

During the survey, farmers were questioned about the need of fertilizer application for green gram and from the total sample 155 respondents (44%) said that fertilizer application is important due to several reasons. Major reason for the answer of majority of farmers was to get a higher yield and some farmers identified that it is important to apply fertilizer to improve the land degraded due to repeated cultivation of the land. There were 136 respondents (38%) who believed that fertilizer application is not much important for green gram mainly because it is a leguminous crop and on the other hand some said that during the land clearing process more nutrients will be added to the soil as crop residues. Farmers who cultivate the crop in paddy fields claimed that fertilizer applied to the paddy crop remains in the soil and therefore additional fertilizer application was not needed. However, the average yield of the farmers who applied fertilizer was slightly higher than that of the farmers who did not apply fertilizer where the yields of two categories were 196.37 kg/ac and 181.96 kg/ac respectively.

4.6 Weed Control

As weeds compete with the crop since early stages weeding is required to be carried out between 15th and 30th days after planting. Almost all farmers in the study areas (98% in Kurunegala, 81% in Monaragala and 31% in Hambantota) claimed that they weeded their crops. Seasonal analysis which was done to identify the seasonal variation in weed control revealed that 91 percent of farmers cultivated in paddy fields for the third season did not practice weeding. This was the key reason for the less number of farmers who weeded their plots in the Hambantota district.



Source: HARTI Survey Data, 2013

Figures 4.4: Average Labour Used in Weed Control by Districts

Figures 4.4 shows the average labour use for weed control in three selected districts and it establishes the above statement. According to the Figures, labour use for weed control in Kurunegala district was very high while this was very low in the Hambantota district. In most of the areas there was evidence of mammotying being the most prevalent method of weeding while some farmers used chemical control methods. Among the total sample of 352 farmers, 105 farmers (30%) used chemical methods to control weeds in their crops, comprising 60 farmers (51%) in Monaragala district, 28 (22%) in Hambantota (25 of them were cultivated in *Maha* season) and 17 (16%) in the Kurunegala district. According to the survey results farmers who did weeding had practiced it from 5 to 30 days after planting. Majority of them weeded their crops as per the recommendations of DOA (It is recommend to weed the crop fortnightly after planting until the crop canopy develops) and the others who failed to do it at the desired time have claimed that the major reason for delaying was the lack of time due to engaging in paddy cultivation.

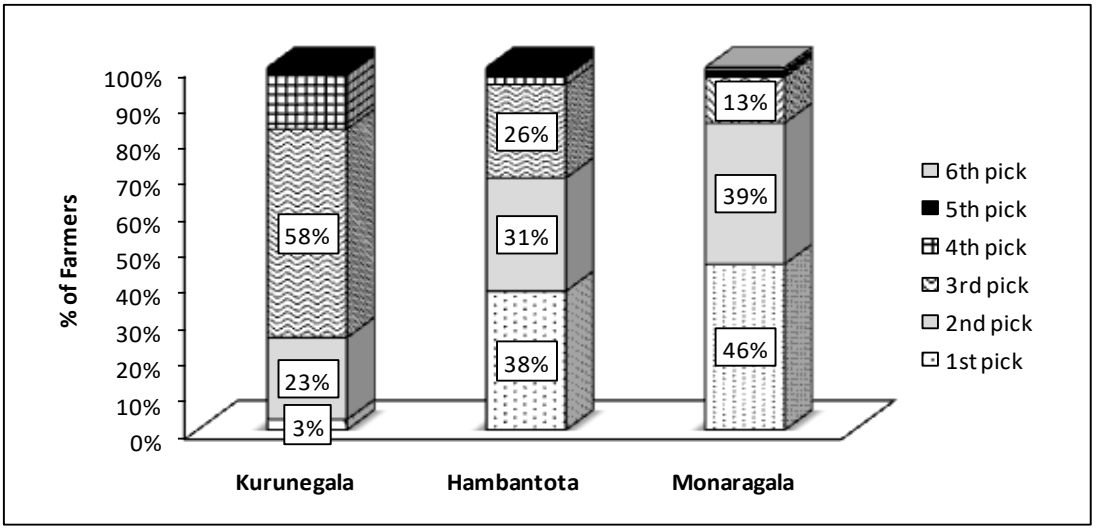
4.7 Pest and Diseases

Mung bean Yellow Mosaic Virus (MYMV) was a disease reported by a large number of farmers of the study sample. Some farmers referred to MYMV as 'Nagawalli disease' or `Yellow disease'. Other diseases reported were fungal attacks and the rust. Leaf and pod borer attack was the main pest attack reported in the sample. District wise analysis was done to identify variation in the major pest and disease attack in three selected districts. MYMV was the major disease reported in all three districts. Leaf and pod borer emerged as the main insect pest that caused damage to the crop in Hambantota and Monaragala while aphids were the main pest attack reported in the Kurunegala district. Other than those major pests and diseases fungal attack in some areas of Hambantota and Monaragala, bean fly attack in all three districts and rust in Kurunegala were reported. On the other hand, wild elephants posed a grave problem for most of the farmers in Kurunegala and for some farmers in Hambantota. This was the major reason for most of the farmers in the Kurunegala district to abandon cultivation.

No control measures were adopted for any of the diseases or pests as mentioned by 67% of farmers (310) out of those who claimed that their crops were affected by a pest or disease. Although the remaining 33% of farmers used several types of agrochemicals, they had been ineffective due to lack of adequate knowledge on the use of agrochemicals.

4.8 Harvesting

It is recommended to harvest green gram when about 80% of the crop is matured and the entire crop could be harvested by 2-3 picks in general. According to the survey results farmers had performed for one to six picks but approximately equal numbers of farmers had involved in 1, 2 and 3 picks per crop respectively.



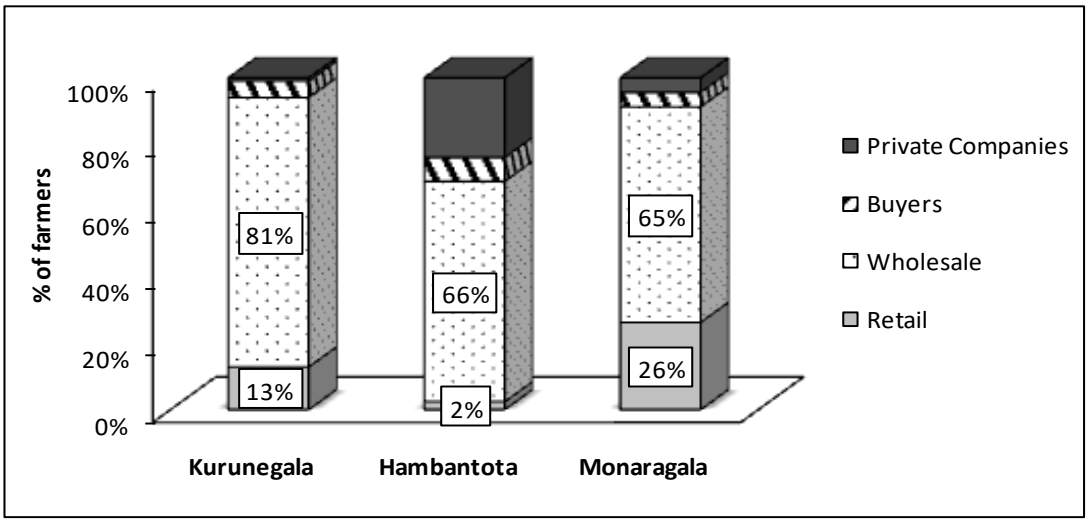
Source: HARTI Survey Data, 2013

Figures 4.5: Number of Picks per Crop by District

As revealed by the Figures 4.5 majority of the farmers in the Kurunegala district harvest their crop in three picks while farmers in Hambantota and Monaragala districts preferred to harvest the entire crop at the first pick. Majority of farmers in the Hambantota district said that they did not go for more than one pick because the opportunity cost of labour is much higher than the income they could get from the rest of the harvest. In case of Kurunegala, farmers usually were not profit oriented and they cultivated green gram in chena lands at subsistence level without paying much attention and generally they used family labour. According to the information received during the survey more than 80% of the total yield can be harvested during the first pick.

4.9 Marketing

Only 12 farmers had used the entire harvest of green gram for their consumption whereas the rest had sold at least a certain portion. In the three districts surveyed, the wholesale shops are the most important buyers at the producer level (70% of the total sample sold their products to wholesale shops in the neighbouring town).



Source: HARTI Survey Data, 2013

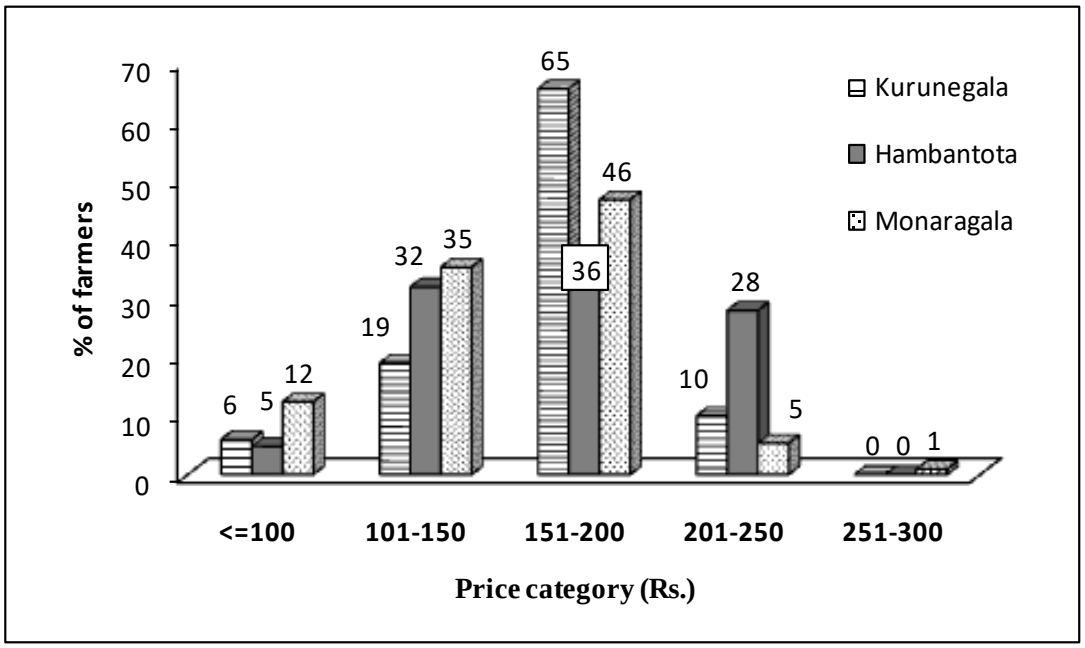
Figures 4.6: Place of Selling Green Gram Harvests by District

In contrast to that, the produce was sold to private company by a considerable number of farmers (24%) in the Hambantota district. As per the information of key informant interviews there was a forward contract with "Plenty Foods" to sell green gram in the Hambantota district and that was the reason for the above mentioned situation. As indicated in the Figures, 26% of the farmers in Monaragala district sold their products to retail shops in the village itself.

4.9.1 Farmgate Prices of Green Gram

As mentioned by the farmers, selling prices of green gram varied between Rs. 30 to Rs. 280 per kilo and the price category recorded in the highest frequency was Rs. 151

to Rs. 200 per kilo (48%). On the other hand, 77% of the total number of farmers who sold their products have received a price between Rs. 100 to Rs. 200.



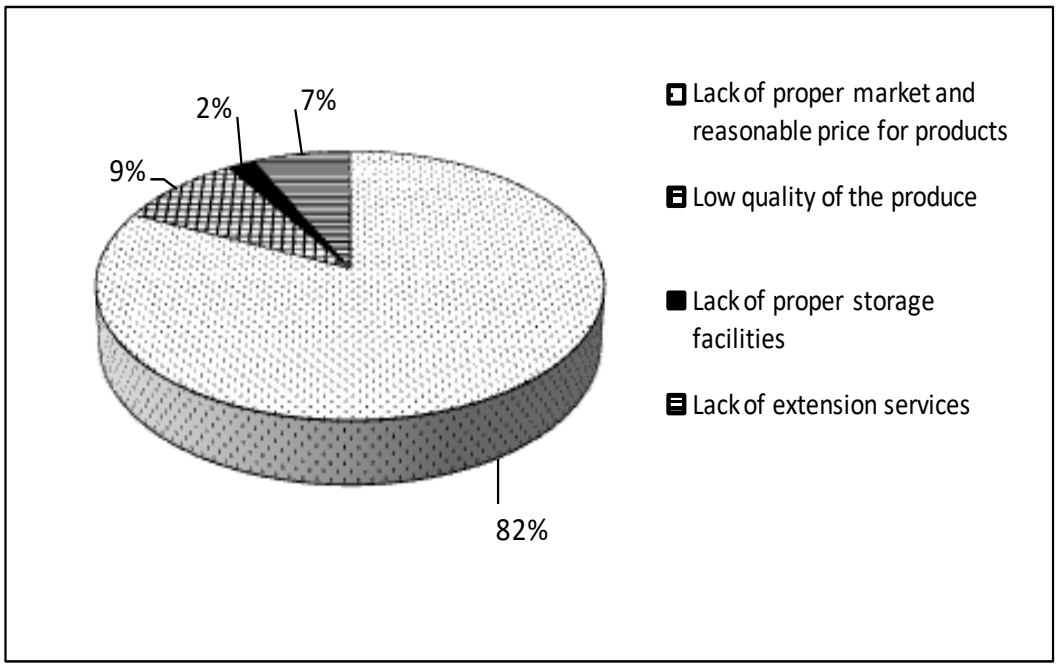
Source: HARTI Survey Data, 2013

Figures 4.7: Farm Gate Prices of Green Gram

During the survey farmers were questioned whether they were satisfied with the price received for their products and the 50% of them replied as being satisfied while the other 50% was were not satisfied with the price they received. 77% of farmers who were not satisfied with the price received were from the Monaragala district. Although 81% of the farmers in the district have received a price between Rs. 100 and Rs. 200, the percentage of farmers who have received a price more than Rs. 200 was less in (6%) Monaragala compared to other two districts in the sample (10% and 28% in Kurunegala and Hambantota respectively). On the other hand, this Figures was comparatively high (28%) in Hambantota and the forward contract existed in Hambantota district with the "Plenty Foods" company would be the reason behind this situation (The company has bought the produce at the price of more than Rs. 200 per kilo).

Farmers were questioned about major problems faced in marketing of their products and possible means to overcome those problems and they were categorized as;

a. Lack of proper market and reasonable prices for products
b. Low quality of the produce
c. Lack of proper storage facilities
d. Lack of extension services



Source: HARTI Survey Data, 2013

Figures 4.8: Problems Associated with Produce Marketing (% of total responses)

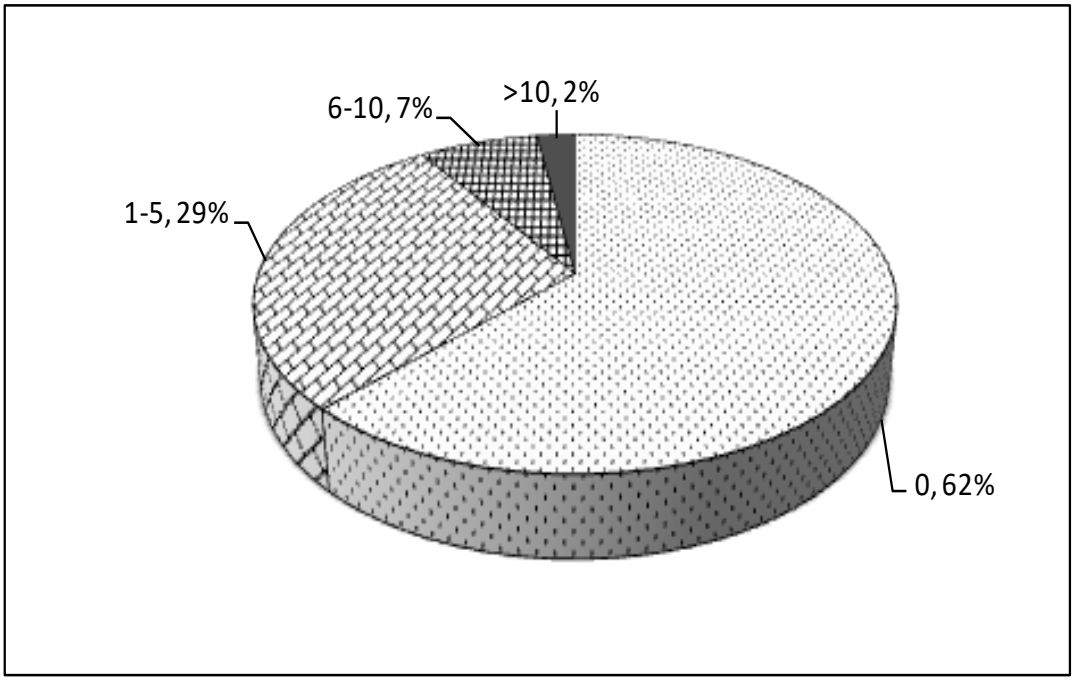
As indicated in the Figures, lack of a proper market and a reasonable price was the major problem. According to 70% farmers they were not able to cover even the cost. In addition, due to the lack of storage facilities farmers had to sell their products immediately after harvesting at a low price. Furthermore, farmers said that buyers decide the price of the product by considering the quality and therefore they could not obtain a reasonable price for their products.

Among the farmers who identified lack of proper market and reasonable price for their products as the major problem in marketing, over 95% suggested to have government intervention to establish sTables producer price for green gram and also to establish a proper mechanism to buy products while only 3% out of the total responses said that it was better to have private sector participation in purchasing of their products. It was also suggested by farmers to expand and improve the existing extension services to provide better awareness on the proper cultural practices, control of pests and diseases and also about the current rainfall pattern to avoid crop damages which reduce the quality of the output since the quality of the product acts as a major decisive factor in determining the farmgate price. Furthermore, it was suggested to have better storage facilities to store their products until the prices soar.

4.10 Exposure of Farmers to Extension Service

In this survey, information on the frequency of visits by farmer to the extension officer and vice versa was collected based on the farmers' response and then, total extension visits per season were calculated by adding up two types of visits mentioned above. The survey data revealed a very low level of exposure of farmers to the extension service in all study locations.

About 62 percent of the total sample had not had at least a single visit during the cropping season. However, about 29 percent of the sample farmers had 1-5 extension visits and another 7 percent had contacted the extension officer 6-10 times per cropping season (Figures 4.7).



Source: HARTI Survey Data, 2013

Figures 4.9: Number of Extension Visits per Cropping Season (% of total sample)

The farmers' views on the adequacy of extension contacts (they were having), to acquire knowledge on cultivation of green gram were also collected. As per the responses, 54 percent of farmers said that current extension contacts were not adequate and needed to be increased and improved whereas 46 percent said that it was adequate. On the other hand, the farmers were asked to give suggestions to improve the existing extension service and the ideas recorded in the highest frequency were; encourage extension officers to visit farmers fields frequently (7% of the total sample), conduct more consultancies with farmer organizations (5%),

conduct more training programmes (4%) and establish a mechanism for rapid delivery of the latest information on new varieties and pest and disease control methods to farmers (4%).

CHAPTER FIVE

Yield Gap and Factors Affecting the Productivity of Green Gram

This chapter presents the analysis of yield data of green gram in three selected districts and the nature and extent of yield gap in the sample. Further it presents the empirical findings on the socio-economic factors affecting the productivity of green gram in Sri Lanka.

5.1 Variation in Green Gram Yields

From the total sample of 352 green gram farmers, 224 farmers who cultivated green gram in 2011/12 *Maha* season were considered as the sample for the yield and productivity analysis as the comparison of yield data in two different seasons were not appropriate due to seasonal weather changes seriously affecting the agricultural production.

Tables 5.1: Variations in Average Productivity of Green Gram by District –2011/12 *Maha* Season

District	Productivity (kg/ac)
	Mean
Kurunegala	160.15
Hambantota	150.41
Monaragala	191.49
Overall	172.34

Source: HARTI Survey Data, 2013

Survey results revealed that the average yield of green gram in selected areas in the 2011/12 *Maha* season was 172.34 kg/ac. Among three selected districts the highest average yield of 191.49 kg/ac was recorded in the Monaragala district whereas the lowest average yield of 150.41 kg/ac was in the Hambantota district. The average yield of the Kurunegala district was 160.15 kg/ac. With the introduction of third season cultivation of green gram, farmers in the Hambantota district were encouraged to cultivate in paddy lands and therefore upland cultivation in *Maha* season was confined only to areas where farmers cultivated green gram over a long period of time at subsistence level. This could be the main reason behind the low yield of the sample under consideration in the Hambantota district. According to the facts received during the survey period, unexpected rainfall during the cropping season was one reason for the low yield in the Kurunegala district and on the other hand, farmers in the Kurunegala district were cultivating green gram in *chena* lands mixing with other crops at subsistence level rather than cultivating it for commercial purposes. Therefore attention paid to this crop was very low when compared to other districts. In case of the Monaragala district, majority of farmers were commercial oriented compared to the Kurunegala district and farmers who

cultivated in the *Maha* season in the Hambantota district and at the same time the cultivated extent of individual farmers were comparatively higher in the district.

5.1.1 Yield Comparison between Varieties

According to the farmers, they were cultivating mainly three types of green gram varieties, MI 5, MI 6 (classified as recommended varieties) and the Australian variety. In case of the farmer not being able to name the variety, those were classified under the category of unidentified and therefore traditional and other local varieties have fallen into this category.

Tables 5.2: Average Yields of Cultivated Varieties by Farmers

Variety	Average Yield (kg/ac)
MI 5	188.23
MI 6	201.71
Australian	145.94
Unidentified	150.24

Source: HARTI Survey Data, 2013

As per the Tables 5.2 the average yields of the recommended varieties are higher than the other two types of varieties which were used by farmers. Despite some farmers believing that the yield of the Australian variety was higher than the DOA recommended varieties this was a good indication of the yield quality of improved varieties by DOA.

5.1.2 Yield Gap of Green Gram

The yield gap is the difference between the potential yield and actual yield of crop and the actual yield is the yield reported by farmers in the study area and the information on potential yield were obtained from the Department of Agriculture. Only farmers who cultivated recommended varieties in stipulated season were taken as the sample for yield gap analysis since the information on potential yields was available only for recommended varieties. As per the Department of Agriculture, potential yield of recommended green gram varieties varied between 1200-2000 kg/ha or 486-810 kg/ac (potential yield of MI 5 is 1200-1500 kg/ha and in MI 6, 1800-2000 kg/ha).

Tables 5.3: Yield of Green gram

Yield (kg/ac)	% of farmers
< 100	35
100 - 500	61
>= 500	4

Source: HARTI Survey Data, 2013

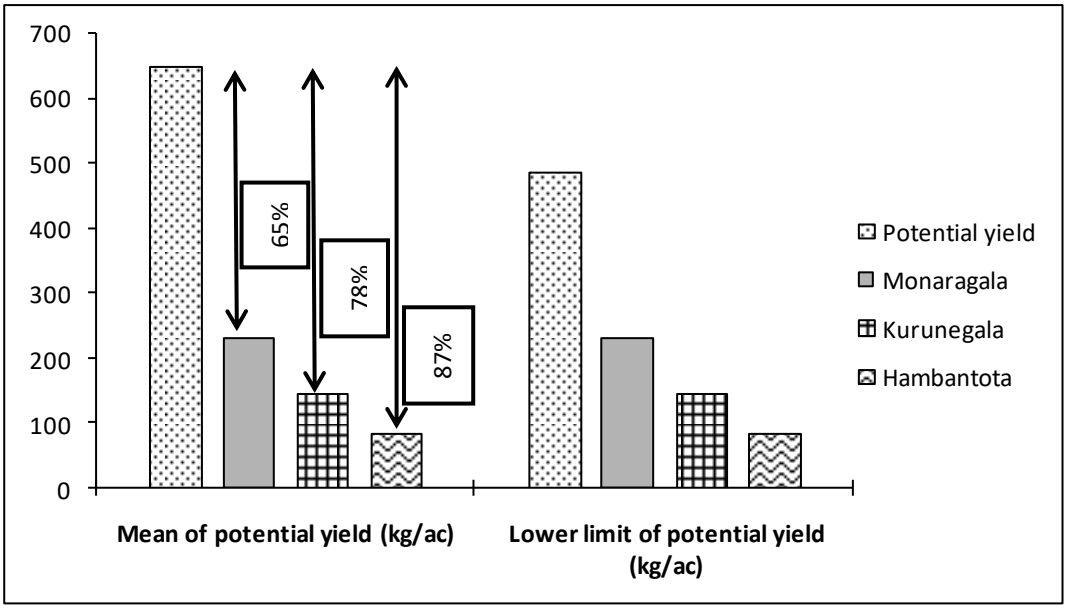
As illustrated by Tables 5.3, only 4 percent of the farmers in the sample obtained yields greater than 500 kg/ac whereas 35 percent of farmers obtained the yields less than 100 kg/ac. Majority of farmers (61%) obtained the yields ranging from 100 – 500 kg/ac.

Tables 5.4: Estimated Yield Gap of Green Gram in Study Locations

	Kurunegala		Hambantota		Monaragala		Overall	
	Yield Gap (kg/ac)	% of Yield Gap	Yield Gap (kg/ac)	% of Yield Gap	Yield Gap (kg/ac)	% of Yield Gap	Yield Gap (kg/ac)	% of Yield Gap
Compared to Mean of the potential yield	503	78	564	87	418	65	470	73
Compared to Lower limit of the potential yield	341	70	402	83	256	53	308	63

Source: HARTI Survey Data, 2013

The data revealed that yield gap existed for green gram in all the areas. The actual yields of the crop were less than the potential yield in all three districts and the resulting yield gaps were very high (Tables 5.4). When compared to the mean value of the potential yield (648 kg/ac), the value of yield gap was 470 kg/ac and the percentage of yield gap was 73%. The yield gap of green gram was 63% compared to the lower limit of the potential yield of 486 kg/ac.



Source: HARTI Survey Data, 2013

Figures 5.1: Comparison of Yield Gaps in Districts

The highest yield gap in particular season was seen in the Hambantota district and the lowest was recorded in Monaragala. As discussed above, most of the farmers in the Hambantota district were moved to third season cultivation and therefore the cultivation of green gram in uplands practiced only by traditional farmers and it could be a reason for the recorded higher yield gap and on the other hand, facts received during the survey revealed that severe pest and disease attacks occurred in major *Maha* producing areas such as Bandagiriya and Weerawila. As a result most farmers in those areas could not get the expected yields.

By considering above results of the yield gap analysis it was clear that it is needed to increase the productivity by 1.5 times than the existing level to achieve at least the lower level of the potential yield of green gram and double the productivity to reach the mean value of the potential yield. To find out the means of improving the productivity it is important to know the factors affecting the productivity and therefore the analysis was done to realize such factors which contributed to the productivity of the crop.

5.2 Factors Affecting the Productivity of Green Gram

A step-wise regression analysis was done using data collected from green gram farmers who cultivated in three selected districts in 2011/12 *Maha* season in uplands to find the factors determining the productivity. Though 352 green gram farmers were included in the total sample of the study there were only 224 farmers who cultivated the crop in *Maha* season and also in uplands. After removing the outliers from that sub sample 202 farmers were included in the tested model.

The variables tested in the model were Family/ unpaid labour cost (FL), Hired labour cost (HL), fertilizer cost (F), machinery cost (M), age of the farmer (A), level of education (G), D_1- seed rate; 1= greater 12 kg/ac 0= Otherwise, D_2 - District; 1= Kurunegala 0= otherwise, D_3- District; 1= Monaragala 0= otherwise, D_4 - Extension visits; 1= at least one visit 0= no visits, , and D_5- variety used; 1- Recommended varieties 0= otherwise , D_6- variety used; 1= Australian variety, 0= otherwise.

The Tables 5.5 shows the results of the empirical model.

Tables 5.5: Results of the Empirical Model

Variables	Coefficient	Std.Error	t-ratio	P>t
Intercept	3.837***	1.307	2.94	0.00
Family/ unpaid labour cost (Rs/ac)	0.032	0.069	0.47	0.64
Hired labour cost (Rs/ac)	0.050***	0.019	2.58	0.01
Fertilizer cost (Rs/ac)	0.061**	0.028	2.15	0.03
Machinery cost (Rs/ac)	0.030	0.035	0.86	0.39
Age (years)	-0.037	0.302	-0.12	0.90
Level of education (years)	-0.152	0.121	-1.26	0.21
Seed rate (1= greater than 12kg/ac)	-0.336*	0.200	-1.68	0.10
District 1 (1= Kurunegala)	0.412	0.284	1.45	0.15
District 3 (1= Monaragala)	0.661***	0.263	2.51	0.01
Extension visit (1=yes)	0.051	0.158	0.32	0.75
Verity 1 (1= Recommended)	-0.097	0.141	-0.69	0.49
Verity 3 (1= Australian)	0.040	0.265	0.15	0.88
F(12, 187)	2.810			
Prob. > F	0.001			
R-squared	0.123			

***, ** and * denote significant at 1%, 5% and 10% respectively

The results R^2 = 0.123, imply that around 12% of the variation in green gram productivity is explained by the explanatory variables. Biophysical factors (climate/weather, soils, water, pest pressure, weeds etc.) and land factor, which are the main factors that contribute to productivity of a crop, were not considered in this model and this can be explained as the reason for low R^2 examined in the model.

5.2.1 Hired Labour Cost

Availability of labour plays a vital role in green gram cultivation as it is a more labour intensive crop especially during the operations of weed control and harvesting. Farmers in the sample had depended on three sources of labour ie; family labour, *attam* labour (both were categorized under unpaid/family labour) and hired labour. In this study both unpaid labour and hired labour were tested in the regression model and result showed that unpaid labour was not significant while the productivity was positively related to hired labour in which the coefficient was 0.050. This implies that a 10% increase in hired labour results in a 0.5% increase in productivity.

It was expected that there would be a positive relationship between productivity and all types of labour. In other words, it was expected that productivity increases with the availability of unpaid labour as green gram cultivation is more labour intensive. But it was noted that the unpaid labour factor was not significant in this study, which means that an increase in the number of unpaid labour in the field would not support to increase the yield. According to Bhavan and Maheswaranathan (2012) this happens since the marginal productivity of unpaid labour may get zero and this sector is classified as a surplus labour sector by Lewis (2010).

However, the model illustrates the farmers with access to hired labour were more productive than the others. When farmers were using hired labour, they hired them when they exactly needed them as they have to pay for them. In case of using family labour, priority was given to paddy cultivation than to other crops. Weeding and harvesting are the most labour consuming operations in green gram and carrying out operations at the proper time may result in a higher yield. The given scenario explains the positive and significant relationship between the productivity and hired labour use.

5.2.2 Fertilizer Usage in Green gram Cultivation

From the findings productivity of green gram is positively related to the cost of fertilizer as shown by the coefficient of 0.061 implying that as farmer increases the fertilizer cost by 10%, the productivity will increase by 0.61%. Even if green gram does not require a large quantity of fertilizer as it is a leguminous crop, application of fertilizer will help obtain a better yield from lands which are continuously used for cultivation.

5.2.3 Seed Rate

In the model, seed rate was tested as a dummy variable and the results showed that the productivity increases with the seed rate up to the recommended level (12 kg/ac) and decreases thereafter as reported the coefficient of -0.336. In other words, when the seed rate increases after the recommended level by 1%, the productivity decreases by 0.336%. This could be explained as, with the continuous increase in seed rate the crop density increases and it may lead to lowering the productivity due to difficulty in weeding. On the other hand, high crop density may accelerate the spread of pests and diseases. Therefore, it is understandable that the yield is lower at certain level of seed rate.

5.2.4 District

Cultivation district of green gram also tested as two dummy variables and the results showed that the productivity of green gram in district 3 (Monaragala) is significant at 1% level. Implying that there is a significant difference in the productivity of green gram in the Monaragala district compared to the productivity in the Hambantota district. In the Hambantota district, most of the farmers cultivate green gram in third

season and this could be the reason for this situation, as in this analysis we consider farmers only who has done upland cultivation in *Maha* season. Results of the model also showed that there is no significant difference in the productivity of the Kurunegala district compared to the Hambantota district.

5.2.5 Variety

In the model, variety was tested as a dummy variable. Though it was expected that the use of recommended varieties will increase the productivity compared to other varieties, results of the model showed that there is no significant difference in using different types of varieties with the productivity of green gram. At the same time, mean comparison was carried out for the average yield of different varieties used by farmers and this also did not show any significant difference in average productivity and the Tables 5.6 shows the average productivity of different varieties.

Tables 5.6: Average Productivity of Different Green Gram Varieties

Variety	Mean Productivity (kg/ac)
Recommended Varieties	178
Traditional Varieties	163
Australian Variety	199

Source: HARTI Survey Data, 2013

As per the Tables, Australian variety imported for the consumption purpose reported the highest average yield proving most farmers' view that this consumption variety is superior in yield with compared to the local varieties. However, results show that the average yield of DOA recommended varieties is higher than the other traditional varieties and this situation can be considered as a good indication to further enhance the government seed distribution programme as it increases the number of farmers using recommended varieties.

5.2.6 Age of Farmer

As expected, productivity of green gram is negatively related to the age of the farmer as shown by the negative coefficient of 0.037 but not significant at any level as reported by the statistics of 0.9.

Tables 5.7: Relationship between the Productivity and Age of Farmer

Age Category (years)	Average Productivity (kg/ac)
<40	190.7099
40-50	159.2016
50-60	142.1368
>60	118.9810

Source: HARTI Survey Data, 2013

As per the results, the highest productivity was reported among the farmers aged less than 40 years and the lowest among the group of more than 60 years. The reason behind this situation was that younger farmers are keen to try out new improved technologies, thereby could obtain a higher yield. In contrast, older farmers with more experience in farming were reluctant to change the way they used to and they always relied on the knowledge they have gained from their own experience. Due to this, they could not get the benefits from the new technologies introduced to improve the yield and therefore lower productivity was reported.

5.2.7 Frequency of Extension Visits

The availability of extension services to farmers was taken from the frequency of visits by farmer to the extension officer and visits by the extension officer to the farmers' field during the period. Since the study was focusing only on green gram production, the interesting fact was to know whether these services are offered to farmers with a view to develop green gram production. However, according to the information given by the respondent-farmers, extension officers mainly focused on paddy cultivation and farmers obtained the support of extension services for other crops only when they had to face problems.

In the model effect of extension services to the productivity was tested as a dummy variable and the results showed that extension services were not a significant variable.

CHPATER SIX

Conclusions and Recommendations

6.1 Summary of Findings

- Majority of green gram farmers were between the ages of 40-60 years highlighting less involvement of youth in green gram farming.

- The average land area owned by an individual farmer was 4.6 acres while the area under green gram was reported as less than 3 acres among the 80% of the total sample.

- Majority of farmers (66%) grew green gram in Maha season and 26% of the sample practiced a third season which was largely popular in the Hambantota district.

- Only 40% of the total sample had a knowledge about available varieties of green gram. Farmers in Hambantota displayed a greater awareness of available varieties and on the contrary was Kurunegala district had a very few farmers who are aware of available varieties.

- Although the Department of Agriculture was the source of seeds for 42% of farmers, 59% of the total sample had grown recommended varieties while the other 41% of farmers had used traditional and other consumption varieties. A considerable number of farmers (36%) in the Hambantota district had grown the Australian variety.

- Main concerns of farmers in selecting a variety were high yield and the quality of the output.

- From the farmers' view point main problems they faced in obtaining required seeds were lack of good quality seeds and difficulty in obtaining seeds at the required time.

- The percentage of farmers who had followed the recommended seed rate was 42% of the total sample.

- The level of machinery use was very low among green gram farmers and the use of machinery was reported only in land preparation.

- Rainfall availability is the major decisive factor for crop establishment and therefore farmers generally commence planting with the onset of rainfall.
- In most cases farmers had rarely followed the recommendations in maintaining the crop specially in agronomic practices such as thinning out,

weeding and pest and disease management as the priority is given to paddy farming.

- The level of fertilizer usage was very low among green gram farmers and application was not always done as per recommendations.

- Weeding and harvesting are the most labour intensive activities in green gram farming and in most of the areas there was evidence of the use of mammoty as a prevalent method of weeding while some farmers used chemical control methods.

- Mung bean Yellow Mosaic Virus (MYMV) was a disease reported by a large number of farmers of the study sample and other diseases reported were fungal attacks and the rust while Leaf and Pod Borer attack was the main pest attack reported in the sample.

- Wild elephants posed a grave problem for most of the farmers in Kurunegala and some in Hambantota. This was the major reason for most of the farmers in the Kurunegala district to abandon cultivation.

- Only 33% of farmers who claimed that their crops were affected by any type of pest or disease used several types of agrochemicals to control them and ineffective measures were observed among the responses due to lack of knowledge on the use of agrochemicals.

- While wholesale shops being the most important buyers at the producer level, the product was sold to a private company by a considerable number of farmers in the Hambantota district as there was a forward contract with "Plenty Foods" to sell green gram in the Hambantota district.

- Nearly a half of the farmers from the total sample has sold their products at a price of Rs. 151 to Rs. 200 per kilo. From the farmers' point of view, lack of a proper market and a reasonable price for their products were the major problems faced by them.

- Green gram farmers in Sri Lanka sell their produce soon after the harvest due to lack of proper storage facilities. However, good prices do not exist during the harvesting season and therefore green gram cultivation remains at subsistence level with low productivity. Therefore it is required to take necessary steps to convert the green gram farming system of subsistence nature into a optimal external input system that achieves high productivity.

- About 62 percent of the total sample had not had a single extension visit during the cropping season. However, about 29 percent of the sample had 1-5 extension visits and another 7 percent had contacted 6-10 times with the extension officer per cropping period.

- Extension service is not adequate in case of green gram and it needs to be improved.

- The average yield of green gram (172 kg/ac) was considerably low compared to the potential yield in selected season and yields of the recommended varieties (178 kg/ac) are higher than the other traditional varieties but, lower than the Australian variety which is used by most of the farmers.

- The actual yields of the crop were less than the potential yield in all three districts and the resulting yield gaps were very high. When compared to the mean value of the potential yield (648 kg/ac), the value of yield gap was 470 kg/ac and the percentage of yield gap was 73%. The yield gap of green gram was 63% compared to the lower limit of the potential yield of 486 kg/ac.

- It is needed to increase the productivity by 1.5 times than the existing level to achieve at least the lower level of the potential yield of green gram and double the productivity to reach the mean value of the potential yield.

- Estimated relationship between the productivity and socio-economic factors of green gram producers established that the degree of using hired labour, cultivation district of green gram, fertilizer cost and seed rate, have a significant relationship with the productivity of green gram in the descending order of significance.

- Seed rate is an important factor in increasing the productivity of green gram. The maximum level of productivity was demonstrated at the seed rate of 12 kg/ac. Further increase in seed rate had shown a decrease in productivity attributing to increased plant density that constrains weeding and stimulates rapid spread of pests and diseases.

- An important aspect of green gram cultivation is revealed through positive relationship between access to hired labour and the productivity. Hired labour is used in agriculture only if it is essential and those who utilize hired labour derive maximum efficiency. If weeding and harvesting, the most labour consuming operations in green gram cultivation are carried out at the proper time it leads to higher productivity for which some farmers who are commercial cultivators use hired labour. Thus the relationship between hired labour use and productivity explains that the productivity is higher in commercial cultivations.

- Even if green gram does not require a large quantity of fertilizer as it is a leguminous crop, and on the other hand most of the farmers had neither used fertilizer in green gram cultivation nor complied with recommendations, application of fertilizer will help to obtain a better yield from lands which are continuously used for cultivation.

6.2 Summary and Conclusions

The study diagnosed the nature and the extent of yield gap of green gram in Sri Lanka, and examined the socio-economic factors affecting the productivity of green gram. The results of the study revealed that the yield gap existed for green gram in all three selected districts and the reported yield gap was very high.

The other main objective of this study was to investigate the socio-economic factors affecting the productivity of green gram in Sri Lanka. After estimating the relationship between the productivity and various socio-economic factors, the findings show that various socio-economic factors have to be reviewed in order to increase the productivity of green gram in the country. The results described that hired labour, district, fertilizer cost and seed rate have a significant relationship with the green gram productivity. These are the factors which should be taken into account by relevant parties in order to increase the productivity of green gram. There are other factors such as age of the farmer and education which in this study has shown negative coefficients, but explained an insignificant relationship to the green gram productivity. One of the findings is that educated people are not attracted to the agriculture sector in the country thus, move from rural areas to urban areas for better employment opportunities.

However, based on the findings, it can be concluded that labour, knowledge (on varieties, seed rate, proper cultural practices etc) and extension service are the important socio-economic factors that have an effect on the productivity of green gram in Sri Lanka.

6.3 Recommendations

- Since the extent of land available is invariable farmers should be encouraged to use fertilizer in order to achieve high productivity.

- As green gram is a more labour intensive crop it is essential to develop a variety which allows mechanized operations specially labour consuming operations such as harvesting and weeding and introduce low cost machines.

- The Government should improve current methods of gathering and dissemination of information and increase its current level of extension services to provide better awareness on proper cultural practices, control of pest and diseases and about changing rainfall pattern to avoid the crop damages which reduce both the quality and the quantity of output.

- The current scenario resulting in the low green gram productivity in Sri Lanka is attributed to subsistence nature of farming caused by low prices prevailing during harvesting season and lack of storage facilities to store the products until the prices increase. Therefore policies should be formulated to promote

investment on value addition that would offer high prices for green gram, to encourage forward sales contracts with the participation of the private sector and to assist improving storage facilities.

- Meanwhile the existing government seed distribution programme should be improved in order to provide every farmer with adequate amount of good quality seeds on time.

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