Baseline Survey
National Food Production Programme: 2016 - 2018

M.A.C.S. Bandara
W.A.N. Wijesooriya
M.P.N.M. Dias
G.G.de.L.W. Samarasinha
R.D. Wijesinghe
R.Y.D.M.R.N.K. Rambukwella
T. P. Munaweera
P.C. J. de Silva
R.P. Vidanapathirana
H.J.C. Jayasooriya
I.K. Edirisinghe
M.D.S. Lurdu
D.T.P.S. Dharmawardhana
B.A.D.S. Bamunuarachchi
P.A.J. Champika
R.M.M.H.K. Rambodagedara
J.A.U.P. Jayasinghe
I.P.P.M. Wijesinghe

Research Report No: 235 January 2021

Hector Kobbekaduwa Agrarian Research and Training Institute
114, Wijerama Mawatha
Colombo 07
Sri Lanka

First Published: 2021

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Final type setting and lay-out by: Niluka Priyadarshani De Silva

ISBN: 978-955-612-267-1

Suggested citation: Bandara, M.A.C.S., Wijesooriya, W.A.N., Dias, M.P.N.M., Samarasinha, G.G.de.L.W., Wijesinghe, R.D., Rambukwella, R.Y.D.M.R.N.K., Munaweera, T.P., de. Silva, P.C.J., Vidanapathirana, R.P., Jayasooriya, H.J.C., Edirisinghe, I.K., Lurdu, M.D.S., Dharmawardhana, D.T.P.S., Bamunuarachchi, B.A.D.S., Champika, P.A.J., Rambodagedara, R.M.M.H.K., Jayasinghe, J.A.U.P. and Wijesinghe I.P.P.M. (2021). Baseline Survey: National Food Production Programme: 2016 - 2018. HARTI Research Report No: 235, Hector Kobbekaduwa Agrarian Research and Training Institute, Colombo, Sri Lanka.

FOREWORD

Farming is an indispensable part of the rural economy in Sri Lanka accounting for seven percent of GDP and 25 percent of the Sri Lankan workforce. We need to support the farming systems that are viable in the long term, particularly for smallholder farms, to secure the livelihoods of rural populations, generate a decent income and provide a basis for inclusive growth and poverty reduction while securing the countries food sufficiency.

Today, agricultural systems across the world especially in the Asia Pacific regions are challenged by climate change and other threats such as ever increasing energy costs. Sustainable and resource-efficient agricultural practices help farmers to adapt to the change and improve their livelihoods while reducing greenhouse gas emissions from farm activities.

National Food Production Programme necessitates the development of sustainable food value chains in order to offer innovative pathways out of poverty, e.g by local value addition through local processing and by linking farmers directly to higher-value export markets while increasing food self-sufficiency of the country reducing import costs.

I wish to congratulate the authors of this report for undertaking this valuable piece of study, which provides much insight to the food production programme that has been implemented in 2016-2018. This study will also enable benchmarking the changes taken place as a result of implementing the National Food Production Programme. The findings will provide a clear direction for the relevant authorities for further planning and monitoring the progress in the coming years.

Senior Professor Ranjith Premalal De Silva
Director/CEO

ACKNOWLEDGEMENT

First and foremost, I wish to pay my tribute to the farming communities of eighteen districts of Sri Lanka for their valuable support and co-operation extended during the survey. The officers of the Agriculture Department, Agrarian Development Department, Irrigation Department and Provincial and Inter Provincial Agriculture Departments, who provided necessary support and information for this study, are highly appreciated.

My appreciation goes to former Directors Mr. Haputhanthri Dharmasena, Mr. K.E.W. Karalliyadda, Mr. Keerthi Kotagama and Acting Director Mr. W.H.D. Priyadarshana for their constant direction and support provided throughout the process of conducting and finalizing the report. Further, my heartiest thanks go to Senior Professor Ranjith Premalal De Silva, Director/Chief Executive Officer of HARTI and Dr. W.A.R. Wickramasinghe, Additional Director of HARTI for facilitating published the report.

I am very much grateful to Mr. J.K.M.D Chandrasiri, and Mr. R.L.N. Jayatissa former Additional Directors of HARTI for reviewing the earlier versions of this report and providing valuable suggestions. Researchers of Ms M.T. Padmajani, Ms G.G.De.L.W. Samarasinha and Miss Uthpala Jayasinghe are highly appreciated for their commitment rendered during the proposal development stage and the final report reviewing stage. Further thanks are also due to all the division Heads and Researchers of HARTI who have contributed to the relevant chapters of this baseline study report. Furthermore, I will express my sincerer thanks to all the research and statistical staff of HARTI who engaged in data collection and supervising the field data collection phase. Services rendered by M.D.L. Senarath, Senior Analyst Programmer of HARTI and his staff in analyzing the data and preparing necessary data tables for this report are thankfully acknowledged.

The excellent services provided by Ms. Niluka Priyadarshani de Silva and Ms. Uthapala Jinadari of HARTI in typesetting the report and the preparation of final manuscript are greatly valued. My sincere thanks are due to Mr. H.A. Siriwardana, an outside copy editor and Mrs. K.S.N. Perera, Editor, HARTI for their expert editorial assistance. Finally, my appreciation goes to Mr. C.U. Senanayake, Head/Publication Unit of HARTI for proof reading the final report and making arrangements for printing the report. I would extent my thanks to the printing staff of HARTI as well. Finally, I wish to reiterate that this project has been a truly remarkable team effort which highlights the value of each individual contribution – big or small - to the final product.

M.A.C.S. Bandara
Study Coordinator

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LIST OF ABBREVIATIONS

AER	-	Agro Ecological Regions
ASC	-	Agrarian Service Centre
COP	-	Cost of Prodcution
CIF	-	Cost, Insurance and Freight
CWE	-	Cooperative Wholesale Establishment
DDEC	-	Dambulla Dedicated Economic Centre
DEA	-	Department of Export Agriculture
DEC	-	Dedicated Economic Centers
DOA	-	Department of Agriculture
DS	-	Divisional Secretariat
FCRDI	-	Field Crop Research and Development Institute
GN	-	Grama Niladhari
HIES	-	Household Income and Expenditure Survey
MPCS	-	Multi-Purpose Cooperative Societies
NFPP	-	National Food Production Programme
OFC	-	Other Field Crops
PMB	-	Paddy Marketting Board
USDA	-	United State Department of Agriculture

CHAPTER ONE

Summary of the Survey Findings

1.1 Household Demographic and Socio-Economic Characteristics

The baseline data was obtained from 2553 households in 66 Divisional Secretariat areas in 20 districts. A total of 1,660 of the households (92%) were headed by a male and 139 households (8%) were female-headed.

Regarding the age of the head of household, majority were in the age category of 50-60 years (32%) and 26 percent of the sample was aged between 40-50 years. Only three percent of the sample household heads were below the age of 30 years while, 24 percent were above 60 years.

Average household size of the survey sample is 4.7 members and this was consistently higher than that of the average household size of 3.8 members in Household Income and Expenditure Survey of 2016 in Sri Lanka. Majority of the sample households had 4 members (32%) in their family and it varies 1 – 9 in total sample.

Majority of the heads of households (37%) reported to have an education up to GCE Ordinary Level while 30 percent have achieved education up to GCE Advanced Level. Nearly 91 percent of the economically active population of the sample was employed and remaining nine percent is unemployed and seeking for jobs. Majority of the household heads (86%) in the survey sample are engaged in farming or animal husbandry as their primary employment. However, there are some deviations from main trend in some districts such as Matara, Gampaha, and Kurunegala etc. As an example in Matara district only 38 percent of sample farmers were involved in agriculture and these values are 50 percent and 60 percent respectively in Gampaha and Kurunegala districts.

1.2 Agricultural Inputs

The following section of the chapter discusses the availability and accessibility of inputs to main agricultural production by the sample farmers.

1.2.1 Land

Cultivated land size was discussed under three main land types of lowland, highland and chena. More than 44 percent of the sample farmers have 2-5 ac of lowlands and 29 percent of them have 1-2 ac of lowlands. Farmers who are having more than 5 ac of lowland are only 12 percent. Lowland endowment which is less than or equal to 0.25 ac is nearly four percent. Highland and chena land size distribution shows the same pattern as lowland. Highland land size category 1-2 ac and 2-5 ac have nearly 30 percent of representation. Nearly 54 percent of the Chena lands are in 2-5 ac land extent category and there are around 30 percent of chena lands that are larger than 5 ac.

When considering the land size distribution based on the type of crop, more than 50 percent of the paddy land holdings come under the land category of 2-5 ac. Also for the most of cereal crops and pulses including maize, finger millet, cowpea, green gram, soybean and black gram, the prominent land category is 2-5 ac followed by 1-2 ac categories. Widespread land class category for most of the low country vegetables and potato cultivation is 1-2 ac for in contrast, noticeable amount of lands cultivated with up country vegetables are at in the land group of 0.25-05 ac. Condiments including big onion, red onion, chilly and fruit crops included in the survey are mostly cultivated in 2-5 ac land parcels.

1.2.2 Irrigation

There are four main sources of water for crop production including, major irrigation, minor irrigation, rainfed and ground water. Type of irrigation method adopted to irrigate the crop is important aspects in water use efficiency concerns. In lowland crop production most common irrigation method is flood irrigation and more than 75 percent of farmers practicing it. Under such circumstances farmers who are using improved irrigation technologies like drip and sprinkler irrigation is less than seven percent.

1.2.3 Seeds

Seed is one of the most important inputs used in crop production and basic determining factor of the quantity and quality of the production. For paddy cultivation more than 54 percent of the farmers are using locally produced Agriculture Department certified seeds and rest of the 30 percent of paddy farmers are using locally produced seeds that are not certified by the Department of Agriculture. Similarly, majority of the other field crop farmers are using locally produced certified seeds and the second large group of people is using locally produced uncertified seeds. On the contrary, majority of the farmers who are cultivating finger millet, red onion, groundnut, black gram, turmeric, gingerly, ginger and okra are using locally available uncertified seeds by highlighting the issue of unavailability of good quality certified seeds in the market.

Department of Agriculture certified seeds which are available in DOA outlets and Agrarian Services Centres became the most popular place of seed purchasing by reporting more than 35 percent of the sample farmers. Furthermore, 26 percent of the farmers are using self-produced seeds and another 11 percent has used the seeds purchased from neighbouring farmers for their cultivation. Farmers who have purchased seeds from private companies is less than nine percent , while 17 percent has purchased seeds from nearby local market. However, it is important to highlight that when farmers are cultivating a third season most of them have used certified seeds purchased from DOA outlets.

1.2.4 Credit

Credit is another important input when it comes to agriculture. Out of total 2553 sample farmers, 64 percent of them have obtained loans in the period of previous two years starting from the beginning of 2015 to the end 2016. Highest number of loans was recorded in Batticaloa district and it recorded as 97 percent of the district sample. Least number of loans was recoded as 18 percent in Gampaha district. Furthermore, it is important to note that Batticaloa district farmers selected for the crops green gram, cowpea and paddy and Gampaha district for ginger and turmeric. Further studying on source of the credit revealed that farmers have obtained loans from both formal and informal sources but, more than 72 percent of the majority has acquired loans from formal sources. From the total of loan obtained 1172 farmers, 62 percent of them have received loans for agricultural purposes.

More than 68 percent of farmers are continuing the loan repayment and another 20 percent reported that they are still in grace period. Remaining 10 percent is reported they are not repaying their loans due to various reasons that hinder their loan repaying capacity. Reviewing the difficulties faced by farmers when they are seeking loans from formal sources, 23 percent of them reported they faced the difficulty in finding a suitable guarantor. Another 22 percent stated the adversity of obtaining loan in required time from formal sources. In addition, farmers also indicate the troubles of fulfilling required prerequisites for a credit in formal sources and higher interest rates specifically charged by the informal sources.

1.3 Agricultural Marketing

Almost all type of crop growing farmers has always pointed out the issues with marketing of their products. Among various marketing channels available in the agricultural sector more than 72 percent of the sample farmers sell their products to local private traders or village level collectors irrespective of the crop. Farmers have indicated several marketing issues based on their experience and according to that more than 46 percent of the sample farmers mentioned not having good price for their product as main issue. In addition to that there are some more concerns like difficulties in maintaining requested quality of the product, absence of assured marketing channel for the production, quantity restrictions in purchasing specially in paddy, etc.

1.4 Access to Agricultural Extension and Participation in Groups

Farmers get update on new technologies and agriculture related information from different sources including formal and informal sources. According to the survey results 64 percent of the sample farmers reported they received extension service of Agricultural Instructor and they consider it as priority source of information based on the accuracy and reliability. Other 44 percent stated that they get information via Agricultural Research and Productivity Assistants. Neighbouring farmers, farmer organizations and private traders who are selling agricultural inputs also play an important role as information dissemination based on farmers' point of view. However, electronic and print media is not familiar to farmers as source of agriculture related information. Even though, farmers get access to agricultural information through vast array of sources they have well recognized government extension services as priority source.

Further detailing of the type of information received through different agencies reveal that more than 63 percent of the incidences they get awareness on pest and disease management. More than 53 percent of the sample farmers stated that they received information on seeds and fertilizers. Less than 20 percent of them have received knowledge on new agricultural technologies, marketing and water management techniques etc.

Approximately, 42 percent of the farmers complained about the weaknesses in government extension service. Major issue highlighted by more than 63 percent of the sample farmers is it is difficult to meet instructors in the field and therefore, they cannot get accurate information on time.

1.5 Crop Diversification and Commercialization Trends

Since one of the major intentions of implementing NFPP is to increase the production of OFCs via crop diversification, farmers were asked about their willingness to diversify their cropping system. Out of total sample of 2553 farmers, around 59 percent of them are willing to shift for a new crop. Because of the importance of this information in future decision making following Table 1.1 represent the most preferred three crops given by the farmers in each district. As present in the Table 1.1 most of the farmers are preferred to cultivate OFCs and type of crop differed based on prevailing agro climatic situation of each locality and crop climatic requirement.

Table 1.1: Farmer Preference for Crop Diversification

District	Most preferred three crops

	District Total	Respondents willing to shift for a new crop	1st priority	2nd priority	3rd priority
Matale	79	54%	Chili	Maize	Okra
Kurunegala	310	47%	Ground nut	Ground nut	Maize
Anuradhapura	290	58%	Papaya	Green gram	Soy bean
Polonnaruwa	78	65%	Maize	Big onion	Ground nut
Ampara	161	54%	Pineapple	Maize	Black gram
Monaragala	226	70%	Maize	Green gram	Chili
Vavuniya	79	75%	Papaya	Mango	Jack
Puttalam	118	69%	Water melon	Papaya	Water melon
Hambantota	255	62%	Chili	Maize	Water melon
Mulativ	39	59%	Ground nut	Chili	Black gram
Batticaloa	118	59%	Papaya	Red onion	Papaya
Mannar	79	61%	Ground nut	Maize	Ground nut
Jaffna	118	57%	Finger millet	Chili	Chili
Trincomalee	78	42%	Red onion	Maize	Green gram
Badulla	130	62%	Turmeric	Knol khol	Knol khol
Nuwara-eliya	126	60%	Tea	Beetroot	Leeks
Matara	39	46%	Cinnamon	Maize	Brinjal
Rathnapura	76	66%	Maize	Finger millet	Brinjal
Kilinochchi	78	60%	Cowpea	Cowpea	Ground nut
Gampaha	76	53%	Pineapple	Pineapple	Okra
Total	**2553**	59%			

Source: HARTI Field Survey Data, 2016

1.6 Impacts of Climate Change

Negative effects of climate change are no longer a projection. In Sri Lanka agricultural activities are negatively affected due to climate change. With this understanding farmers were asked about their awareness on climate change. According to the baseline survey results more than 88 percent of the sample farmers are aware on the climate change. Further more than 87 of the respondents reported that they are experiencing the climate change impacts especially when it comes to agricultural production.

Subsequently, farmers were asked to elaborate more on the events they are experiencing. Accordingly, more than 80 percent reported that rainfall pattern and the frequency of the rainfall have been changed when it compared with last decade. Further 77 percent recounted that the rainfall intensity and total volume of rainfall received for a particular season has also altered. Yet again, 69 percent of the farmers have got the impression of significant fluctuations in the atmospheric temperature more than ever.

1.7 Challenges in Crop Production

Since agriculture is the main livelihood of most of the sample farmers, they were questioned about the major challenges that they are facing during crop production. According to the findings majority of the farmers (42%) stated water scarcity or not having an assurance on water availability as main challenge. Moreover, nearly 41 percent of the respondents have identified not have quality seeds or planting material and high cost of planting materials as major difficulty in their livelihood. In addition, high cost of other most important inputs such as pesticide and fertilizers and depletion of the quality of the inputs regarded as an issue for the farmers. Among many other issues faced in various magnitudes 32 percent of the farmers designated damage caused by wild life as huge challenge for the crop production.

CHAPTER TWO

Introduction

2.1 Background

Presidential Task Force of Sri Lanka has been initiated a 'National Food Production Programme' for the period of 2016 to 2018 as foundation step of establishing productive agricultural system based on agro-ecological zones while maintaining sound coordination between all parties involved in the production process. The study was designed as a baseline study to the National Food Production Programme (NFPP) by the request of Secretary to the Ministry of Agriculture and carried out as a rapid study. Purpose of this study was to undertake a baseline survey as part of the start-up of project activities to obtain a reference against which to assess the achievements and effectiveness of the programme. The results of this baseline survey will enable benchmarking of changes taken place as a result of the programme and useful to inform relevant authorities to further planning and monitor the progress. Food production programme has been covering the main areas of agriculture including crop production, dairy production and fisheries. However due to time and financial constraints this baseline survey undertaken by Hector Kobbekaduwa Agrarian Research and Training Institute only covered the food crop production and agricultural development component of the programme which have been mainly undertaken by Ministry of Agriculture and Department of Agriculture.

2.2 National Food Production Programme (NFPP)

Sri Lanka has been spending a huge sum of money to import main food items including livestock and fisheries products annually. There is high potential and possibility to produce most of the imported food items locally, and it will reserve a considerable amount of foreign exchange that has been spent on food commodity imports. Therefore, considering the above facts, "National Food Production Programme" (NFPP) was implemented during the period from 2016 to 2018 to achieve self-sufficiency in quality food through strategies and activities, proposed by the relevant national and provincial line ministries, departments and institutions.

The national food production programme is an agriculture development programme that was implemented by the Presidential Task Force of Sri Lanka for the period of 2016 to 2018 with the collaboration of more than 15 relevant stakeholders including national and provincial level ministries, departments and institutions to achieve the self-sufficiency in quality food through various strategies and activities. The programme consists of several components and those are,

Component 1: Increase food production and agricultural development
Component 2: Livestock development
Component 3: Increase fisheries and aquaculture production
Component 4: Promotion of plantation crops

Main objectives of the NFPP were to make the country self-sufficient in food which can be produced locally, utilizing the lands available in optimal manner thus saving foreign exchange on food imports, produce sufficient quality food for people by adopting environmentally friendly cultivation methods and using chemicals for weeds and pests to the extent of minimum possible, ensure food security through proper management of buffer stocks, ensure balanced development in the country by introducing and implementing a food production programme based on agro-ecological zones, minimize production cost and maximize productivity through application of quality inputs and appropriate technological methods, establish a proper coordination among all stakeholders who are involved in the domestic food production programme and make it part and parcel of daily life of people including school children, farmer organizations and civil organizations.

For the above NFPP, government expected to invest approximately rupees billion 27 starting from 2016 to 2018. The NFPP consisted of several components to achieve its primary targets. Due to the continuation of the project and spending of a large sum of money, post project evaluation and progress monitoring is utmost important to do the project in a right path and measure the economic impacts.

Baseline information is crucial inputs for post impact evaluations. It has to be collected at an early point in the project cycle, and it can be used as benchmark and indicators. So, conducting a baseline survey is an important and necessary for monitoring and evaluation of the NFPP.

2.3 Aims and Objectives of the Baseline Survey

The purpose of the NFPP baseline study was to take a first measurement of the major long-term indicators for success of the NFP programme. The specific objectives of the baseline were:

1. To serve as the first measure of all main programme indicators, thus establishing the foundation for the programme's monitoring and evaluation (M&E) system (the assessed conditions as of the start of interventions).
2. To establish or validate the indicator targets described under each crop.

CHAPTER THREE

Survey Design

3.1 Survey Locations

Different components of the programme was implemented in different parts of the country covering all nine provinces and 25 districts. Surveying the whole population that is dispersed all over the country with limited time and resource availability is not realistic. Therefore, a random sample was drawn from the population which allows making projection or generalizing to entire population.

3.2 Sampling

The purpose of the baseline survey was to obtain information on all socio-economic and production data related to agricultural activities in Sri Lanka. Therefore, it felt more sensible to seek such information from the population who are mostly involved in agriculture activities, i.e. the rural population. The target population for the baseline survey was therefore not the total population of Sri Lanka, but those who live in areas classified as “agricultural” areas. Since the different components of the project implemented in different areas, the sample was drawn in a way to represent all 25 districts and all crops coming under the NFPP.

Total sample size was decided based on the total agricultural population and the total agricultural land extent under each crop in each district. The calculation of the sample followed a ‘probability proportional to size’ approach, based on the proportion of agricultural households in each district. A stratified random sampling technique was employed in selecting the survey sample. At first, secondary data including the number of households, agricultural land extent, and the major crops grown in the area, etc. was collected at divisional secretariat level and based on the above secondary information sample size for each district was determined. Final sample based on the district and crop was given in Table 3.1.

According to the Table 3.1, finally 20 districts were selected for the survey by considering the dispersion of more than 18 crops that would cover under NFPP. Total number of sample farmers interviewed was restricted to convenient number of 2553 considering the time, resource availability and handling capacity.

Table 3.1: Summary of the Final Survey Sample based on the District and Crop

District	Main crops	Sample size
1. Matale	Big onion, Low country vegetables	78
2. Anuradhapura	Maize, Finger millet, Soybean, Chili, Paddy, Gingerly, Low country vegetables	290
3. Polonnaruwa	Soybean, Paddy	78
4. Kurunegala	Paddy, Black gram, Cowpea, Groundnut, Ginger, Turmeric, Fruits	310
5. Ampara	Maize, Red onion, Cowpea, Soybean, Paddy	161
6. Monaragala	Maize, Green gram, Groundnut, Black gram, Finger millet, Gingerly	226
7. Vavuniya	Cowpea, Black gram	79
8. Puttalam	Chili, Potato, Low country vegetables	118
9. Hambantota	Red onion, Green gram, Groundnut, Paddy, Finger millet, Chili, Fruits	255
10. Mullaitivu	Red onion	39
11. Batticaloa	Paddy, Green gram, Cowpea	118
12. Mannar	Big onion, Gingerly	79
13. Jaffna	Red onion, Potato, Big onion	118
14. Trincomalee	Red onion, Groundnut	78
15. Badulla	Potato , Up country vegetables	130
16. Nuwara eliya	Potato, Up country vegetables	126
17. Matara	Paddy	39
18. Ratnapura	Fruits, Low country vegetables	76
19. Kilinochchi	Chili, Paddy	78
20. Gampaha	Ginger, Turmeric	76

Source: HARTI Field Survey Data, 2016

3.3 Questionnaire

The baseline household survey was conducted by using a multi-module questionnaire, with a specific focus on agricultural production, accessibility and availability of agricultural inputs, extension services and marketing channels and rural finance (lending and credits) and food security. Further to that focus group discussions were conducted for each crop that covers under the NFPP. The draft questionnaire was developed simultaneously in English and Sinhalese, and once the questionnaire was finalized it was translated into Tamil language. A questionnaire was finalized after conducting two questionnaire pre-testing rounds in the field. The NFPP baseline survey questionnaire consisted with 22 sections. The focus and purpose of each section of the questionnaire was detailed as follows.

When the interviewer arrived at the household, she or he introduced her- or himself and explained the purpose of the survey. If the respondent agreed to give an interview the eligibility of the household for this study purpose was checked. Only the households that grow at least one or more of the selected food crops were interviewed.

Household identification section includes basic data on the district, DS division ASC, GN and village where the interviewed household lives. Such data is important to compare the results by locality. At the same time the names of the interviewer and supervisor and date of data collection were included for future reference

The Section two, Information on the farm household holds data on the all household members including head of the household (name, age, sex, marital status, level of education). This data on the household, together with data on the location, is important for subsequent rounds of survey, if it is decided that the same households – or a subsample of them – should be revisited in later years.

The section four of the questionnaire is about household land and it collects information about all the land endowments hold by the household. It collects more on land type, ownership status, water source, pattern of cultivation, issues related to a particular land and irrigation facilities etc. Household crop production and related information section consist with three sub sections separately for lowland, upland and home garden land with relate to data of 2015/16 *Maha* season, 2015 *Yala* season and 2015 intermediate season. This data provides information on multi-cropping/inter-cropping on both rainfed and irrigated land. Further, in this section, the respondents were asked about each crop cultivated in a particular land in the particular season, seed type, variety, yield, irrigation method, quantity sold, whether they had experienced damages or losses to these crops between planting and harvesting, and if yes, the reasons for such losses.

The data on production can be used to calculate estimates of yield, but the interpretation of such information is difficult, especially if intercropping has practised, and if the crop was not planted over the entire plot reported in the previous section. Information on causes of crop damages and losses is important to help explore ways of reducing such losses, especially if the losses are substantial.

Section five of the questionnaire inquired about the cost of production data related to the main crop that the household is considered related to NFPP. This section has all the information of quantity, price and expenditure of all inputs used in crop production such as seeds, fertilizer, pesticides, machinery, labour, and marketing.

In subsequent subsections information on improved technical methods used in cultivation of particular crop, nature of the indebtedness and sources of credit, information related to marketing of agricultural production, farmers' involvement in community based organization, perception on extension service and acquisition of new knowledge more specifically the questionnaire asked the respondents on their knowledge of, and interaction with, the agricultural extension services, and the type of services they had received – if any – during the past six month, farmer perception and experience on climate change. The respondents were also asked if they, or members of their household, take part in one or more types of community organizations and if they are involved whether he, or member of the household, had participated in training activities (and, if yes, what types of training). From those who have participated for training, type of training they have received was also inquired.

Under the section of farming tools and farm equipment the farmers were asked whether or not they possessed certain types of agricultural tools, and if yes, how many. The possession or non-possession of agricultural tools, together with information on the housing condition and the ownership of household amenities provides information on the socio-economic status of the household. The field interviewers were asked to get main materials of construction of the external walls, the roof and the floor of the houses from direct observation. Interviewers also asked the respondents whether or not they owned certain types of common and not-so common, household items.

3.4 Data Collection and Field Monitoring

The data collection related to 18 crops in selected 20 districts was done by 18 teams by the Hector Kobbekaduwa Agrarian Research and Training Institute. Each team consisted of a Researcher as field supervisor, one Statistical Officer or Statistical Assistant and four investigators and a driver. During the second week of March 2016, all Investigators and supervisors received orientation on the questionnaire, and conducted mock interviews in questionnaire pre-testing that were not part of the sample. From October, all teams departed for their respective districts, and data collection started and the data collection was completed by the end of October 2016.

The interviews were conducted by the Investigators, and the field supervisor checked whether the answers given for the questionnaires are acceptable and completely filled in.

3.5 Data Entry, Cleaning and Analysis

Once the field data collection teams returned to the office each questionnaire was checked for the finality and questionnaire coding was practiced. Then the coded questionnaire was sent to the Statistics and Data Processing Unit of HARTI. After data entry was completed data was converted into spread sheets and performed a first check of the raw data. Descriptive data analysis, producing summary statistics, and correlation analysis was done with MS Excel and SPSS statistical package.

3.6 Data Analysis

Data analysis was done using MS Excel and SPSS statistical package. Further to that descriptive statistics was employed to identify the relationships. After that whenever applicable univariate, bivariate and multivariate analysis were used to analyse the surveyed data. In the report separate chapters are available for each crop, providing information on cultivated extent, production and marketing information. The data was demonstrated by using charts and tabular formats.

Chapter Four

Paddy

W.A.N. Wijesooriya

SUMMARY

Sri Lanka views rice as a strategic commodity because of its importance in the diet of the people and income generation of farmers. The average paddy cultivated extent during the period of 2011 to 2015 was 1.146 million hectares and the average production is 4.11 million metric tonnes. Nearly, two third of the paddy extent are grown under irrigated conditions.

Seasonal variation of paddy prices begins an upward trend in the month of September every year and reaches the maximum by the end of December and then records a declining trend, which continues at a rapid rate till March and at a lower rate till May. The second phase of paddy price decline occurs in the months of July and August with the *Yala* season harvest. From August to January paddy prices increase gradually mainly due to the limited market supply of paddy. During December and January rice prices increases at unaffordable levels and it badly affects the urban consumers and other low income groups. In February and March prices are declining sharply adversely affecting the marginalized farmers.

In an average production year nearly 80 percent of the total marketable surplus of paddy in country reached to the markets from Anuradhapura, Ampara, Polonnaruwa, Kurunegala, Hambanthota and Batticaloe districts. The study found that more than half of the respondent farmers sold over 75 percent of their total production and it was prominent in Batticaloe, Polonaruwa, Ampara and Kurunegala districts. In Batticaloe district, large scale paddy farmers sold major portion of paddy immediately after the harvest. Among the issues raised by the farmers, most prominently highlighted issue is the water deficit. Study found that the issues related to paddy marketing are one of another burning issue raised by the farmers in all major producing areas. After popularization of combined harvester, the arrival of high moisture paddy to the markets gradually increased and this created many marketing problems. In all major producing areas, farmers are lack of drying facilities to dry their wet paddy and proper storage facilities especially during the peak harvesting period.

The frequent crop damage caused by wild animals like elephants, peacocks, monkeys and wild boars was reported frequently. Crop damage due to the climate impacts were reported mainly by the farmers in Kilinochchi, Matara and Batticaloa. The other pointed issues related to paddy are availability of agro chemicals, pest outbreak, high labour and machinery cost, lack of extension services, and so on.

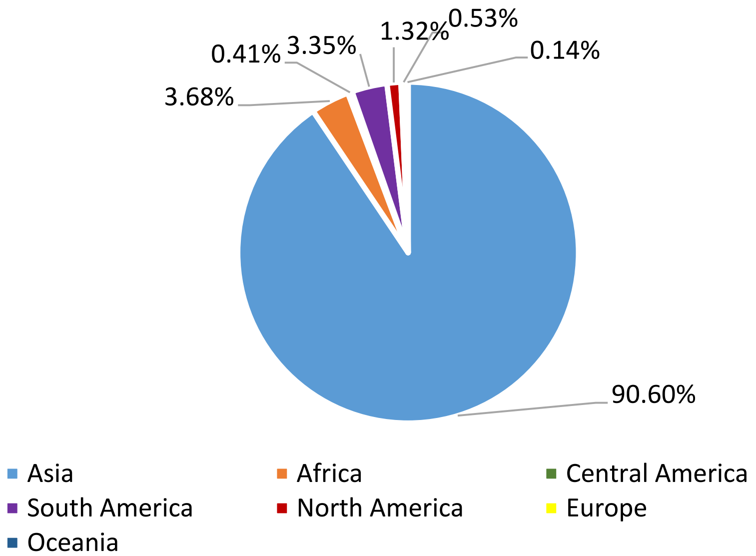
CHAPTER FOUR

Paddy

4.1 Introduction

4.1.1 An Overview of Paddy/Rice Sector

Rice is the staple food of nearly half of the global population. About one billion households depend on rice cultivation for employment and it is their main source of livelihood (IRRI, 2012). Like most Asian governments, Sri Lanka still views rice as a strategic commodity due to its importance in the diet of the poor and as a source of living and an income generation of the farmers. Historically, governments in the main rice-producing and consuming countries had favoured policies that maintained stable prices for consumers in urban centers and provide subsidies to farmers (Hossain, 2004). Asia accounts for nearly 90 percent of the global rice production (Figure 4.1).



Source: Food Outlook, Food and Agricultural Organization, 2016

Figure 4.1: World Rice Production (2012-2014 Average)

China is the largest rice producer in the world followed by India. Indonesia, Bangladesh, Vietnam, Thailand, Myanmar and Philippines are the other major rice producing countries within the Asian region (Table 4.1). Despite being the largest producer, China imports a sizeable stock of rice. The largest exporters of rice are India followed by Vietnam and Thailand (Table 4.1). Currently, cultivation patterns, marketing channels and consumption patterns of rice are changing faster than ever before. Yet there is a tendency among some sectors of the farming community who resist such changes and prefer to go on with the prevailing rice systems. There are tremendous variations in tastes and preferences for rice across the world. The demand for rice is shifting from lower- to higher-quality.

Table 4.1: Rice Production, Imports and Exports in Asia (Million Tonnes) *- 2012-2014 Average*

	Production	Imports	Exports
ASIA	**446.1**	**20.2**	**34.0**
Bangladesh	34.2	0.5	-
China	141.5	5.5	0.4
Republic of China	1.2	0.1	-
India	105.8	-	10.8
Indonesia	44.2	1.1	-
Iran, Islamic Republic of	1.5	1.6	-
Iraq	0.2	1.3	-
Japan	7.9	0.7	0.1
Korea, DPR	1.8	0.1	-
Korea, Republic of	4.2	0.4	-
Malaysia	1.7	1.0	-
Myanmar	16.8	-	1.4
Pakistan	6.4	0.1	3.7
Philippines	12.2	1.2	-
Saudi Arabia	-	1.3	-
Sri lanka	2.7	0.2	-
Thailand	23.8	0.4	8.1
Viet Nam	28.8	0.5	8.2

Source: Food Outlook, Food and Agricultural Organization, 2016

4.1.2 Rice Economy in Sri Lanka

Agriculture has been the backbone of the Sri Lankan economy with one-third of the rural population perceiving it as their mainstay. It contributes to about eight percent of the country's Gross Domestic Product (GDP) and represents 28 percent of the total employment (Central Bank of Sri Lanka, 2015).

Apart from other spheres of farming, paddy/rice sector assures a considerable importance in the country's economy. It contributed nearly one percent to the total GDP in 2015 and also provided livelihood to nearly 0.9 million farm families island wide (Central Bank of Sri Lanka, 2015, Department of Census and Statistics, 2013). Out of total agricultural labour force of the country half of it is involved in the paddy industry. In the year 2015, paddy production of the country reached the highest of 4.8 million metric tonnes (Central Bank of Sri Lanka, 2015). According to the Household Income and Expenditure Survey (HIES), 2012/13 of Department of Census and Statistics, the annual per capita consumption of rice was around 107.8Kg.

Paddy is cultivated in two main seasons: *Maha* season under North East monsoon and *Yala* season under South West monsoon. *Maha* (October to March) usually accounts for about 65 percent of the annual production and the rest comes from the *Yala* crop (April to September). Average cultivated extent during the period 2011-2015 was 1.146 million hectares of which two thirds were grown under irrigated conditions. Paddy crop is heavily dependent on rainfall. Some performance indices of the paddy sector are shown in the Table 4.2. It clearly shows that both production (tonnes in million) and productivity (t/ha) have increased during last 70 years.

Table 4.2: Trends of Annual Paddy Production, Average Yield, Rice Imports and Population Growth over the Past Decades

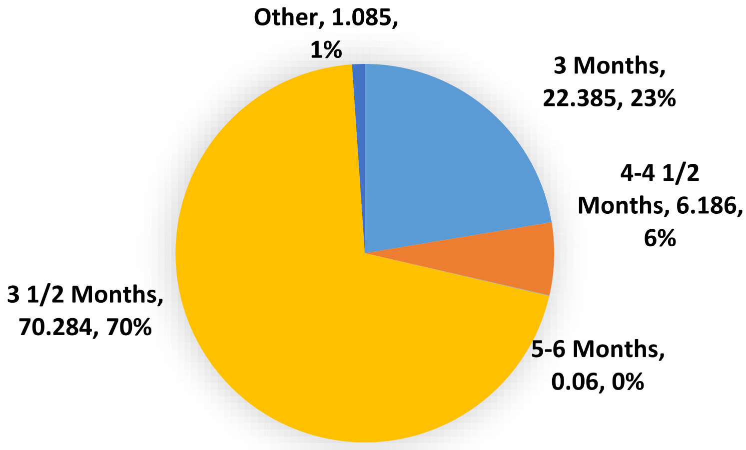
Decade	Population (Millions)	Production (Mn.Tonnes)	Yield (t/ha)	Rice Imports as a % requirement
1940	6.0	0.26	0.65	60
1950	7.5	0.60	1.56	50
1960	9.9	0.90	1.86	40
1970	12.5	1.62	2.63	25
1980	14.7	2.13	2.94	10
1990	16.3	2.50	3.18	05
2000	18.5	2.86	3.86	<1
2010	20.6	3.12	4.45	<1
2012	20.3	3.84	4.29	<1
2015	20.9	4.81	4.44	<1
Increase Over 1940	3.48 fold	18.5 fold	6.8 fold	

Source: Annual Symposium of Department of Agriculture, 2010, and Department of Census and Statistics

4.1.3 Species Variability

Rice botanically belongs to *Oryza sativa L.* of *Gramineae* family. There are two prominent cultivated species of paddy, namely *Oryza sativa* and *Oryza glaberriumn*. While *Oryza sativa* is grown in most parts of the Asian and American continents, *Oryza glaberriumn* is grown only in Africa. There are three sub species of paddy cultivated the world over i.e. Indica (long grain), Japonica (round grain) and Javanica (medium grain).

The percentage of major varieties cultivated inclusive of the time duration of the strains in 2015 is given in the Figure 4.2 and Table 4.3. This reveals that nearly 70 percent of the paddy varieties cultivated in the country belongs to the 3-1/2 Months category and the major varieties are Bg 352, At 362, Bg 358, Bg 360 and Bg 94-6. Next group is 3-month varieties which represent 22 percent of total cultivated extent and major varieties are Bg 300, At 307 and At 308. Six percent of the total paddy cultivated extent consists of 4 – 4½ months' age group varieties and the major varieties are the *Pokuru* samba and Bg 379-2. The remaining three percent represent traditional rice varieties and old improved varieties.



Source: Department of Agriculture, 2016

Figure 4.2: Varietal Distribution of Paddy Extent (ha) by Age Group in Sri Lanka – 2015

The Table 4.3 reveals that the mostly cultivated long grain white varieties (which produce Nadu rice) are Bg 352, Bg 300, and Bg 94/1. The long grain red rice varieties mainly cultivated are the At 362, At 307, and At 308. The major short grain (Samba rice) varieties are the Bg 358, Bg 360 and Pokuru Samba.

Table 4.3: Cultivation Extents of Major Varieties of Paddy - 2015

Variety	2014/15 *Maha* ('000 ha)	%	2015 *Yala* ('000 ha)	%	Annual ('000 ha)	%
Bg 352	143	18.8	90	18.5	232	18.6
Bg 300	123	16.2	71	14.7	194	15.6
At 362	80	10.5	75	15.4	155	12.4
Bg 358	81	10.6	43	8.9	124	10.0
Bg 360	46	6.0	24	5.0	70	5.6
Bg 94-1	38	5.0	25	5.2	63	5.1
Bg 359	38	5.0	22	4.4	60	4.8
Bg 366	30	4.0	25	5.2	56	4.5
At 307	26	3.4	15	3.2	41	3.3
At 308	19	2.5	13	2.6	32	2.5
Bg 357	16	2.1	11	2.2	27	2.2
Pokuru Samba	18	2.4	5	1.0	23	1.9
Bw 367	9	1.2	13	2.7	23	1.8
Other	94	12.3	53	11	146	11.7

Source: Department of Agriculture, 2016

4.1.4 Agro – Ecological Requirements

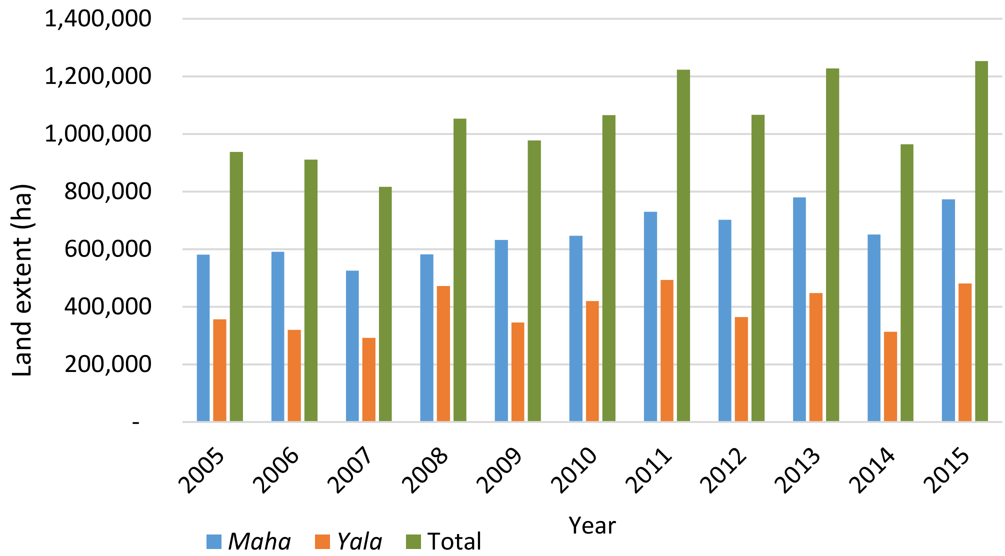
The rice plant usually takes 3–6 months from germination to maturity, depending on the variety and the environment under which it is grown. During this period, rice completes basically two distinct sequential growth stages: vegetative and reproductive. Normally a Three months' (120-day) variety, when planted in a tropical environment, spends about 60 days in the vegetative stage, 30 days in the reproductive stage, and 30 days in the ripening period.

Sri Lanka has traditionally been categorized in to three climatic zones Wet, Intermediate and Dry Zone and these three zones comprising seven agro-climatic zones covering the entire island. These seven agro-climatic zones have further sub-divided into Agro-Ecological Regions (AER) with a total of 46 AERs covering the entire island. The wet zone receives relatively high mean annual rainfall over 2,500 mm without pronounced dry periods. The dry zone receives a mean annual rainfall of less than 1,750 mm with a distinct dry season from May to September. The intermediate zone receives a mean annual rainfall between 1,750 to 2,500 mm with a short and less prominent dry season. Except up country wet and intermediate zones, in almost all AERs paddy is the most common land use in valley bottoms.

Rice is grown under diverse environmental conditions in Sri Lanka; from drought prone areas of the dry zone to water logged and flood prone plains of the wet zone. Rice is grown in flat valleys almost at sea level to highly dissected terrains up to 1000 m above sea level. The temperature range varies from 17 to 40 Celsius. Rice is cultivated either as a rain fed or as a supplementary or fully irrigated crop. The rice lands are distributed into three main production systems based on the type of irrigation as major irrigation schemes, minor irrigation schemes and rain fed schemes. The major rice growing agro climatic zone is Low Country Dry Zone (LCDZ) and most of the major and minor irrigation schemes located in this zone. Rice growing soils are varying from properties such as texture, drainage, nutritional status and edaphic problems.

4.1.5 Production Extent

Since independence, paddy production of Sri Lanka has increased steadily and the, utilizing extent of arable lands for paddy cultivation has also increased (Figure 4.3). As shown in the Figure 4.3 total cultivated extent of paddy lands has increased by nearly 34 percent from 937,175 ha to 1,253,288 ha in the last 10 years (2005 to 2015). Normally, the cultivated extent of paddy during *Maha* season is always higher than that of the *Yala* season and this situation was remained unchanged for the past 10 years. During the *Maha* season all the paddy lands are used for cultivation due to the availability of water. The data, indicates that average extent under paddy in *Maha* season from 2005-2015 was 653,884 ha (63%) and during the *Yala* season it was 391,058 ha (37%). After 2009 the cultivated extent and production of paddy gradually increased due to the increase of the contribution to the national production from the Eastern and Northern Provinces as a result of the ending of the prolonged war especially in the Eastern Province. As well government has implemented a long term plan to increase the cultivation of abundant paddy lands in the country. When comparing to data from 2005 to 2015, in 2015, the highest cultivated extent of paddy in the history can be seen, indicating total of 1,253,288 ha of cultivated extent.



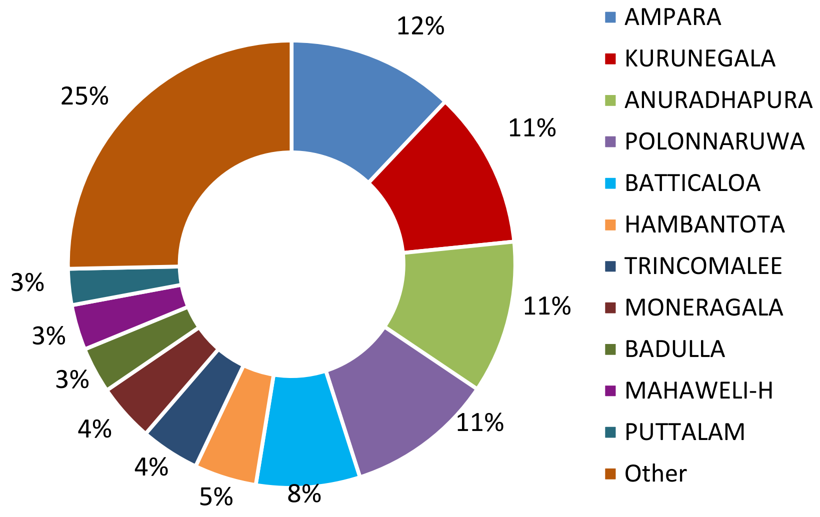
Source: Department of Census and Statitics, 2016

Figure 4.3: The Cultivated Extent of Paddy by Seasons in Sri Lanka

4.1.6 Cultivated Extent of Paddy by Major Growing Districts

The major paddy cultivating districts in Sri Lanka are Ampara, Kurunegala, Anuradhapura, Pollonnaruwa and Batticaloa districts. The total average land extent of more than 50 percent is located in above five districts. Out of the total, another 25 percent of extent is from Hambanthota, Mahaweli H, Badulla, Trincomalee, Monaragala and Matara districts. The rest is from the districts such as Matale, Galle, and Puttalam etc. As shown in the Figure 4.4 Ampara ranks as the district with the largest extent of land under paddy in Sri Lanka for the period of 2011-2015.

According to the Department of Census and statistics Anuradhapura, Hambanthota, Kurunegala, Batticaloa and Ampara districts shows a rapid expansion in the extent of paddy cultivation during the period of 2006-2015. Among the major paddy producing districts Batticaloa shows a remarkable increase in the extent of paddy cultivation after 2008 mainly due to the end of the war situation that prevailed more than two decades in the district.

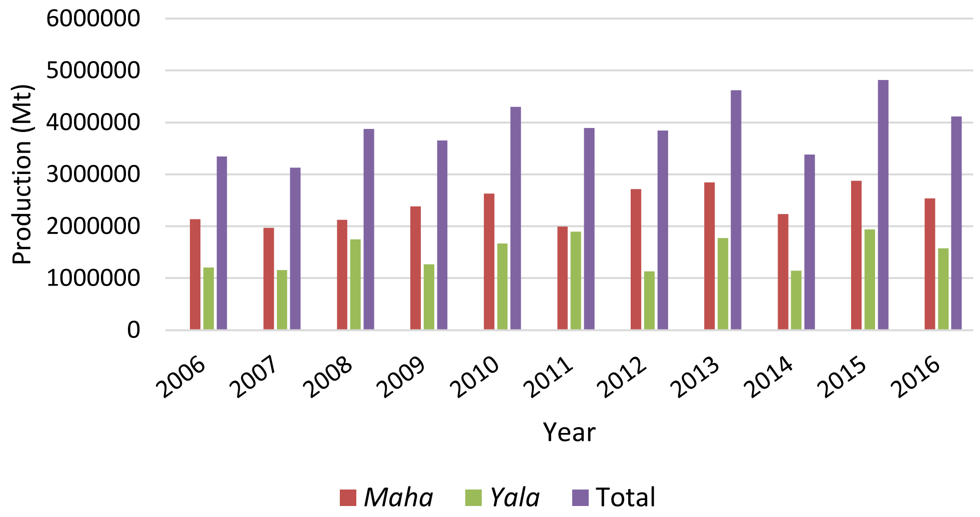


Source : Department of Census and Statistics, 2016

Figure 4.4: Percentage Distribution of Average Extent of Paddy by Districts (2011-2015)

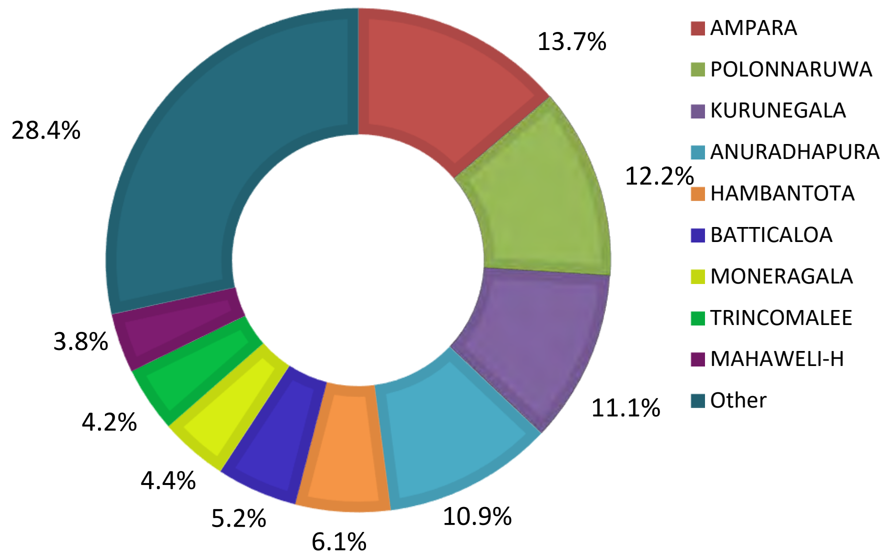
4.1.7 Production and Yield

Sri Lanka's rice production achieved remarkable results in the last four decades. When comparing 2005 with 2015 total paddy production has increased by 48 percent from 3,246,190 mt to 4,819,395 mt. Figure 4.5 illustrates the trend in paddy production in Sri Lanka during the period 2005 to 2015. At a glance it is apparent that the rice production has increased over the last 10 years. Supported by higher prices (Guaranteed Prices of Paddy) and government assistance in the form of fertilizer subsidies and land rehabilitation programmes, area planted with paddy is reported to have reached unprecedented levels during the 2015 paddy seasons. This coupled with generally favourable growing conditions resulted in the production of 2,876,987 mt of paddy during *Maha* season and 1,942,408 mt during *Yala* season, finally giving the total production of 4,819,395 mt for the year 2015. This was recorded as the highest paddy production ever in the country in *Maha* and *Yala* seasons. Figure 4.5 reveals the annual paddy production by seasons. The average production data for the last five years shows that (Figure 4.6) the district wise contribution to the total paddy production is Ampara (14%), Polonnaruwa (12%), Kurunegala (11%) and Anuradhapura (11%). Similarly, the production trend of rice cultivation and the average yield also registered an upward trend especially after the 1970, s. It's far as the average yields of paddy in 1970's (2.63 mt/ha) is concerned it has nearly doubled now. The average yield of paddy for the year 2015 is 4.44 mt/ha (Table 4.2).



Source : Department of Census and Statistics, 2017

Figure 4.5: Annual Paddy Production in Sri Lanka by Season



Source : Department of Census and Statistics, 2016

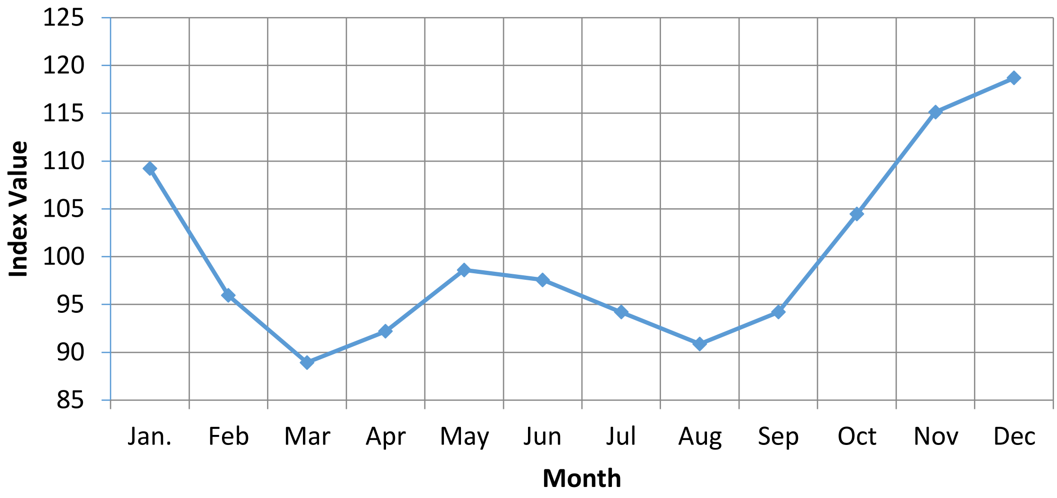
Figure 4.6: Percentage Distribution of Average Production of Paddy by Major Producing Districts (2011-2015)

4.1.8 Marketing, Consumption and International Trade

4.1.9 Price Behaviour of Paddy and Rice

Seasonal variation of paddy prices begins an upward trend in the month of September every year and reaches the maximum by the end of December and then registers a declining trend, which continues at a rapid rate till March and at a lower rate till May.

The second phase of paddy price decline occurs in the months of July and August with *Yala* harvest. From August to January paddy prices increase gradually mainly due to the limited market supply of paddy. During December and January rice prices increases at unaffordable levels and it badly affects the urban consumers and other low income groups. In February and March prices decline sharply adversely affecting the marginalized farmers. The *Yala* season harvest reaches the market and prices decline until the end of August. The same price behaviour can be observed for rice (Figure 4.7, Figure 4.8, Figure 4.9 and Figure 4.10). The highest paddy and rice prices were recorded in major producing and consuming areas in December and January in every year as a result of limited paddy stocks.

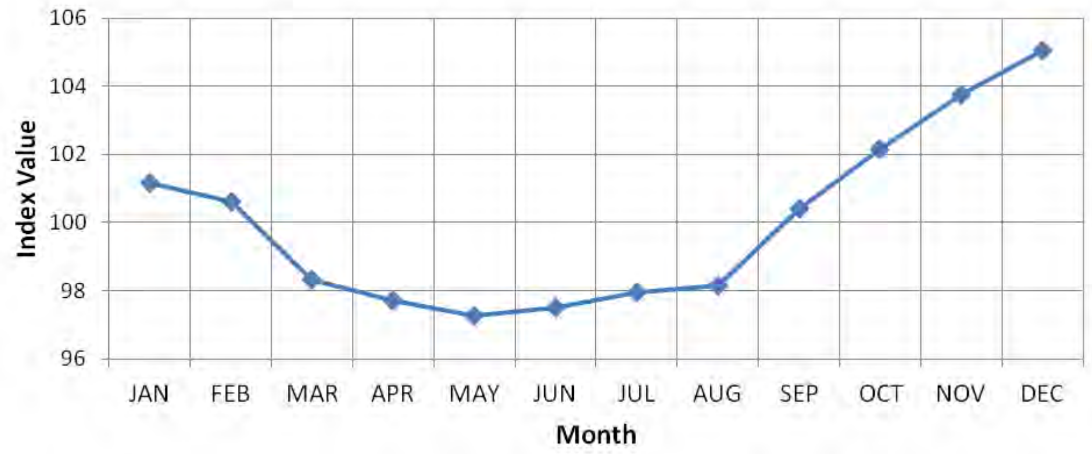


Source: Marketing and Food Policy Division/HARTI

Figure 4.7: Seasonal Price Index of Paddy (Long grain white) in Sri Lanka

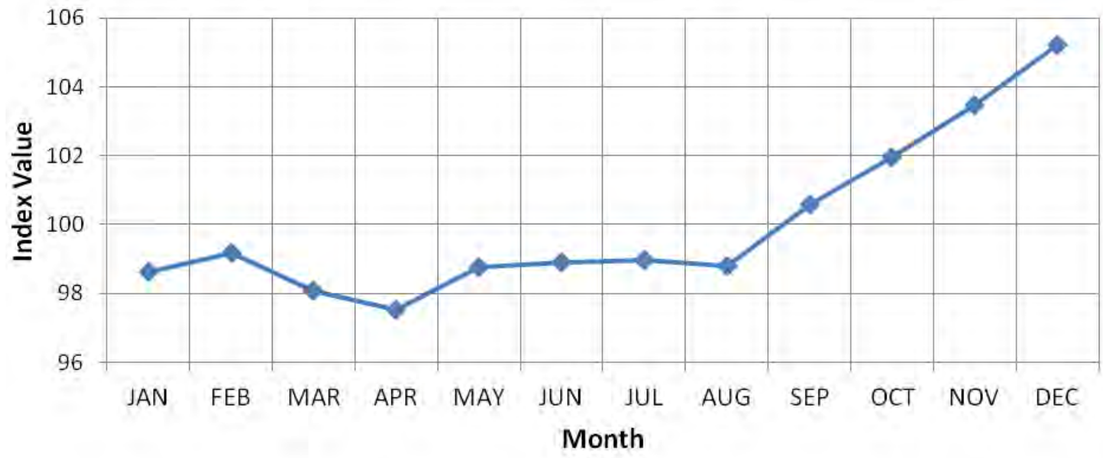
Source: Marketing and Food Policy Division/HARTI

Figure 4.8: Seasonal Price Index of Long Grain White Parboiled (Nadu) Rice in Sri Lanka (2011-2015 = 100)



Source: Marketing and Food Policy Division/HARTI

Figure 4.9: Seasonal Price Index of Rice (Raw Red) in Sri Lanka (2011-2015=100)

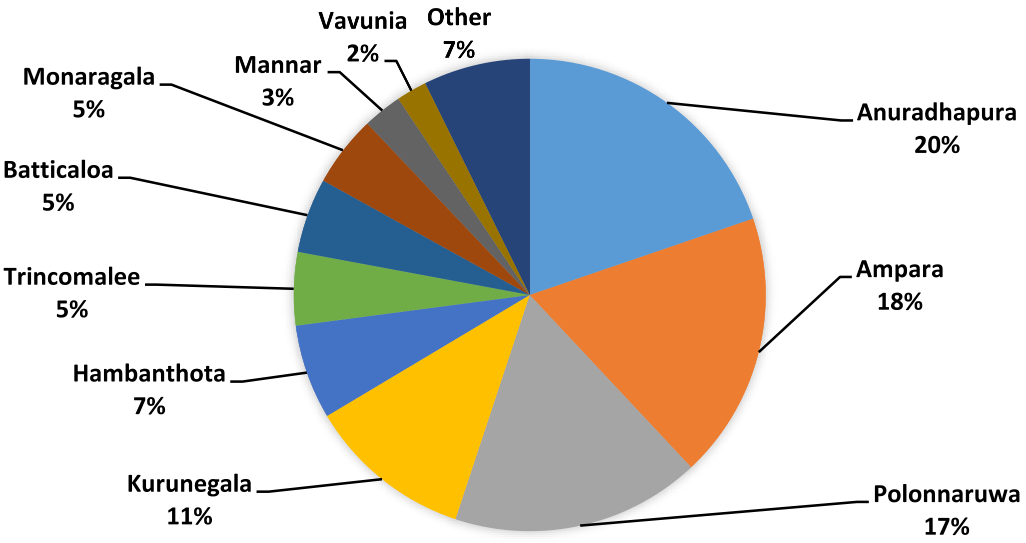


Source: Marketing and Food Policy Division, HARTI

Figure 4.10: Seasonal Price Index of Rice (Samba) in Sri Lanka (2011-2015=100)

4.1.10 Marketable Surplus

The Figure 4.11 shows the behaviour of the marketable surplus from major producing districts in the country and the highest annual surplus was from Anuradhapura followed by Ampara and Polonnaruwa. Nearly 75 percent of the annual marketable surplus of paddy reached the markets from the North Central and the Eastern Provinces (Ampara, Anuradhapura, Polonnaruwa and Batticaloa districts). Therefore, it is clear special attention should be given to those areas during the peak harvesting seasons.



Source: Department of Census and Statistics, 2016

Figure 4.11: Percentage of Annual Marketable Surplus of Paddy in Sri Lanka in an Average Production Year, 2013

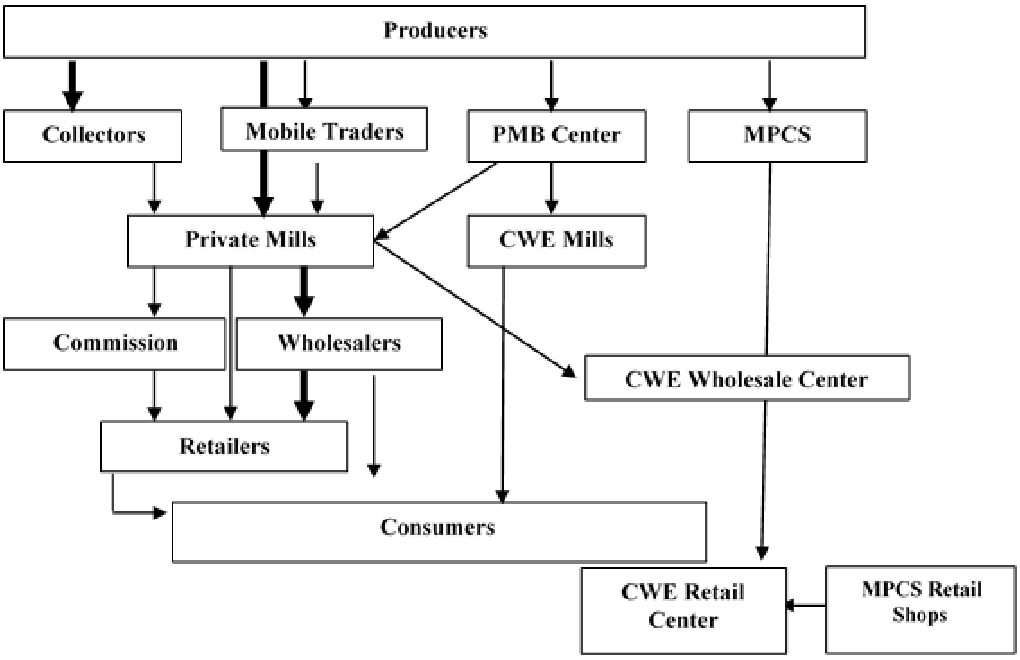
4.1.11 Marketing Channels

Paddy marketing is a flow of exchange from the farmer to the miller and from the miller to the consumer at various stages. It includes, the village collectors, outside traders from distant areas, farmer organizations, marketing agents, private millers and government institutions such as the Paddy Marketing Board (PMB) and the cooperatives. During the harvesting period, all these parties are active in purchasing paddy. Nearly 80 percent of the total marketable surplus of paddy is collected by private traders (collectors and millers), and a meagre portion of the harvest is going to the Paddy Marketing Board, farmer organizations, cooperatives, etc.

Government Intervention in paddy marketing in Sri Lanka mainly focuses on procurement of paddy, fixing and maintaining Guaranteed Prices (GP) of paddy, stock management, grain distribution and disposal of paddy in order to stabilize the rice market. Stabilization of farm gate prices of paddy in major producing areas during the harvesting seasons is a very crucial factor, since the larger share of the paddy farmer's income and living conditions is highly sensitive to paddy price in the open market. The paddy production in the war affected areas like Batticaloa, Trincomalee, Ampara and Mannar increased significantly after 2009 when the war ended. The market equation of paddy started to change as a result of huge supply of paddy coming to the market from those areas. Apparently, the role of the marketing institutions became quite prominent to stabilize the market ever than before. The main focus of the government intervention through the PMB is to stabilize farm gate prices and maintain buffer stocks.

Among the private sector led marketing channels, the dominant playesr are the Farmer/Collector/Miller/Wholesaler/Retailer (Figure 4.12).

The flow of paddy marketing starting from the farmer to consumer is depicted in the Figure 4.12.



Source: Compiled by the Author

Figure 4.12: Marketing Flow of Paddy/Rice

Among the different participants in marketing flow (Figure 4.12) the collector also known as [1]assemblers who operates at village level is the first link between the farmer and other middlemen. Wijesooriya and Priyadharshana, (2013), revealed that normally about three collectors operate in a single village in Polonnaruwa and each has his own collecting center to which he collects several smaller lots of the village paddy production at his own expense and accumulates them into a single load. In Hambanthota no collectors are found at village level and each miller has a permanent farmer base to obtain paddy stocks directly to the millers in nearby areas and the outside millers through brokers.

In the paddy/rice marketing channel, the private millers doing the most significant processing function. They change the form of the product: paddy into brown/polished rice. The quality of rice at the market mostly depends on the quality of processing. Millers can be divided into three groups as small, medium and large scale. In addition, the brokers are involved in the paddy buying system in most of the major producing districts. The brokers in marketing flow work for a commission on behalf of other participants. They operate between the paddy collector and the miller. They do not

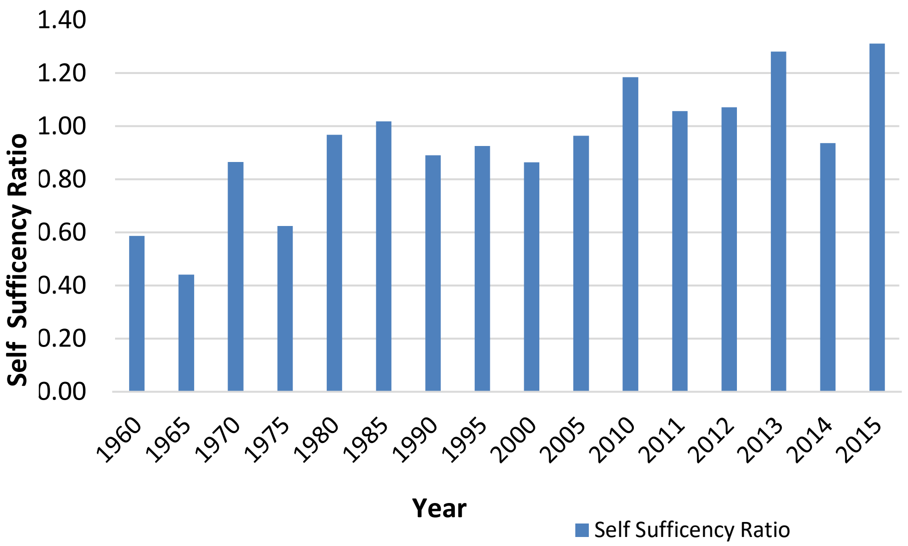
[1] Village level Paddy Collection Centers

invest in paddy trade and do not take any price risks. They generally have a long standing relationship with millers and make purchases for them. Brokers bring buyers and sellers together and assist in negotiations on a more ad hoc basis.

The government may keep different types of storage reserve, depending on the extent they wish to intervene in the paddy/rice market. As a government institution, the Paddy Marketing Board (PMB) in Sri Lanka is involved in storage for the purpose of stabilising prices and revenues to the farmers and protecting consumers during the off season. In some districts the Multi-Purpose Cooperative Societies (MPCS) involve in paddy purchasing, milling and selling rice to the consumers eg: MPCSs in Polonnaruwa district. The Cooperative Wholesale Establishment (CWE) has two large scale rice processing mills. Usually CWE milled storage paddy purchased by the PMB in their own mills or by milling through private sector mills and rice selling their franchise shops.

4.1.12 Self Sufficiency Ratio

Self-sufficiency in rice is interpreted using self-sufficiency ratio. Self-sufficiency ratio is calculated using total rice production and total rice requirement in a respective year. After the liberalization of Sri Lankan economy in 1977 self-sufficiency ratio showed an increasing trend. In 2008 it reached the value of 1.1 indicating that Sri Lankan rice production is sufficient to cater the total rice demand. In 2009, it showed a decline, due to adverse climatic condition that impacted the production locally as well as globally. However, after 2008 almost in every year country achieved self-sufficiency in rice. As shown in the Figure 4.13 and Table 4.4 below and the Table 4.5 in 2015 self-sufficiency ratio is 1.31.



Source: Calculated by the Author by Using Data of Department of Census and Statistics, 2017

Figure 4.13: Self Sufficiency Ratio of Rice

Table 4.4: Rice - Self Sufficiency Ratio

Year	Mid-Year Popula-tion (000')	Per Capita Consumption Rice (kg/Year)	Rice Requirement for Consump-tion (mt/Year)	Paddy Extent Sown (acres)	Seed Paddy Requirement (Rice-mt)	Total Rice Require-ment (mt)	Gross Paddy Production (000 mt)	Net Paddy Production (000 mt)	Total Rice Produc-tion (mt)	Self Sufficiency Ratio
2005	19,668	106.2	2,088,938	2,315,808	65,724	2,152,113	3,246	3,051	2,074,843	0.96
2006	19,886	104.4	2,076,098	2,249,876	63,853	2,139,951	3,342	3,141	2,136,206	1.00
2007	20,010	107.9	2,159,079	2,018,139	57,276	2,216,355	3,131	2,943	2,001,335	0.90
2008	20,217	107.9	2,181,414	2,592,356	73,573	2,254,987	3,875	3,643	2,476,900	1.10
2009	20,450	107.9	2,206,555	2,415,604	68,556	2,275,111	3,652	3,433	2,334,358	1.03
2010	20,653	108.7	2,244,981	2,632,670	74,717	2,319,698	4,301	4,043	2,749,199	1.19
2011	20,869	108.7	2,268,460	3,023,068	85,797	2,354,257	3,895	3,661	2,489,684	1.06
2012	20,424	108.7	2,220,089	2,635,666	74,802	2,294,891	3,846	3,615	2,458,363	1.07
2013	20,579	107.8	2,218,416	3,032,594	86,067	2,304,483	4,621	4,344	2,953,743	1.28
2014	20,771	107.8	2,239,114	2,382,756	67,624	2,306,738	3,381	3,178	2,161,135	0.94
2015	20,966	107.8	2,260,135	3,096,940	87,893	2,348,028	4,819	4,530	3,080,305	1.31

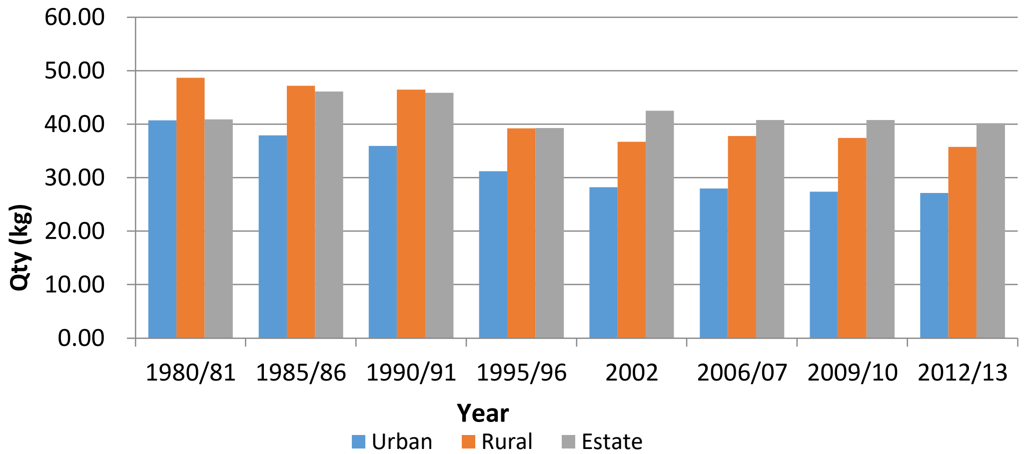
*Seed Paddy Reqirement = Extent Sown * Seed Rate (2 Bu/acre)*
Wastage Factor = 6 %
1 mt Paddy = 47.92 Bushels of Paddy
1 mt Paddy = 0.68 of Rice

Primary Source : Registrar Generals Department
Central Bank of Sri Lanka
Department of Census & Statistics

Secondary Source : Data Bank of HARTI, 2017

4.1.13 Consumption

Per capita consumption of rice is an important indicator when analyzing the rice flow of the country within different sectors and within different income levels. The Figure 4.14 reveals the per capita household consumption of rice per year for different years in terms of three main sectors Urban, Rural and Estate Sector.



Source: Department of Census and Statistics, 2015

Figure 4.14: Monthly Households Consumption of Rice by Sectors

According to the consumption data household rice consumption declined over the decades in urban sector from 1980 to 2012. The rural sector also shows a drop in it rice consumption during the period of 1980-2012. However, during that period consumption in the estate sector remained static. In 1980/81 monthly household consumption of rice was 40.7 kg and it declined in 2012/13 to 27.12 kg.

According to the Household Income and Expenditure Surveys (HIES) in 2006/07, 2009/10 and 2012/13 the annual per capita consumption of rice is 107.9, 108.7 and 107.8 kg /person/year respectively. The variety wise monthly rice consumption, records raw rice as the highest with nearly 15 kg in 2012/13 survey (Table 4.5).

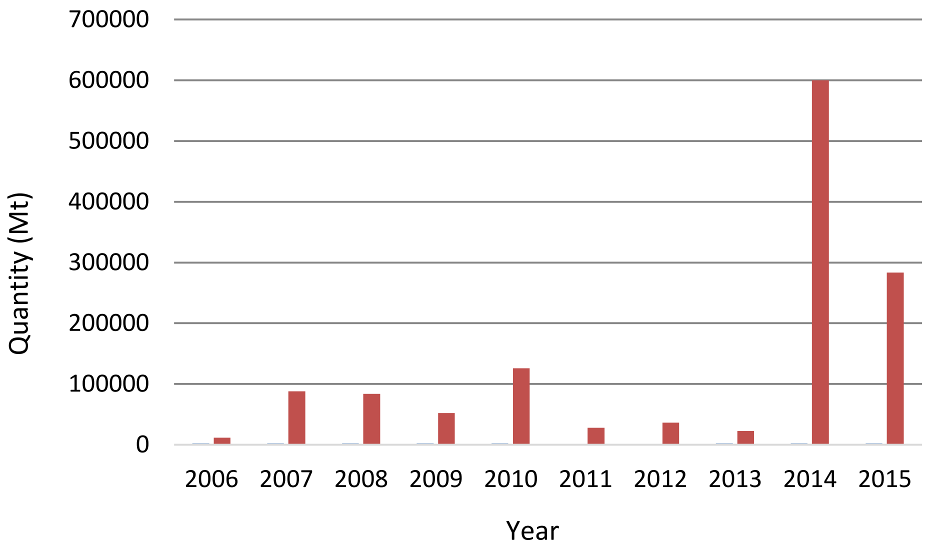
Table 4.5: Household Monthly Consumption Quantities of Rice by Sector and Province - 2012/13

	Kekulu		Samba - Kekulu		Samba	Nadu	
	White (kg)	Red (kg)	White (kg)	Red (gram)	(kg)	White (kg)	Red (kg)
Sri Lanka	7.27	7.5	0.9	0.4	5.6	11.4	1.4
Sector							
Urban	4.0	5.7	1.3	615	8.2	6.0	1.3
Rural	8.0	8.0	0.8	344	5.2	12.1	1.3
Estate	6.1	6.7	0.7	371	2.6	20.6	3.1

Source: Department of Census and Statistics, 2015

4.1.14 Imports of Rice

Rice is mainly imported from the countries like India, Myanmar, Pakistan and Thailand. During the last ten-year period almost in every year country achieved self-sufficiency in rice. However, in 2014 both seasons paddy crop failed due to the extreme climatic events (Figure 4.15). Consequently, in 2014 country imported a considerable amount of rice from India and imports were extended until first few months of 2015, in most of the other years a little quantity of rice imports was recorded and those were rice of the *Basmathie* variety.



Source: Data Bank, HARTI

Figure 4.15: Imports of Rice (mt)

4.2 Government Policies and Programmes

Agricultural policies in Sri Lanka are historically pervasive, especially those pertaining to rice—a staple for entire population and a source of livelihood for nearly a 0.9 million farm families. Because of its strategic and political importance, the rice sector has been subject to a number of policy interventions.

Production Policy: Paddy farmers receive free irrigation water, free extension services and fertilizer subsidy. The government introduces new seed varieties, technologies through research and development activities mainly done by the Department of Agriculture. The government injects massive doses of capital in every year for the rehabilitation of irrigation networks.

Price Support through Marketing Policy: The Sri Lankan government maintains a guaranteed price for paddy and maintain it through paddy purchases by the Paddy Marketing Board (PMB) as a parastatal body. The guaranteed price for paddy in the year 2016 was Rs. 38.00/ kg for long grain and Rs. 41.00/kg for short grain paddy. PMB also maintains a buffer stock of paddy. In addition, various credit programmes are implemented focusing production and marketing of paddy.

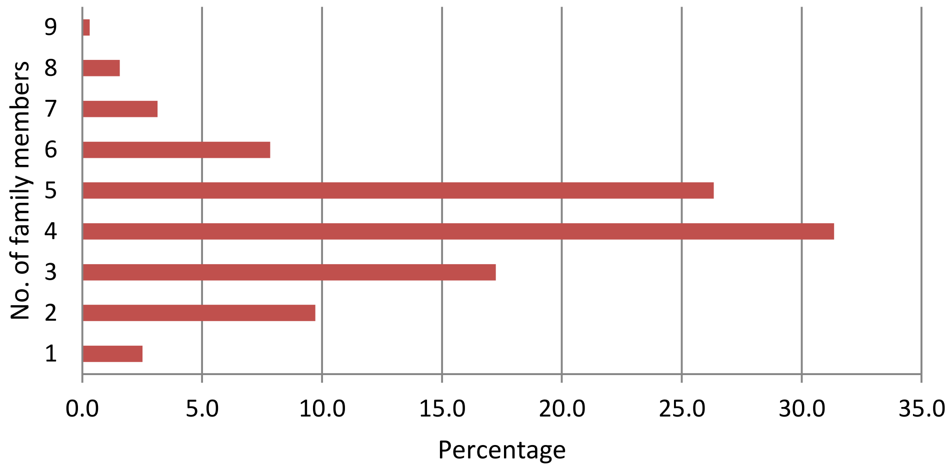
Import Policy: Normally rice import tariff is Rs. 20.00/kg. However, during surplus and deficit years the tariff will be adjusted accordingly in order to protect the farmers as well as consumers. The government plans to increase the average yield at present 4.1 mt/ha to 5.0 mt/ha in the year 2018 through promoting quality seed paddy programme.

4.3 Socio-economic Characteristics of the Sample Farmers

4.3.1 Demographic Information of the Farmer Households

4.3.1.1 Family Size

In the total sample (319) of paddy farmers, in major producing districts, the highest percentage of (nearly 75 percent) households consisted of 3-5 members including both parents and children. Also, there were nearly 13 percent of households with more than five family members (Figure 4.16). Nearly 31 percent of the households consisted of 4 members and it was in line with the national data of Household Income and Expenditure Survey, 2012/13 (Department of Census and Statistics, 2013).



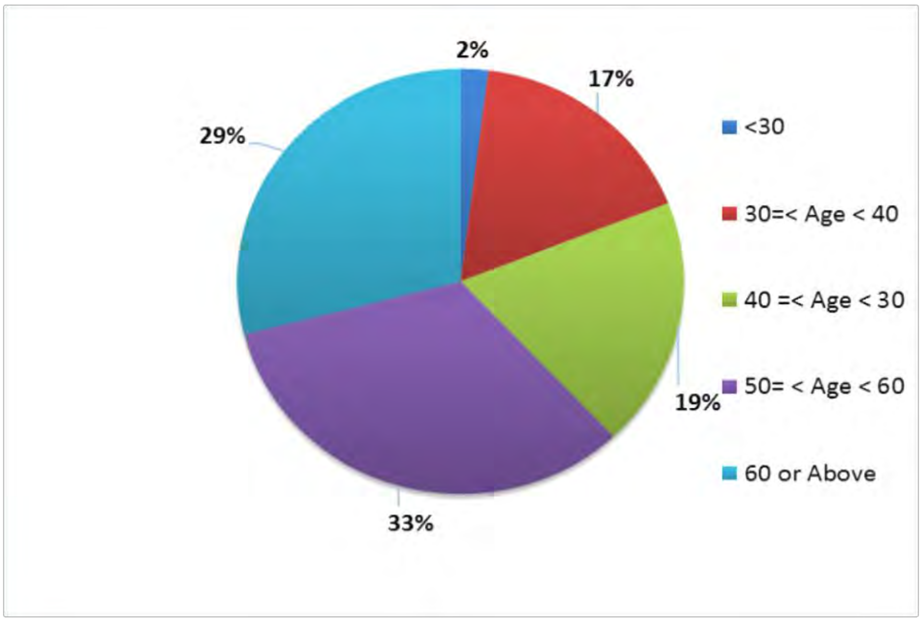
Source: HARTI Field Survey Data, 2016

Figure 4.16: Family Size of Paddy Farmers (%)

4.3.1.2 Age Categories

Many research studies have concluded that educated young farmers are more likely to adopt new technologies than others. In these circumstances the study sought to find out the age groups of the key respondent farmers in producing areas. The respondent farmers were grouped into five in terms of age. The results show that only two percent of the sample farmers were coming uder the age group of less than 30 years and the majority (33 percent) is in the age group of 50-60-years followed by 19 percent in the age group of 40-50 years (Figure 4.17).

Farmers who were 60 years of age and above were 29 percent. Overall results indicate that that nearly 62 percent of the sample farmers who are engaged in paddy cultivation are over 50 years of age.



Source: HARTI Field Survey Data, 2016

Figure 4.17: Age Distribution of Head of Households of Paddy Farmers

4.3.1.3 Education Level of the Paddy Farmers

Many researchers are convinced that farmer education increases the probability of adopting new agricultural technologies such as High Yielding Varieties (HYV), fertilizers, and pesticides (summarized in Feder *et al.,* 1985). Therefore, the study sought to find out the level of education of the respondent farmers in producing areas. The results recorded in Table 4.6 show that more than 50 percent of respondents have achieved secondary grade (up to G.C.E. O/L) educational level. However, it was revealed that nearly 27 percent of the farmers had received primary education only. The lowest education levels were recorded from the paddy farmers in Batticaloa and Kilinochchi districts.

Circumstances in Kilinochchi and Batticaloa districts seem to be significantly different from the other districts concerned. Therfore, special attention should be given in creating awareness among the farmers in these areas prior to introducing new technologies.

Table 4.6: Level of Education of Head of Household of Paddy Farmers

Level of Education	Districts (%)								
	Kurunegala (N=42)	Anuradhapura (N=42)	Polonnaruwa (N=39)	Ampara (N=39)	Hambantota (N=39)	Batticaloa (N=40)	Matara (N=39)	Kilinochchi (N=39)	Total (N=319)
Primary(1-5 Grades)	17	19	31	21	28	40	18	43	27
Secondary (6-11 Grades)	38	24	35	53	36	23	21	23	32
Passed G.C.E. (O/L)	33	34	28	13	13	15	35	23	25
Up to G.C.E.(A/L)	3	14	3	5	10	7	15	5	8
Passed G.C.E.(A/L)	2	2	3	3	8	7	8	3	4
Graduate	0	5	0	0	0	0	0	3	1
Post Graduate	2	0	0	0	0	0	0	0	0
Not attended school	5	2	0	5	5	8	3	0	3
Total	100	100	100	100	100	100	100	100	100

Source: HARTI Field Survey Data, 2016

4.3.1.4 Income Source of Farmers

Rural income generating activities are mainly correlated with the agriculture in Sri Lanka. The main income source of nearly 87 percent (Table 4.7) of the respondents is agriculture and livestock. Therefore, majority of the respondents can be considered as fulltime farmers.

Table 4.7: Main Income Source of Head of the Household – Paddy Farmers

Primary Employment	No of Farmers	Percent
Farming/Animal husbandry	279	87.5
Agri labour	1	0.3
Non-agri labour	1	0.3
Government job	14	4.4
Private sector job	3	0.9
Self-employment	8	2.5
Foreign employee	1	0.3
Skilled labour	3	0.9
Hired employment	2	0.6
Other	7	2.2
Total	319	100.0

Source: HARTI Field Survey Data, 2016

4.4 Agricultural Inputs

4.4.1 Land

To get a comprehensive idea of the paddy land distribution of the sample farmers all surveyed farmers were classified according to their paddy land size. Paddy lands were classified into four categories (Table 4.8 and 4.9).

Table 4.8: Distribution of Sample Farmers by Size of Paddy Land by Districts

District	Land Class (ac)	No.of farmers	%	Extent	%
Kurunegala	0.5<=ext<1	1	2.38	0.75	0.55
	1<=ext<2	9	21.43	12.43	9.15
	2<=ext<5	25	59.52	75.75	55.78
	ext>=5	7	16.67	46.87	34.51
	Total	42	100.00	135.80	100.00
Anuradhapura	0.5<=ext<1	2	4.76	1.50	0.82
	1<=ext<2	4	9.52	4.80	2.64
	2<=ext<5	22	52.38	77.08	42.32
	ext>=5	14	33.33	98.75	54.22
	Total	42	100.00	182.13	100.00
Polonnaruwa	2<=ext<5	35	89.74	108.75	80.41
	ext>=5	4	10.26	26.50	19.59
	Total	39	100.00	135.25	100.00
Ampara	1<=ext<2	1	2.56	1.75	1.24
	2<=ext<5	30	76.92	89.25	63.41
	ext>=5	8	20.51	49.75	35.35
	Total	39	100.00	140.75	100.00
Hambantota	0.5<=ext<1	1	2.56	0.75	0.51
	1<=ext<2	6	15.38	9.25	6.30
	2<=ext<5	22	56.41	63.00	42.93
	ext>=5	10	25.64	73.75	50.26
	Total	39	100.00	146.75	100.00
Batticaloa	2<=ext<5	10	25.00	32.00	6.47
	ext>=5	30	75.00	462.50	93.53
	Total	40	100.00	494.50	100.00
Matara	0.5<=ext<1	1	2.56	0.71	0.39
	1<=ext<2	8	20.51	11.43	6.24
	2<=ext<5	21	53.85	69.72	38.07
	ext>=5	9	23.08	101.27	55.30
	Total	39	100.00	183.13	100.00
Kilinochchi	1<=ext<2	8	20.51	13.90	6.09
	2<=ext<5	15	38.46	52.79	23.14
	ext>=5	16	41.03	161.49	70.77
Total		39	100.00	228.18	100.00

Source: HARTI Field Survey Data, 2016

Except in Kilinochchi district majority of farmers in other selected districts have paddy lands around 2-5 acres of lands while majority of farmers in kilinochchi district (41%) are cultivating land plots greater than five acres.

Table 4.9: Distribution of Sample Farmers by Size of Paddy Land

Land Class	No.of Farmers	%	Extent	%
0.5<=ext<1	5	1.57	3.71	0.23
1<=ext<2	36	11.29	53.56	3.25
2<=ext<5	180	56.43	568.34	34.52
ext>=5	98	30.72	1020.88	62.00
Total	319	100.00	1646.49	100.00

Source: HARTI Field Survey Data, 2016

The profile of the paddy farmers gave information about their land ownership status. Types of the land ownership in surveyed areas are sole ownership, leased status, and tenancy, mortgaged and encroached lands. Study found that sole ownership of low land and highland is 67 percent and 86 percent respectively (Table 4.10). The district level information reveals that the highest percentages of sole ownership lands are recorded in Polonnaruwa (94%) and Kilinochchi (92%) districts while the lowest extents recorded in Ampara (67%) and Matara (65%) locations. In addition to that among sample farmers 19 percent of them cultivate paddy lands under tenurial agreements in Batticaloe and four percent of lands under encroached category in Ampara district.

Table 4.10: Land Ownership Status of Sample Farmers

Type of Ownership	Low Land (N=368) No of Farmers (%)	High Land (N=181) No of farmers (%)
Sole ownership	66.6	85.6
Shared	4.1	6.63
Leased	7.1	-
Tenure in	7.1	2.76
Tenure out	12.8	1.1
Permits	0.5	2.76
Encroached	0.5	1.1
Mortgaged	0.3	-
Other	1.1	-
Total	100	100

Source: HARTI Field Survey Data, 2016

4.4.2 Seeds

The quality of seeds is of pivotal importance for increasing yield. The use of quality seeds in paddy cultivation helps greatly in higher production per unit area to attain food security of the country. Quality seeds imply the efficient utilization of the inputs such as fertilizers and irrigation. In paddy cultivation certified local seeds are the seeds produced by the government farms or the Department of Agriculture certified private sector seed producers. The study revealed that farmers in Matara and Polonnaruwa districts use the highest rate of certified seeds (Table 4.11). Study also reveals that the majority of the farmers in Batticaloa and Kilinochchi districts do not use certified seeds. It may be due to lack of availability and accessibility to quality seeds in those areas. Uncertified local seeds are the seeds produced by the farmers themselves or seeds exchanged with the other farmers. Other categories are the traditional seeds used by the farmers.

Table 4.11: Type of Seeds Used by the Paddy Farmers by District (%)

Districts	Certified seeds – Local (%)	Uncertified seeds – Local (%)	Others (%)	Total
Kurunegala (N=45)	71	27	2	100
Anuradhapura (N=50)	58	40	2	100
Polonnaruwa (N=40)	88	10	2	100
Ampara (N=40)	60	40	0	100
Hambantota (N=41)	76	22	2	100
Batticaloa (N=49)	49	51	0	100
Matara (N=39)	90	10	0	100
Kilinochchi (N=41)	49	47	4	100
Total	66	32	2	100

Source: HARTI Field Survey Data, 2016

The study reveals that most popular source of seed paddy for the farmers in Kurunegala, Anuradhapura, Polonnaruwa and Hambanthota districts are outlets of the Department of Agriculture. They obtain certified seeds from those centers (Table 4.12). And it also shows that a considerable percentage of farmers obtained certified seeds from agents of the private companies and local markets. It is noted that in Killinochchi dsitrict 70 percent of the paddy farmers use their own seeds for cultivation and consequently average yield was comparably low. Increasing farmer's accessibility for quality seeds should be the focus of any activity envisaging the enhancement of the average paddy yield within an area.

Table 4.12: Source of Seeds Used by the Farmers by District

Districts	Source of Seeds as a Percentage					
	*DOA	Self-produced	Private company	Neighboring farmers	Local market	others
Kurunegala (N=48)	46	25	2	21	4	2
Anuradhapura (N=55)	38	27	15	7	13	0
Polonnaruwa (N= 45)	38	18	18	11	13	2
Ampara (N=42)	21	29	14	10	26	0
Hambantota (N=42)	36	17	0	28	17	2
Batticaloa (N=58)	17	26	16	14	24	3
Matara (N=40)	13	5	10	15	57	0
Kilinochchi (N=40)	22	70	3	5	0	0

* *(DOA) Department of Agriculture*

Source: HARTI Field Survey Data, 2016

4.4.3 Irrigation

Majority of the surveyed farmers (Table 4.13) that cultivate lowlands had major irrigation facilities (55%) and a considerable percentage of farmers had minor irrigation (33%) followed by rain fed (11%). The farmers of the sample who were cultivating under major irrigation mainly recorded from Anuradhapura, Hambanthota, Kilinochchi and Batticaloa districts. Paddy farmers cultivating under minor irrigation schemes were mainly recorded from Kurunegala, Polonnaruwa and Matara districts. The rainfed farmers were mainly located in Matara, Kilinochchi and Batticaloa districts. More than 93 percent of the farmers practiced flood irrigation as a method of irrigation.

Table 4.13: Land Holdings Based on Water Source

Source of water	Lowland (N=339) No of farmers (%)	Highland (N=183) No of farmers (%)
Major Irrigation	55	12
Minor Irrigation	33	2
Rain-fed	11	69
Agro well	0	7
Other	1	10
Total	100	100

Source: HARTI Field Survey Data, 2016

4.4.4 Paddy Marketing

Marketable Surplus

The following table reveals that more than half of the respondent farmers sell over 75 percent of their total production and it was prominent in Batticaloa, Polonnaruwa, Ampara and Kurunegala districts. In Batticaloe district, large scale paddy farmers sell major portion of paddy immediately after harvesting. However, the lowest selling percentage is recorded in Matara district where the majority of the farmers cultivate paddy to maintain their household food security (Table 4.14).

Table 4.14: Percentage of Farmers Sold Paddy by Different Degrees by District

District	Sold amount as a % of total production			
	75% or above	50%-75%	25%-50%	less than 25%
Kurunegala (N=42)	48	17	24	12
Anuradhapura (N=42)	31	36	19	14
Polonnaruwa (N=39)	59	31	08	03
Ampara (N=39)	49	26	05	21
Hambantota (N=39)	38	44	10	08
Batticaloa (N=40)	65	23	10	08
Matara (N=38)	05	37	26	32
Kilinochchi (N=39)	51	26	10	13
Total (N=318)	43	30	14	13

Source: HARTI Field Survey Data, 2016

4.4.4.1 Type of Buyers

The study reveals that majority of the paddy farmers sell their surplus produce to rice millers, where as in some areas a considerable proportion of farmers sell their paddy to village level collectors. The village level collector's presence was mostly observed in Batticaloa and Killinochchi areas and it was mainly due to limited intervention of private rice millers (Table 4.15).

Table 4.15: Farmers Selling Paddy to Different Sources: Percentage of Responses by Districts

Sources	Districts							
	Kurunegala (N=48)	Anuradhapura (N=46)	Polonnaruwa (N=43)	Ampara(N=46)	Hambantota (N=47)	Batticaloa (N=55)	Matara (N=56)	Kilinochchi (N=47)
Government stores	8	18	28	15	9	4	2	2
Rice Millers	88	78	51	60	67	51	74	77
Input Supplier	-	-	-	-	-	13	-	-
Government stores and Private Traders	-	-	16	9	2	2	-	-
Village Collectors	4	-	-	7	11	25	13	17
Others	-	4	5	9	11	5	11	4
Total	100	100	100	100	100	100	100	100

Source: HARTI Field Survey Data, 2016

4.4.4.2 Productivity of Paddy Cultivation of Sample Paddy Farmers

The study measured the average yield of paddy under two land categories, 2-5 acres and more than 5 acres (Table 4.16). Sample farmers in Matara and Kilinochchi areas have recorded the lowest average yields in both classes. The highest average yields under the 2-5 acres land category was recorded from Hambanthota followed by Anuradhapura. In >5 acres category the highest yield values also was recorded in Anuradhapura.

Table 4.16: Average Yield of Paddy under the Different Land Classes by District (kg /ac)

District	Per acre Average Yield (kg /ac)	
	Extent 2-5 ac	Extent more than 5 ac
Kurunegala	1737	1565
Anuradhapura	1855	2126
Polonnaruwa	1521	1794
Ampara	1649	1800
Hambantota	2067	1787
Batticaloa	1033	1429
Matara	789	642
Kilinochchi	997	1337

Source: HARTI Field Survey Data, 2016

4.5 Cost and Returns

4.5.1 The Cost of Production

In order to obtain a clear perspective of the economics of paddy cultivation, the study utilized recent data on cost of cultivation of paddy from the Department of Agriculture. According to the available statistics of the Department of Agriculture, the cost of cultivation per acre of paddy is measured in terms of the main inputs such as labour, seed, fertilizer and agrochemicals and machinery.

The cost of cultivation is considered as a decisive factor of paddy cultivation. The following table (4.17) reveals that the total cost of cultivation by major components in different producing districts in 2014/15 *Maha* season. The total cost of cultivation per acre including farmer owned inputs, like family labour and own seeds ranged between Rs/ac 38,191 to Rs/ac 44,116 in irrigated regimes. In rainfed regimes the cost ranged from Rs/ac 35,742 to Rs/ac 43,515. The highest and the lowest percentage of labour cost from the total cost in irrigated areas are reported respectively in System H and Mannar producing areas. The machinery cost which represent 25 percent to 43 percent in the total cost is noted in irrigated major producing areas with the lowest and highest percentage reported in System H and Anuradhapura respectively. In rainfed producing areas the lowest and highest percentage share of power cost is reported in Kandy (23%) and Kurunegala (45%) respectively. The material cost of paddy cultivation mainly consists of seed, fertilizer, weedicides and pesticides.

Table 4.17: Cost of Cultivation (Including Cost of Farmer Owned Inputs) - 2014/15 *Maha Season*

District/ System	Irrigation	Cost (Rs./ac)			
		Labour	Power	Material	Total
Ampara-East	IR	15,604 (41)	13,305 (35)	9,282 (24)	38,191
Ampara-West	IR	16,026 (41)	14,569 (37)	8,856 (22)	39,451
Anuradhapura	IR	17,303 (42)	17,712 (43)	6,653 (16)	41,668
Hambantota	IR	19,031 (43)	16,070 (37)	8,799 (20)	43,900
Kurunegala	IR	19,188 (44)	17,096 (39)	7,009 (16)	43,293
Mannar	IR	15,981 (38)	16,742 (40)	9,342 (22)	42,065
Polonnaruwa	IR	18,734 (45)	16,477 (39)	6,664 (16)	41,875
System B	IR	16,750 (40)	17,328 (42)	7,427 (18)	41,505
System C	IR	17,110 (42)	16,071 (39)	7,566 (19)	40,747
System H	IR	25,992 (59)	10,920 (25)	7,204 (16)	44,116
Trincomalee	IR	17,564 (43)	16,192 (39)	7,520 (18)	41,276
Gampaha	RF	15,669 (40)	16,552 (42)	6,907 (18)	39,128
Kalutara	RF	26,504 (64)	10,164 (24)	5,018 (12)	41,686
Kandy	RF	30,205 (69)	10,029 (23)	3,281 (08)	43,515
Kurunegala	RF	12,664 (35)	16,246 (45)	6,832 (19)	35,742
Whole Island	IR	17,393 (42)	16,635 (40)	7,691 (18)	41,719
Whole Island	RF	12,880 (36)	16,143 (45)	7,113 (20)	36,136

Values within parentheses denote as a percentage of the total cost
Source: SEPC/Department of Agriculture year/2015

Table 4.18: Unit Cost of Paddy- 2014/15 *Maha Season*

District/ System	Irrigation	Unit Cost (Rs./kg)	
		1	2
Ampara-East	IR	17.96	13.93
Ampara-West	IR	18.53	12.75
Anuradhapura	IR	20.31	14.91
Hambantota	IR	17.88	12.20
Kurunegala	IR	20.04	12.38
Mannar	IR	18.77	14.61
Polonnaruwa	IR	18.38	12.51
System B	IR	18.87	13.15
System C	IR	19.99	13.52
System H	IR	19.72	12.99
Trincomalee	IR	19.14	14.34
Gampaha	RF	27.27	16.60
Kalutara	RF	31.63	27.94
Kandy	RF	36.91	22.59
Kurunegala	RF	23.44	15.06
Whole Island	IR	20.52	14.55
Whole Island	RF	28.43	19.42

1. Including Cost of Farmer Owned Inputs
2. Excluding Cost of Farmer Owned Inputs

Source: SEPC/Department of Agriculture/2015

The table 4.18 reveals the unit cost which means cost of production of one kilogram of paddy including and excluding the cost of farmer owned inputs. The unit cost including farmer owned inputs in irrigated producing areas ranged from Rs. 17.88/kg in Hambanthota to Rs. 20.31/kg in Anuradhapura. It was noted that the unit cost comparably higher in rainfed producing areas mainly due to low productivity. The unit cost including farmer owned inputs in rain fedproducing areas ranged from Rs. 23.44/kg in Kurunegala to Rs. 36.91/kg in Kaluthara.

A detailed view of the cost of cultivation is terms of different activities can be pictured from the data in the following tables (Table 4.19 and Table 4.20) on Ampara and Anuradhapura major producing areas in the 2014/15 *Maha* season. So far as the labour component of cost is concerned, it is clear that the major portion of labour goes to land preparation and water management activities in both districts. The cost of combined harvesters is higher in Anuradhapura than in Ampara.

Table 4.19: Cost of Cultivation per acre of Paddy (Irrigated) – Ampara East- 2014/15 *Maha* Season

Operation	Cost (Rs./ac)			
	Labour	Machinery	Input	Total
1^{st}, 2^{nd} & 3^{rd} plough with 4wt	520.00	5266.00	-	5786.00
Plastering bunds	2268.00	-	-	2268.00
Levelling & broadcasting	2092.00	-	4816.00	6908.00
Fertilizer application	1102.00	-	854.00	1956.00
Weed control with weedicide	648.00	-	2142.00	2790.00
Pest & disease control	554.00	-	1470.00	2024.00
Water management	6230.00	-	-	6230.00
Harvesting & processing with combine harvester	880.00	6512.00	-	7392.00
Additional drying	1110.00	-	-	1110.00
Transport produce to stores	200.00	1527.00	-	1727.00
Total including imputed cost	15604.00	13305.00	9282.00	38191.00
Total excluding imputed cost	7194.00	13139.00	9282.00	29615.00

Source: SEPC/Department of Agriculture/2015

Table 4.20: Cost of Cultivation per acre of Paddy (Irrigated) – Anuradhapura - 2014/15 *Maha* Season

Operation	Cost (Rs./ac)			
	Labour	Machinery	Input	Total
General land preparation	530.00	-	-	530.00
1st, 2nd & 3rd plough with 2wt	-	7407.00	-	7407.00
(1st, 2nd & 3rd plough with 4wt)	-	(7533.00)	-	-
Plastering bunds	4670.00	-	-	4670.00
Levelling & broadcasting	2670.00	-	2852.00	5522.00
Fertilizer application	890.00	-	980.00	1870.00
Weed control with weedicide	643.00	-	2111.00	2754.00
Pest & disease control	450.00	-	710.00	1160.00
Water management	4890.00	-	-	4890.00
Harvesting & processing with combine harvester	2560.00	9756.00	-	12316.00
(Do manually)	(11000.00)	-	-	-
(Threshing & with 4w thresher)	-	(3520.00)	-	-
Transport produce to stores	-	549.00	-	549.00
Total including imputed cost	17303.00	17712.00	6653.00	41668.00
Total excluding imputed cost	7508.00	16724.00	6354.00	30586.00

Source: SEPC/Department of Agriculture, 2016

4.5.2 Returns

The productivity of paddy is higher in major irrigated producing areas in the dry zone of the country when compared with that of the rain fed cultivations in the wet zone due to favourable agro climatic conditions. Ampara, Anuradhapura, Polonnaruwa, Hambanthota and Mahaweli areas are in the dry zone and districts like Gampaha, Kaluthara and Galle come under wet zone producing areas. The unit cost is comparatively lower in major irrigated dry zone producing districts when compared with that of the rain fed producing areas like Gampaha, Kaluthara, Kandy and Kurunegala (Table 4.21).

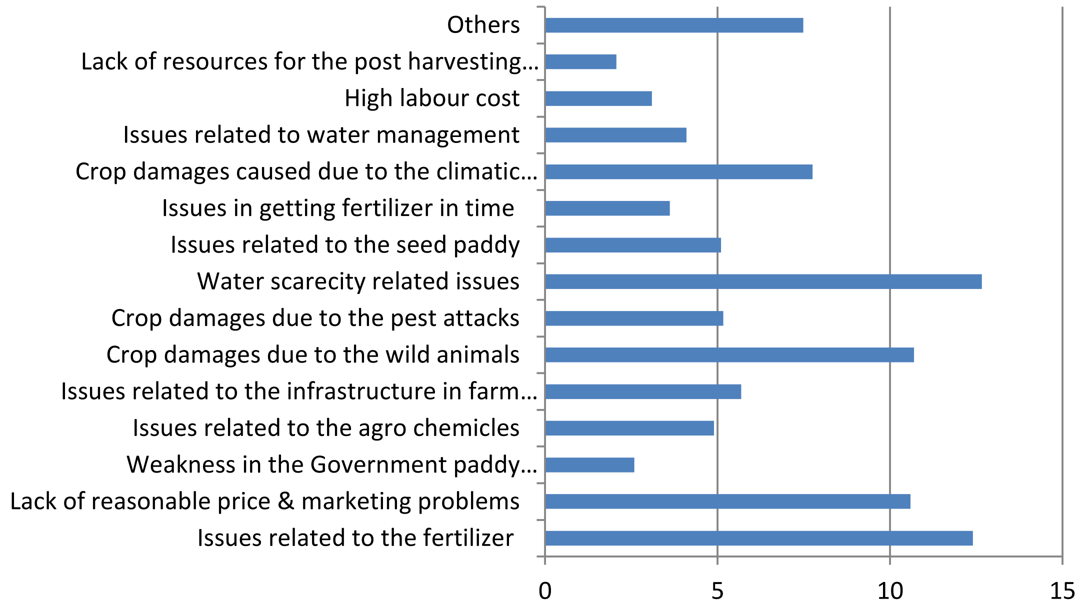
Table 4.21: Yield and Returns of Paddy in 2014/15 *Maha* Season in Ampara and Anuradhapura Major Producing Districts

Yield and Returns(Per Ac)	Ampara East	Anuradhapura
Average yield (kg)	2126.00	2052.00
Price of produce (Rs./kg)	37.99	35.63
Gross income (Rs.)	80767.00	73113.00
Profit including imputed cost (Rs.)	42576.00	31445.00
Profit excluding imputed cost (Rs.)	51152.00	42527.00
Unit cost (Including imputed cost Rs./kg)	17.96	20.31
Unit cost (Excluding imputed cost Rs./kg)	13.93	14.91

Source: SEPC/Department of Agriculture, 2016

The profit, including, the imputed cost is Rs. 42,576.00 in Ampara East producing area when the producer price is Rs. 37.99/kg. In Anuradhapura the profit including the imputed cost is Rs. 31,445.00 when the producer price is Rs. 35.63/kg. For a season comprising six months a farmer received Rs. 7096.00 per month in Ampara and Rs. 5241.00 in Anuradhapura. However, this income also depends on farm gate price received by the farmer. The farm gate price of paddy received by the farmer depends on many factors like, time of selling, type of buyer prevailing guaranteed price etc.

4.6 Major Issues Related to Paddy Farming



Source: HARTI Field Survey Data, 2016

Figure 4.18: Percentage of Responses on Major Issues Related to Paddy Farming in Major Paddy Producing Districts

The study examines the major issues faced by the farmers who cultivated paddy mainly. Among the issues most prominently highlighted issue is water scarcity (Figure 4.18). Many water related issues were recorded in Ampara, Polonnaruwa, Kilinochchi and Matara locations. The farmers of Ampara district belongs to the Mahaoya and the Sadunpura Agrarian Services Center areas mainly cultivate paddy under minor irrigation and rain fed cultivations. Kilinochchi was different from other paddy cultivating areas which were selected for the survey because this location has been experiencing frequent flooding. In Hakmana and Kamburupitiya study locations in Matara district paddy growers face water issues during Yala and farmers in Kamburupitiya face floods in *Maha*.

Paddy marketing is one of the issues highlighted by the respondent farmers. Out of total 11 percent of the farmers revealed that the lack of a reasonable price for paddy is their main marketing issue. Another three percent of the farmers pointed out weaknesses in the government paddy purchasing programme. Altogether nearly 14 percent of the farmers raised issues related to paddy marketing. The major problems related to paddy marketing were; regular low farm gate price during peak harvesting periods, lack of government purchasing centers in remote areas, limited quantities of paddy purchased by government purchasing centers, lack of space to dry wet paddy during peak harvesting periods, lack of storage facilities and so on. It was noted that this situation was mostly predominant in the Eastern Province.

Another serious issue highlighted (nearly 12%) was regarding the main input fertilizer. With regard to fertilizer, they have pointed out many issues such as not having cash grant for fertilizer on time, high fertilizer price in open market and quality concerns. Farmers showed their preference to fertilizer in kind than in cash.

However, the cash grant is a new policy mechanism introduced by the government substituting fertilizer subsidy provided in kind. The cash grant programme is a novelty to the paddy sector farmers who will need more time to get used to it and it is too early to comment. The frequent crop damage by the wild animals like elephants, peacocks, monkeys and wild boars was intractable problem faced by the farmers (nearly 11 %) in the surveyed areas mainly in Anuradhapura, Ampara and Matara.

Problems related to the field canals, water management structures like anicuts and rural farm roads were onother main concern of the farmers in the study areas in relation to rural farming infrastructures.

Crop damage due to the adverse climatic conditions (nearly 8%) reported mainly by the farmers in Kilinochchi, Matara and Batticaloa districts. The other issues are related to agro chemicals, pest outbreak, high labour and machinery cost, lack of extension services, and so on.

4.7 Recommendations Based on the Baseline Findings

The findings of the study highlighted the issues related to paddy marketing as the most pressing issue among other difficulties faced by the farmers in all major producing areas. This situation demands special attention which requires state intervention to minimize the issues related to marketing to protect farmers who mostly work at subsistence level and need some cash for their subsistence immediately after collecting the harvest.

The development of infrastructure in farming areas is of pivotal importance to improve the farm level productivity as well as the accessibility to the markets.

With increased use of combined harvesters, higher moisture level in the paddy has become an issue in paddy marketing that resulting lower prices for the farmers. In all major producing areas, facilities for paddy drying at farmer level are lacking. Therefore, supporting drying yard facilities in major producing areas would help farmers drying paddy just after harvesting.

Investments should be promoted to establish commercial rice mills in high surplus producing rural areas in major producing districts like Ampara, Batticaloe and Anuradhapura.

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Chapter Five

Maize

M.P.N.M. Dias

SUMMARY

Maize is one of the important cereal crops grown in Sri Lanka with grown extent of 69,971ha in 2015. Maize is used as human food and animal feed industries as well. Out of the total Maize requirement of the country, more than 60 percent has been required for animal feed production. Sicne Sri Lanka has not self sufficient with maize, part of the maize requirement is imported from different countries mainly from India.

Anuradhapuara, Monaragala, Badulla, Ampara and Kurunegala district are identified as the major maize cultivating areas. Anuradhapura and Monaragala districts accounts for 60 percent of the total maize cultivated extent.

According to the farmers view major issues related to the maize cultivation are crop damages cuased by wild animals and lack of quality input materials at the time of cultivation such as seeds, fertilizer and water for irrigation. Therefore, there is a need to take some remedial measures to overcome or minimize the main contraints faced by farmers to increasing the production of maize in the country.

CHAPTER FIVE

Maize

5.1 Overview of the Crop

5.1.1 Introduction

Maize (*Zea mays*) which belongs to the family *poaceae* originated in the South Central part of the Mexico and later introduced into other parts of America. Due to its ability to growen under different environmental conditions, maize popularized all over the world mainly in tropics and subtropics areas and it has become one of the major grain produced in the world. Maize is a staple food for a large propotion of the population around the world mainly in African countries. The United States produces more than 40 percent of the total world production (Ranum *et al*, 2014).

Maize is considered as the second important cereal crop grown in Sri Lanka. It is cultivated in many districts under rainfed conditions almost in both seasons and cultivated as a monocrop as well as a mixed crop in both highlands and shifting (*chena*) cultivation.

Traditional cultivated varieties of maize are tall, leafy and late maturing. These varieties generally attaining a height about 180 – 200 cm with 18 – 20 leaves per plant and mature in 130 -135 days. Now there are four open pollinated varieties of maize which are recommended by the Department of Agriculture namely Bhadra, Aruna, Ruwan and Muthu. Table 5.1 shows the specific characters of those four varieties

Table 5.1: Specific Features of Recommended Maize Varieties in Sri Lanka

Variety	Bhadra	Ruwan	Aruna	Muthu
Year of release	1977	1990	1992	1992
Plant height at maturity (cm)	195	215	155	170
No of leavesplant	13	13	10-13	13
No of ears/plant	1-2	1-2	1-2	1-2
Days to mature	105-110	105-110	90-100	110-115
Seed colour	Orange	Orange	Orange yellow	White
Average yield (kg/ha)	4100	4300	4400	5300

Source: Department of Agriculture

In recent years hybrid maize varieties such as Pacific, 999 jet were introduced and they became popular among farmers due to their high yield potential, uniform growth and ability to provide extra grains per each year. (Malaviarachchi *et al,* 2007). Department of Agriculture released the first local hybrid maize variety (Sampath) in 2004 and recently they introduced another two hybrid varieties named as M1H1 and M1H2.

5.1.2 Major Growing Areas and Extent under Cultivation

The extent under cultivation and total productivity of maize in Sri Lanka for the period of 2006 to 2015 are shown in Table 5.2.

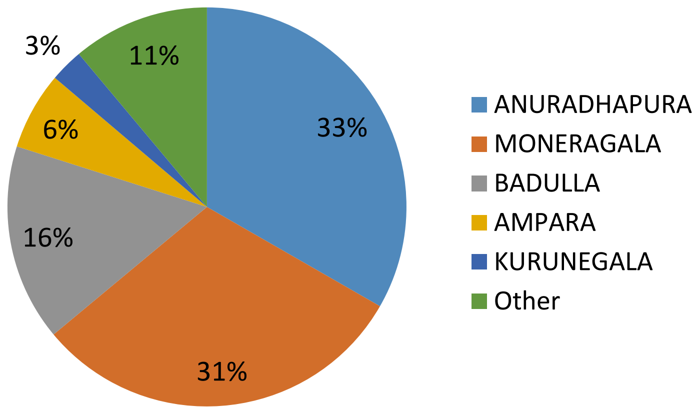
Table 5.2: Extent and Production of Maize in Sri Lanka from 2006- 2015

	Extent				Production			
	Maha		*Yala*		*Maha*		*Yala*	
Year	**ha**	**%**	**ha**	**%**	**mt**	**%**	**mt**	**%**
2006	26310	82.2	5692	17.8	40376	85.0	7145	15.0
2007	27095	79.3	7089	20.7	45068	79.9	11370	20.1
2008	42864	83.1	8744	16.9	91046	81.1	21241	18.9
2009	44786	88.1	6071	11.9	114655	88.4	15114	11.6
2010	48887	84.8	8731	15.2	127761	79.0	33933	21.0
2011	41906	82.8	8685	17.2	104491	77.3	30665	22.7
2012	50881	85.5	8648	14.5	165999	82.0	36316	18.0
2013	55892	82.5	11830	17.5	173320	82.9	35722	17.1
2014	57525	85.6	9694	14.4	210886	87.7	29702	12.3
2015	60954	87.1	9017	12.9	230871	88.4	30250	11.6
Average	45710	84.4	8420.1	15.6	130447.3	83.8	25145.8	16.2

Source: Department of Census and Satistics

According to the last ten years data, more than 80 percent of maize production comes from the *Maha* season and *Yala* season produces only less than 20 percent.

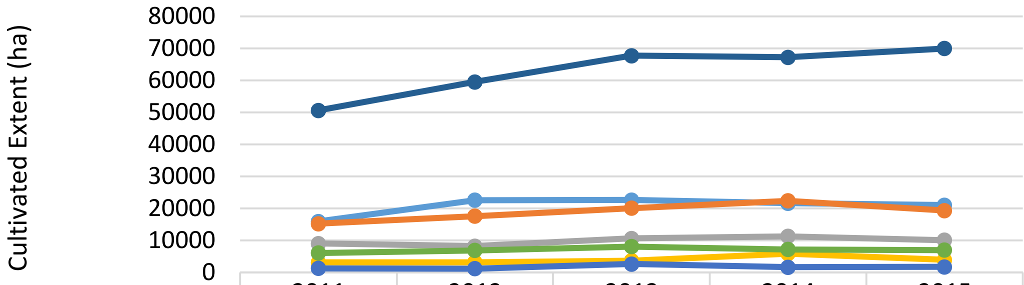
Maize is traditionally cultivated all over Sri Lanka and it is hardly found in the Southwest coastal districts (Matara, Galle, Colombo, Kalutara, and Gampaha) and Kegalle district in the mid country. The extent of cultivation is relatively small in the Northern districts of Jaffna, Vavuniya, Mullativ and Mannar as well. Major maize producing districts are Anuradhapura, Monaragala, Badulla and Ampara with the percentages respectively of 33 percent, 31 percent, 16 percent and six percent of the total cultivated extent (Figure 5.1).



Source: Department of Census and Statistics

Figure 5.1: Average Land Extent under Maize Cultivation in Major Producing Disrticts as a Percentage of Total Maize Lands (2011-2015)

As shown in Figure 5.2, total cultivating extent of maize in the country has gradually increased in the last five years. Anuradhapura and Monaragala districts have the highest maize cultivated lands.



	2011	2012	2013	2014	2015
Anuradhapura	15900	22548	22603	21634	20994
Monaragala	15202	17545	20092	22390	19323
Badulla	9005	8204	10620	11287	10052
Ampara	3136	3194	3692	5851	3944
Kurunegala	1262	1185	2647	1636	1705
Other	6083	6855	8069	7174	6990
Total	50,591.00	59529	67722	67219	69971

Source: Department of Census and Statistics

Figure 5.2: Cultivated Extent of Maize (mt) (2011 to 2015)

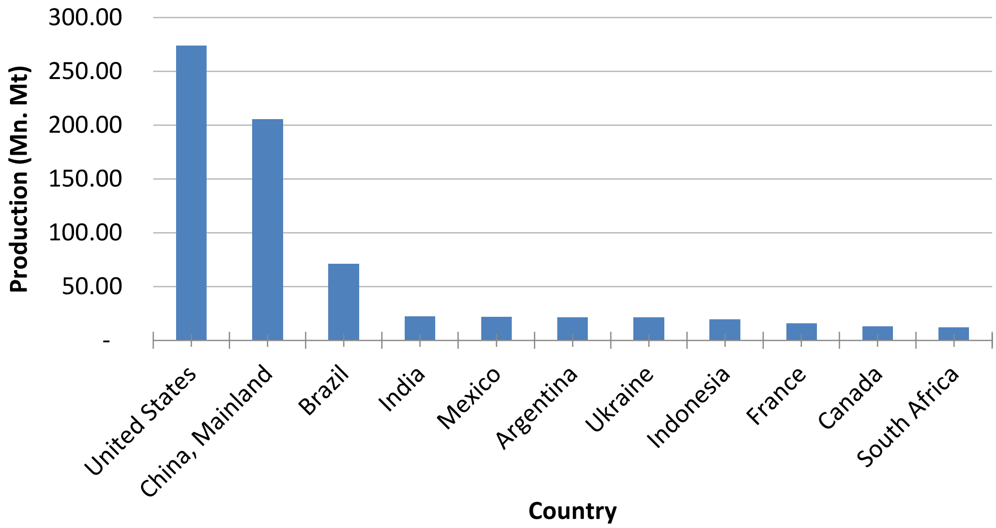
5.1.3 Climate and Soil

Maize can be cultivated under different environmental conditions. It is a warm weather crop and it can be grown in the areas where mean daily temperature is between 19 – 32 ^{0}C. In the *Maha* season the maize crop can be raised as a rainfed crop with supplementary irrigation when it is required. By establishing the crops with the onset of the rainy season the crops can be harvested before depletion of soil moisture. Maize crop is established with the onset of the *Maha* rains that occur at the end of September or first week of October for successful growth. In the *Yala* season it should be established at the end of April for optimum growth. Deep loamy fertile soils rich in organic matter with the pH of 5.6 – 8.0 are preferred for growth of maize plant. A well-drained soil with adequate moisture supply is required for the uninterrupted growth of this crop.

5.1.4 Importance of the Crop to Economy

5.1.4.1 Production

Maize is widely cultivated all over the world as a major cereal. According to the Food and Agriculture Organization (FAO), in 2012 world total production of maize was 746 million metric tons. Figure 5.3 shows the major producing countries in the world.

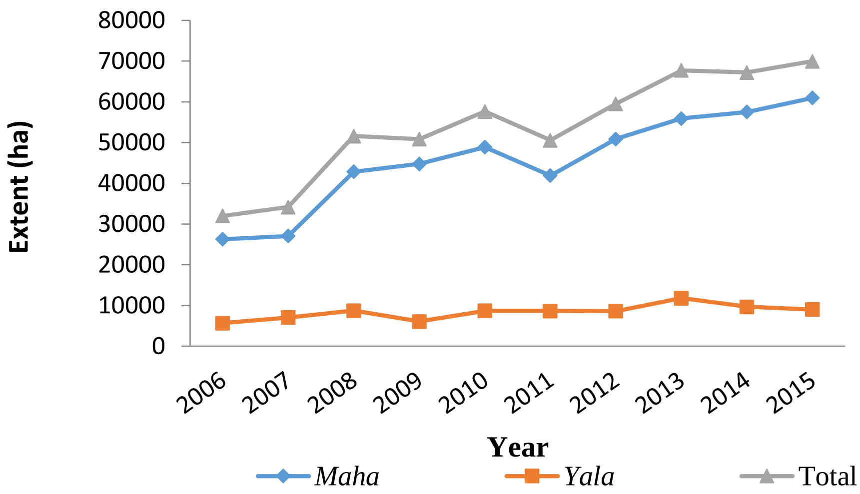


Source: Food and Agriculture Organization, 2012

Figure 5.3: Maize Production in the World

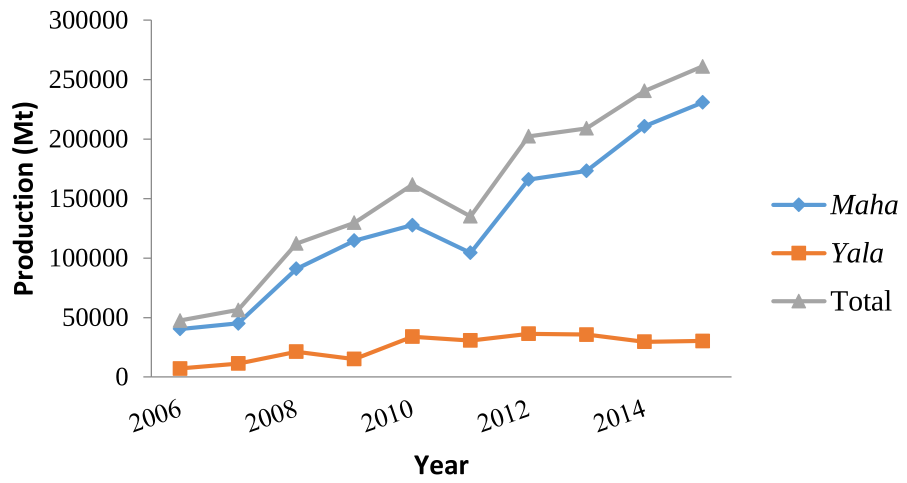
In Sri Lanka maize has become the second most important cereal crop grown in an extent of 69971 ha with the total annual production of 261121 mt in 2015. (Table 5.2) Maize production of the country has recorded a gradual upward trend with the introduction of high yielding hybrid maize varieties.

Figures 5.4, 5.5, and 5.6 are showing the variation of extent, production and an average yield of maize during the last ten years (2006 to 2015) respectively. From 2006 to 2010 the increasing trend of maize production was due to the expansion cultivated extent. In 2011 land extent dropped by 6981 ha in the *Maha* season causing a reduction in the total production by 23270 mt. (Table 5.2). From 2011 onwards the maize production shows the incremental change both in production and the cultivated extent (Figure 5.5).



Source: Department of Census and Statistics

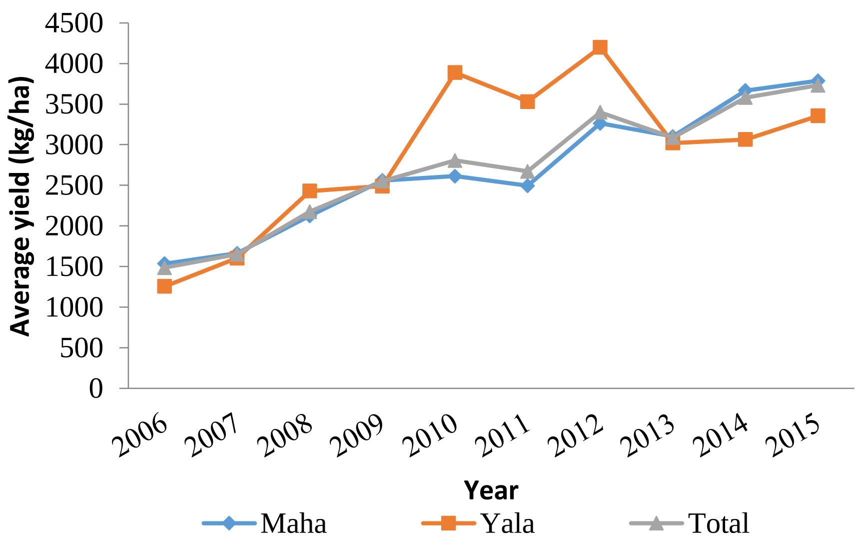
Figure 5.4: Extent under Maize Cultivation from 2006 to 2015



Source: Department of Census and Statistics

Figure 5.5: Maize Production from 2006 to 2015

The extent under maize cultivation is more prominent in the *Maha* season than in the *Yala*. From 2006 to 2010 the average yield of maize has shown an increasing trend. Maximum average yield of maize was 4199 kg/ha recorded in 2012 *Yala* season. Thereafter, the *Maha* season recorded the highest average yield and this trend continued from 2006 to 2015 with few fluctuations.



Source: Department of Census and Statistics

Figure 5.6: Annual Average Production from 2006 to 2015

5.1.4.2 Imports

Maize is widely used as a source of food for both humans and livestock. The overall maize production is not enough to meet the local demand consequently maize imports have been increasing over the last two years (2014 and 2015). According to the Sri

Lankan Customs, the highest quantity of maize has been imported from India in 2014 (Table 5.3).

Table 5.3: Imported Quantity of Maize and Value from 2006 to 2015

Year	Quantity (mt)	Value (000' Rs.)
2006	83695	1628052
2007	78366	2073540
2008	82488	2469697
2009	27200	729744
2010	9,571	278,316
2011	7,011	257,501
2012	1,005	52,802
2013	528	41,694
2014	86,824	3,136,954
2015	67,237	2,347,530

Source: Department of Customs

Imported quantity of maize significantly dropped from 2010 and it upped drastically again from 2014. In 2013 only maize seeds were imported since the country's total requirement was met by local production. Recently the maize imports have increased significantly.

5.1.4.3 Price Variations

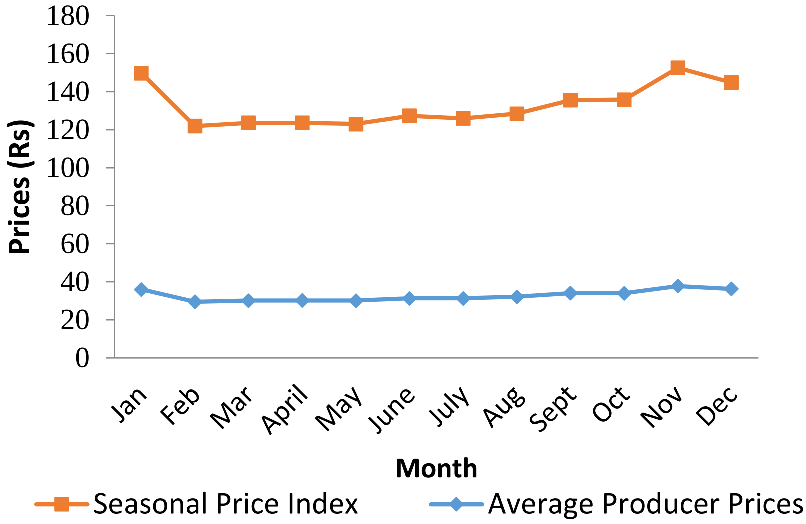
Table 5.4 shows the variation of average annual retail and producer prices of one kilogram of maize for the last 10 years. During that period producer price remained more or less constant but retail price has been rising at increasing rate.

Table 5.4: Average Producer Prices and Retail Prices

	Prices (Rs for 1 kg)	
Year	Producer prices	Retail prices
2006	19.78	61.81
2007	25.55	68.03
2008	35.38	101.76
2009	35.22	94.95
2010	34.18	116.02
2011	39.76	104.17
2012	35.44	93.63
2013	31.38	70.86
2014	33.63	87.87
2015	35.69	168.36

Source: Department of Census and Statistics

It was observed that the retail price of maize is three to four times higher than the producer price and highest retail price of Rs. 168.36 was recorded in 2015. The Figure 5.7 illustrates the seasonal price index of maize. The higher price index values were observed during the months of November, December and January.



Source: Department of Census and Statistics

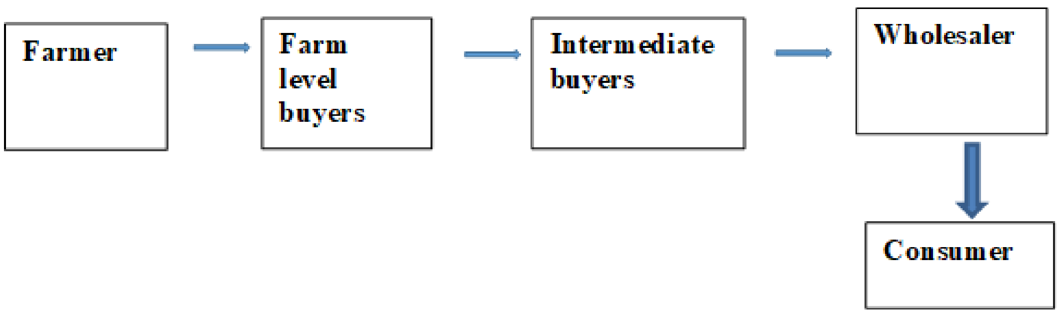
Figure 5.7: Average Producer Prices and Seasonal Price Index

5.1.4.4 Marketing of Maize

Mainly maize is markets as two product commodities as unripe cobs and maize grains. Unripe cobs are collected by the collectors or directly by retailers and sold as unripe cobs or even sometimes as boiled cobs.

Farmer/Producer → **Collector/Retailer** → **Consumer**

For maize grains there are three intermediates between the farmer and the consumer. They are farm level buyers such as local collectors, local traders and co-operatives, intermediate buyers and wholesalers. (Henegedara et al, 2005)



5.1.4.5 Per Capita Consumption

Maize is considered as highly nutritious cereal and 100g of maize contain 359.8 calories. Nutrient value of the maize is shown in Table 5.5.

Table 5.5: Nutritive Value of the Maize

Nutrition component	%
Carbohydrate	73.76
Protein	7.20
Fat	3.99
Minerals	1.04
Moisture	12.81
Fiber	1.20

Source: Department of Agriculture

Riped seeds are converted to maize flour which is used to make variety of foods in rural areas. Popcorn is a heated kernel of maize that is eaten as a snack. Also there are some products such as breakfast cereals made mainly from maize flour and the main ingredient of "threeposha" which is one of the nutrient supplements given to lactating mothers and malnourished infants is maize. Per capita consumption of maize in Sri Lanka is shown in Table 5.6.

Table 5.6: Per Capita Consumption of Maize

Year	grams/year
2005	122.88
2006/07	168.24
2009/10	144
2012/13	166.8

Source: Household Income and Expenditure survey – Dept. of Census and Statistics

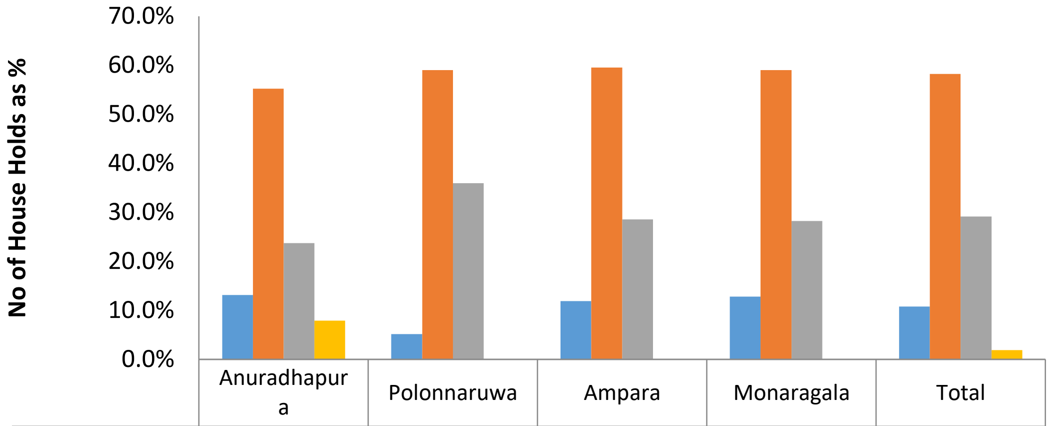
Maize grains are widely used as a source for livestock feed. Maize stem and left overs are used as fodder for livestock. Starch extracted from maize is used to produce some plastics, fabrics, and many other products. Also maize is increasingly used to produce ethanol as a biofuel.

5.2 Socio Economic Characteristics of the Sample Farmers

5.2.1 Demographic Information of the Farmer Households

5.2.1.1 Family Size

As shown in Figure 5.8, out of the total sample (158) of farm families engaged in maize cultivation 58.2 percent consists of three to five family members. Twenty-nine percent farm families comprise five to seven members and 10.8 percent of them had fewer than three members. Out of total only about two percent of farm families with more than seven members were observed in the Anuradhapura district.



	Anuradhapura	Polonnaruwa	Ampara	Monaragala	Total
members<3	13.2%	5.1%	11.9%	12.8%	10.8%
3<=members<5	55.2%	59.0%	59.5%	59.0%	58.2%
5<=members<7	23.7%	35.9%	28.6%	28.2%	29.1%
members>=7	7.9%	0.0%	0.0%	0.0%	1.9%

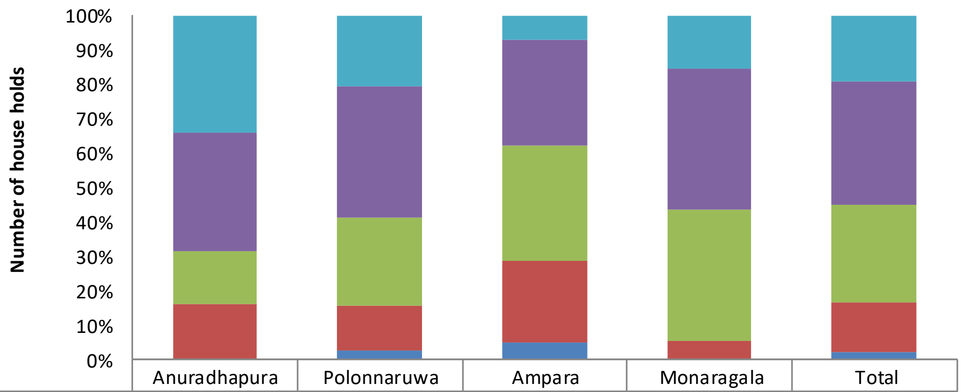
Source: HARTI Survey Data, 2016

Figure 5.8: Family Size of Selected Households

5.2.1.2 Age Categories

Age distribution of farmers is shown in Figure 5.9. Majority of the farmers (65 percent) engaged in maize cultivation in the study area were in between 40 to 60 years of age.

Younger generation in the age category below 30 is not involved in maize cultivation in Anuradhapura and Monaragala districts. A very small percentage (2 to 4) was reported in Ampara and Polonnaruwa districts.



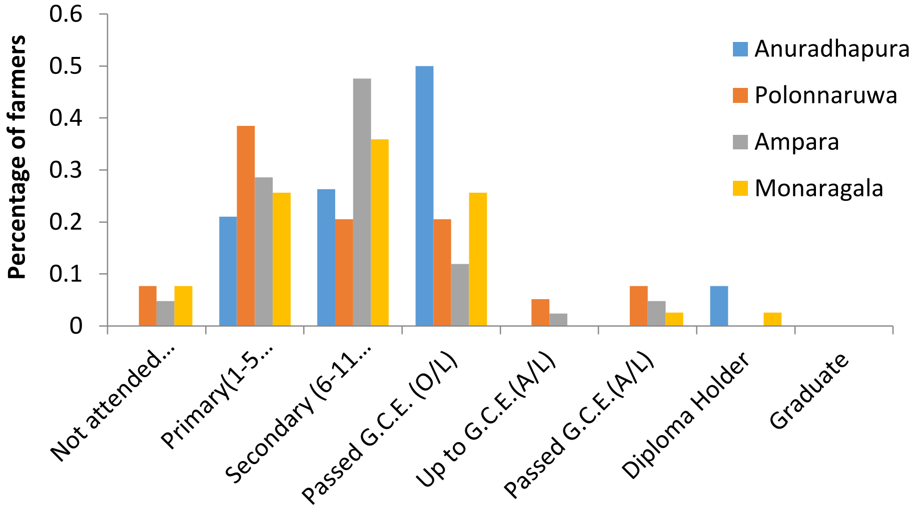
	Anuradhapura	Polonnaruwa	Ampara	Monaragala	Total
Age>=60	34.2%	20.5%	7.1%	15.4%	19.0%
50<=age<60	34.2%	38.5%	31.0%	41.0%	36.0%
40<=age<50	15.8%	25.6%	33.3%	38.5%	28.5%
30<=age<40	15.8%	12.8%	23.8%	5.1%	14.6%
age<30	0.0%	2.6%	4.8%	0.0%	1.9%

Source: HARTI Survey Data, 2016

Figure 5.9: Age Distribution of Farmers

5.2.1.3 Level of Education

As shown in Figure 5.10, majority of the farmers have received education (32.9%) up to G.C.E. (O/L). Comparatively, in the Anuradhapura district most of the farmers have passed G.C.E. (O/L). There was one diploma holder and one degree holder engaged in maize cultivation in the Monaragala and Anuradhapura district respectively. Farmers who have not received any formal education were about six percent of the total sample.



Source: HARTI Survey Data, 2016

Figure 5.10: Educational Level of Farmers in the Sample

5.2.2 Economic Characteristics of the Sample Population

Majority of the farmers (89%) in the surveyed area depended on farming and animal husbandry as their primary source of income (Table 5.7). However, 20 percent of the respondents in the Ampara district were employed in the government sector and it was above 10 percent in the Anuradhapura district.

Table 5.7: Primary Occupation of Maize Farmers

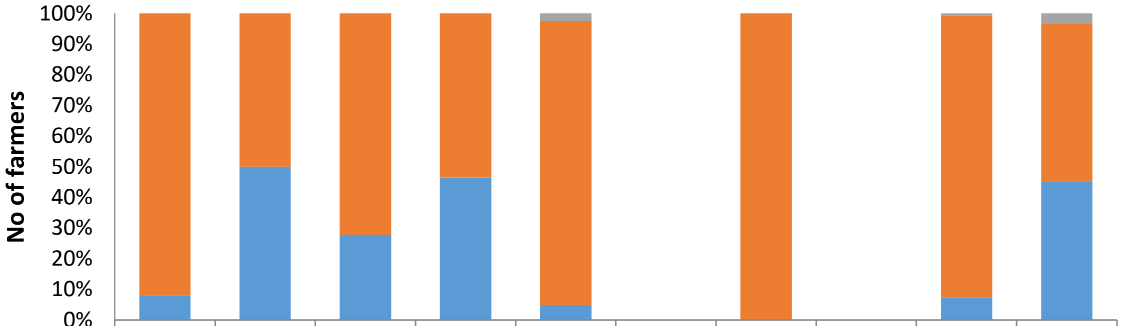
Primary Employment	Anuradhapura		Polonnaruwa		Ampara		Monaragala		Total	
	N	%	N	%	N	%	N	%	N	%
Farming/Animal husbandry	31	86	38	97	31	76	35	97	135	89
Non-agricultural Labour	0	0	0	0	2	4	0	0	2	1
Government job	4	11	1	3	8	20	1	3	14	9
Private sector job	1	3	0	0	0	0	0	0	1	1
Total	36	100	39	100	41	100	36	100	152	100

Source: HARTI Survey Data, 2016

5.3 Agricultural Inputs

5.3.1 Land

According to the surveyed data, *Maha* season is the major maize cultivating season and mainly cultivated in highlands. Out of the total sample (158) 79 percent of the farmers cultivated maize in the *Maha* season in highlands and 10% on lowlands (Figure 5.11). Only six percent of farmers cultivated maize in the *Yala* season in highlands and nine percent cultivated in lowlands. Maize cultivation is hardly practised in the intermediate season and it was only one percent.

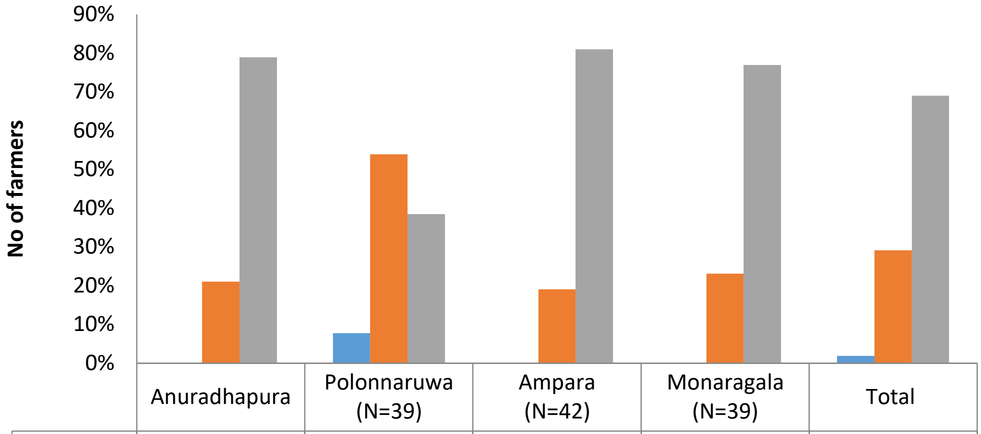


	Anuradhapura		Polonnaruwa		Ampara		Monaragala		Total	
	Highland	Lowland	Highland	Lowland	Highland	Lowland	Highland	Lowland	Highland	Lowland
Inter					2%				1%	1%
Maha	92%	3%	33%	38%	90%		100%		79%	10%
Yala	8%	3%	13%	33%	5%				6%	9%

Source: HARTI Survey Data, 2016

Figure 5.11: Maize Cultivation Based on the Types of Land

Land size directly determines the management practices and input use of the maize cultivation. In each district majority of the total sample farmers that is, around 69 percent have more than five acres (Figure 5.12). Twenty-nine percent of the farmers have land extent between two to five acres. Only two percent out of the total has less than two acres.



	Anuradhapura	Polonnaruwa (N=39)	Ampara (N=42)	Monaragala (N=39)	Total
1<=ext<2	0%	8%	0%	0%	2%
2<=ext<5	21%	54%	19%	23%	29%
ext>=5	79%	38%	81%	77%	69%

Source: HARTI Survey Data, 2016

Figure 5.12: Distribution of Farmers by Size Class of Land

Land ownership is a critical factor in the relevant farming systems since the level of management of land and maintenance depends on the ownership. Majority of the farmers accounting for 49.8 percent in each district practised their maize cultivations in their own lands. There were 25.68 percent of encroachers and 11.67 percent permit holders for their lands (Table 5.8).

Table 5.8: Land Ownership of Maize Farmers in Surveyed Areas

Ownership	No. of Farmers								Total	
	Anuradhapura		Polonnaruwa		Ampara		Monaragala			
	N	%	N	%	N	%	N	%	N	%
Single owner	36	54.55	36	76.60	23	31.94	33	45.83	128	49.81
Jointly owner	5	7.58	4	8.51	1	1.39	1	1.39	11	4.28
Leased in	7	10.61	0	0.00	1	1.39	1	1.39	9	3.50
Tenancy in	1	1.52	1	2.13	2	2.78	1	1.39	5	1.95
Tenancy out	0	0.00	1	2.13	2	2.78	1	1.39	4	1.56
Permit holder	4	6.06	3	6.38	15	20.83	8	11.11	30	11.67
Encroached	12	18.18	2	4.26	27	37.50	25	34.72	66	25.68
Mortgaged	1	1.52	0	0.00	0	0.00	0	0.00	1	0.39
Other	0	0	0	0.00	1	1.39	2	2.78	3	1.17
Total	66	100.00	47	100.00	72	100.00	72	100.00	257	100.00

Source: HARTI Survey Data, 2016

5.3.2 Irrigation

Maize is mainly cultivated as a rainfed crop during the *Maha* season and the highest number of irrigated farmers practised flood irrigation. In addition, some farmers followed several water efficient irrigation methods like, drip and sprinklers.

Supplementary irrigation was also practised in both seasons whenever required by using kerosene, petrol and electric pumps.

5.3.3 Labour

In maize cultivation, labour is mostly deployed for farming practices such as land preparation, crop establishment, fertilizer application, crop management, agrochemical applications and for harvesting and so on (Table 5.9).

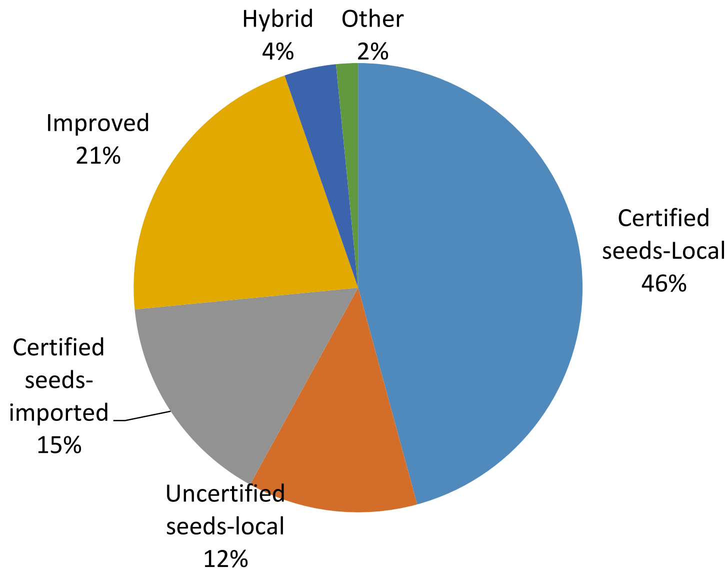
Table 5.9: Labour Cost for Maize Cultivation (Rs.)

Activity	Responses	Family labour	Hired labour	Exchange labour
Land preparation	133	972.08	1197.96	177.48
Crop establishment	126	1152.58	1267.97	303.17
Fertilizer application	150	725.76	506.37	62.54
Crop management	100	931.24	956.29	510.63
Agro chemicals	67	162.16	91.19	
Harvesting	154	884.75	2850.70	1023.30
Other	33	384.53	1181.57	1062.71
Total		5213.10	8052.04	3139.83

Source: HARTI Survey Data, 2016

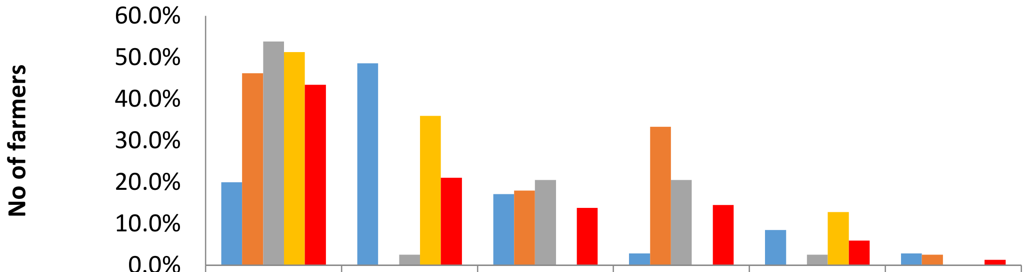
5.3.4 Seeds

Use of quality seeds for cultivation is one of the major factors that determine the quality and the quantity of the final harvest. Therefor, it is pivotal to use recommended seed varieties for the cultivation. According to the observed data around 46 percent of the farmers used certified local seed varieties. However, in Anuradhapura district most farmers used uncertified local seeds. It was observed that improved seeds were also used by another 21 percent of the farmers in the surveyed area (Figure 5.13). Results from some research works related to maize cultivation reveals that a higher yield can be obtained from the hybrid varieties rather than other varieties (Malaviarachchi *et al,* 2007). The use of hybrid varieties by the farmers is low as about four percent. Farmers are not much aware of the type of seeds they are planting; consequently, the actual number of farmers using hybrid seeds may be greater than this (Figure 5.14). Nevertheless, there is a strongly felt need to create awareness among the farmers and introduce high yielding varieties of maize for the purpose of meeting the national demand through enhanced productivity.



Source: HARTI Survey Data, 2016

Figure 5.13: Types of Maize Seeds Used by Farmers in Surveyed Areas



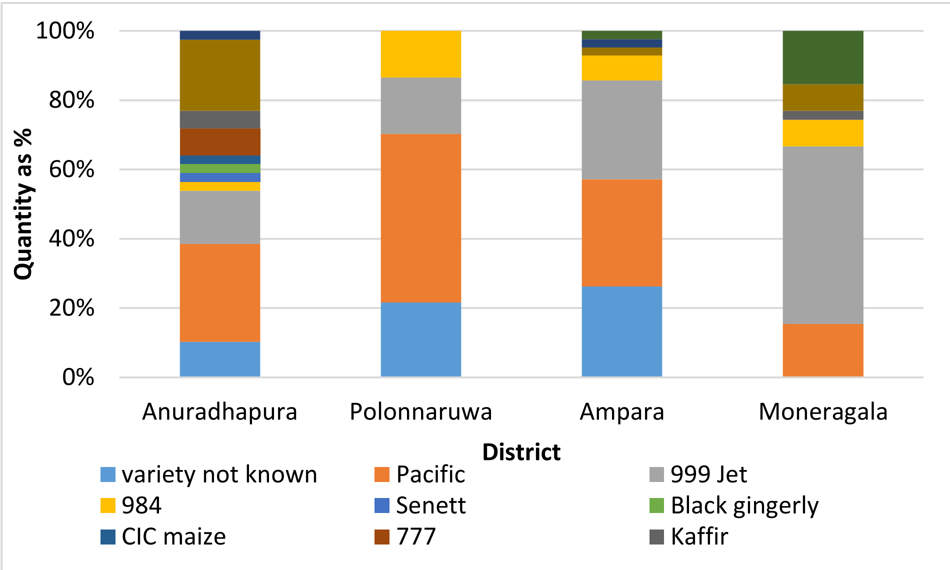
	Certified seeds-Local	Uncertified seeds-local	Certified seeds-imported	Improved	Hybrid	Other
Anuradhapura	20.0%	48.6%	17.1%	2.9%	8.5%	2.9%
Polonnaruwa	46.2%	0.0%	17.9%	33.3%	0.0%	2.6%
Ampara	53.8%	2.6%	20.5%	20.5%	2.6%	0.0%
Monaragala	51.3%	35.9%	0.0%	0.0%	12.8%	0.0%
Total	43.4%	21.1%	13.8%	14.5%	5.9%	1.3%

Source: HARTI Survey Data, 2016

Figure 5.14: Different Types of Seeds Used by Farmers in Major Maize Growing Districts

Pacific and 999 JET varieties are the most popular varieties among the maize farmers. Diversity of the varieties of maize in each district is shown in Figure 5.15. Anuradhapura district has the highest varietal diversity and the farmers cultivated around 10 maize varieties, in Polonnaruwa farmers growing four varieties. Some farmers in the sample did not have any idea about the variety they cultivated. Each variety has specific characters that are suitable for different environmental conditions.

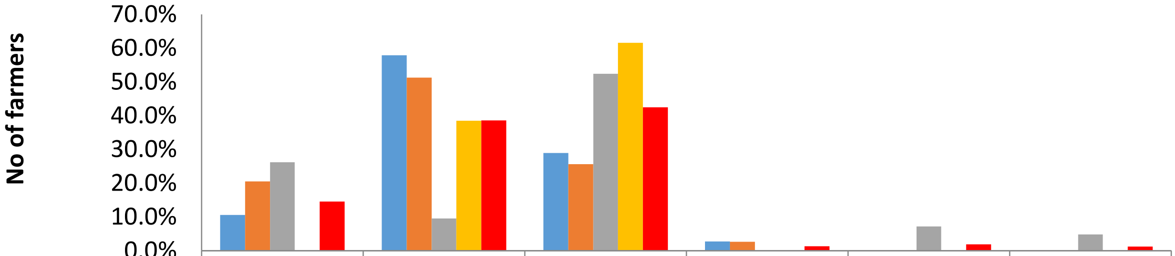
Farmers should be encouraged to maximize their yield through identification of suitable seed variety which performs well in their agro ecological region.



Source: HARTI Survey Data, 2016

Figure 5.15: Different Maize Varieties Cultivated by Farmers in Surveyed Areas

According to the surveyed data, local market and private companies are the main suppliers of maize seeds for the farmers that accounts for 42 percent and 39 percent respectively. Contribution for seed supply from Department of Agriculture (DOA) is only 15 percent. Only two percent of the farmers used self-produced seeds for their maize cultivation (Figure 5.16).



	Dept.of Agriculture	Private companies	Local Market	Other	Self produced	Neighboring farmers
Anuradhapura	10.5%	57.9%	28.9%	2.7%	0.0%	0.0%
Polonnaruwa	20.5%	51.3%	25.6%	2.6%	0.0%	0.0%
Ampara	26.2%	9.5%	52.4%	0.0%	7.1%	4.8%
Monaragala	0.0%	38.5%	61.5%	0.0%	0.0%	0.0%
total	14.6%	38.6%	42.4%	1.3%	1.9%	1.2%

Source: HARTI Survey Data, 2016

Figure 5.16: Sources of Seeds for Maize Cultivation in Surveyed Areas

5.3.5 Fertilizer and Pesticides

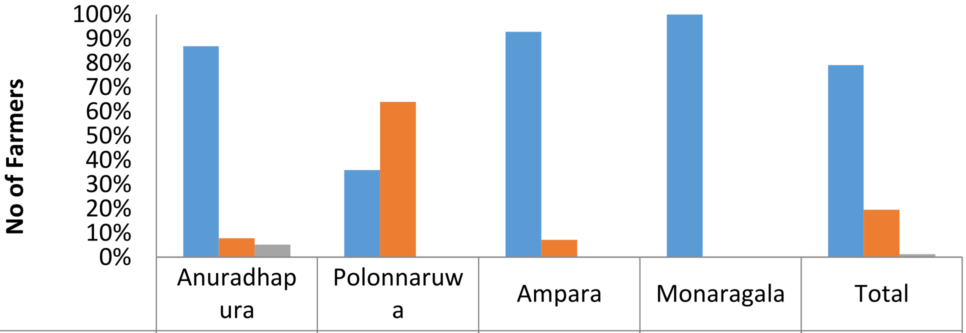
Maize plant can be cultivated in diverse environmental conditions with minimum management practices, requesting a very low use of fertilizer and pesticides. Out of 158 farmers, 55 percent did not use any pesticide for their cultivation in the last season.

Table 5.10: Use of Pesticides for Maize Cultivation in Surveyed Areas

Usage of Pesticides	Number of Farmers									
	Anuradhapura		Polonnaruwa		Ampara		Monaragala		Total	
	N=38	%	N=39	%	N=42	%	N=39	%	N=158	%
Used Pesticides	9	24	37	95	7	17	18	46	71	45
Not used Pesticides	29	76	2	5	35	83	21	54	87	55
Total	38	100	39	100	42	100	39	100%	158	100

Source: HARTI Surveyed Data, 2016

When considering the use of fertilizer for the maize cultivation, most of the farmers, around 79 percent used chemical fertilizer. Only 20 percent of the farmers used both organic and chemical fertilizer with one percent using none. Farmers in Monaragala district used only chemical fertilizers and in Polonnaruwa district there was a significant number of farmers who used a combination of organic and chemical fertilizers.



	Anuradhapura	Polonnaruwa	Ampara	Monaragala	Total
Only chemical fertilizer	87%	36%	93%	100%	79%
Both organic & chemical	8%	64%	7%	0%	20%
No fertilizer	5%	0%	0%	0%	1%

Source: HARTI Surveyed Data, 2016

Figure 5.17: Use of Fertilizer for Maize Cultivation in Surveyed Areas

5.3.6 Machinery

Machinery cost for the maize cultivation is shown in Table 5.11. The highest cost in this respect was the use of tractors for their cultivation operations.

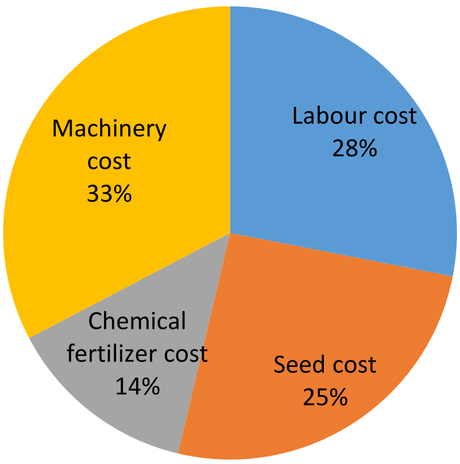
Table 5.11: Machinery Cost for Maize Cultivation

Operation	Responses	Fuel cost - own	Fuel cost - hired	Total cost
Cattle /Buffalo	27		1337.66	1337.66
Four wheel tractors	112	77.36	2982.57	3059.94
Two wheel tractors	41	500.60	1880.95	2381.55
Land pre-other	95	19.95	1353.00	1372.95
Harvest-other	4	157.14	142.86	300.00
Water-other	20		1245.16	1245.16
Total		755.05	8942.21	9697.26

Source: HARTI Survey Data, 2016

5.3.7 Total Cost of Production

Maize is a crop that can be cultivated with minimum inputs and less agronomic practices. As shown in Figure 5.18, the highest share of the total cost of production of 33 percent accounts for the machinery component. The other costs are as given in Figure 5.18.



Source: HARTI Survey Data, 2016

Figure 5.18: Total Cost of Production for Maize

As for the total cost of production in each district, Monaragala district accounted for the highest cost of Rs. 21,416.00/ac for the maize production. In Anuradhapura and Polonnaruwa districts highest cost was more for labour than for seeds, chemicals and fertilizer. According to the survey data Ampara and Monaragala districts have recorded the highest machinery cost for maize cultivation. The mean total cost calculation for maize is around Rs. 19,099.00 per acre of land.

Table 5.12: Mean Total Cost of Production for Maize Cultivation in District Wise

Component	Mean Total Cost (Rs.)				
	Anuradhapura	Polonnaruwa	Ampara	Monaragala	Total
Labour cost	6260.00	5881.00	5137.00	4185.00	5362.00
Seed cost	4597.03	4129.56	4843.94	6161.08	4892.20
Chemical fertilizer	2559.53	2649.45	1674.20	3575.59	2603.06
Machinery cost	5931.39	5273.37	6237.12	7494.38	6242.23
Total cost (Rs/ac)	19347.95	17933.38	17892.26	21416.06	19099.13

Source: Survey Data HARTI, 2016

5.4 Potentials and Constraints of Production

According to the survey data the major issues confronted by the maize farmers are summarized below. (Table 5.13)

1. Crop damages causing by wild animals and pests and diseases has identified as a major issue in maze cultivation by impeding 26.6 percent of the farmers during their cultivation.
2. The non-availability of high quality seeds for maize cultivation is the next issue faced by the majority of the farmers in the study area and it accounts for 21.8 percent. Inability to obtain good quality seeds, increasing seed cost and non-availability in time are the other implications of this issue.
3. Problems related to fertilizer cost, availability and accessibility are impediments faced by 16.5 percent maize farmers in the study area. Out of the total, 79 percent of the farmers make use of only chemical fertilizers for their cultivations.
4. Water related issues also created problems for 12.5 percent of the maize farmers. Maize is mainly cultivated as a rainfed crop in the *Maha* season. High variability of climatic parameters such as rainfall will have a negative impact on maize production.
5. Issues in marketing the harvested product highlighted by 10 percent of the maize farmers. Out of the total, 79 percent of the farmers sold their harvest to the private traders and only nine percent sold their harvest to government sources.
6. Obtaining other input materials such as machinery, labour and pesticides etc. is another obstacle faced by 7 percent of the farmers during maize cultivation. Higher prices, unavailability and timely availability are the issues they faced mostly under the above category.
7. Drawbacks in the extension services in those areas negatively impacted on a 3 percent of farmers in their cultivations. Lack of knowledge to select the most suitable maize varieties for the area, unawareness of new farming technologies such as efficient irrigation methods and planting methods and other crop management practices are recorded as major issues under that category.

8. Poor soil fertility is another issue stated by two percent of the farmers in the study area.

Table 5.13: Major Problems Faced by Maize Farmers in Surveyed Area

Issue	% of farmers
Increasing crop damages by wild animals, pest and diseases	26.6
Issues related to good quality seeds and its availability	21.8
Issues related to fertilizer	16.5
Water scarcity and water management issues	12.5
Marketing issues	10.1
Problems related to other input materials such as labour, machineries and pesticides, etc.	6.8
Weakness in extension services and lack of knowledge about new technologies	3.3
Issues related to farm lands	2.4

Source: HARTI Survey Data, 2016

5.5 Recommendations

- A recommendation that goes with findings is to introduce some mechanism to increase the availability of input materials such as seeds, fertilizer, machinery, water, etc.
    - Government intervention is necessary to popularize good quality improved and high yielding maize varieties and increase the availability of those seeds at low cost.
    - Introduction of new machinery for maize cultivation such as seeders, weeders and harvesters will reduce the labour cost and increase the production and the storing quality of the harvested maize grains.

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Chapter Six

Groundnut

G.G.de.L.W. Samarasinha

SUMMARY

Groundnut (*Arachis Hypogaea L.*) is the sixth most important oil seed crop in the world and the seeds are high in nutritional value. It is one of the crops identified by the government's National Food Production Programme (2016-2018) to be self-sufficient. In Sri Lanka, groundnut is grown mainly in Monaragala, Mullativ and Kurunegala districts. Tissa, Indi, Tikiri and Walawe varieties most popularly grown in the country; however, in the study area white groundnut, red groundnut and Spanish red were most popular. During the period of last fifteen years, the highest average production was reported from Monaragala district. Groundnut is mainly a *Maha* season crop. It has a demand as a snack and confectionary also. Average retail price of groundnut is more or less equal in all the months over the year.

Most of the landholdings where groundnut was cultivated belonged to the size category of more than 2 acres owned by single owners. Cultivation of groundnut was mainly practiced under rainfed conditions. Mean total cost of production including family labour was about Rs. 28, 529 per acre. About 70 percent of the groundnut farmers had not applied any type of fertilizer.

Not getting a fair price for their harvest, lack of quality seeds, unavailability of a proper marketing channel, lack of sufficient water for cultivation were reported as constraints to groundnut production. A common threat menacing the farmers was the damages caused by wild animals.

In these circumstances it is mandatory to strengthen the seed production system within the country and further regulating the seed certification process to ensure use of quality seeds for cultivation. The study has brought out the dire need to revamp the available marketing channels for groundnut ensuring a good price for the farmers and a fair price for the consumers.

Since it is envisaged to achieve self -sufficiency in groundnut which is now farmed as a small scale enterprise, thoughts need to be given to the possibility of attracting more growers with a planned exercise to provide them with the needy inputs – quality seeds, fertilizer, expanding the land extents, assistance in farm technology and proper marketing channels, extension services and so on.

CHAPTER SIX

Groundnut

6.1 Overview of the Crop

6.1.1 Introduction

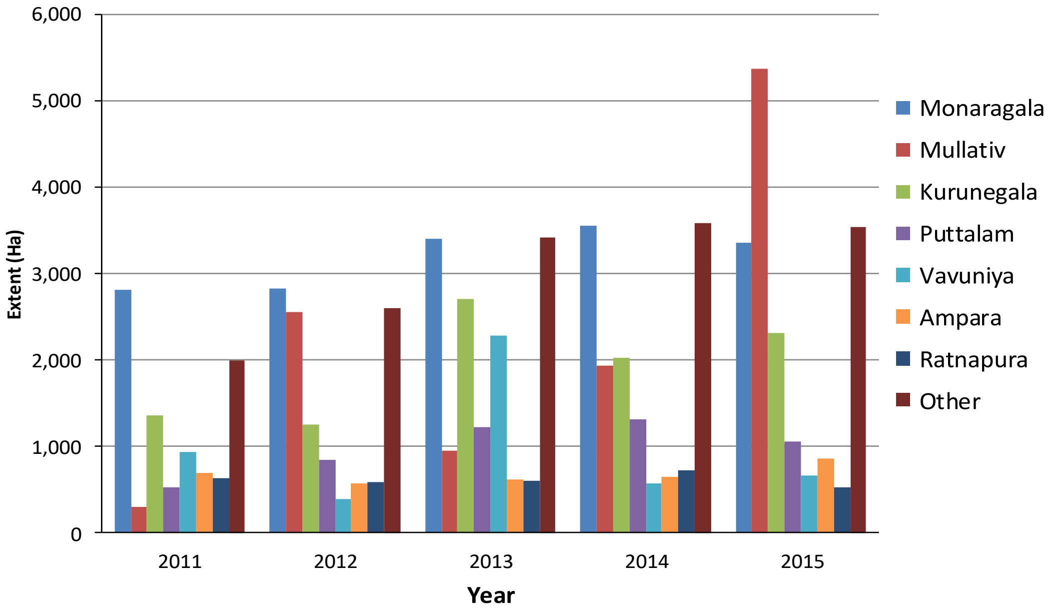
Groundnut (*Arachis Hypogaea L.*) is the sixth most important oil seed crop in the world and believed to have originated from South American continent. Groundnuts are also identified by several other names such as peanuts, earth chestnuts, Chinese nuts, African nuts, monkey nuts and Goober pea (DOA, 2012). The plants are grown for its edible seeds. The seeds are high in nutritional value and it contains 48 – 50 percent oil, 26 - 28 percent protein and 11 - 27 percent carbohydrate, minerals and vitamin (Mukhtar, 2009). Largest producers as well as consumers of groundnut in the world are in China and in India respectively. Other major groundnut consuming countries include Nigeria, the United States and the European Union. In Sri Lanka, it is being cultivated in highlands under rainfed condition in the *Maha* season and in low lands of dry and intermediate zones under irrigation during the *Yala* season. Groundnut varieties recommended by the Department of Agriculture are Red Spanish, Tissa, Walawa, Indi, Tikiri, ANK G1 (Field Crop Research and Development Institute, undated). The plants are low growing annuals and they branch profusely covering the ground with their foliage.

Source: Encyclopedia Britannica, 2017

Plate 1: Uprooted Groundnut Plant with Mature Pods

6.1.2 Major Growing Areas, Extent under Cultivation and Production

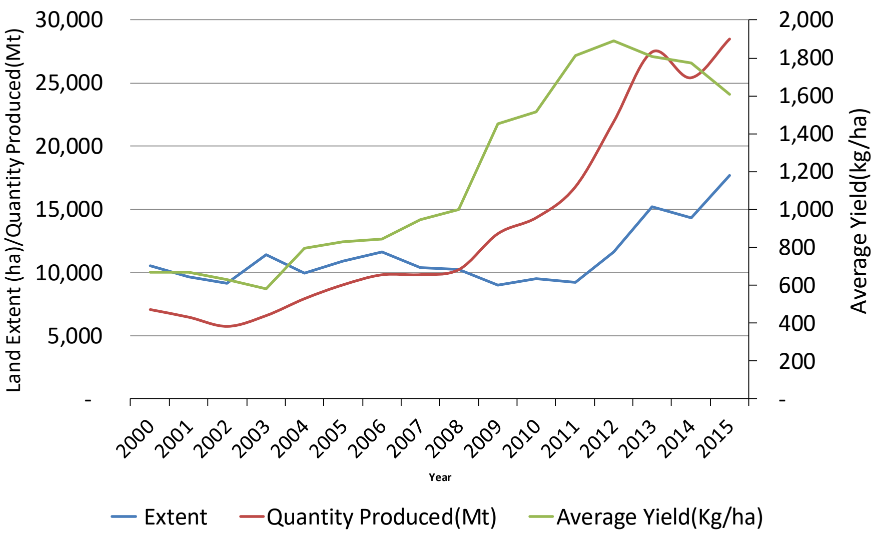
In Sri Lanka, groundnut is grown mainly in Monaragala, Mullativ and Kurunegala districts. It is popular in Puttalam, Vavuniya, Ampara, and Rathnapura districts as well. Average cultivation extent in major groundnut cultivation areas from 2011 to 2015 is given in Figure 6.1.



Source: Department of Census and Statistics

Figure 6.1: Average Cultivation Extent of Groundnut in Major Growing Districts Production and Yield

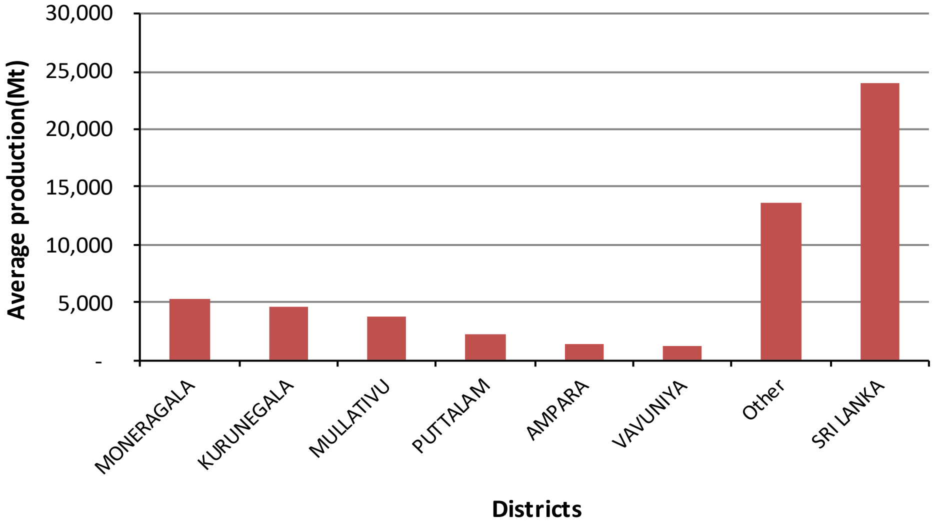
Tissa, Indi, Tikiri and Walawe varieties are the most popular varieties grown in the country. Variety Walawe is grown only in Anuradhapura and Polonnaruwa districts and the crop is grown both in the *Yala* and the *Maha* seasons equally (DOA, 2012). As described in Figure 6.2, when considering the last 15 years (2000 – 2015), cultivation extent as well as the quantity of groundnut produced shows an increasing trend over time. There is a steady increase in the quantity produced from 2008 to 2013. Average yield has also increased over time and more or less stagnated from 2011.



Source: Department of Census and Statistics

Figure 6.2: Extent, Production and Average Yield of Groundnut

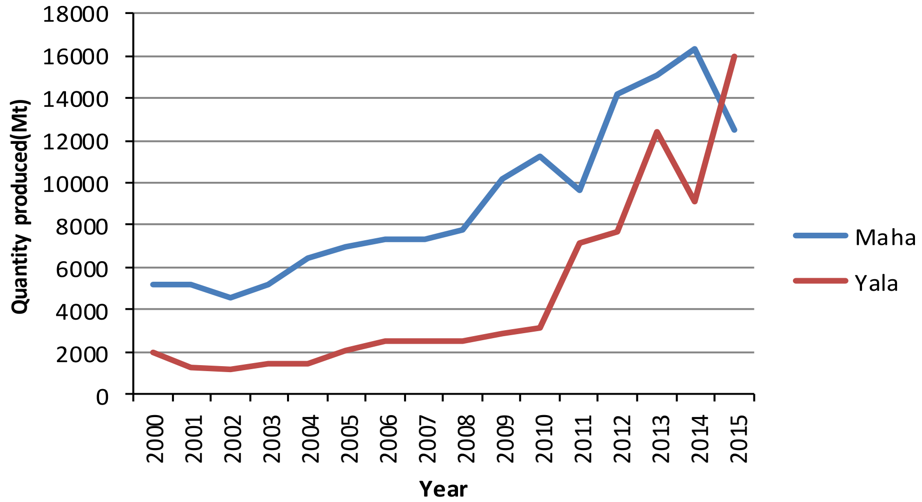
During the period from 2000 to 2015, the highest average production was reported from Monaragala district. Second and third highest production was from Kurunegala and Mulativu districts respectively (Figure 6.3).



Source: Department of Census and Statistics

Figure 6.3: Average Annual Production of Groundnut

Production of groundnut is higher in the *Maha* season as it is mainly a *Maha* season crop. However, from 2013, production in the *Yala* season has increased while that of *Maha* season has dropped (Figure 6.4). Cultivated extent was about 8000 ha during the period 2000 to 2010 and after a slight drop in 2011 extent under groundnut has increased steadily. Average yield was more or less similar in both seasons until 2011. However, during the *Yala* seasons there is a slight increase in the average yield afterwards.



Source: Department of Census and Statistics

Figure 6.4: Production of Groundnut in Two Cultivation Seasons (2000-2015)

6.1.3 Climate and Soil

Groundnut is grown in well-drained sandy loam or clay loam soil. Deep well drained soils with a pH of 6.5 - 7.0 and high fertility are best suited for groundnut (Field Crop Research and Development Institute, undated). Heat and/or drought-induced stresses are the major environmental factors that limit pod yields of groundnut. The optimum day/night temperature for vegetative and reproductive growth and development in groundnut varies from 25/25 ^{0}C to 30/26 ^{0}C and from 25/20 ^{0}C to 26/22 ^{0}C (Aiome and Silva, 2014).

6.1.4 Importance of the Crop to the Economy

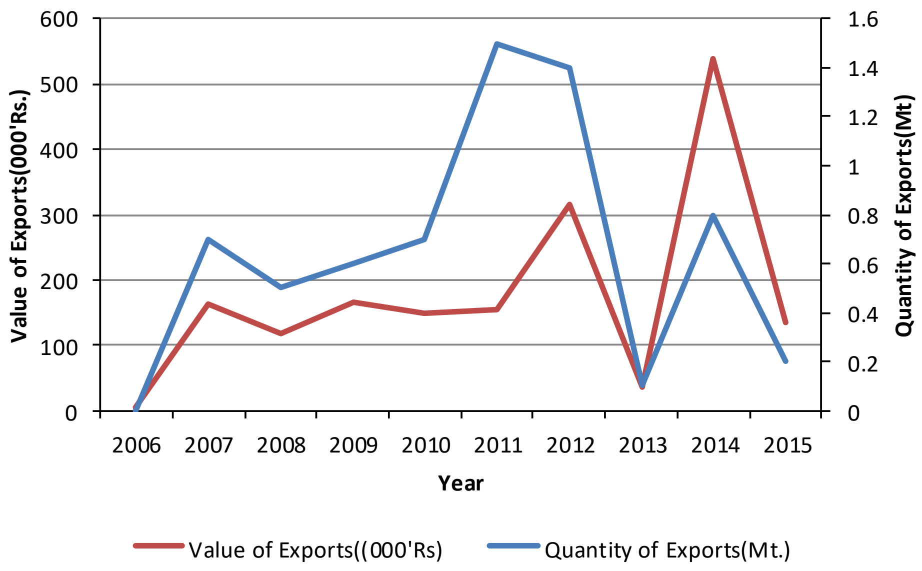
In Sri Lanka groundnut is grown as a high value oil seed crop. It has a demand as a snack and confectionary also. The seeds are not normally fed to livestock, as the high-unsaturated fatty acid content results in oily fat deposits in animals. As shown in Table 6.1, annually the country imports a considerable quantity of groundnut in the form of nuts as well as oil for various needs. Importation is done mainly from India while smaller quantities have been imported from other countries (China, France and Netherlands) as well.

Table 6.1: Quantity and Value of Imports

Year	Groundnut		Groundnut oil	
	Quantity of Imports	Value of Imports 000'mt	Quantity of Imports	Value of Imports 000'mt
2006	5023	110058	0.5	129
2007	3847	132692	0.6	165
2008	4175	237294	0.4	95
2009	4005	334743	0.4	359
2010	4604	455339	2.1	557
2011	4920	595573	2.8	1083
2012	1792	238414	0.4	563
2013	1023	143346	6.8	1510
2014	1517	224600	0.5	452
2015	3480	611122	0.6	255

Source: Department of Custom

During the period 2006 to 2015 the highest quantity exported was less than two metric tons and the highest values were reported in 2011 and 2012 (Figure 6.5). These export varieties are different from import varieties and the imported nuts are from varieties not locally available such as jumbo peanuts.

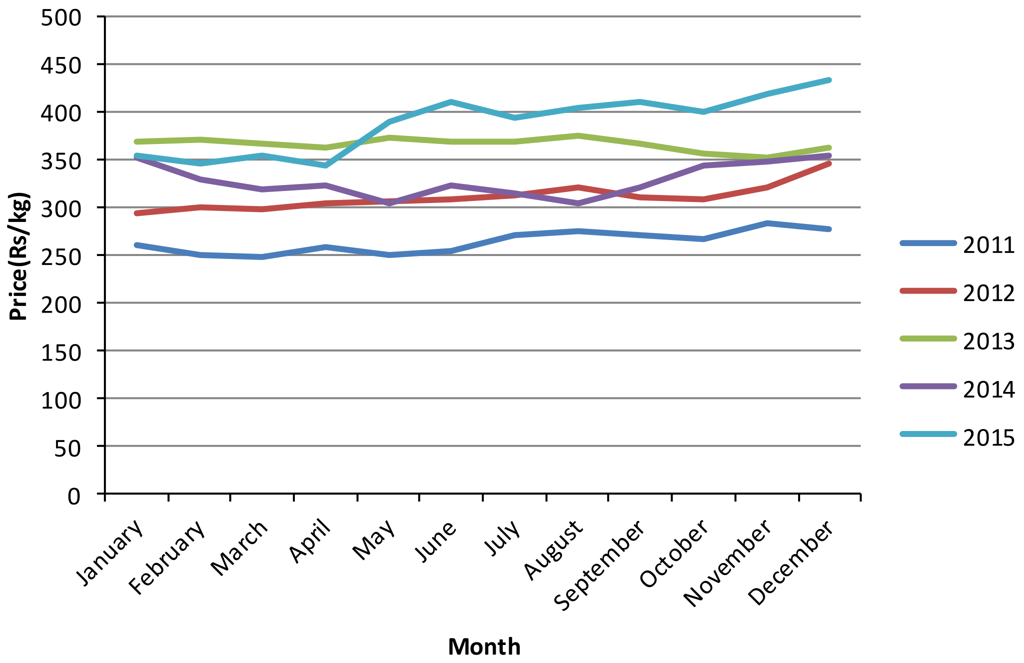


Source: Department of Custom

Figure 6.5: Quantity and Value of Exports

6.1.5 Price Variation of Groundnut

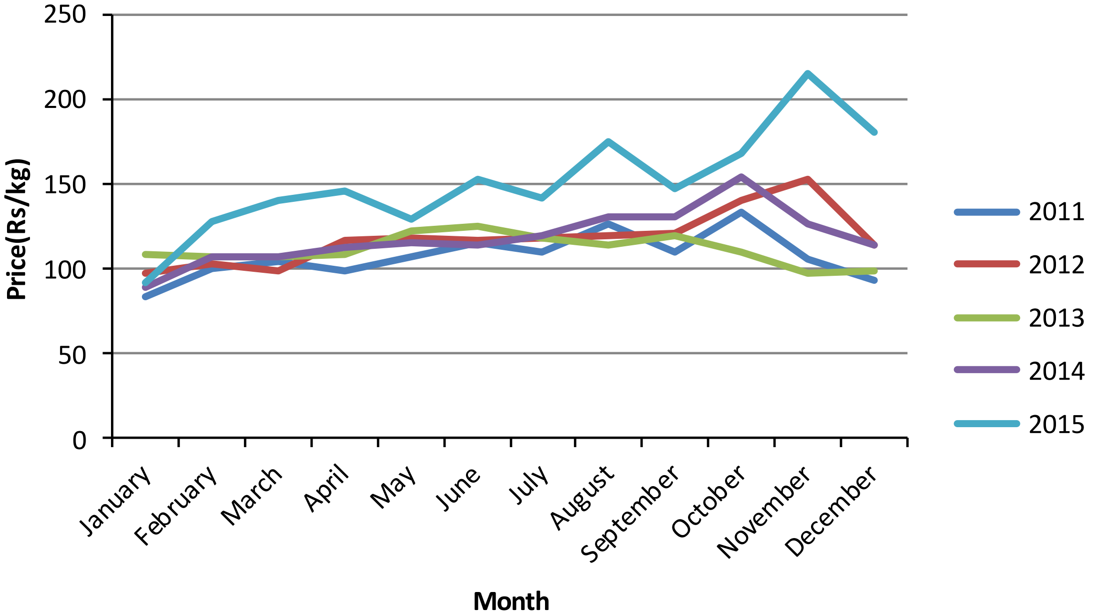
Change of average retail price of groundnuts over the years is as shown in Figure 6.6. Except in 2015, average retail price is more or less equal in all months of the year.



Source: Department of Census and Statistics

Figure 6.6: Monthly Average Retail Prices of Groundnut – Rs./kg

Change of average producer prices during the period of 2011 to 2015 is described in Figure 6.7. For the reference time period highest producer price could be observed in the latter part of 2015.



Source: Department of Census and Statistics

Figure 6.7: Change of Average Producer Prices (2011 to 2015)

6.1.6 Consumption of Groundnut

Consumption of groundnut is more among the consumers belonging to higher income categories compared to lesser income categories (DOA, 2012). Per capita consumption of groundnut is as Table 6.2.

Table 6.2: Per Capita Consumption of Groundnut

Year	grams/Year
2005	124.56
2006/07	84.48
2009/10	80.64
2012/13	79.92

* Data not available for 2008 and 2011

Source: House hold Income & Expenditure Survey, Dept. of Census & Statistics

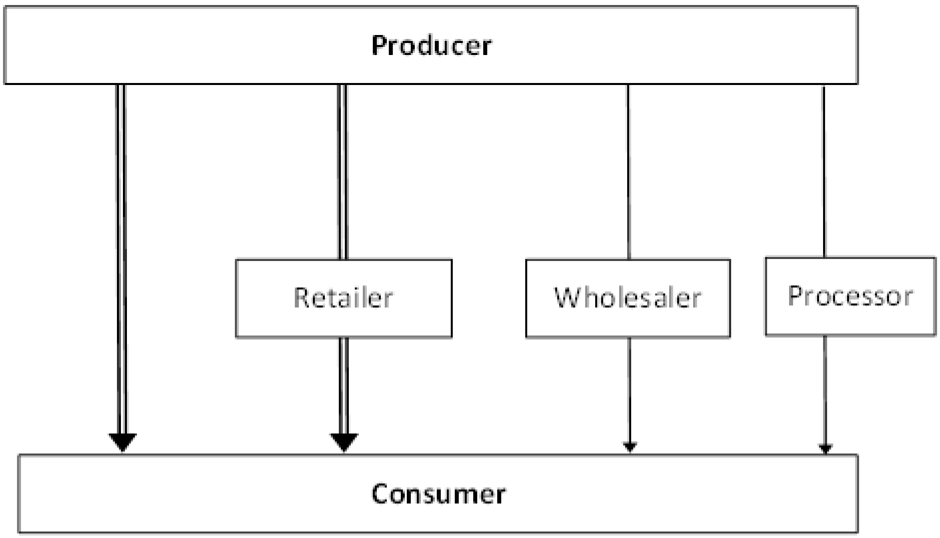
6.1.7 Government Policies and Interventions

Department of National Planning of Sri Lanka, through its Development Policy Framework of the Government of Sri Lanka for the period of 2010 to 2016 (Mahinda Chinthana) has identified certain interventions to increase the productivity of groundnut as well as the competitiveness in marketing at domestic and international markets. Some of the key areas identified to develop in this policy framework were strengthening the input delivery system, farmer friendly agriculture lending, better breeding for higher yield, links between producers and consumers, use of ICT in agriculture.

Again in 2016, The Government in its National Food Production Programme (2016-2018) has identified groundnut as a crop that the country should achieve self-sufficiency in 2018. To achieve the objective various activities are planned and going on such as expansion of cultivation to new areas, establishment of groundnut farmer organizations and strengthen them through provision of machinery and supporting to create revolving funds, continuing assistance to research activities to develop varieties that give nuts with qualities that is high in demand. Further this programme will pay attention on producing quality seeds as well.

6.1.8 Marketing Channels

The farmers' harvest mainly reaches the consumers retailers as well as wholesalers. In addition, consumers get nuts in the form of processed nuts through processors (Figure 6.8).



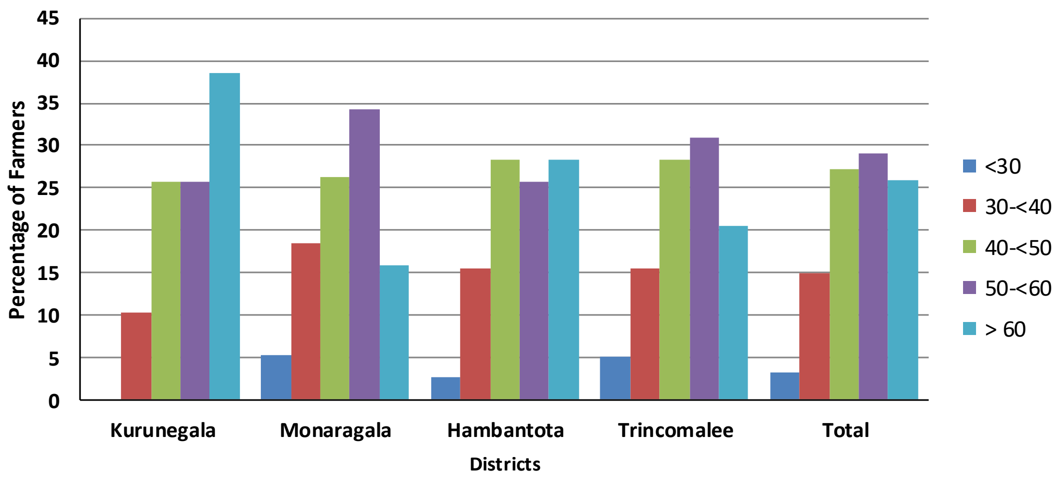
Source: Adopted from DOA, 2012

Figure 6.8: Marketing Channels of Groundnut

6.2 Socio Economic Characteristics of the Sample Farmers

6.2.1 Demographic Characteristics of the Sample Population Age Distribution

As shown in Figure 6.9 in all the four districts surveyed for groundnut, more than 75 percent of the sample farmers were above 40 years of age. However, there is a considerable percentage of farmers who are above 60 years of age in all the districts. Youth participation in groundnut cultivation is very low.

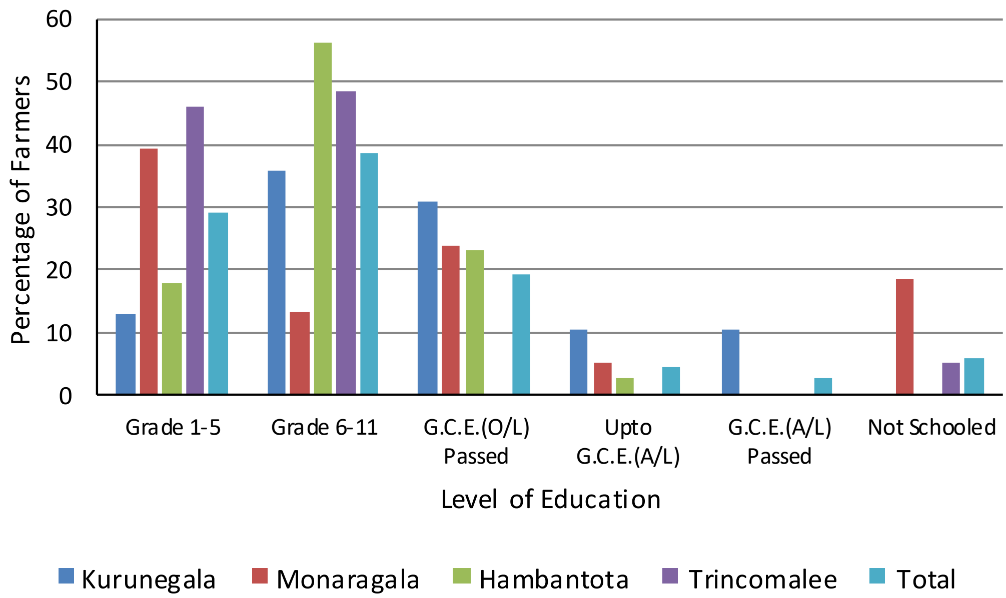


Source: HARTI Survey Data, 2016

Figure 6.9: Age Distribution of the Sample Farmers

Level of Education

As per the survey data shown in Figure 6.10, except in Kurunegala district, farmers who have successfully completed the G.C.E. (O/L) examination are fewer than 30 percent of the sample. G.C.E. (A/L) qualified farmers (10.3%) involved in groundnut cultivation was only reported from Kurunegala district. In Monaragala district about 18.4 percent of the farmers have not received formal education at all and nearly 40 percent of the farmers had only primary education.

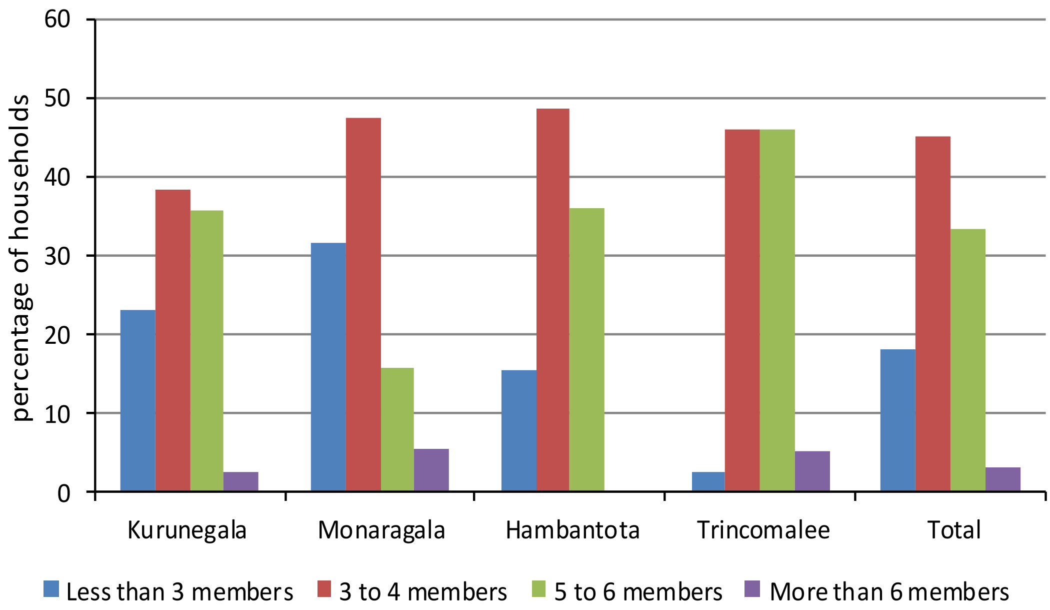


Source: HARTI Survey Data, 2016

Figure 6.10: Level of Education of the Sample Farmers

Family Size

Distribution of family size is mostly similar in all the districts (Figure 6.11). The highest percentage of the sample households consisted of three to four family members in all the four districts. Second highest percentage of households had five to six members in all other districts except Monaragala. In Monaragala district about 32 percent of households consisted of fewer than three members in the family. Household with more than six members accounted for a mere six percent. Higher number of households with fewer family members highlights the issue of getting family labour for cultivation.



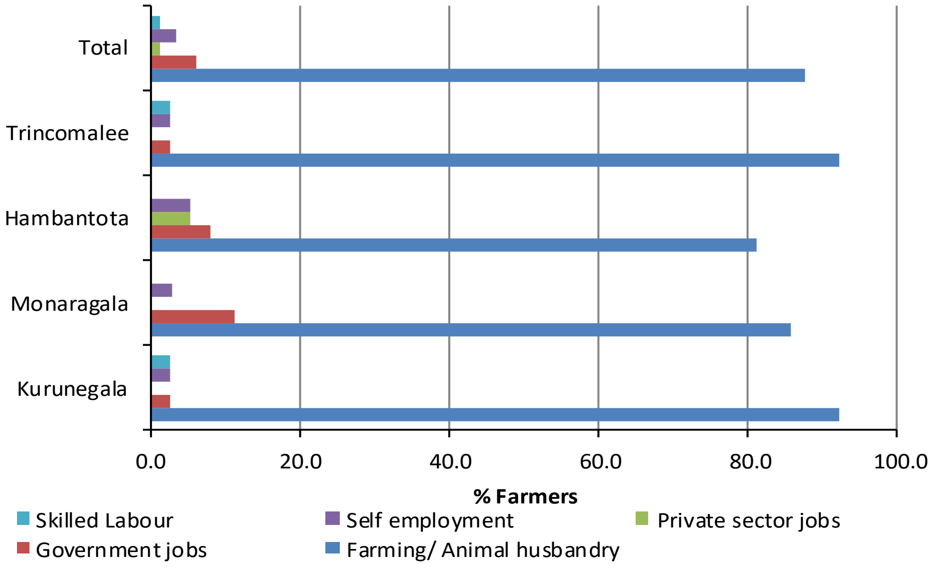
Source: HARTI Survey Data, 2016

Figure 6.11: Family Size of the Sample Farmers

6.2.2 Economic Characteristics of the Sample Population

Primary Employment

In all the four districts primary employment of over 80 percent of the household heads was farming or animal husbandry (Figure 6.12). Other than seven farmers who were cultivating groundnut for home consumption all the other sample farmers pursued it as an income earning activity. Percentage of farmers who were engaged in salaried jobs in the government or the private sector from where they are getting a secured income is only about three to 11.



Source: HARTI Survey Data, 2016

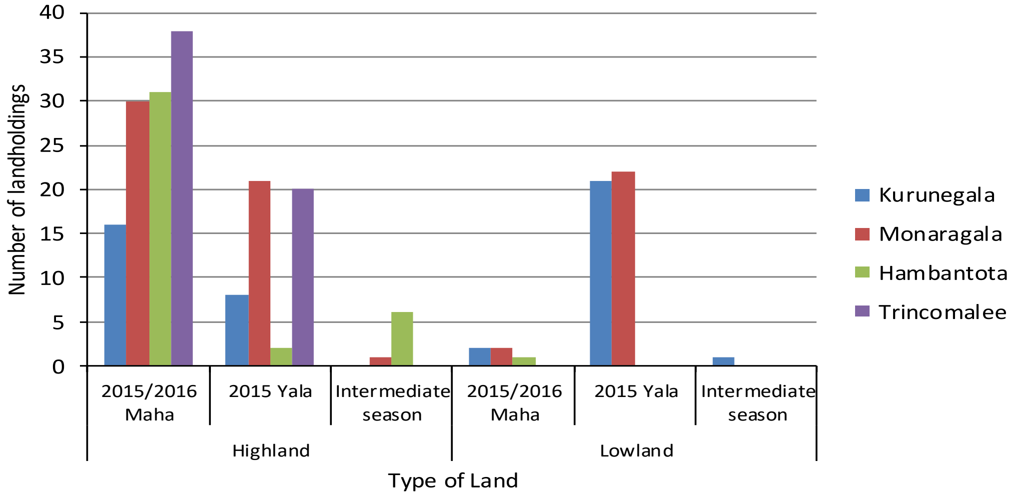
Figure 6.12: Primary Employment of the Sample Farmers

6.3 Agricultural Inputs

6.3.1 Lands

Land Type

Groundnut is farmed generally on highlands in the *Maha* season excluding Trincomalee where they also do it on highlands but in the *Yala* season. Both lowlands and highlands are cultivated in *Yala* season in Monaragala district. About ten percent of the highlands have been cultivated with groundnut during the intermediate season in Hambantota district (Figure 6.13).



Source: HARTI Survey data, 2016

Figure 6.13: Type of Land Cultivated by the Sample Farmers

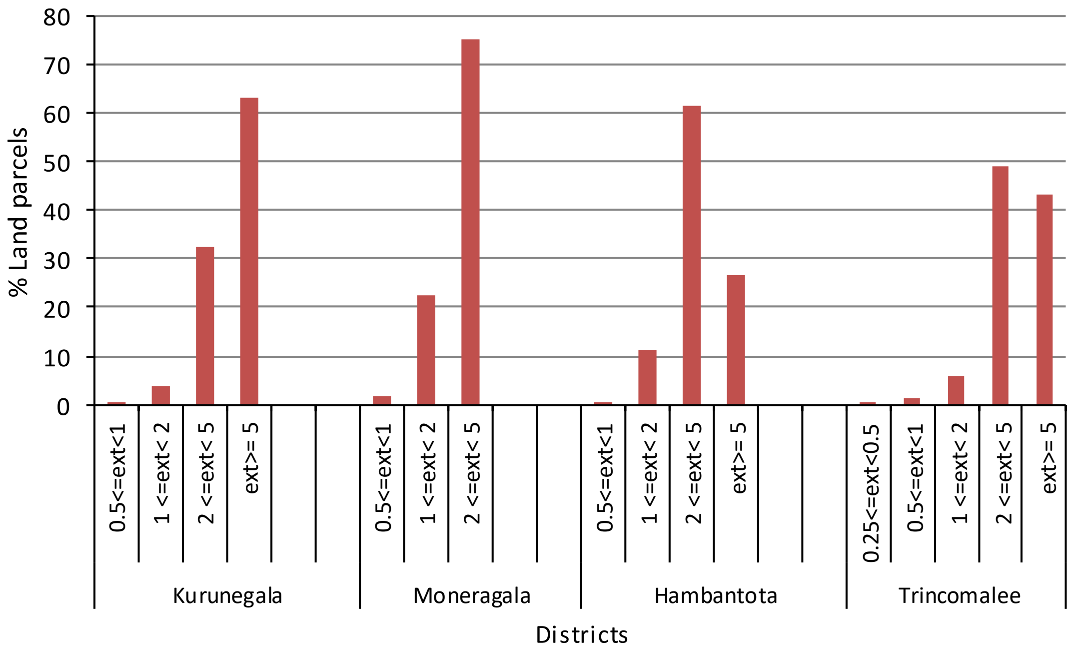
Distribution of Land Holdings Sizes Cultivated

As described in Figure 6.14, in Monaragala district, from the total extent cultivated about 75 percent of landholdings are in size category of 2 acres to fewer than 5 acres. Landholdings that come under the category of 1 acre to less than 2 acres are about 23 percent. Only about two percent of landholdings are being cultivated in Monaragala district in extend of 0.5 acres to less than 1 acre.

In Kurunegala district about 63 percent of landholdings equal or larger than 5 acres are under groundnut. Second highest land size category was 2 acres to fewer than 5 acres.

There are about 61 percent of landholdings with acreage of 2 to fewer than 5 in Hambantota district. Landholdings that are equal or larger than 5 acres are about 27 percent. Nearly 11 percent of landholdings are in the size class of 1 acre to fewer than 2 acres.

Size distribution of landholdings in Trincomalee shows that about half (49%) of the total landholdings belong to the 2 acres to fewer than 5 acre category and another 43 percent of the land parcels were within the size class of 5 acres or more.

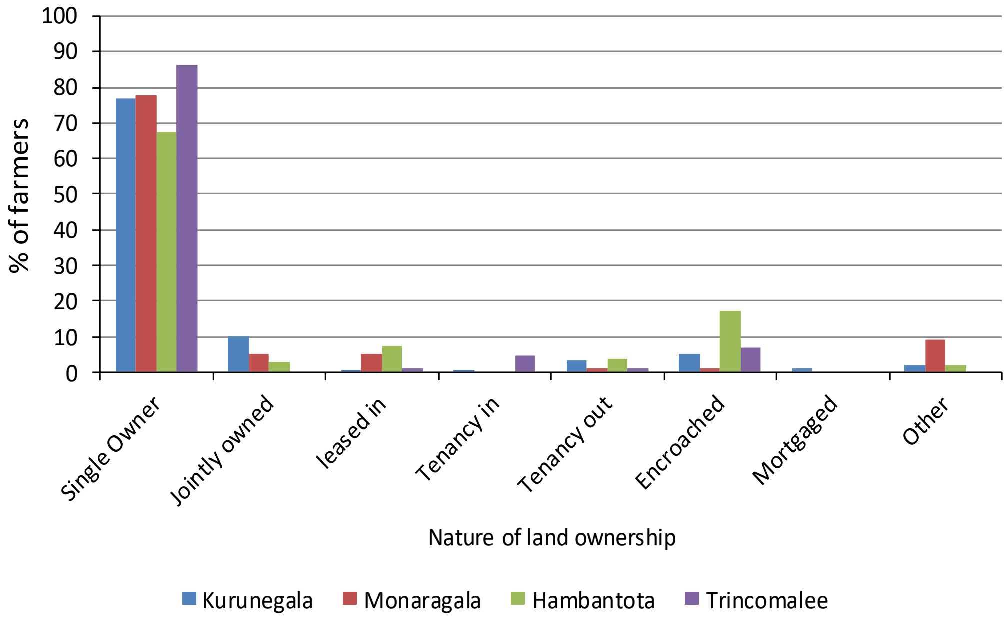


Source: HARTI Survey Data, 2016

Figure 6.14: Distribution of Operators by Size Class of Land

Land Ownership

Distribution of groundnut cultivated land holdings according to landownership is shown in Figure 6.15. In all four districts concerned highest percentage of the farmers grow groundnut on their own land. Except in Hambantota district percentage of landholdings with single ownership is above 77 percent whereas in Hambantota it is about 60 percent. In Hambantota and Trincomalee districts there are about six to 10 percent of farmers who cultivate landholdings with land permits. Number of encroached land holdings in Hambantota, Kurunegala and Trincomalee are 17, five and seven percent respectively.



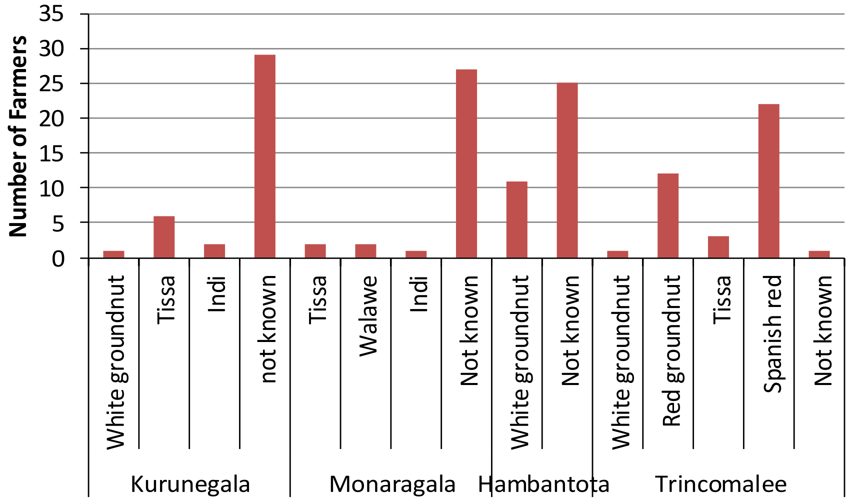
Source: HARTI Survey Data, 2016

Figure 6.15: Nature of Land Ownership of the Sample Farmers

6.3.2 Seeds

Seed varieties

Most of the farmers were unaware of the name of the variety they have been cultivating. According to the available information most popular varieties in the study area were white groundnut, red groundnut and Spanish red varieties (Figure 6.16). The use of a very high percentage of an unknown seed variety indicates the poor status of extension services and highlights the necessity of improving the extension in those areas. Farmers should be well aware of the high value groundnut varieties that are available and suitable for their fields and appropriate management practices to get maximum productivity.

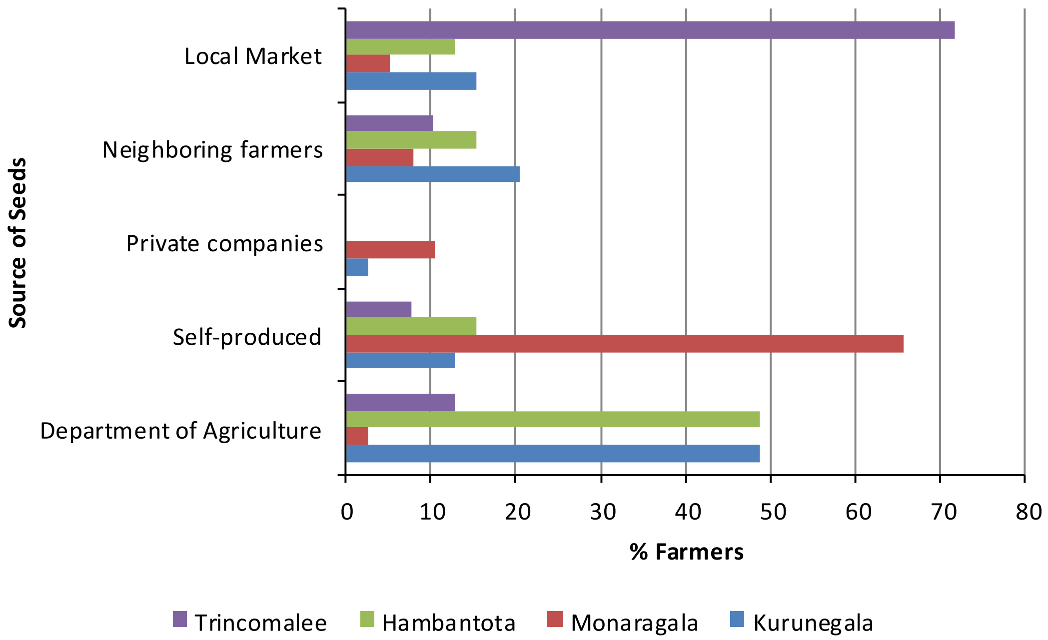


Source: HARTI Survey data, 2016

Figure 6.16: Different Groundnut Varieties Cultivated by the Sample Farmers

Source of Seeds of the Sample Farmers

Quality seeds are a key factor in any crop production system. In Kurunegala and Hambantota districts about 49 percent of the farmers have used seeds from the Department of Agriculture. In Monaragala district about 66 percent of the farmers used self-produced seeds for cultivation. Majority of the farmers (72%) from Trincomalee district obtained seeds at the local market (Figure 6.17).

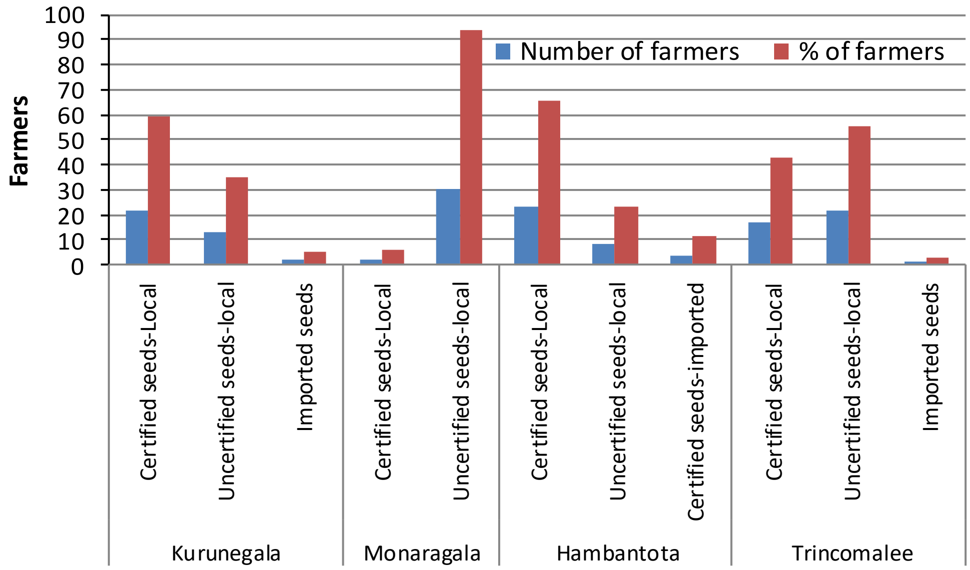


Source: HARTI Survey Data, 2016

Figure 6.17: Source of Seeds of the Sample Farmers in each District

Type of Seeds used by the Sample Farmers

According to Figure 6.18, in Kurunegala district majority (56%) of the farmers used locally produced certified seeds whereas another 33 percent of them used locally produced but uncertified seeds. Only five percent depended on improved seeds. Use of uncertified local seeds was observed in the case of 79 percent in Monaragala district. Certified local seeds were farmed by 59 percent in Hambantota district with about eight percent of them using certified imported seeds and nearly 20 percent farmers depending on uncertified local seeds. In Trincomalee district uncertified local seeds were the most popular (56%) type of seeds. Generally, use of improved seeds of Groundnut is limited to a few farmers in all the four districts concerned.



Source: HARTI Survey Data, 2016

Figure 6.18: Type of Seeds used by the Sample Farmers

Cost of Seeds

So far as the cost of seeds in four districts is concerned, mean cost of seeds is about Rs. 8000 to 10,000 (Table 6.3). Cost of seeds was about 37 percent from the mean total cost of production in the study area.

Table 6.3: Mean Cost of Seeds

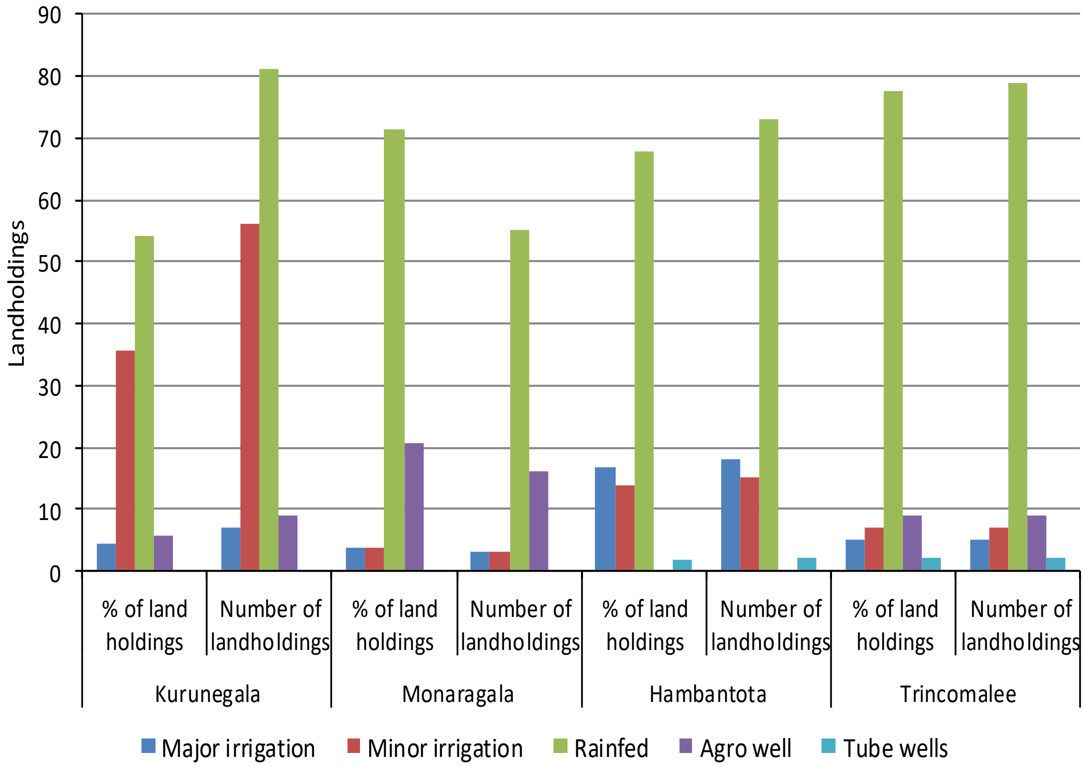
District	Mean cost of seeds(Rs/ acre)	Number of Observations
Kurunegala	7892	39
Monaragala	8451	34
Hambantota	7414	37
Trincomalee	10332	18

Source: HARTI Survey Data, 2016

6.3.3 Irrigation

Water Source for Cultivation

In all the four districts majority of land holdings were being cultivated under rainfed conditions. In Kurunegala district about 36 percent of the land holdings had minor irrigation for groundnut cultivation. In Monaragala district for about 21 percent of landholdings agro wells were the source of water. Use of water for irrigation from agro wells is less than ten percent in Kurunegala and Trincomalee districts. About 17 percent of the landholdings under groundnut in Hambantota district had water from major irrigation systems. Few landholdings in Hambantota and Trincomalee were reported to be depending on tube wells for groundnut cultivation (Figure 6.19).



Source: HARTI Survey Data, 2016

Figure 6.19: Distribution of Landholdings based on the Water Source for Cultivation

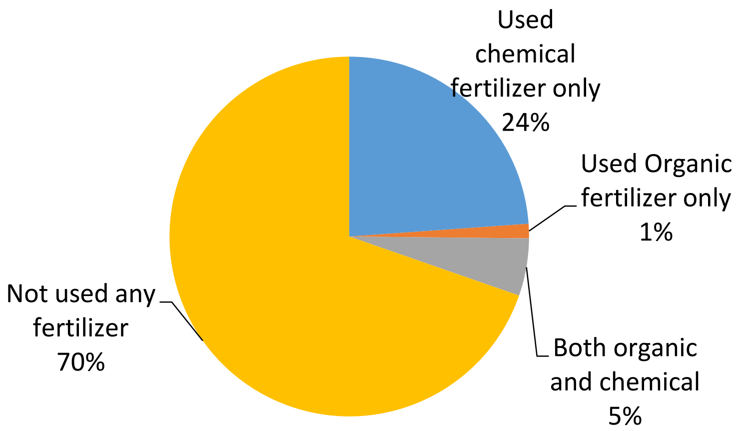
6.3.4 Labour

Average cost of labour including family labour in the study area was about 44 percent from the total cost of production. Cost of labour in all three districts except Hambantota range from Rs. 4000 to 6000 per acre. However, in Hambantota the mean total labour cost was reported to be about Rs. 2000 per acre. Mean of total hired labour cost is about Rs. 2000 to 3000 in Kurunegala, Hambantota and Trincomalee districts. Highest cost of hired labour was reported at Monaragala district.

6.3.5 Fertilizer and Pesticides

Most of the farmers (70%) have not applied any type of fertilizer for groundnut except for 24 percent who have used only chemical fertilizers. Use of organic fertilizer was so meagre to be about six percent of the farmers and of that about 5 percent had applied use organic fertilizer with a combination of chemical fertilizers (Figure 6.20). According to the recommendation of Department of Agriculture composition of basal dressing should be Urea 35kg/ha, TSP 100kg/ha and MOP 75kg/ha. As a top dressing Urea at a rate of 30kg/ha should be applied at the flowering stage.

To control pests and diseases in groundnut such as early leaf spot, late leaf spot and rust The Department of Agriculture advises the use of recommended fungicides. To manage leaf eating caterpillars, thrips and termites DOA recommends insecticides. However, about 69 percent of the farmers have not used any pesticide on their cultivation. About 18 percent of the farmers have applied weedicides while 46 percent have practised hand weeding.



Source: HARTI Survey data, 2016

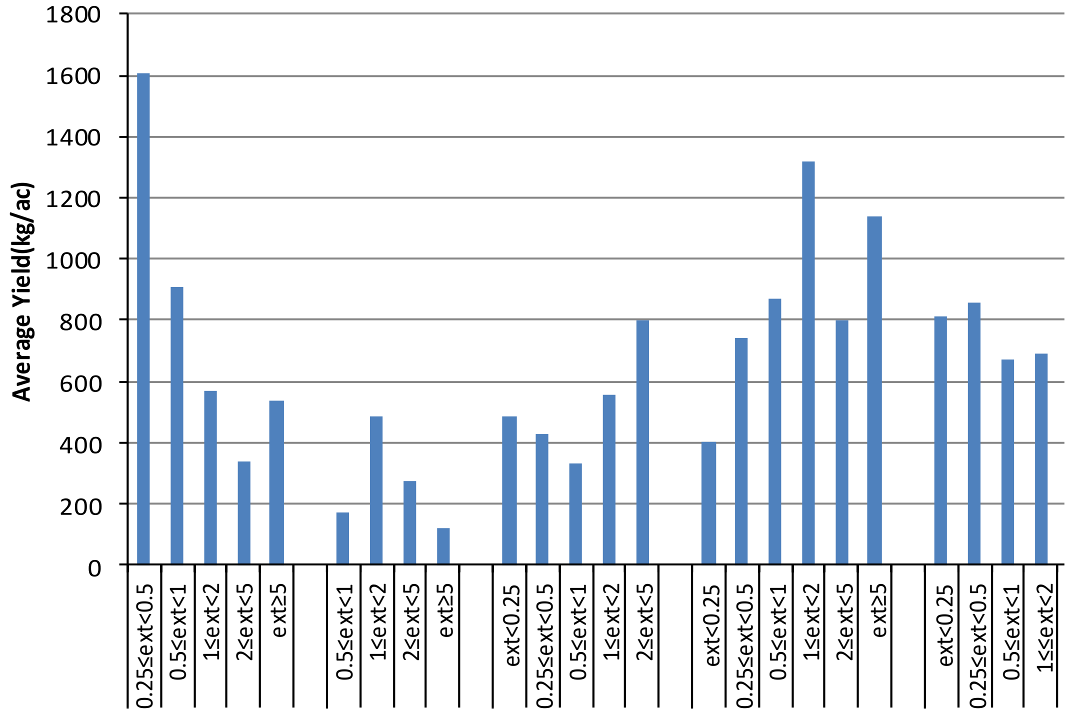
Figure 6.20: Type of Fertilizer Applied by the Sample Farmers

6.3.6 Machinery

Mean cost for machinery in Monaragala and Hambantota districts was about Rs. 2000.00 per acre and for Kurunegala district it was about Rs. 4000.00 per acre. However, in Trincomalee district mean cost for machinery is about Rs. 7000.00. Generally, cost of machinery was about 13 percent of the total cost of production including family labour.

6.3.7 Average Yield

As shown in Figure 6.21, in the whole study area average yield is more or less equal in all size categories. However, in Kurunegala district average yield is very high in landholdings of fewer than 0.25 to 0.5 acres. In Trincomalee district comparatively high average yield could be observed in one to less than two acre landholding category and more than 5 acre category. Average yield in Monaragala district is relatively low in all size categories.

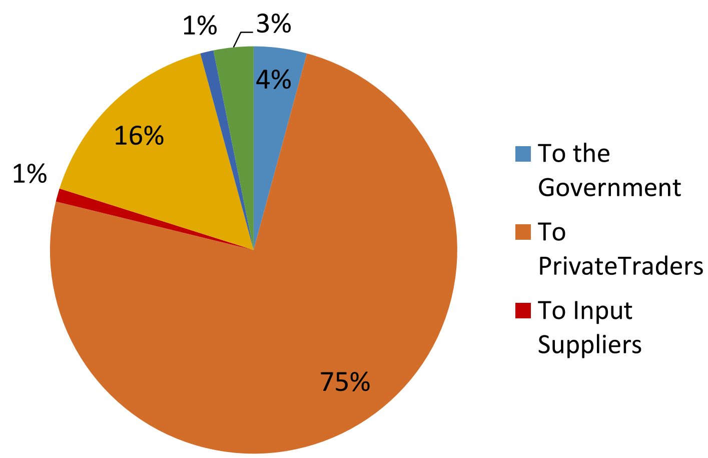


Source: HARTI Survey Data, 2016

Figure 6.21: Distribution of Average Yield in Different Size Categories of Landholdings

6.3.8 Marketing

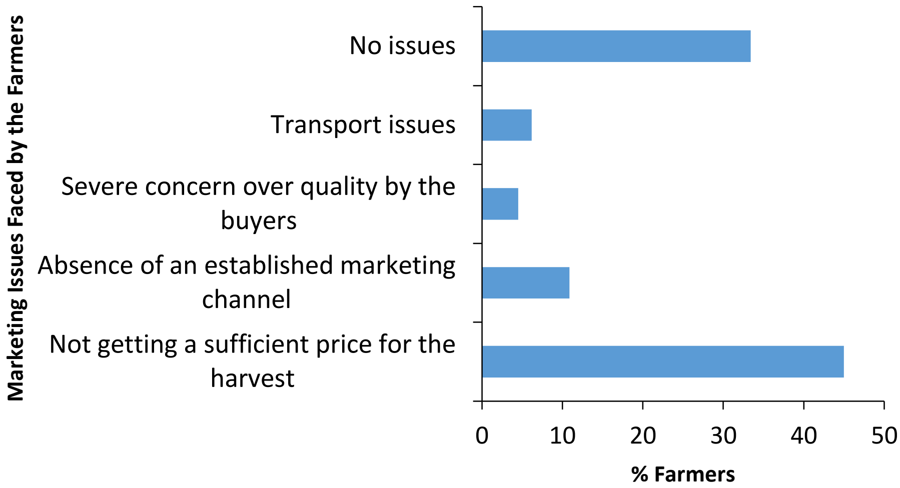
As shown in Figure 6.22, majority of the farmers (75%) sold their product to the private traders. Percentage of farmers who marketed their harvest to the government sources is about 16. The village fairs were the markets for 16 percent of the farmers to dispose of their harvest.



Source: HARTI Survey Data, 2016

Figure 6.22: Methods of Marketing in the Study Area

However, about 44 percent of the farmers reported of not getting a reasonable price for their harvest. Non availability of an established marketing channel was also mentioned by about 11 Percent of the farmers.



Source: HARTI Survey Data, 2016

Figure 6.23: Marketing Issues Faced by the Farmers

6.3.9 Cost of Production of Groundnut

Average cost of cultivation in Monaragala district is tabulated in 6.4. Labour cost which is about 70 percent is the highest cost component of the cost of production including imputed cost.

Table 6.4: Average Cost of Cultivation and Net Return per acre in Monaragala District in *Maha* Season under Rainfed Condition (Rs.)

Input	2012/ 13	2013 /14
Labour	38,423	34,318
Seed	9,366	9,425
Draught power machinery equipment	5,054	6,638
Total cost - including imputed cost	52,843	50,381
Total cost - excluding imputed cost	30,923	32,749
Net return - including imputed cost	22,325	17,351
Net return - excluding imputed cost	44,245	34,983

Source: Department of Agriculture

However, the average cost of production of groundnut in the study area was about Rs. 28, 529 per acre of land including the cost of family labour. It was about Rs. 22,529 per acre of land excluding family labour (Table 6.5)

Table 6.5: Average Cost of Production in the Study Area

Cost Component	Mean Total Cost(Rs/ac)
Family labour	6049
Hired labour	6566
Seed cost	10600
Chemical fertilizer	497
Organic fertilizer	26
Weedicide cost	585
Fungicide cost	65
Insecticide cost	337
Machinery cost	3689
Total cost including family labour	28529
Total cost excluding family labour	22529

Source: HARTI Survey Data, 2016

6.4 Constraints of Production

As given in Table 6.6 in rainfed farming areas lack of sufficient water for cultivation was stated as a major constraint by about 35 percent of the farmers. Damages from wild animals such as wild boars, peacocks, and monkeys were another common threat mentioned by the farmers. About eight percent of the farmers stated that lack of quality seeds is a problem in getting a higher production.

Table 6.6: Problems Faced by the Groundnut Farmers

Issues Reported	Number of Responses	% of Responses
Water scarcity under rainfed condition	54	35
Increased crop damages due to wild animals	45	29
Crop damages due to pest & diseases	20	13
Not having a defined price in marketing	18	12
Lack of quality seeds	13	8

Source: HARTI Survey data, 2016

6.5 Recommendations

It is essential to develop seed production within the country and strengthening the seed certification process to ensure the use of quality seeds for cultivation. Government should intervene to improve the quality of the produce and to establish a proper marketing channel for groundnut farmers to ensure a fair price for the producers**.**

In view of the target of self-sufficiency in groundnut envisaged in the national agricultural policies, a comprehensive plan of action should be afoot with special reference to such area as, an improved extension service, possibility of expanding the land extents under cultivation, provision of effective marketing channels and a research and training programme to have more farmers for this enterprise which promises a lucrative activity.

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Chapter Seven

Green gram

R.D. Wijesinghe

SUMMARY

In Sri Lanka, green gram is a popularly grown grain legume crop in the dry and the intermediate regions of the country while Hambantota, Monaragala and Kurunegala districts accounted for about 61 percent of the total cultivated extent and about 56 percent of the total green gram production of the country. The overall trend of green gram production has marked signs of increase while the imports have shown a decreasing trend over the last ten years. A sharp decline of imports and a growth of production can be observed after the year 2010 due to the additional production coming into the market as a result of the introduction of third season cultivation. Per capita consumption of green gram shows a decreasing trend over the time and the highest monthly average expenditure on pulses is recorded in estate sector while the urban sector recorded the lowest.

Survey findings related to three major growing districts Kurunegala, Monaragala and Hambantota revealed that among the great majority (93%) of green gram farmers cultivate the crop for the income generating purpose and farming and/or animal husbandry is the primary income generating activity of 85 percent of this group of farmers. Average yield of the crop is far behind the potential yield where Hambantota farmers has got comparatively higher yield than the other two districts mainly due to large scale cultivation of the crop in paddy lands during the third season.

Major issues related to green gram farming which were raised by farmers are absence of a defined price for the product, damages due to pest attacks, crop damages due to climate related issues and lack of quality seeds. Since low prices and absence of a defined price for the product were attributed to the subsistence nature of the green gram farming it is suggested to formulate policies to promote investment on value addition and to encourage forward sales contract with the participation of the private sector. Productivity improvement is a must in green gram in order to narrow down the existing yield gap and it is recommended to develop a variety which allows mechanized operations since at present green gram growing is a labour intensive farming activity. Enhancing current level of extension service which ensures the flow of correct information on marketing, inputs, technological information and climate is also an area where the state intervention is needed.

CHAPTER SEVEN

Green gram

7.1 Overview of the Crop

This section will give a general description of the crop and the importance of green gram to the economy of the country by deliberating about the production, extent, external trades and consumption.

7.1.1 Introduction

Green gram or mung bean, botanically known as *Vigna radiata* has long been a food crop in Asia. Native to India; it now widespread throughout the tropics and is still widely grown in Southeast Asia, Africa, South America and Australia. In Sri Lanka, green gram is a popularly grown grain legume crop in the dry and the intermediate regions of the country. MI 5, MI 6 and Ari are the major varieties of green gram cultivated in Sri Lanka where MI 5 is the most popular variety used by the farmers.

7.1.2 Major Growing Areas, Extent and Production of Green gram

7.1.2.1 Major Producing Areas

As perceived in the last ten-year data (2006-2015), until the year 2009 Monaragala was the major green gram producing district in terms of production and extent of cultivation but from the year 2010, Hambantota district became the major green gram producing district both in terms of production and extent (Table 7.1 and Table 7.2). This is mainly due to the introduction of third season cultivation of green gram in paddy lands in Hambantota district by the Ministry of Agriculture in 2010 in order to meet the country's green gram requirement.

Table 7.1: Extent of Green-gram by Major Growing Districts

District	Extent (ha)									
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Hambantota	1,135	1,507	1,369	1,234	2,315	2,568	2,330	2,744	3,644	2,703
Monaragala	1,730	1,760	1,880	1,724	1,938	1,162	1,664	1,893	2,044	2,057
Kurunegala	1,674	1,585	1,830	1,924	1,760	1,610	1,175	1,803	1,520	2,164
Anuradhapura	579	706	677	712	787	522	645	586	643	560
Ampara	458	352	606	541	636	496	553	624	643	350
Kilinochchi	243	243	202	-	200	559	697	125	327	362
Other	2,881	2,611	2,793	2,437	2,649	2,150	2,691	3,372	3,020	3,151

Source: Department of Census and Statistics

Table 7.2: Production of Green-gram by Major Producing Districts

District	Production (mt)									
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Hambantota	1,103	2,048	1,700	1,554	3,122	3,808	3,612	4,271	4,706	5,308
Monaragala	1,938	1,473	1,615	2,428	2,147	1,416	1,788	2,168	2,170	2,291
Ampara	355	299	593	572	546	727	1,141	1,159	1,197	828
Kurunegala	1,042	1,116	915	978	1,130	807	589	1,583	753	982
Anuradhapura	504	574	606	849	941	492	747	678	708	583
Matale	80	202	442	285	287	280	387	591	611	823
Other	2,953	2,801	3,007	2,592	3,530	3,005	3,692	3,802	4,207	4,243

Source: Department of Census and Statistics

Average annual extent under green gram was 10,631 ha in Sri Lanka during the period 2006-2015 and Hambantota, Monaragala and Kurunegala districts accounted for about 61 percent of the total cultivated extent of green gram of the country in the year 2015.

According to the Department of Agriculture (DOA) the yield potentials of major varieties vary from 1,500 kg/ha to 1,800 kg/ha. However, the average yield obtained during 2011-2015 in the *Yala* and the *Maha* seasons was 1151 kg/ha and 1375 kg/ha respectively indicating a sizeable yield gap in the average situation. The cultivation of green gram under rainfed conditions with lesser inputs is the major reason for the lower yield in average situation. However, the data revealed that there could be seen a slight increase in the average yield over the time where the average yield of *Maha* season during 2006-2010 and 2011-2015 was 1009 kg/ha and 1153 kg/ha respectively.

Table 7.3: Extent, Production and Average Yield of Green gram

Year	Extent - (ha)			Production -(mt)			Average Yield - (Kg/ha)		
	Maha	*Yala*	Total	*Maha*	*Yala*	Total	*Maha*	*Yala*	Total
2006	6,174	2,526	8,700	5,760	2,215	7,975	933	877	917
2007	6,093	2,672	8,765	5,846	2,667	8,513	959	998	971
2008	7,123	2,233	9,356	6,543	2,335	8,878	919	1,046	949
2009	6,674	1,895	8,569	7,516	1,742	9,258	1,126	919	1,080
2010	6,888	3,395	10,283	7,594	4,109	11,703	1,102	1,210	1,138
2011	5,467	3,601	9,068	5,786	4,749	10,535	1,058	1,319	1,162
2012	6,662	3,093	9,755	7,740	4,216	11,956	1,162	1,363	1,226
2013	6,689	4,458	11,147	7,669	6,583	14,252	1,147	1,477	1,279
2014	6,481	5,359	11,840	7,420	6,932	14,352	1,145	1,294	1,212
2015	6,119	5,227	11,346	7,617	7,438	15,055	1,245	1,423	1,327

Source: Department of Census and Statistics

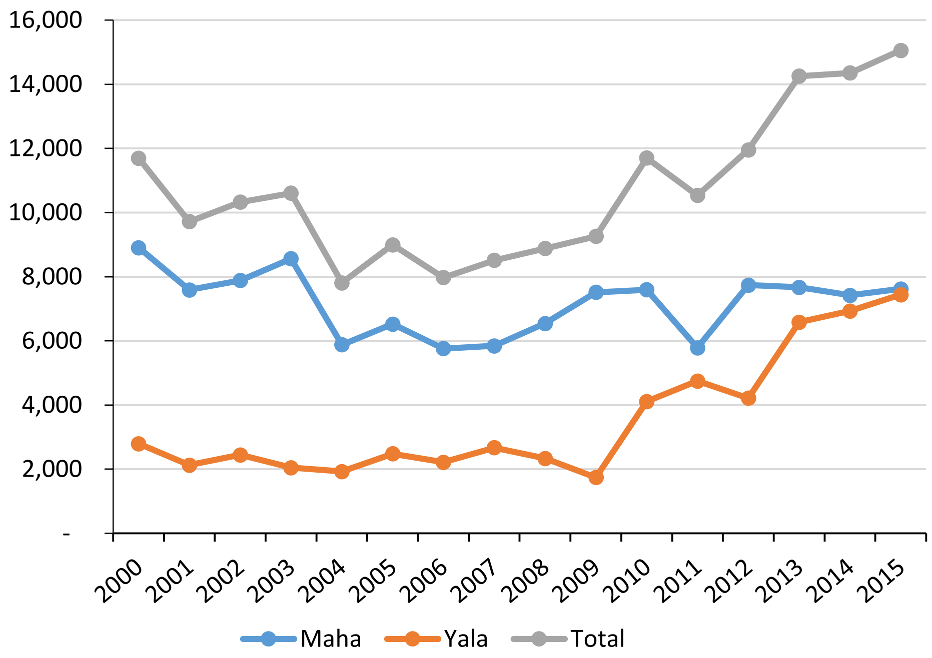
7.1.2.2 Production

Average annual green gram production in Sri Lanka during the period 2006-2015 was 13,230 mt while Hambantota, Monaragala and Ampara districts accounting for about

56 percent of the total green gram production of the country (in year 2015) (Tables 7.2 and 7.3).

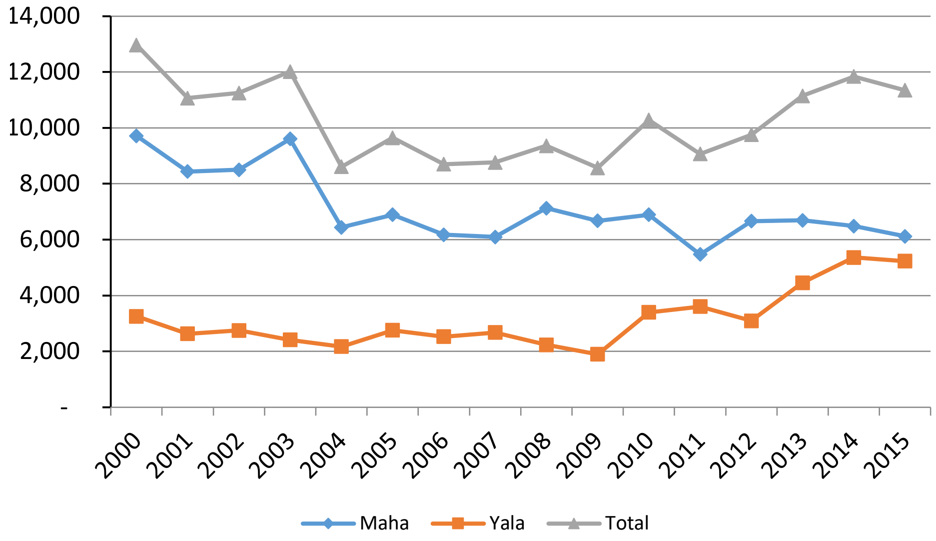
According to the production data for the period of 2006 – 2015, *Maha* is the major green gram producing season both in terms of land extent and production except in Hambantota district after the year 2010. Since 2010 the production and cultivated extent in the Y*ala* season has been much higher than that of the *Maha* season in Hambantota district as data pertaining to production and extent of the third season cultivation are also added to the *Yala* season data. In the 2006 *Maha* season production accounted for 72 percent of the total national production while was 55 percent in 2015.

The overall trend of green gram in terms of production, extent cultivated and the average yield over the last ten years is illustrated in Figures 1, 2 and 3. As shown in the figures, both production and cultivated extent of green gram has fluctuated until the year 2003 and a sudden decline could be seen in 2004. The main reason for that was failure of the crop during the *Maha* season due to heavy rains which led to the flood condition throughout the country.



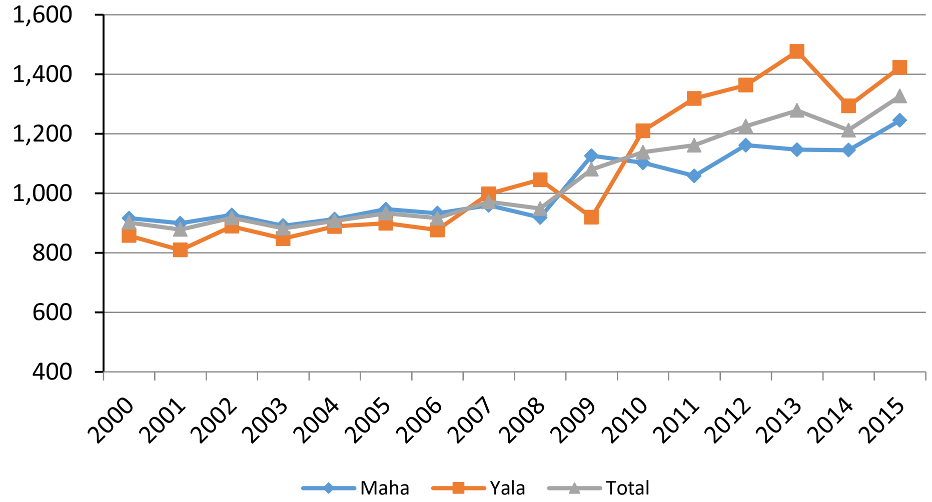
Source: Department of Census and Statistics

Figure 7.1: Green gram Production in mt (2000-2015)



Source: Department of Census and Statistics

Figure 7.2: Cultivated Extent of Green gram in ha (2000 – 2015)



Source: Department of Census and Statistics

Figure 7.3: Average Yield of Green gram – kg/ha (2000 – 2015)

After 2004 there was a slight increment both in production and cultivated extent until the year 2009 and afterwards there could be seen a rapid growth due to the introduction of the third season cultivation. The extent under green gram has dropped from 12,969 ha to 11,346 ha during the period of 2000 to 2015 representing a 12 percent decline while the total annual green gram production has increased from 11,695 mt in 2000 to 15,005 mt in 2015, a 29 percent increase reflecting the improvement of the average yield of the crop. As illustrated in Figure 3, the average yield of green gram showed signs of stagnation until the year 2008 and then there was a rapid improvement of the yield.

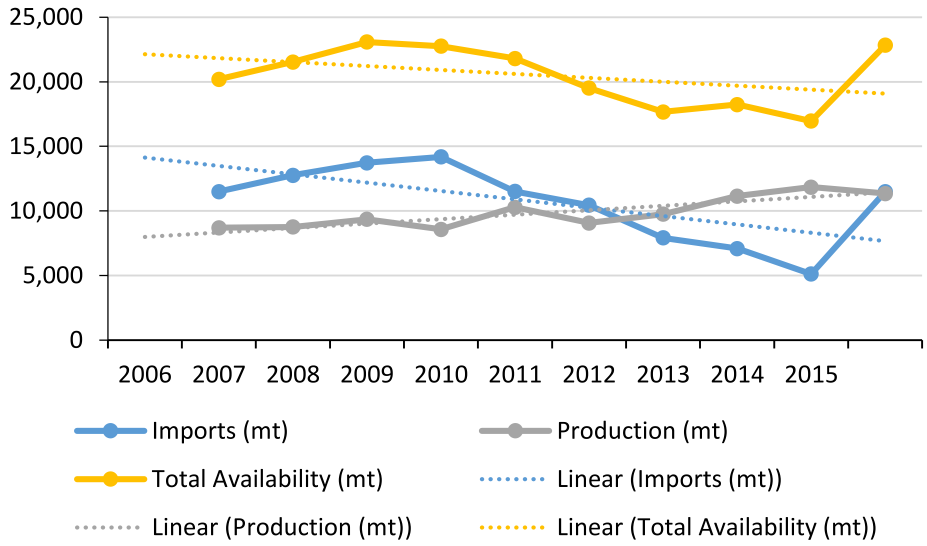
7.1.3 Climate and Soil

Green gram grows in a wide range of climatic conditions. A warm humid climate with a temperature range of 25°C to 35°C, with moderate and well distributed rainfall of 700-900mm per year is quite suitable for its cultivation. The crop is grown on a variety of soils and a well-drained loamy to sandy loam soil is the best soil for its cultivation.

7.1.4 Importance of the Crop to the Economy

7.1.4.1 Imports of Green Gram

As shown in Figure 7.4, the overall trend of green gram production has marked signs of increase while the imports have shown a decreasing trend over the last ten years. A sharp decline of imports and a growth of production can be observed after the year 2010 due to the additional production from the third season cultivation coming into the market.



Source: Department of customs

Figure 7.4: Production, Imports and Total Availability of Green gram (2006 – 2015)

The contribution of imports to the total green gram requirement of the country was around 57 percent in the year 2006 and it has gradually declined to 30 percent in the year 2014. Percentage share to the total requirement in the year 2015 has suddenly increased to 50 percent because of the low production during that year.

Green gram was imported from a variety of countries mainly Australia, Myanmar Thailand, and Malaysia. Out of the total imports in 2013, 46 percent came from Australia and 40 percent from Myanmar (Table 7.4).

Table 7.4: Imports of Green gram by Country of Origin (2010 – 2013)

Country	2009		2010		2011		2012		2013	
	Qty. (mt)	Value (000 Rs.)	Qty. (mt)	Value (000 Rs.)	Qty. (mt)	Value (000 Rs.)	Qty. (mt)	Value (000 Rs.)	Qty. (mt)	Value (000 Rs.)
Australia	8,074	651,730	8,055	1,213,661	7,142	1,049,800	5,519	642,988	3,230	466,651
Malaysia									218	29,295
Singapore	984	86,758	797	124,786	197	24,289	221	25,250		
Thailand	2,027	198,007	1,215	192,678	1,334	195,649	1,206	149,947	432	54,136
Myanmar	912	75,942	941	144,941	1,118	169,168	430	52,858	2,864	385,994
China	1,375	133,832								
Other Countries	811	78,315	507	79,843	656	84,549	536	57,923	342	43,126
Total	14,183	1,224,584	11,515	1,755,909	10,447	1,523,455	7,912	928,966	7,086	979,202

Source: Department of customs

7.1.4.2 Consumption

Per capita consumption of green gram in Sri Lanka in 2012/13 is 447.6 g per annum while it was 588.6 in the year 2005 (Table 7.5). Data pertaining to the total availability of green gram in the country shows that the overall trend of demand for green gram has slightly declined over the time (Figure 7.4). According to the Household Income and Expenditure survey - 2009/10 conducted by the Department of Census and Statistics, estate sector recoded the highest monthly average expenditure on pulses (Rs. 719.00) while the urban sector recorded the lowest (Rs. 533.00).

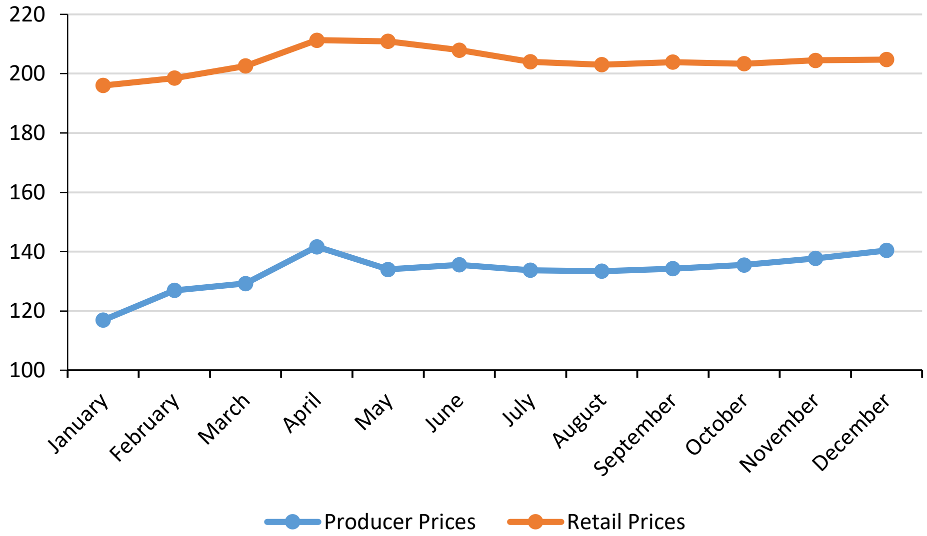
Table 7.5: Per Capita Consumption of Green gram

Year	Per capita consumption (g/year)
2005	588.6
2006/07	602.2
2009/10	604.8
2012/13	447.6

Source: House hold Income & Expenditure Survey - Dept. of Census & Statistics

7.1.4.3 Price Variation

Figure 7.5 illustrates the average monthly variation of producer and retail prices of green for the ten-year period of 2006-2015. During that period, the average annual retail price and the producer price of green gram have increased by 125 percent and 175 percent respectively. A precise pattern in monthly average prices of green gram cannot be seen mainly because the country was importing green gram all over the year to fulfill the total requirement and therefore the price remained just about same throughout the year.



Source: Marketing Food Policy & Agri business division of HARTI

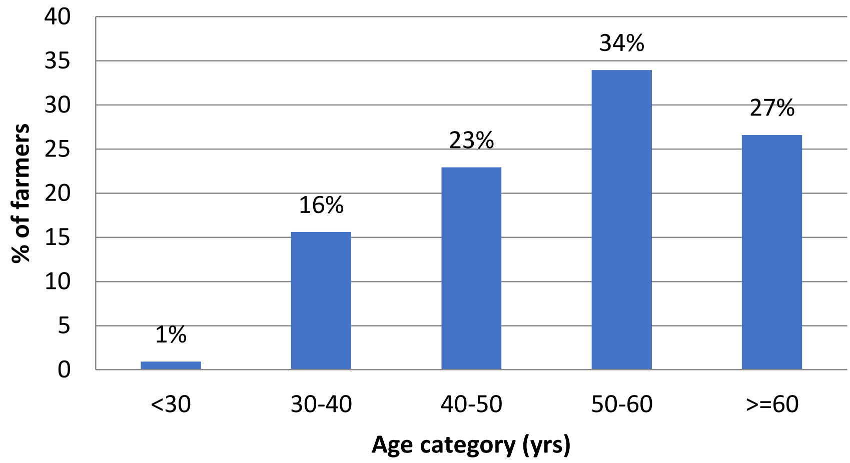
Figure 7.5: Monthly Average Prices of Green gram from 2006 to 2015

7.2 Socio-economic Characteristics of the Sample Farmers

7.2.1 Demographic Characteristics of the Sample

This section briefly discusses the socio-economic characteristics, such as the age, educational background, income and land distribution of green gram farmers in the sample.

7.2.1.1 Age Distribution of Farmers



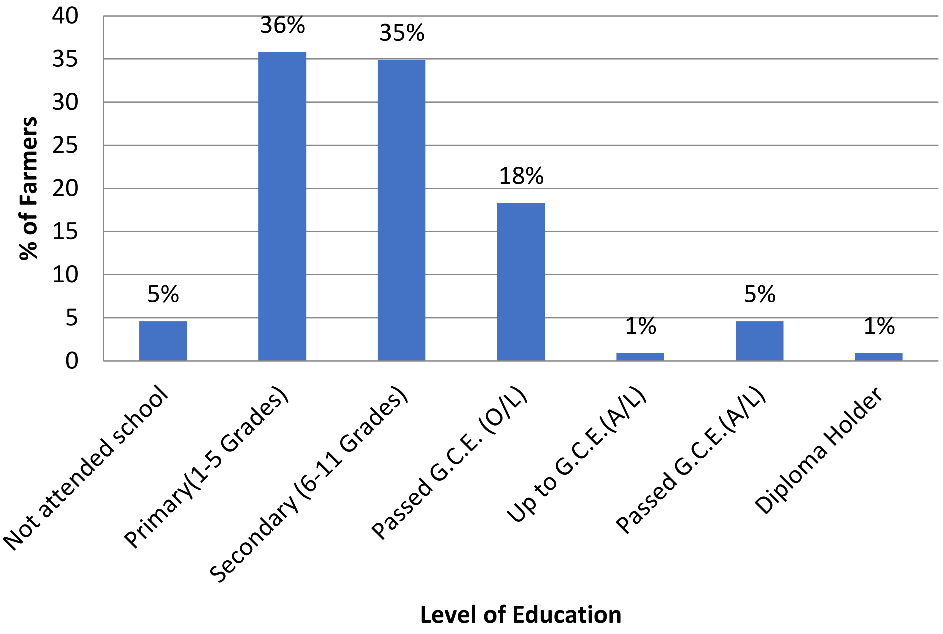
Source: HARTI survey data, 2016

Figure 7.6: Age Distribution of Sample Farmers

Findings of the survey indicate that, majority of green gram farmers (about 84%) were older than 40 years of age and among them 27 percent were more than 60 years of age. (Figure 7. 6). Only one percent of the total numbers of farmers were below 30 years and only 16 percent of the total was between 30 – 40 years of age.

7.2.1.2 Level of Education

The educational status of green gram farmers shows that five percent of the sample had no formal education while 36 percent and 35 percent of the respondent farmers had received only primary and secondary education respectively. About 19 percent had been able to qualify at the G.C.E. O/L for Advanced Level and six percent of them have been successful at the Advanced Level (Figure 7.7). The major difference in the level of education which can be identified across three districts was that in the Monaragala district 16 percent from the sample had no schooling at all.

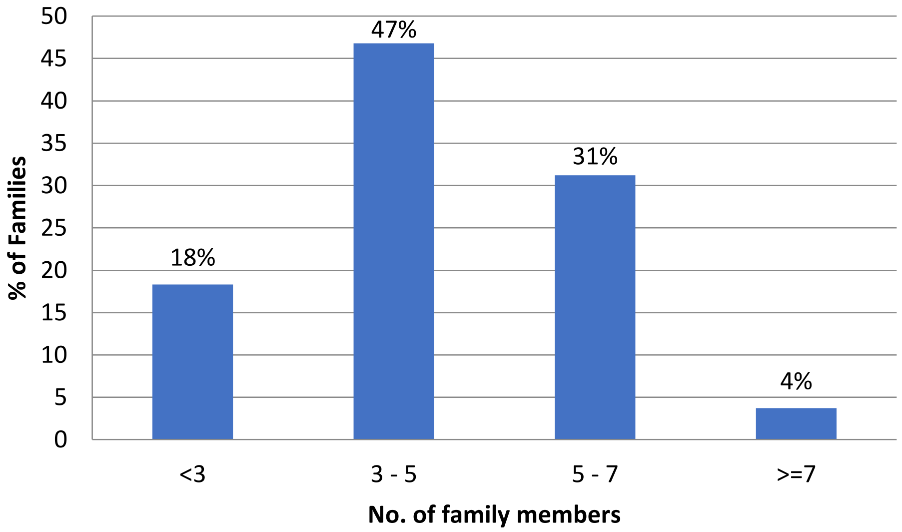


Source: HARTI survey data, 2016

Figure 7.7: Level of Education of Green gram Farmers

7.2.1.3 Family Size

The distribution of family size among the selected households is of utmost significance because green gram cultivation is considered more labour intensive and at the same time the allied activities largely depend on family labour. Figure 7.8 shows that most of the households (47%) belong to the category of family size of 3-5 members and survey did not show a considerable difference of family size among three districts.

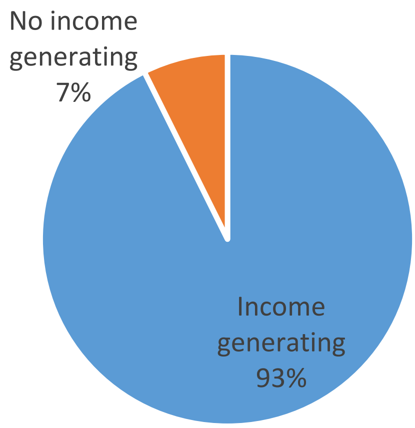


Source: HARTI survey data, 2016

Figure 7.8: No. of Family Members

7.2.2 Economic Characteristics of the Sample Population

As illustrated in Figure 7.9, 93 percent of green gram farmers cultivated the crop for the income generating purpose while only seven percent of farmers produced it for consumption. Farming and/or animal husbandry is the primary income generating activity of 85 percent of green gram farmers among the group of income generating farmers who pursued green gram farming to earn an income (Table 7.6).



Source: HARTI survey data, 2016

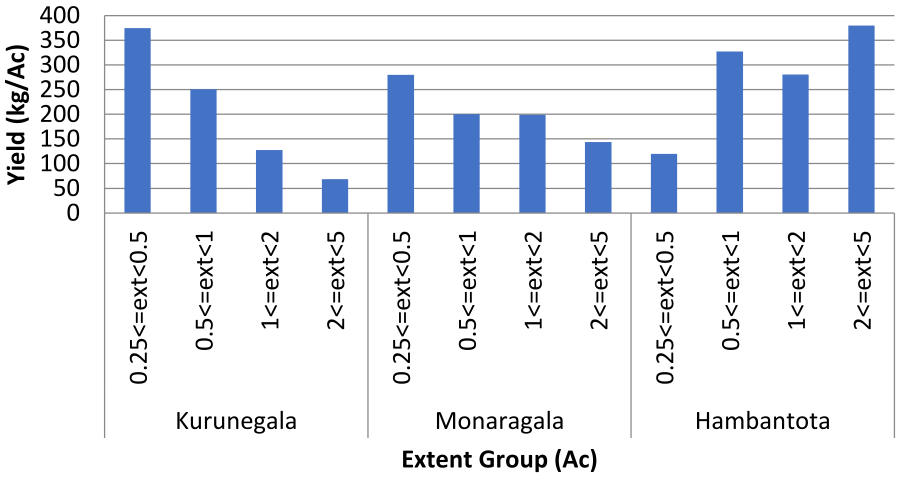
Figure 7.9: Types of Farmers Based on the Purpose of Cultivation of the Crop

Table 7.6: Primary Employment from Income Generating Farmers

Primary employment	No. of farmers	% of farmers
Farming/Animal husbandry	86	85
Agricultural labour	1	1
Non-agricultural labour	1	1
Government job	6	6
Private sector job	4	4
Self-employment	1	1
Skilled labour	2	2
Total	101	100

Source: HARTI survey data, 2016

As per data pertaining to the per acre average yield of green gram in the surveyed districts, the overall average productivity figures are 175.93 kg/ac, 168.80 kg/ac and 321.08 kg/ac in Kurunegala, Monaragala and Hambanthota districts respectively. Figure 7.10 shows that the per acre average yields of Kurunegala and Monaragala districts had dropped with the increasing cultivated land area while it had gone up with the increasing land size in Hambantota district. Large scale cultivation of the crop in paddy lands during the third season may be the main reason behind the dissimilarity of the pattern of growth in Hambantota district.

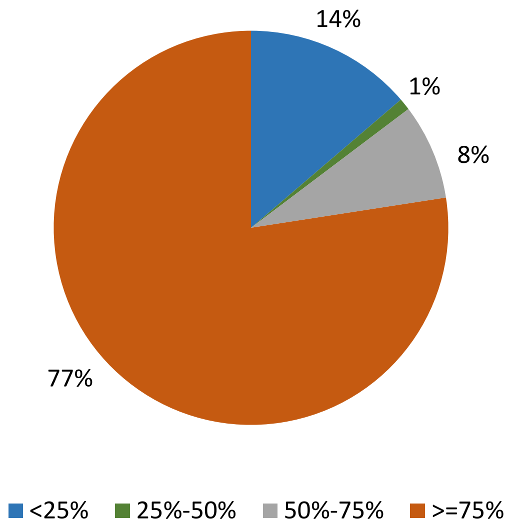


Source: HARTI survey data, 2016

Figure 7.10: Average Yield of Green gram by Districts

7.2.2.1 Production and Marketing

As illustrated in Figure 7.11 main purpose of cultivating the crop was the generation of an income as the majority of farmers (77 percent) had sold over 75 percent of the produce and only a little portion had been retained for consumption in all three districts. About 97 percent of the farmers had disposed of their produce soon after harvesting without storing it.



Source: HARTI survey data, 2016

Figure 7.11: Sold Amount as a Percentage of Total Yield

Table 7.7: Average Prices of Green-gram by Districts

District	Average Price (Rs/kg)	
	2015/16 *Maha*	2015 *Yala*
Kurunegala	180.00	
Monaragala	144.20	
Hambantota	-	127.50

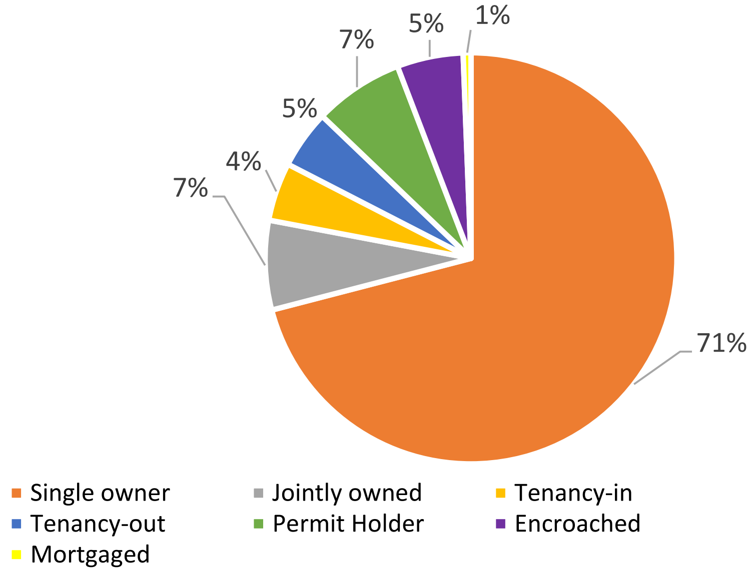
Source: HARTI survey data, 2016

As per the Table 7.7 the average price of green gram in Kurunegala and Monaragala districts was Rs. 180/= and Rs. 144.20 per kilogram during the 2015/16 *Maha* season respectively and it was Rs. 127.50 per kilogram in Hambantota district during the 2015 *Yala* season.

7.3 Agricultural Inputs

7.3.1 Land

Figure 7.12 shows the distribution of land holdings by ownership and it shows that 71 percent of farmers have their own lands. Both permit holders and farmers who owned lands with joint ownership accounted for seven percent. In Hambantota district 18 percent of the surveyed farmers were permit holders while this figure was five percent in Kurunegala district and no permit holders were observed in Monaragala district.



Source: HARTI survey data, 2016

Figure 7.12: Distribution of Land Holdings by Ownership

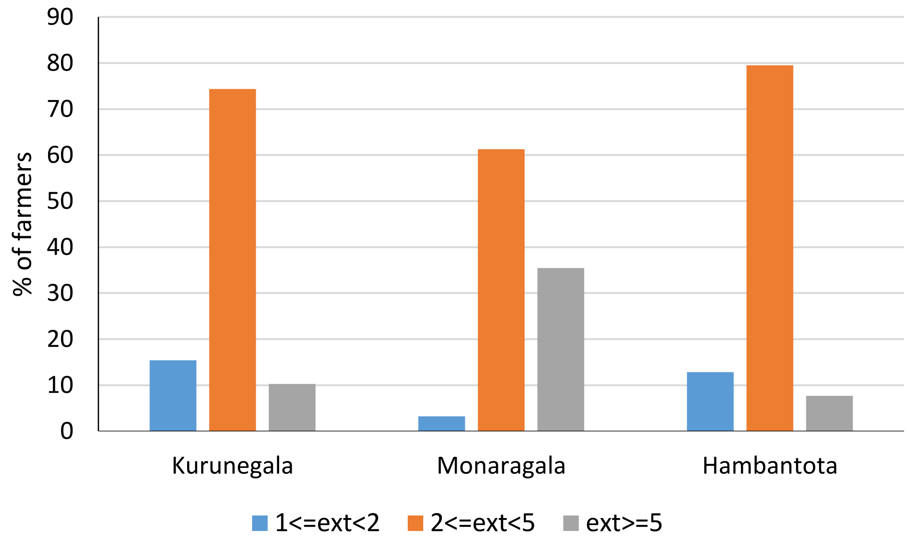
Table 7.8: Extent under Cultivation by Districts

District	No.of HH	*Yala* - Highland	*Yala*- Lowland	*Maha*- Highland	*Maha*- Lowland	Inter- Lowland
Kurunegala	39	1	-	1	-	39
Monaragala	30	-	-	29	1	-
Hambantota	39	-	25	-	-	14
Total	108	1	25	30	1	53

Source: HARTI survey data, 2016

According to the Table 7.8 almost all the farmers in Kurunegala district and in Hambantota district cultivated green gram in lowlands while all the farmers in Monaragala district resorted to grow the crop on uplands during the *Maha* season. All the lowland farmers in Kurunegala district had cultivated the crop during the intermediate season where as in Hambantota district 25 farmers selected the *Yala* season and the rest of them confined to the intermediate season.

In accordance with Figure 7.13 majority of farmers in all three districts held lands in the size class of 2 to 5 ac but a relatively higher percentage of farmers in Monaragala district held lands in the size class of more than 5 ac.



Source: HARTI survey data, 2016

Figure 7.13: Distribution of Operators by Size Class of Land

7.3.2 Irrigation

Great majority of lowland farmers had used flood water as their key source of irrigation where as rainfed irrigation was prominent among the majority of the upland farmers in all three districts (Table 7.9).

Table 7.9: No. of Land Holdings Based on Method of Irrigation

Irrigation Method	% of Land extent	
	Lowland	Upland
Flood	82	0
Pump water	6	4
Sprinklers	0	3
Rainfed	12	93
Total	100	100

Source: HARTI survey data, 2016

Main source of water for 79 percent of the total land extent in Hambantota district is coming from major irrigation scheme and this is mainly because all the farmers in this district had cultivated green gram as a lowland crop. In Kurunegala district water source for 45 percent of total land holdings was major irrigation while minor irrigation and rain water were the other sources for 11 percent and 33 percent of the total land holdings. As in Monaragala district almost all the farmers cultivate the crop as an upland crop, with rain water as the major water source for 81 percent of total land holdings (Table 7.10).

Table 7.10: No. of Land Holdings Based on Main Water Source

Water Source	% of total extent		
	Kurunegala	Monaragala	Hambantota
Major irrigation	45	-	79
Minor irrigation	11	10	7
Rainfed	33	81	14
Other	11	9	-

Source: HARTI survey data, 2016

7.3.3 Seeds

Table 7.11: Seeds Varieties Used by Farmers

Variety used	% of farmer		
	Kurunegala	Monaragala	Hambantota
MI 6	26	-	51
MI 5	19	-	21
Not known	55	100	28

Source: HARTI survey data, 2016

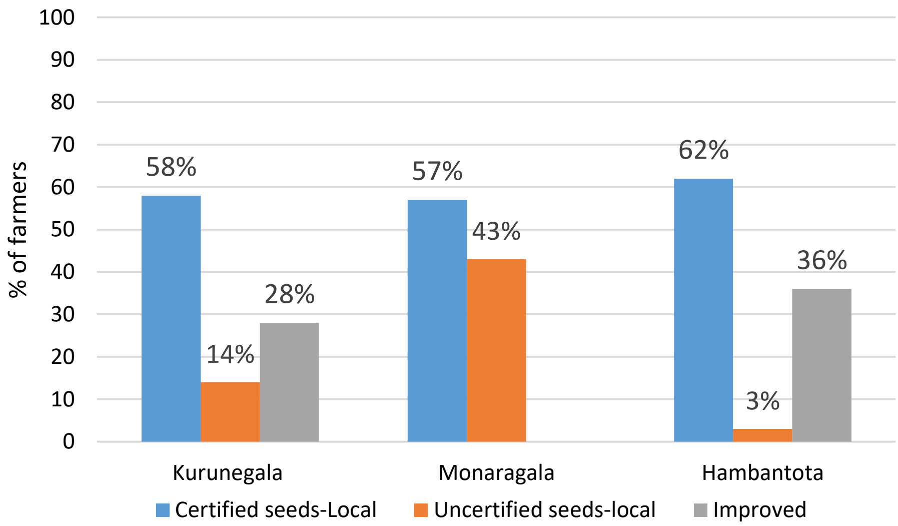
According to the farmer responses in the survey 72 percent in Hambantota district have grown the recommended green gram varieties of MI 5 and MI 6. On the other hand, almost all farmers in Monaragala district and 55 percent in Kurunegala district were not aware the exact name of the variety they have grown and the reason behind this unawareness may be that they have grown traditional and other consumption varieties (Table 7.12).

Table 7.12: Source of Seeds

Source of seed	% of farmers		
	Kurunegala	Monaragala	Hambantota
Dept. of Agriculture	83	40	92
Neighbouring farmers	2	-	-
Local market	15	3	8
Self-produced	-	13	-
Private companies	-	43	-

Source: HARTI survey data, 2016

As illustrated in Table 7.12, great majority of the Kurunegala and Hambantota districts (83% and 92% respectively) have obtained required seeds for cultivation from the DOA while 43 percent and 40 percent of farmers in Monaragala district had used seeds obtained from private companies and from the DOA respectively. Although a considerable proportion of farmers from the sample in Monaragala district had obtained seeds from the DOA they were not aware about the name of the variety they cultivated. The survey responses indicated that over 50 percent of the total sample in all three districts had used locally certified seeds and on the other hand, 36 percent and 28 percent of farmers in Hambantota and Kurunegala districts respectively had used improved varieties (Figure 7.14).



Source: HARTI survey data, 2016

Figure 7.14: Types of Seeds Used by Farmers

7.3.4 Total Cost of Production

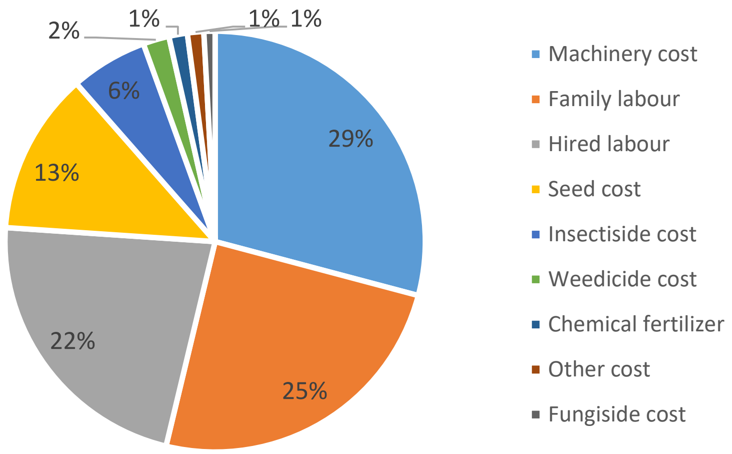
Total cost of cultivation of green gram was calculated using the collected data and is illustrated in Table 7.13. As per the table, total cost of production per acre (including family labour) was Rs. 13,648.00, Rs. 17,133.00 and Rs. 18,324.00 in Kurunegala, Hambantota and Monaragala districts respectively. Accordingly, the lowest cost of production of the crop was recorded in Kurunegala district.

Table 7.13: Mean of Total Cost of Production of Sample Farmers

District	Mean of total cost of production (Rs/ac) – Including family labour
Kurunegala	13,648.00
Monaragala	18,324.00
Hambantota	17,133.00

Source: HARTI survey data, 2016

Figure 7.15 illustrates the share of various cost components to the total cost of production. Total labour cost was the prominent which accounted for 47 percent of the total cost and it is apparent that green gram is a highly labour intensive crop.



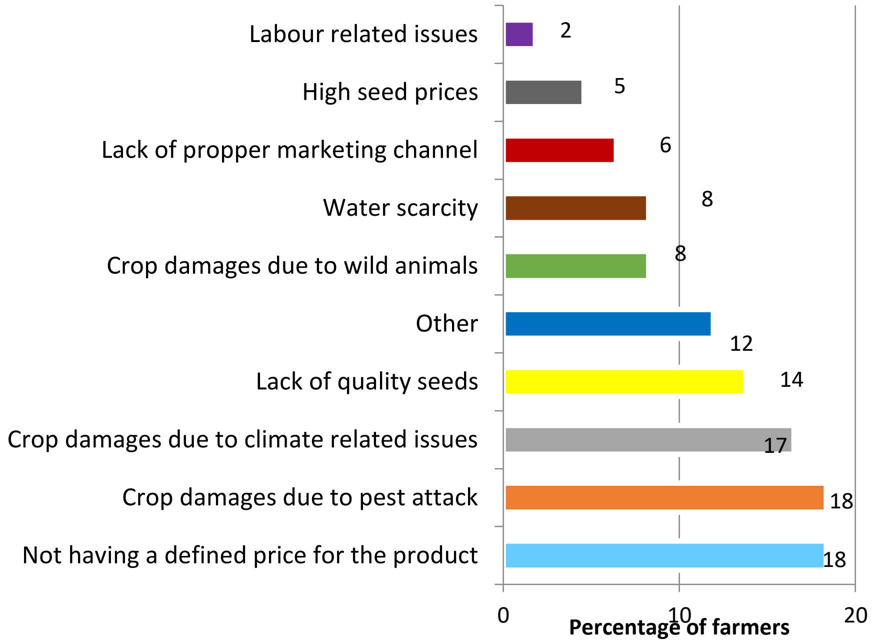
Source: HARTI survey data, 2016

Figure 7.15: Share of Cost Components to the Total Cost of Production

Machinery cost ranked second contributing 29 percent and 13 percent of the total cost was the seed cost. Main reason for high machinery cost may be the usage of machinery for land preparation in upland cultivation.

7.4 Potentials and Constraints of Production

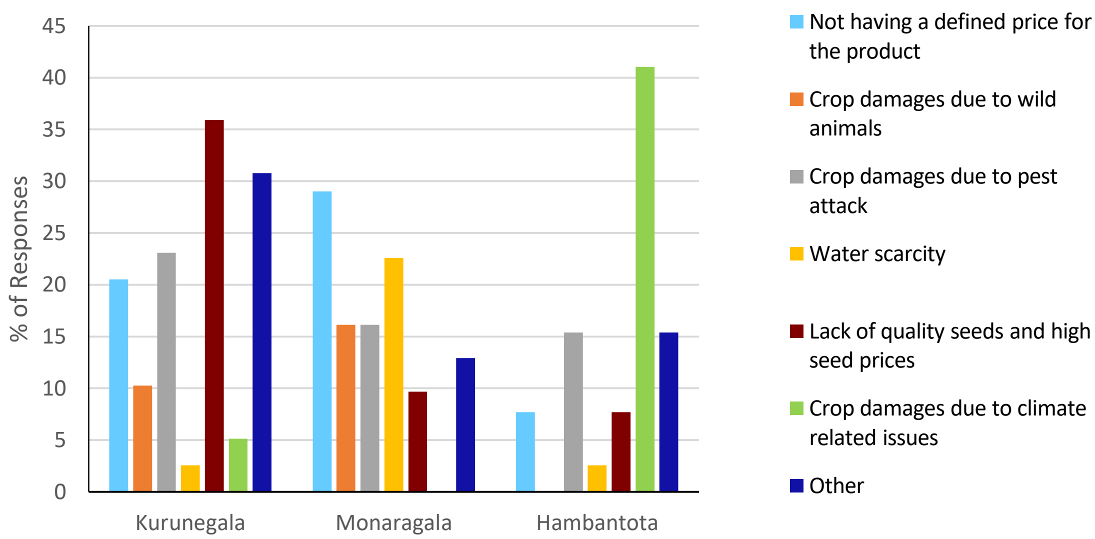
During the survey farmers were inquired about major issues related to the crop and those responses are given in Figure 7.16. According to Figure 7.16 two reasons are addressed; absence of a defined price for the product and damages due to pest attacks equally affecting (17%) the farmers. Crop damages due to climate related issues ranked as second for a percentage of 15. Thirteen percent of total responses relates to lack of quality seeds. Of the farmers whose serious issue was absence of a defined price for the product, over 50 percent suggested to have government intervention to establish a stable producer price for green gram.



Source: HARTI survey data, 2016

Figure 7.16: Major Issues Related to Green gram Cultivation

District wise variation of major issues related to the crop is given in Figure 7.17. Accordingly, great majority of farmers in Kurunegala district came out with the pressing problem of a lack of quality seeds and high seed prices. Not having a defined price for the product is an issue in Monaragala district. On the other hand, crop damages due to climate related issues were the major problem faced by farmers in Hambantota district.



Source: HARTI survey data, 2016

Figure 7.17: District wise Variation in Major Issues Related to Green gram Cultivation

7.5 Recommendation and Suggestions

1. Low prices prevailing during the harvesting season and also absence of a defined price for the product were attributed for the subsistence nature of the green gram farming in the country. Therefore, policies should be formulated;
   - To promote investment on value addition that would offer high prices for the product.
   - To encourage forward sales contract with the participation of the private sector.
   - To assist improving storage facilities envisaging prices increases.

2. Productivity improvement is a must in green gram as there is a high yield gap between the potential yield and the actual yield. In order to achieve high productivity, it is important;
   - To develop a variety this allows minimizing labour intensive operations like harvesting and weeding. This is more imperative since at present green gram growing is a labour intensive farming activity.

   - State intervention is a long-felt need to improve current methods of gathering and dissemination of information. This is an area which needs much attention since in the rural setting the farmers can be misguided by the middlemen as the farmers are not getting correct and reliable information. A comprehensive communication system ensuring the flow of correct information on marketing, inputs, technological information, climate and so on is necessary.

   - It is important to enhance the current level of extension services to provide better awareness on proper cultural practices, control of pest and diseases. Further creating awareness on climate change impacts specially the changing the pattern of rainfall to avoid crop damages which reduce both the quality and the quantity of output.

References

Department of Census and Statistics, Statistical Abstract 2016, Department of Census and Statistics, Colombo, Sri Lanka

Chapter Eight

Soybean

G.G.de.L.W. Samarasinha

SUMMARY

Soybean (*Glycine Max*) is one of the five major grain legumes cultivated in Sri Lanka. It is an important crop for its high nutritional properties and for its use in industries. Though soybean can be grown in many agro-climatic regions in the dry zone of the country the drier parts of the intermediate zone is more suitable and therefore it is mainly cultivated in Mahaweli 'H' and Anuradhapura area. The *Yala* season is the major season of soybean cultivation practiced under irrigated conditions. In the *Maha* season soybean is cultivated as a rainfed crop.

Majority of the soybean farmers belonged to the age group of 50-60 years and all of them were literate. About 44 percent of the sample farmers’ main annual agricultural income was from soybean cultivation.

All the landholdings under soybean crop were almost equal in extent or larger than one acre. Around 70 percent of the landholdings ranged from two acres to lesser than 5 acres. Single ownership represented about 64 percent. About 46 present of the landholdings had major irrigation facilities, but flood irrigation was the main method of watering for soybean farmers. Minimal use of pesticides was observed in soybean cultivation though about 80 percent of the farmers had used only chemical fertilizers.

Most (57%) of the farmers had used locally produced seeds certified by the Department of Agriculture with another 32 percent using locally produced uncertified seeds. However, about 98 percent of the sample farmers were not aware of the name of the seed variety they used. Average yield of soybean in Sri Lanka is about 800kg per acre and average price of one kg of soybean is around Rs. 80/-. Most of the sample farmers (76%) sold their produce to individual private traders and those who sold it to the Government were only about nine percent. Inability to dispose their produce at a fair price and severe concern shown over the quality by the buyers were pointed out by the farmers as prevailing marketing issues.

Strengthening the buyback system through public private partnership and increasing the quality of the produce through fruitful training programmes for soybean farmers is recommended to promote soybean cultivation in the country. Further, training is recommended to create awareness among the farmers about the available seed varieties and selecting suitable varieties for their specific areas. To guarantee the quality of seeds available at the market it is suggested to strengthen the seed certification process.

CHAPTER EIGHT

Soybean

8.1 Overview of Soybean

8.1.1 Introduction

Soybean (*Glycine max*) which belongs to the legume crop family is basically native to East Asia. It is also known as the Golden Bean due to its high nutritional properties. Soybean was introduced to Sri Lanka in 1970's and currently it ranks among the five major grain legumes cultivated in Sri Lanka (Arulandy, 1995). Protein and fat content of the Soybean can be as high as 40 percent and 22 percent respectively. Fiber content may vary up to nine percent. In addition to its nutritional value, Soybean has a high industrial potential.

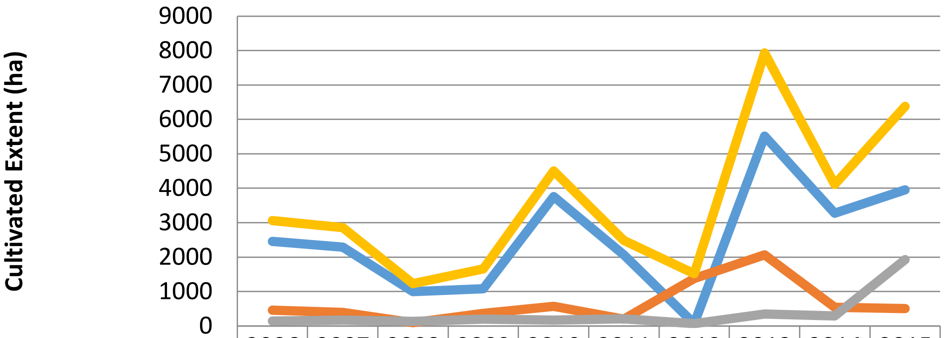
There are three varieties of soybean recommended by the Department of Agriculture. They are Pb-1, PM-13 and PM-25. From these three varieties, Pb-1 was introduced by India and it is a selection from the variety Nanking.

Source: Encyclopedia Britannica, 2017

Plate 8.1: Soybeans

8.1.2 Major Growing Areas and Extent under Cultivation

Soybean is mainly cultivated in Mahaweli 'H', Anuradhapura. In addition, it is cultivated in Matale, Kurunegala, Nuwara Eliya, Monaragala, Badulla and Polonnaruwa areas. Annual extent of total cultivation and distribution of cultivation extent in the country is shown in Figure 8.1. However, for this study we only looked at the major soybean growing areas namely Anuradhapura and Mahaweli H areas.

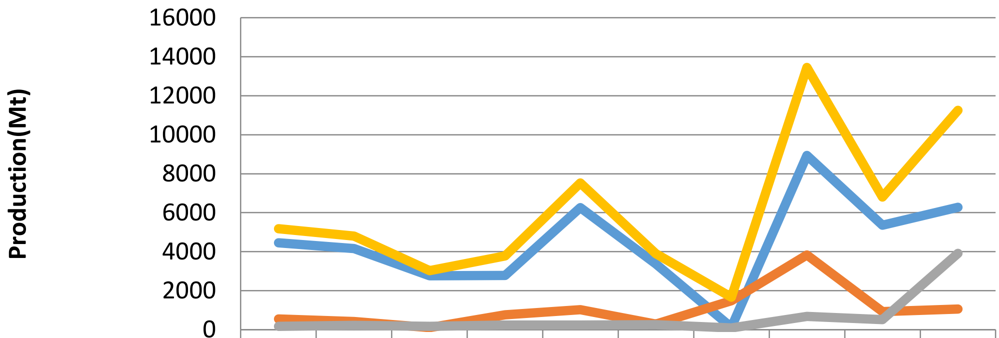


	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mahaweli H	2456	2287	1000	1085	3755	2069	72	5512	3274	3952
Anuradhapura	459	393	95	368	572	202	1378	2068	544	501
Other	147	175	131	200	174	212	69	351	294	1929
National	3062	2857	1226	1654	4500	2483	1517	7929	4112	6383

Source: Department of Census and Statistics

Figure 8.1: Cultivation Extent of Soybean from 2005 To 2015

In 2008 and 2009 cultivated extent of soybean had gone down compared to that of 2006 and 2007. However, cultivated extent in the year 2010 marked a significant increase compared to that of two previous years due to government interventions. The spell of drought that prevailed in the country in 2012 resulted in a drop in the extent under soy. Again, in 2013 there was a sizeable increase in the cultivated extent in all the areas where Soybean had been cultivated. Production of Soybean as recorded from 2006 to 2015 is given in Figure 8.2.



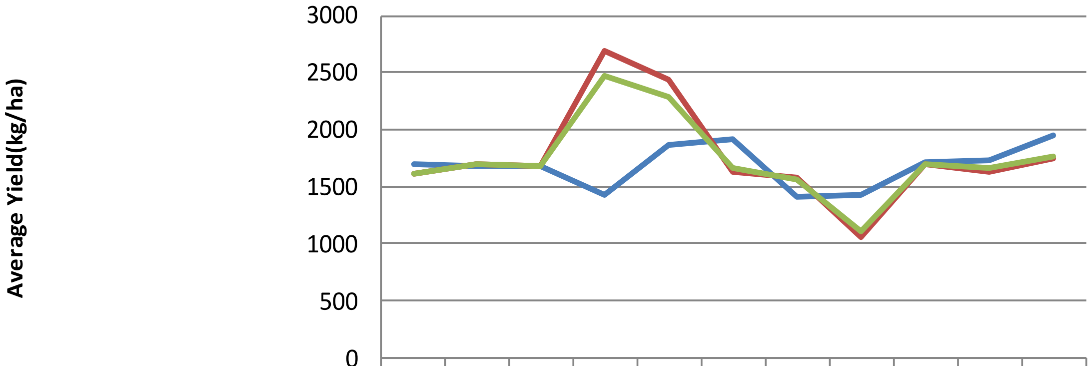
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mahaweli H	4452	4162	2756	2783	6256	3365	114	8941	5360	6279
Anuradhapura	550	420	103	762	1023	280	1477	3832	933	1056
Other	175	215	173	243	242	244	80	672	511	3919
National	5177	4799	3032	3788	7521	3889	1671	13445	6804	11254

Source: Department of Census and Statistics

Figure 8.2: Production of Soybean from 2006 to 2015 in Major Producing Areas in the Country

Cultivation of soybean follows the same pattern of land extent throughout the last 10 years.

Soybean is mostly cultivated in the *Yala* season under irrigated conditions and as a rain fed crop in the *Maha* season. According to the Department of Agriculture, yield potential under irrigated condition is about 3000kg/ha and 2000kg/ha under rain fed conditions. Actual average yield during 2005 to 2015 in the *Yala* and the *Maha* seasons and annual average yield is shown in Figure 8.3.



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Average Yeild - (kg/ha) Maha	1702	1681	1682	1434	1873	1908	1404	1422	1705	1727	1947
Average Yeild - (kg/ha) Yala	1609	1692	1680	2699	2434	1627	1582	1062	1694	1625	1754
Average Yeild - (kg/ha) Annual	1620	1691	1680	2473	2290	1671	1566	1102	1696	1655	1763

Source: Department of Census and Statistics

Figure 8.3: Average Yield of Soybean from 2005 to 2015

8.1.3 Climate and Soil

Soybean can be grown in many agro-climatic regions but preferred areas are the dry zone and drier prats of the intermediate zone. Soybean grows well in warm and moist climate. A temperature of 26 to 32°C appears to be the ideal for most varieties of soybean. Day length is the deciding factor in soybean varieties as they are short day plants.

Almost any soil with a pH of 6-7 is adequate, but excessive moisture is not acceptable. Soybean tolerates a degree of poor drainage. Highlands in the *Maha* and well-drained paddy fields in the *Yala* are preferable for Soybean cultivation. It can also be grown on highlands during the *Yala* if there is sufficient soil moisture (FCRDI, undated).

8.1.4 Importance of the Crop to the Economy

Soybean is the most important food legume in the country because of its nutritional and industrial value. In terms of the nutritional value it is an exceptionally nutritive and protein rich food. Protein content of the Soybean can be as high as 40 percent with the fat reaching even 22 percent. Fiber content can be around nine percent. It also contains oil which is one of the most popular edible oil used in countries like India. Annually the country imports a considerable amount of soybean for various needs spending much valued foreign currency (Table 8.1). Importation of soybean is mainly from India. In addition, soybean has been imported on a lesser scale from countries like the United States of America, Canada, South Africa and Ethiopia during the recent years.

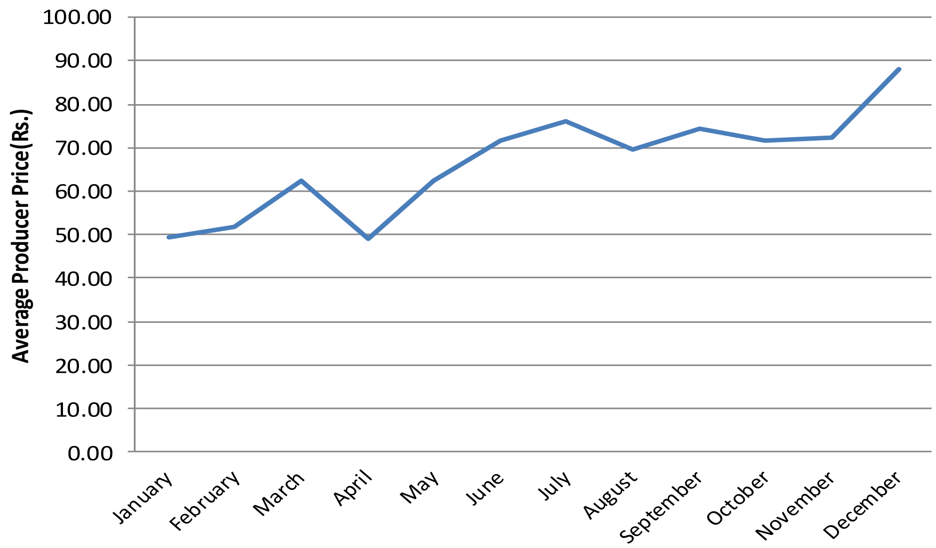
Table 8.1: Quantity and Value of Import of Soybean in Sri Lanka

Year	Quantity (mt)	CIF Price(Rs/kg)	Value (000'Rs)
2006	212	29.07	6,149
2007	1	14.59	14
2008	2,445	41.46	101,347
2009	1,790	47.55	85,118
2010	1,611	58.70	94,548
2012	101	85.97	8,667
2013	1,119	74.59	83,476
2014	18	75.23	1,335
2015	7,293	67.89	495,148

*Data is not available for 2011
Source : Department of Customs

Price Behaviour

During the seven years from 2006 to 2012, distribution of monthly average of producer prices in the twelve months of the year is as indicated in Figure 8.4. Producer prices are comparatively low in the *Yala* season as soybean is mainly cultivated as a *Yala* crop.



Source: Department of Census and Statistics

Figure 8.4: Monthly Averages of Producer Prices of Soyabean – Rs./Kg

Consumption of Soybean

Consumption of soybean is basically in processed forms. Most popular form of consumed soybean is as T.V.P. (Textured Vegetable Protein). In addition Tempeh and Tofu are two soy products that are gaining popularity among vegetarians. Other soy food includes soy milk, soy ice creams and soy sausages (Department of Agriculture, 2012). Table 8.2 shows the consumption of soy based products during the past few years' time.

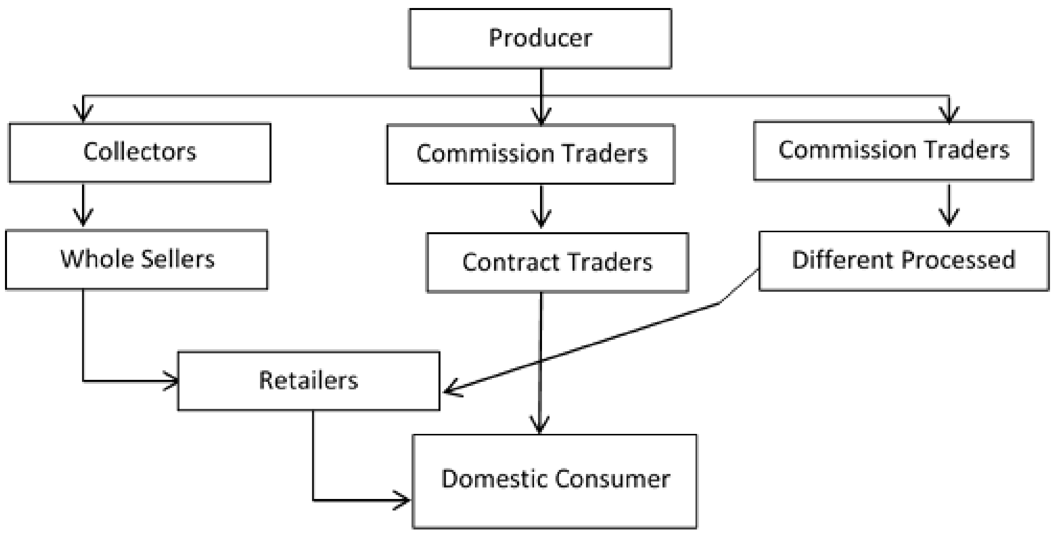
Table 8.2: Per Capita Consumption of Soya

Year	grams/year
2005	103.08
2006/07	89.4
2009/10	108.96
2012/13	109.8

Source: House hold Income & Expenditure Survey - Dept. of Census & Statistics

Marketing and Trade of Soybean

Collectors and commission traders do marketing of soybean from farm gate. Rest of the marketing process is as in Figure 8.5.



Source: Adopted from Socio Economic & Planning Centre, Department of Agriculture, 2012

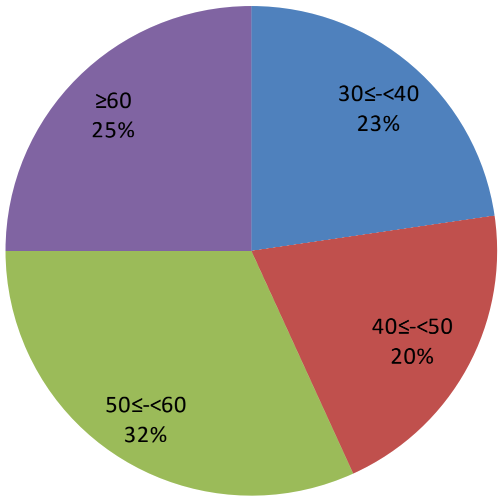
Figure 8.5: Marketing Channel of Soybean

8.2 Socio Economic Characteristics of the Sample Farmers

8.2.1 Demographic Characteristics of the Sample Population

8.2.1.1 Age Distribution

Age distribution of sample farmers was more or less equal among the age categories considered (Figure 8.6). Highest percentage of farmers belonged to the one group of 50 and less than 60 years of age. There were about 23 percent young farmers involved in soybean cultivation who are in the age group ranging from more than 30 years to less than 40 years. It shows that soybean cultivation could be popularized as a source of income earning among young people in areas where conditions are favourable for its cultivation. This is an aspect which needs sharper focus from all the stakeholders in the promotion of a crop with strong potentials for further development.

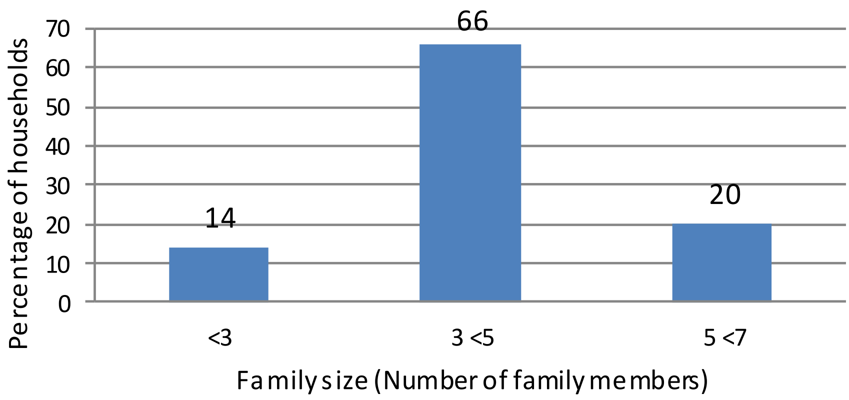


Source: HARTI Survey Data, 2016

Figure 8.6: Age Distribution of the Sample Farmers

8.2.1.2 Family Size

As shown in Figure 8.7, majority (66%) of the households consisted of 3 to 4 family members. It tallies with the national average family size 4.2 as per 2011 census data published by Department of Census and Statistics. There were about 20 percent households with 5 to 6 members in the family. Households with fewer than three members were about 14 percent.

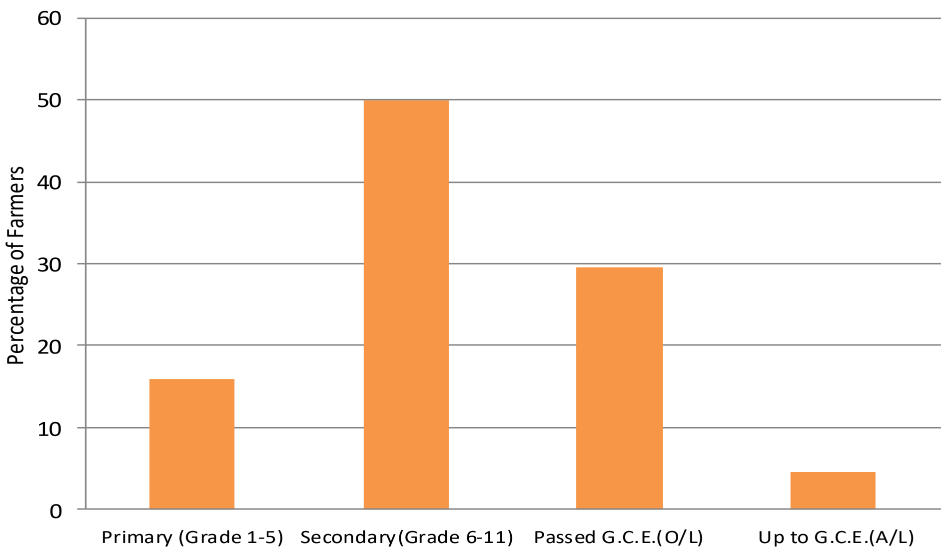


Source: HARTI Survey Data, 2016

Figure 8.7: Family Size of the Sample Farmers

8.2.1.3 Level of Education

About 50 percent of the farmers had received secondary education and another 30 percent of them had achieved success at the G.C.E. (O/L) examination. None had reached the graduate level but about 5 percent of the farmers had education up to G.C.E. (A/L) examination. All the farmers have attended school and 16 percent of them were with only primary level of education (Figure 8.8).



Source: HARTI Survey Data, 2016

Figure 8.8: Level of Education of the Sample Farmers

8.2.1.4 Primary Source of Income

Primary employment of about 89 percent of the household heads was farming or animal husbandry (Table 8.3). Income from soybean cultivation is the main component of annual agricultural income of 44 percent of the sample farmers.

Table 8.3: Primary Employment of the Sample Farmers

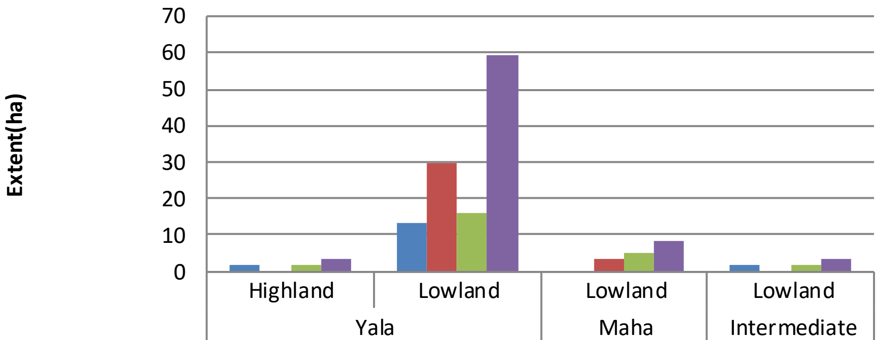
Primary Employment	Frequency	Percent
Farming/Animal husbandry	39	88.6
Government job	1	2.3
Private sector job	1	2.3
Self-employment	1	2.3
Skilled labour	1	2.3
Other	1	2.3
Total	44	100.0

Source: HARTI Survey Data, 2016

8.3 Agricultural Inputs

8.3.1 Land

Sample of the survey included farmers from Katiyawa, Thalawa and Thambuttegama agrarian service areas. As described in Figure 8.9, soybean cultivation is mostly done by the farmers in the *Yala* season as a lowland cultivation. Highest extent of land under soybean was recorded from Thalawa agrarian services area. In both seasons they have cultivated only lowlands. Only 3.5 ha were cultivated in the intermediate season.

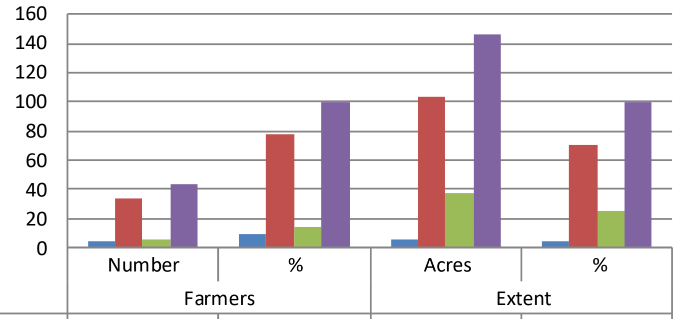


	Yala Highland	Yala Lowland	Maha Lowland	Intermediate Lowland
Katiyawa	1.5	13.25		1.5
Thalawa		30	3.5	
Thambuttegama	2	16	4.75	2
Total	3.5	59.25	8.25	3.5

Source: HARTI Survey Data, 2016

Figure 8.9: Land Type and Cultivation Extent of Soybean by Sample Farmers Land Size Distribution by Operators

As illustrated in Figure 8.10, all the landholdings are equal or larger than 1 acre. Landholdings ranging from one acre to less than 2 acres are about four percent. From the total extent cultivated about 70 percent of landholdings are in the size category of two acres to less than five acres. Landholdings larger than five acres are about 25 percent.



	Farmers: Number	Farmers: %	Extent: Acres	Extent: %
1≤ext<2	4	9	6.04	4
2≤ext<5	34	77	102.87	70
ext≥5	6	14	37.12	25
Total	44	100	146.03	100

Source: HARTI Survey Data, 2016

Figure 8.10: Distribution of Operators by Size Class of Land

Land ownership

Distribution of soybean cultivated landholdings according to landownership is shown in Table 8.4. Highest percentage (64%) of soy cultivated landholdings is under single ownership. About 11 percent of these are jointly owned. Percentage of landholdings leased in and tenancy out by the farmers are seven and six respectively. About five percent of the landholdings are cultivated by permit holders. Encroached land under soybean is about 3.5 acres. Mortgaged type of land ownership claims about five acres of land.

Table 8.4: Nature of Land Ownership in Soybean Cultivation

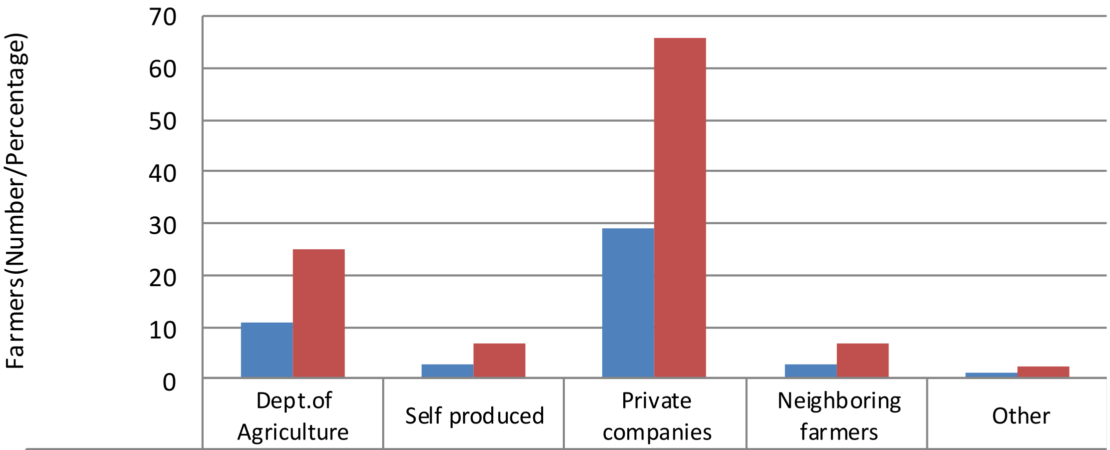
Ownership	No. farmers	Landholdings		Total Extent (ac)	
		Number	%	Extent	%
Single owner	35	66	64.08	82.78	56.69
Jointly owned	8	11	10.68	15.5	10.61
Leased in	5	7	6.80	18	12.33
Tenancy-in	2	2	1.94	3	2.05
Tenancy-out	5	6	5.83	12	8.22
Permit Holder	3	5	4.85	6.25	4.28
Encroached	2	3	2.91	3.5	2.40
Mortgaged	2	3	2.91	5	3.42
Total		**103**	**100**	**146.03**	**100**

Source: HARTI Survey Data, 2016

8.3.2 Seeds

Source of Seeds of the Sample Farmers

As showed in Figure 8.11 the highest percentage (66%) of the farmers had used seeds procured from private firms. Another 25 percent used seeds produced by the Department of Agriculture. Similar percentages (7%) of farmers used self-produced seeds and seeds from neighbouring farmers.



	Dept.of Agriculture	Self produced	Private companies	Neighboring farmers	Other
No.of farmers	11	3	29	3	1
% farmers	25	7	66	7	2

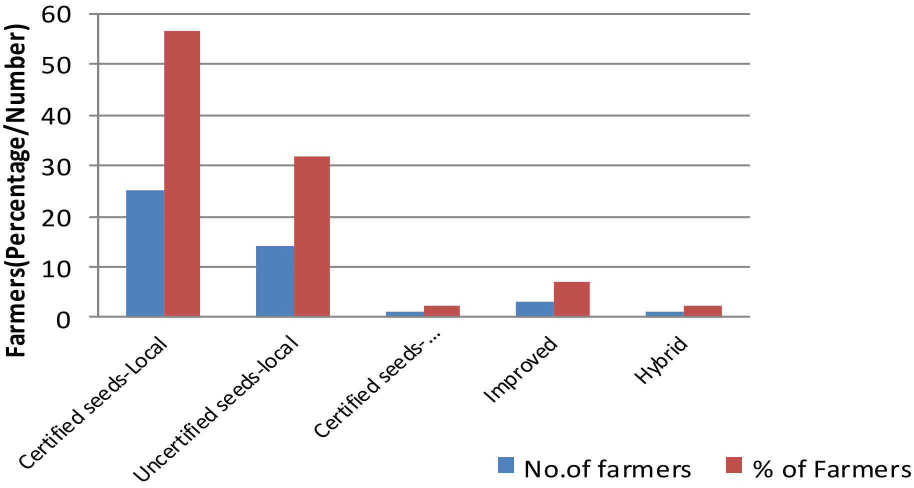
*Multiple reponses

Source: HARTI Survey Data, 2016

Figure 8.11: Source of Seeds of the Sample Farmers

Type of Seeds of the Sample Farmers

According to Figure 8.12 majority (57%) of the farmers used locally produced seeds certified by the Department of Agriculture while another 32 percent of them used locally produced but uncertified seeds. Only two percent of the farmers had depended on certified imported seeds. Use of improved seeds by the sample farmers is about seven percent. Another two percent of them had cultivated hybrid seeds.



Source: HARTI Survey Data, 2016

Figure 8.12: Type of Seeds Used by the Sample Farmers

Seed Varieties

About 98 percent of the sample farmers were not aware of the name of the seed variety they used.

Cost of Seeds

According to the field survey conducted in Anuradhapura district mean cost for seeds required for an acre of land was about Rs. 3682/-Seed cost is about nine percent of the total cost including family labour.

8.3.3 Source of Water

Most (48.54%) of the landholdings with soybean were cultivated under major irrigation. Those cultivated under rainfed condition was about 32 percent. Minor irrigation was the source of water for about ten percent. In addition, numbers of landholdings were farmed using other water sources such as agro wells, domestic wells and by pumping water from natural water streams (Table 8.5).

Table 8.5: Source of Water for Cultivation

Water Source	No. of Farmers	Landholdings		Extent	
		N	%	acres	%
Major irrigation	40	40	48.54	102.75	70.37
Minor irrigation	7	10	9.72	22.50	15.57
Rainfed	32	33	32.04	16.03	10.98
Agro-well	6	6	5.82	2.5	1.54
Surface water bodies (Pumping from river/oya)	4	4	3.88	2.25	1.54

Source: HARTI Survey Data, 2016

Table 8.6: Distribution of Lowland Landholdings Based on Irrigation Method Used

Season	Type of Irrigation	No. of Farmers	No. of Landholdings		Total Extent	
			Number	%	acres	%
2015/16-*Maha*	Flood	4	4	66.67	3.75	45.45
	Other	2	2	33.33	4.5	54.55
	Total		6	100	8.25	100
2015-*Yala*	Flood	37	38	97.44	56.75	85.78
	Other	1	1	2.56	2.5	4.22
	Total		39	100	59.25	100
Intermediate	Flood	1	1	50	2	57.14
	Other	1	1	50	1.5	42.86
	Total		2	100	3.5	100

*Multiple responses
Source: HARTI Survey Data, 2016

8.3.4 Labour

Highest cost component in the soybean production is labour and to cultivate one acre of soybean total labour cost including family labour was Rs. 21,398. It was about 53 percent of the total cost. For landholdings of 0.25 to 0.5 acres, mean of total labour cost including family labour was about Rs. 7600. For 1 to 2 acres landholdings and 2 to 5 acre landholdings this cost was Rs. 29,022 and Rs. 30,260 respectively.

8.3.5 Fertilizer and Pesticides

About 80 percent of the farmers had used only chemical fertilizers for their cultivation and according to the findings of the field survey average cost of chemical fertilizer was about Rs. 700 per acre of Soybean. Farmers who had applied both organic and chemical fertilizers were about 20 percent.

Minimal use of pesticide was reported in soybean cultivation in all the areas concerned. Only fungicides and weedicides had been used. About 45 percent of the farmers had applied fungicides to treat a fungal disease they had come upon. To control weeds about 54 percent of the farmers practised hand weeding and 48 percent of farmers had used weedicides. Cost of weedicides and fungicides was only about four percent of the total cost of production.

8.3.6 Machinery

In Soybean cultivation it was reported that machinery was used for land preparation and harvesting. Four-wheel tractors (87%) and the two wheel tractors (15%) were the most popular machines used for land preparation. Other smaller machines were in use by about 54 percent of the farmers for land preparation. For harvesting about 48 percent of the farmers depended on Tsunami machines. In Anuradhapura district mean cost for machinery use was about Rs. 9000 per acre. It is about 22 percent of the total cost of production including family labour.

Yield

Average yield of landholdings belonging to different size classes in the sample area is shown in Table 8.7. Average yield is more or less similar irrespective to the land size category.

Table 8.7: Average Yield of Different Land Size Category

Land Size Category	No. of Farmers	Total Extent	Total Production	Average Yield(kg/ac)
0.5≤ext<1	2	1.00	855.00	855.00
1≤ext<2	25	32.00	28214.00	881.69
2≤ext<5	15	36.50	25350.00	694.52
ext≥5	1	5.00	3650.00	730.00
Total	43	74.50	58069.00	779.45

Source: HARTI Survey Data, 2016

Price of Soybean

In the study area during the 2015/2016 *Maha* season as well as in the 2015 *Yala* season average price per kilogram of soybean was around Rs. 80/-. During the 2015 *Yala* season price per one kilogram of soybean was around Rs. 75/- and Rs. 80/-

Marketing Methods

Majority (76%) of the sample farmers sold their produce to individual private traders. Those who resorted Government channels were only about 9 percent. About six percent of the famers disposed of the harvest to their input suppliers. It is an informal buy back system. Private organizations also buy the soybean harvest from about five percent of the farmers. Number of farmers who sold their produce at the village fair was about three percent (Table 8.8).

Table 8.8: Marketing Method Used by the Sample Farmers

Method	Frequency*	Percent
To individual private traders	88	76
To the Government	11	9
To input suppliers	7	6
At the village fair	4	3
To private companies	6	5
Total	116	100

* Multiple Responses Possible

Source: HARTI Survey Data, 2016

Marketing Issues of Soybean

Marketing issues faced by the farmers are highlighted in Table 8.9. Inability to procure a fair price for their produce is the major marketing issue mentioned by the majority (40%) of the farmers. Another 13 percent of the farmers stated that the severe concern of the buyers' over the quality is an issue for them to market their produce. Difficulty of transporting their produce to the sellers was a problem for about six percent of the farmers.

Table 8.9: Marketing Issues Stated by Sample Farmers

Issues	Number of respondents*	Percentage
Not paid a good price	51	40%
No issues	43	34%
Severe concern on quality	16	13%
Transport issues	8	6%
Absence of marketing channel	7	6%
Quantity insufficient for selling	1	1%

* Multiple Responses Possible

Source: HARTI Survey data, 2016

8.3.7 Cost of Production

According to the data from the field survey total cost including family labour is about Rs. 40,606/- per acre (Table 8.10). Total cost excluding family labour is Rs. 37,249/- per acre. However according to the statistics of the Department of Agriculture, the total cost including imputed cost in 2013 *Yala*, was Rs. 54,702/- per acre (Table 8.11).

Table 8.10: Cost of Production

Cost Component	Mean Total Cost (Rs/ac)
Family labour	3356.67
Hired labour	19106.17
seed cost	3681.60
chemical fertilizer	1164.69
organic fertilizer	0
weedicide cost	914.79
fungicide cost	825.09
insecticide cost	1972.37
other cost	68.06
machinery cost	9516.17
total cost including family labour	40605.60
total cost excluding family labour	37248.94

Source: HARTI Survey data, 2016

Table 8.11: Cost of Cultivation per acre of Soybean - Mahaweli - H (Irrigated)

	Rs/ac			
Input	**2008 *Yala***	**2011 *Yala***	**2012 *Yala***	**2013 *Yala***
Labour	25,229	33,785	35,429	36,315
Seed	1,788	2,597	2,200	2,530
Fertilizer	287	749	510	539
Agro-chemicals	3,725	5,477	4,500	6,580
Draught power machinery Equipment	5,889	7,058	7,125	8,738
Total cost - including Imputed cost	36,918	49,666	49,764	54,702
Total cost - excluding Imputed cost	20,626	35,078	22,305	36,110

Source: Department of Agriculture

8.4 Potential and Constraints of Production

Table 8.12 describes the issues raised by the farmers regarding soybean cultivation. Pest and disease attackes and water scarecity were idenfified as two main constraints of the soybean cultivation (30%). Further, for about 27 percent of farmers highlighted lack of quality seeds as a main issue.

Table 8.12: Issues Highlighted by the Farmers in Soybean Cultivation

Issue	**No. of Respondents**	**% of Respondents***
High fertilizer prices	1	2
Marketing issues	7	16
Lack of extension facilities	1	2
High cost of seeds	1	2
High cost for labour	3	7
Wild animal attacks	5	11
Pest and disease attacks	13	30
Lack of water under rain fed condition	13	30
No proper mode of marketing	3	7
Lack of quality seeds	12	27
No technical knowledge on novel cultivation practices	2	5
Lack of knowledge to produce quality seeds	1	2
Water management issues	8	18

* Multiple Responses Possible
Source: HARTI Survey Data, 2016

8.5 Recommendations

Almost all the farmers are not aware of the seed varieties they use. To address the issues a comprehensive training is imperative to create awareness among the farmers about the available seed varieties and selecting suitable varieties for their specific areas. Another complaint made by many farmers was the poor quality of seeds. It is suggested to ensure the quality of the seeds available at the market through strengthening the seed certification mechanism. While taking effective measures to popularize the locally produced good quality seeds through Agrarian Services Centers in respective areas, further research could be undertaken to develop available varieties to give more yield and more resistance to pest and diseases.

Strengthening the buyback system through public private partnership and increasing the quality of the produce through training programmes for soybean cultivating farmers would be useful in further promoting soybean cultivation in the country.

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Soybean farming Information Detailed Guide. Viewed online at: http://www.agrifarming.in /soybean-farming-information

Chapter Nine

Big Onion

R.Y.D.M.R.N.K. Rambukwella

SUMMARY

Big Onion is used as a spice in many countries of Asia, including Sri Lanka and it is an essential condiment in the Sri Lankan diet. Big onion cultivation is highly concentrated in to two districts in Sri Lanka namely, Matale and Anuradhapura. Those two districts contribute nearly 90 percent of the national production. Of the cultivated extent of big onion from 2006 to 2015 in the main producing areas, Matale district recorded the largest cultivated area accounting for about 46 percent. These figures were 24 percent in Anuradhapura and 19 percent in Mahaweli H area. Big onion is a highly seasonal crop and its cultivation is limited to the yala season in paddy fields. Major determinant of the big onion production in the country is tariff and non-tariff policy of the government. To protect big onion farmers during the harvesting period, normally government increases the special commodity levy for imported big onion. Main factor that determines the yield of big onion is the quality of seeds. Private sector imports the big onin seeds on an unofficial basis and they do not guarantee the yield potential. National average yield of big onion was around 11 mt/ha in 2006 and it has increased to about 15 mt/ha in 2015. Except during the local production period from August to October, the main stocks of big onion at the market comprise of imported big onion from India and Pakistan. The share of imports has exceeded 80 percent of the country's requirement in some years before 2005.

Escalating input prices such as local seeds, chemicals and fertilizer is the major issue faced by the big onion farmers. Low quality of the imported seed variety and non-availability of proper storage facilities are other issues pressurizing the big onion farmers. Majority of the big onion farmers in Matale, Hambantota and Mannar have been using certified local seeds for their cultivation while their counterpart in Jaffna depends on certified imported seeds.

Priority needs be accorded to resolve the main issues that act as disincentives. i. e. not receiving a reasonable price for big onion, shortage in quality seeds/planting materials and escalating input prices. Effective supportive programmes are a long-felt need to motivate the farmers to sell their products. Specially, because of its perishable nature, this marketing programme should include an extension component to create awareness among the farmers particularly about latest storing process. Importation of quality planting materials, demand sharper focus and rules and regulations on importations need to be tightened. Technical and financial assistance to establish small, medium and large scale storage facilities in Dambulla and Mahaweli ''H'' areas are of pivotal importance.

CHAPTER NINE

Big Onion

9.1 Overview of Big Onion Cultivation

9.1.1 Introduction

Big Onion (*Allium Cepa L.*) is an important vegetable crop in most part of the world which account for nearly 30 percent of total global production. Onions are grown mainly to food and they are highly valued for their flavour and for their nutritional value in supplying minor elements such as minerals etc. (Opara, 2003). It is estimated that annually about 55 million tons of onions are produced all over the World and China and India contributed to almost half of the world onion production. America, Turkey, Russia, Pakistan, Iran, Japan, Brazil and Spain are the other leading countries of onion production (Onion Marketing Strategy, 2006).

Big onion is used as a spice in many countries of Asia, including Sri Lanka and it is an indispensable condiment in the Sri Lanka diet. Big onion is a high value cash crop introduced in the early 1980 in order to supplement the income of the paddy farmers during the dry season.

Except for a few selections of local varieties, big onion cultivation mainly depends on seeds imported from India by private traders. Rampur Red, Nasic Red, Pusa Red and Dambulu Red are recommended seed varieties for Sri Lankan conditions considering the factors such as high yield, seed setting ability, storage adaptability, pungency, colour, etc. Kalpitiya Selection and MI Pusa Red are some of the varieties recommended by the Department of Agriculture. Dambulu Red is a farmer selection of MI Pusa Red. Their seeds are produced in the country during the *Maha* season by a process of vernalisation. Rampur Red, Nasic Red and Dambulu Red are the widely cultivated varieties in main producing areas. According to field information, Nasic Red gives the highest production, but the storing quality is poor. Rampur Red on the other hand has a higher keeping quality though its yield is comparatively low. The Dambulu Selection seems to have both characters of high yield and good keeping quality. The total seed supply of big onion comprised of local production and imports (Henegedara et.al, 2007).

The local seed supply is estimated to be 40 percent of the total seed requirement. There are two types of locally produced true seeds named as “Dambulu Red” and “Galewela Light Red” which have higher germination rates compared to imported seeds (Samantha et.al, 2013). The major seed varieties imported from India were Nasik Red, Bombe Red and Rampur Red.

At present more than 55 percent of the national big onion requirement is imported. In the “National Food Production Programme” to be implemented by the Ministry of

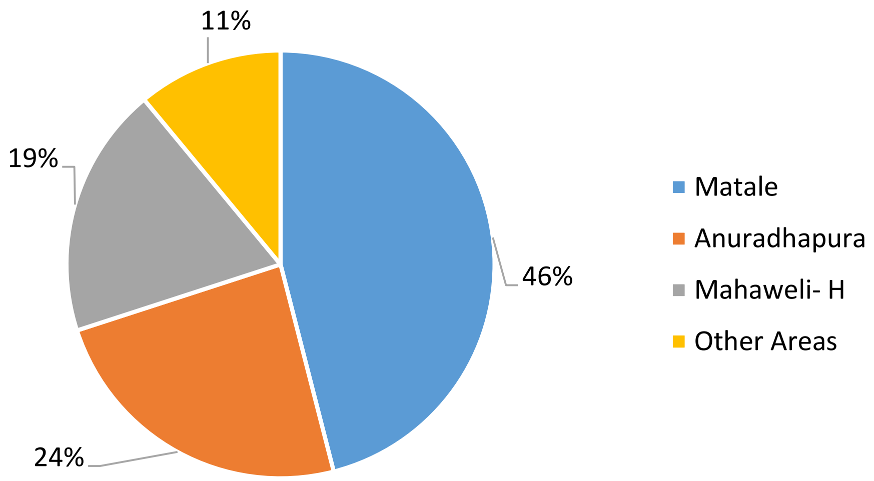
Agriculture has several activities envisaged to expand the big onion production in the country and some of the activities as follows;

- Expansion of cultivation in new areas
- Introduction of improved new varieties to get a higher productivity
- Increasing the safe keeping period from 2-4 months with the introduction of modern technology of storage
- Increasing seed production up to 50,000kg through establishing seed production villages
- Identifying off season cultivation areas, to minimize the price fluctuations during off seasons by maintaining onion production throughout the year

9.1.2 Major Growing Areas and Extent under Cultivation

Big onion cultivation is highly concentrated in to two districts namely, Matale and Anuradhapura. It contributes nearly 90 percent of the national production.

Of the cultivated extent of big onion from 2006 to 2015 in the main producing areas, Matale district recorded the largest cultivated extent accounting for about 46 percent. These figures were 24 percent in Anuradhapura and 19 percent in Mahaweli H area (Figure 9.1). Altogether around 89 percent of the Sri Lankan cultivation took place in Matale, Anuradhapura and Mahaweli-H areas. In the Matale district, Sigiriya, Dambulla, Galewela, Dewahuwa and Naula are the major producing localities due to the specific climatic suitability for big onion cultivation.

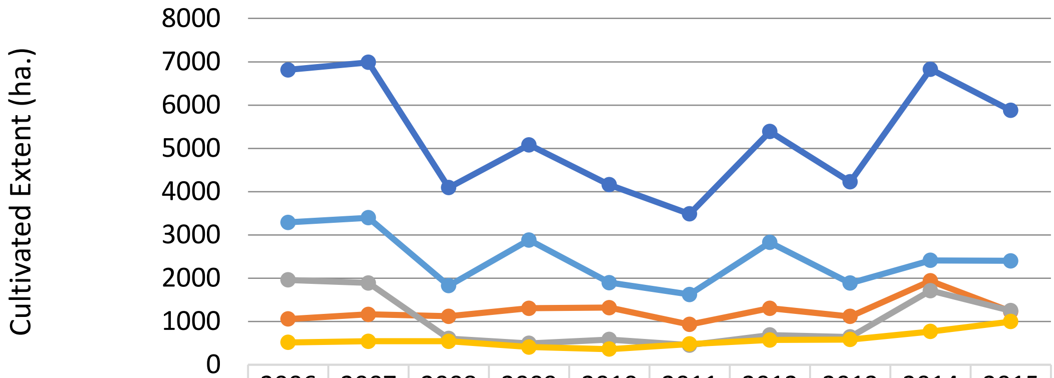


Source: Department of Census and Statistics

Figure 9.1: Average Extent of Big Onion Cultivation in Major Producing Districts (2006-2015)

Big onion cultivation is primarily determined by the import policy of the government. Extent cultivated has increased over the years with sharp declines in some years

(Figure 9.2). However, the cultivation was stagnating around 2700 ha – 3000 ha during 2000-2004 and a sudden increase in cultivated extent was observed in 2006 and 2007 to about 6841 ha and 6988 ha respectively recording the highest ever cultivated extent of big onion in the country in 2007. However, increasing trend of cultivation started from2005 and continued till 2007 which then declined gradually in 2008. Further, cultivation was somewhat stagnating during 2008 -2013 period. A sudden increase in cultivated extent was observed in 2014 and again dropped in 2015 due to adverse climatic condition. In that instance, off season (or *Maha* seasons' cultivation which extends from January to March) Big onion cultivation was mostly done for the seed purpose; hence, national requirement is totally fulfilled by *Yala* (which extends from May to August) seasons' production.



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Matale	3288	3396	1827	2881	1896	1623	2825	1884	2412	2400
Anuradhapura	1055	1164	1118	1302	1319	929	1304	1114	1938	1229
Mahaweli- H	1957	1887	605	492	582	453	685	642	1712	1249
Other Areas	514	541	541	406	361	478	572	583	765	997
National	6814	6988	4091	5081	4158	3483	5386	4223	6827	5875

Source: Department of Census and Statistics

Figure 9.2: Cultivated Extent of Big Onion in Major Producing Districts (2006-2015)

According to the Table 9.1, more than 6,000 farmers pursued the big onion cultivation during the period of 2001-2010. The highest numbers of big onion farmers were recorded in 2006.

Table 9.1: Number of Farmers Cultivated Big Onion 2001-2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Matale	4075	3555	3151	4045	3394	6917	5216	3883	4492	3653
Anuradhapura	2854	3404	2742	3800	4026	3486	4495	3499	4519	4798
Mahaweli-H	2678	3378	1405	2121	4026	7280	4874	1694	975	2418
Other	684	448	281	137	116	187	224	177	143	223
National Total	10291	10785	7579	10103	11562	17870	14809	9253	10129	11092

Source: Department of Census and Statistics

9.1.3 Climate and Soil

Onion crop can be successfully cultivated in most fertile soils; however, soil pH in the range of 6-7 is usually recommended. But on organic soils a lower pH is suitable. Suitable soil types (reddish brown earth and regosols) are available in the dry zone of the country. It was found that only this type of soil varieties can produce good bulbs under Sri Lankan condition. Crop needs longer day length (> 12 hours) as it is a long day plant. There should be lower rainfall (less than 750 mm) throughout the cropping period. At the harvesting time (lasts for a month) dry and hot weather and preferably less than 70 percent relative humidity is favourable for a better yield (Department of Agriculture, 2015).

It is very important to decide the proper timing of nursery establishment because it decides the time of planting. From early April to early May period is recommended to establish nurseries under Sri Lankan ondition. The Yala season of the country has most preferebale climatic requirement for the bog onion crop (May to September). Therefore, it is essential to transplant by mid-May to mid-June to achieve good yields. Crop establishment using dry sets is practised during late *Maha* (December to February). However, climatic conditions are not favourable to the crop during this period. Therefore, set planting is not much popular.

The crop takes about 100 days from transplanting to mature. It depends on the cultivar and the climatic condition. At the 50 percent neck fold stage other plants must be bent or pressed using a plank. Thereafter water supply has to be cut down. Fourteen days' after applying water restriction harvest can be collected. Bulbs need in drying under shady conditions to improve the storing quality and then can be suitably stored until the product is disposed of.

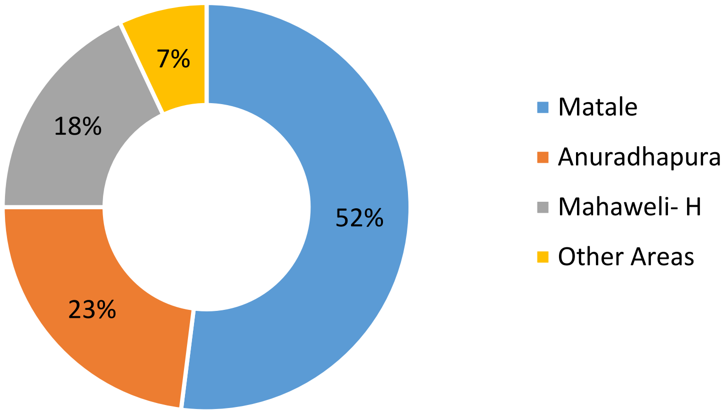
9.1.4 Importance of the Crop to the Economy

Big onion is an important condiment in the daily Sri Lankan diet with a constant demand throughout the year total to an annual requirement of around 235,000 mt. National production of big onion was 89,767mt in the year 2015 which accounted for 30 percent of the national requirement. The production is seasonal cultivation starting from April to September and harvest during August to November. Major determinant of the big onion production in the country is tariff and non-tariff policy of the government. To protect big onion farmers during the harvesting period, government imposes a high special commodity levy for big onion importation and during off-season it comes down.

9.1.4.1 Production

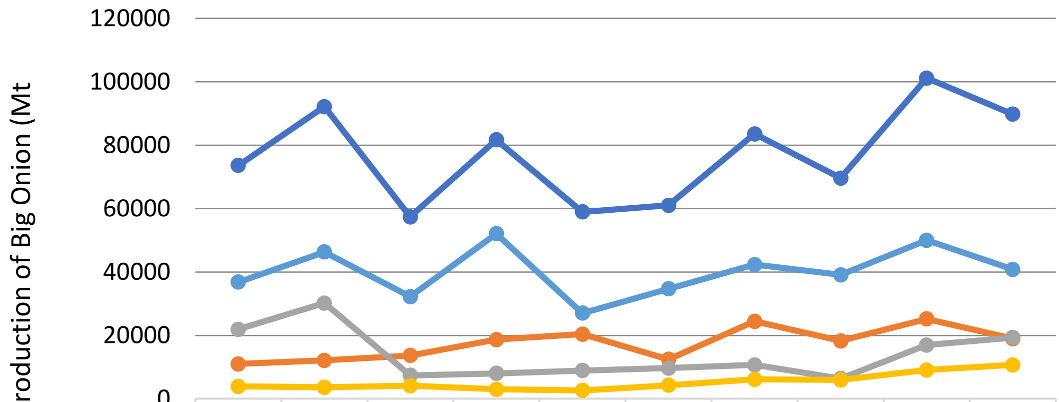
Big onion is highly a seasonal crop and its cultivation is limited to the *Yala* season in paddy fields. Therefore, the main big onion production takes place during the months from August to October. With reference to the ten years' average (2006-2015), 52 percent of the total production was reported from Matale, 23 percent from

Anuradhapura and 18 percent from Mahaweli – H areas (Figure 9.3). As a whole, around 93 percent of the big onion production had been received to the market from Matale, Anuradhapura and Mahaweli – H areas. According to the Figure 9.4, the highest production was reported in 2014 (101,166mt) and the second highest of 92166mt in 2007. The lowest production was in 2008 (57371mt). As mentioned above, local production is concentrated heavily in the *Yala* season, supplying the local market from August to October and the bulk of production reaches the markets during the month of September or October. Big onion production accounted for about 26% - 40% of the local requirement during the last ten-year period of 2006-2015.



Source: Department of Census and Statistics

Figure 9.3: Average Production of Big Onion in Major Producing Districts (2006-2015)



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Matale	36789	46296	32202	52085	26992	34698	42321	39077	49998	40800
Anuradhapura	11000	12068	13672	18639	20394	12431	24416	18260	25200	18953
Mahaweli- H	21918	30184	7400	8004	8908	9656	10674	6358	16919	19329
Other Areas	3909	3618	4097	2979	2636	4252	6150	5940	9049	10685
National	73616	92166	57371	81707	58930	61037	83561	69635	101166	89767

Source: Department of Census and Statistics

Figure 9.4: Production of Big Onion in Major Producing Districts (2006-2015)

Main factor that determines the yield of big onion is the quality of seeds. Mainly the private sector imports the big onion seeds on an unofficial basis, but they do not guarantee the yields that are potential. National average yield of big onion was around 11 mt/ha in 2006 and it has increased to about 15 mt/ha in 2015 (Table 9.2). However, considering the last fifteen years, the highest national average yield of about 18 mt/ha was recorded in the year 2011. The reported productivity of big onion in Sri Lanka in 2012 was 15, 500 kg/ha, which was higher than the productivity recorded for big onions in India (14,350kg/ha) and Indonesia (9,535 kg/ha), but lower than the productivity of Thailand (26,294 kg/ha) and China (24,391 kg/ha).

Table 9.2: Average Yield of Big Onion

Year	Average Yield (kg/ ha)		
	Maha	*Yala*	Total
2006	7,422	10,966	10,804
2007	9,928	13,310	13,189
2008	8,518	14,337	14,024
2009	7,401	16,403	16,081
2010	8,123	14,548	14,173
2011	8,184	18,114	17,524
2012	9,597	15,732	15,514
2013	9,381	16,956	16,489
2014	13,702	14,877	14,819
2015	7,492	16,185	15,279

Source: Department of Census and Statistics

9.1.4.2 Imports

Except during the local production period from August to October, the main stocks of big onion at the market comprise of imported big onion from India and Pakistan. The share of imports has exceeded 80 percent of the country's requirement in some years before 2005. In the years with increased local production this share drops to 60% – 74%. Average yearly imports of big onion accounted for about 232,349mt during the last 10 years. According to the latest estimates, country's annual requirement of big onions is around 235,000 mt. Almost 90 percent of the imports are traded from India, with meagre quantities from Pakistan too. Considering the last ten years the quantity of imported big onion is increasing continuously (Table 9.3 and Table 9.5).

Big onion cultivation and prices are primarily determined by the import policy of the government. Normally the government increased the special commodity levy of big onion in August at the time local big onion production arrives to the market. This was a measure taken to protect the local farmers. At present, the special commodity levy for imported big onion is Rs. 40.00/kg. The table 9.4 shows the special commodity levy for big onion from 2011-2016.

Table 9.3: Total Availability of Big Onion in Sri Lanka

Year	Imported Quantity		Production		Total Availability
	mt.	%	mt.	%	mt.
2006	119,478	62	73,616	32	193,094
2007	140,773	60	92,166	40	232,939
2008	146,623	72	57,371	28	203,994
2009	143,275	64	81,707	36	224,982
2010	158,086	73	58,930	27	217,016
2011	170,731	74	61,037	26	231,768
2012	145,912	64	83,561	36	229,473
2013	168,874	71	69,635	29	238,509
2014	150,534	60	101,166	40	251,700
2015	210,253	70	89,767	30	300,020

Source: Department of Census and Statistics

Table 9.4: Special Commodity Levy for Big Onion (2011-2015)

Year, Month and Date	Special Commodity Levy (Rs. /kg))
2011 August 10	25.00
2012 May 12	35.00
2012 July 14	25.00
2012 August 13	50.00
2012 December 08	15.00
2013 February 08	15.00
2013 June 08	15.00
2013 July 11	30.00
2013 August 23	35.00
2013 November 17	10.00
2014 August 12	25.00
2014 August 23	35.00
2014 December 2	50.00
2015 January 1	10.00
2015 April 25	40.00
2015 September 8	10.00
2015 September 22	30.00
2016 July 1	25.00
2016 August 20	40.00

Source: Department of Customs

Table 9.5: Quantity, Value of Imports and CIF Price of Big Onion (2011-2015)

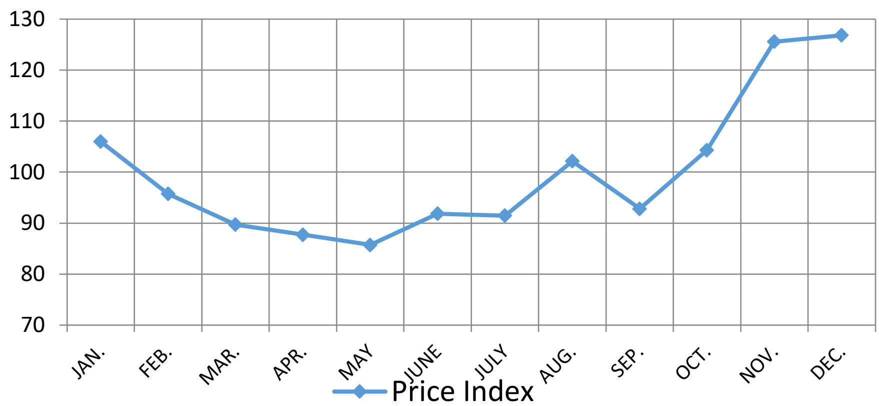
Year	Quantity (mt)	Value(000'Rs.)	CIF Price
2006	119,478	1,940,185	16.24
2007	140,773	4,392,183	31.20
2008	146,623	3,473,243	23.69
2009	143,275	4,687,649	32.72
2010	158,086	6,649,348	42.06
2011	170,731	6,556,191	38.40
2012	145,912	3,757,873	25.75
2013	168,874	9,295,613	55.04
2014	150,534	5,510,678	36.61
2015	210,253	11,619,303	55.26

Source: Department of Customs

9.1.4.3 Price Variation

Prices at the wholesale level are determined by the market forces. Since major propotion of the big onion coming from imports, price is mainly determined by the CIF price, the import duty and the quantity of imports. Fourth Cross Street in Pettah is the main price determination point. However, during the local production period, the prices are mainly determined at Dambulla. Price determined at the Dambulla DEC, gets transmitted to the producer level on a commission basis. A government minimum price scheme was operated during some years with the intervention of purchasing by the CWE.

According to the seasonal price index, the prices escalate to the maximum during the months of November and December with the end of the local production and the relatively low imports. On the other hand, the demand for big onion is also at the maximum towards the end of the year. Another peak is recorded during the months of January and August. Meanwhile, the prices reach the minimum during the months of September and October due to the harvest coming from peak producing season. Retail market prices had also dropped to a minimum during March, April, May and June according to the seasonal price index (Figure 9.5).



Source: Marketing food Policy and Agri-business Division-HARTI

Figure 9.5: Seasonal Price Index of Big Onion (1996-2015)

9.1.4.4 Consumption

Table 9.6: Annual Big Onion Consumption in Sri Lanka

Year	Grams/year
2005	6410.04
2006/07	6837.48
2009/10	6988.56
2012/13	7290.12

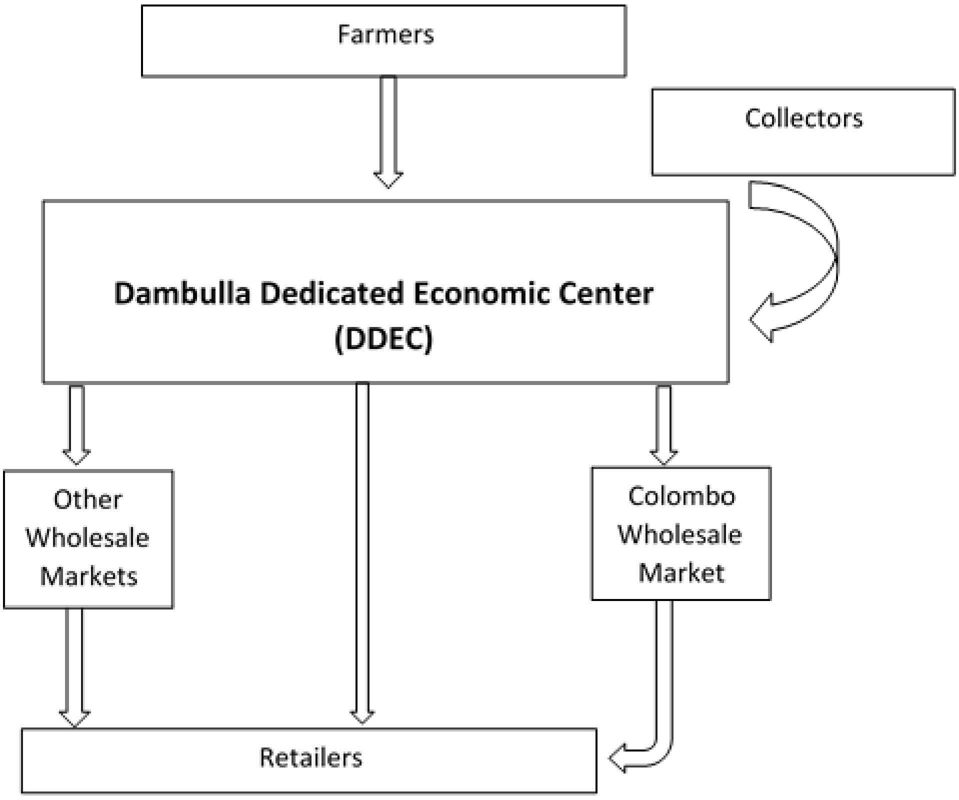
Source: Household Income & Expenditure Survey -Dept. of Census & Statistics

Per capita consumption of big onion seems to be determined jointly with red onion consumption. Increased cultivation of big onion in the country has also resulted in a remarkable increase in consumption. Big onion became the main substitute for red onion, the consumption of which dropped in the recent past. According to the Household Income and Expenditure Survey (HIES) of Central Bank of Sri Lanka, per capita consumption of big onion was 6.41kg/year in 2005 and it increased to 6.84kg/year and 6.99kg/year and 7.29kg/year during 2006/07 and 2009/10 and 2021/13 surveys respectively. Big onion is also an income elastic commodity of which consumption considerably increases in the higher income category particularly in the urban setting.

9.1.4.5 Marketing

Marketing Channels for Local Big Onions

Dambulla is the main market center for big onions in Sri Lanka. It is the meeting point of the producers/collectors, the wholesalers and the retailers. Thambuththegama is also an important market for the farmers in the Anuradhapura district. Fourth Cross Street in Pettah also plays a considerable role as a market for producers/ collectors from some of the main producing areas. Pettah market is the main important wholesale point for imported big onion. The following Figure 9.6 shows the marketing channels for local big onions in Matale district.



Source: HARTI Survey Information

Figure 9.6: Marketing Channels of Big Onion Supplies from Matale

Review of Market Margins

Wastage of big onion is approximates 10 percent of the total production of big onion. Wholesale –retail margin is varied around 18% - 30% of the wholesale price in the period of 2009 to 2015 according to the Table 9.7.

Table 9.7: Annual Average Wholesale and Retail Prices of Big onion and Wholesale-Retail Margin

Year	Wholesale Price (Rs/kg)	Retail Price (Rs/kg)	Wholesale – Retail Margin (Rs/kg)	Percentage
2009	66.18	78.10	11.92	18.0
2010	68.24	85.38	17.14	25.1
2011	62.04	77.76	15.72	25.3
2012	65.24	84.94	19.70	30.2
2013	87.00	103.90	16.90	19.4
2014	71.49	89.46	17.97	25.1
2015	88.76	106.19	17.43	19.6

Source: Marketing food Policy and Agri-business Division-HARTI

The Table 9.8 presents the producer’s share, wholesaler’s gross margin and retailers’s gross margins for Matale big onion during 2009-2015 periods. As a result of farmer protection programme, tariff rate was increased during the harvesting season by facilitating the farmers to earn a higher income. Wholesalers' gross margin was about 1 – 21 percent while the retailers' gross margin was about 17 – 40 percent during that period. Producer price, wholesale price, and the retail price are the key issues in the system of big onion production and marketing. During the period of 2006-2015, the producer's share of local big onions (Matale district) ranged between 58 - 79 percent.

Table 9.8: Producer's Share and Gross Price Margin of Local Big Onion (Matale)

Year	Farm-gate price	Wholesale price	Retail price	Price Margin			3/1	2/1
	1	2	3	Farmer 1/3*100	Wholesaler (2-1)/3*100	Retailer (3-2)/3*100		
2006	34.97	41.38	50.02	69.91	12.81	17.27	1.43	1.18
2007	47.37	51.43	64.26	73.72	6.31	19.97	1.36	1.09
2008	38.53	52.32	66.48	57.97	20.74	21.29	1.73	1.36
2009	51.42	62.20	82.29	62.49	13.09	24.42	1.60	1.21
2010	54.16	73.42	96.62	56.05	19.94	24.01	1.78	1.36
2011	51.49	61.03	83.79	61.45	11.38	27.16	1.63	1.19
2012	57.84	58.27	84.20	68.69	0.51	30.80	1.46	1.01
2013	101.36	105.37	128.02	79.17	3.13	17.69	1.26	1.04
2014	58.01	59.42	99.84	58.11	1.41	40.48	1.72	1.02
2015	86.09	89.54	122.62	70.21	2.81	26.98	1.42	1.04

**Average prices consider August to November as local Big onions not available in other months
Source: Marketing Food Policy and Agri-business Division-HARTI

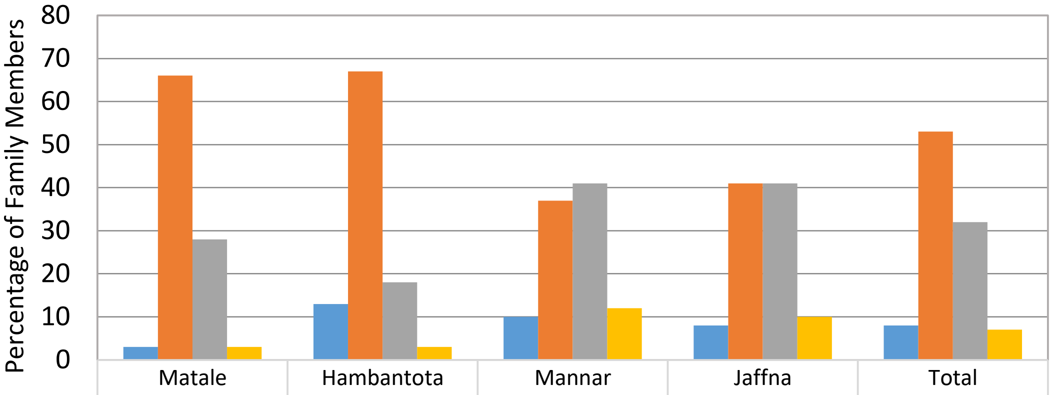
9.2 Socio- Economic Characteristics of the Sample Farmers

9.2.1 Demographic Information of the Farmer Households

This section describes the demographic characteristics such as family size, gender ratio, civil status, age categories, level of education, literacy rate, occupation, and primary sources of income of 158 big onion farmers in Matale, Hambantota, Mannar and Jaffna districts.

As illustrated in Figure 9.7, the highest percentage (53%) of the sample households consisted of 3-4 members in a family. When viewing the district picture, 66 percent households in Matale and 67 percent in Hambantota districts consisted 3-4 family members while in the Mannar district, 41 percent of the households consisted of 5-6 family members.

Age is a decisive factor to be taken into consideration when designing strategies because age could affect willingness to adopt new technologies. The highest sample farmers in Matale, Hambantota, and Jaffna were over 50 years of age and it was recorded as 54 percent, 92 percent and 61 percent respectively while the highest percentage of farmers in Mannar (71%) ranged between over 30 and below 50 years of age. When considering the four districts as a whole, highest percentage of sample farmers (32%) were in the age group of over 50 and below 60 (Table 9.9).



	Matale	Hambantota	Mannar	Jaffna	Total
<3	3	13	10	8	8
3<=<5	66	67	37	41	53
5<=<7	28	18	41	41	32
>=7	3	3	12	10	7

Source: HARTI Survey Data, 2016

Figure 9.7: Number of Family Members

Table 9.9: Age Distribution of Farmers

Age	Matale		Hambantota		Mannar		Jaffna		Total	
Category(years)	N	%	N	%	N	%	N	%	N	%
age<30	0	0	0	0	0	0	1	3	1	1
30<=age<40	10	26	2	5	15	37	7	18	34	22
40<=age<50	8	21	1	3	14	34	7	18	30	19
50<=age<60	12	31	18	46	11	27	9	23	50	32
Age>=60	9	23	18	46	1	2	15	38	43	27
Total	39	100	39	100	41	100	39	100	158	100

Source: HARTI Survey Data, 2016

Out of the total income generating sample farmers, highest percentage (95 percent) in Hambantota, 76 percentage of sample in Mannar and 84 percent of the farmers in Jaffna depended on farming or animal husbandry as their major economic activities to sustain their lives. In Matale district almost all the big onion cultivators are fulltime farmers. As a whole, 88 percent of the sample respondents were depending on farming activities, five percent were skilled labour, three percent engaged in the government sector as well as self-employments and only one percent was nonagricultural labour. This situation is depicted in the Table 9.10.

Table 9.10: Primary Employment of Income Generating Farmers

Primary Employment	Matale		Hambantota		Mannar		Jaffna		Total	
	N	%	N	%	N	%	N	%	N	%
Farming/Animal husbandry	38	100	36	95	31	76	32	84	137	88
Non-agricultural Labour	0	0	0	0	1	2	0	0	1	1
Government job	0	0	1	3	1	2	2	5	4	3
Self-employment	0	0	1	3	4	10	0	0	5	3
Skilled labour	0	0	0	0	4	10	4	11	8	5
Total	38	100	38	100	41	100	38	100	155	100

Source: HARTI Survey Data, 2016

Table 9.11, shows the differences of the level of education of the sample respondents in the four districts. According to that higher proportion (41 percent) of the total sample population in Matale district had passed G.C.E. (O/L) while 28 percent had received secondary education (grade 6 to 11). In Hambantota district, 44 percent of farmers had secondary education with 41 percent had received only primary education (grade 1 to 5). This situation is somewhat similar in the Mannar district reporting the highest percentage (37 percent) of farmers with secondary education while 32 percent had primary education. In Jaffna, 28 percent of farmers had secondary education and had been successful at the G.C.E (O/L) while 26 percent had primary education. We found only 2 graduates from Jaffna and one from Mannar with post graduate qualifications.

Table 9.11: Level of Education

Level of Education	Matale		Hambantota		Mannar		Jaffna		Total	
	N	%	N	%	N	%	N	%	N	%
Primary(1-5 Grades)	4	10	16	41	13	32	10	26	43	27
Secondary (6-11 Grades)	11	28	17	44	15	37	11	28	54	34
Passed G.C.E. (O/L)	16	41	2	5	7	17	11	28	36	23
Up to G.C.E. (A/L)	7	18	2	5	3	7	5	13	17	11
Passed G.C.E. (A/L)	1	3	2	5	0	0	0	0	3	2
Graduate	0	0	0	0	0	0	2	5	2	1
Post Graduate	0	0	0	0	1	2	0	0	1	1
Not attended school	0	0	0	0	2	5	0	0	2	1
Total	39	100	39	100	41	100	39	100	158	100

Source: HARTI Baseline Data, 2016

9.3 Agricultural Inputs

9.3.1 Land

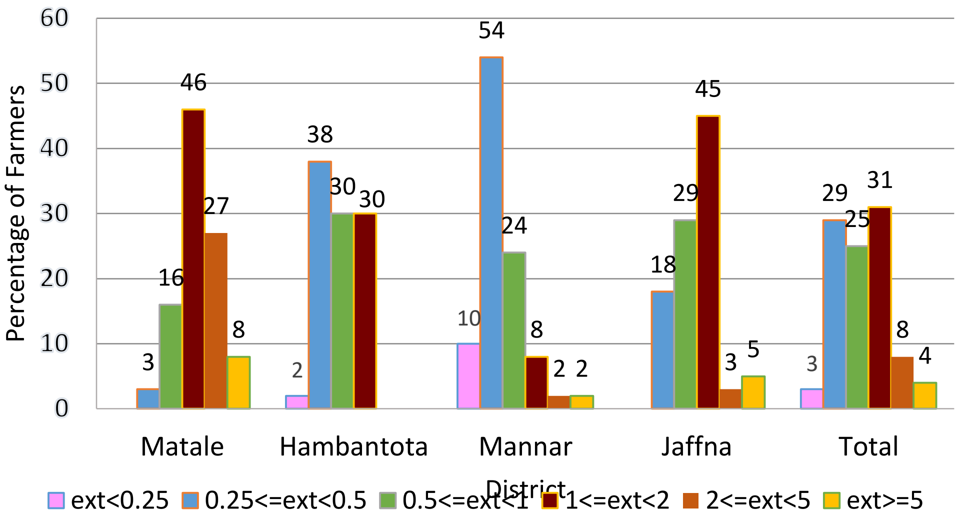
According to the data tabulated below, majority of the big onion farmers in the sample in all the districts surveyed had single ownership of land reportedly 53 percent farmers in Matale, 71 percent in Hambantota, 82 percent in Mannar and 72 percent in Jaffna.

In Matale district, 16 percent of big onion farmers had joint ownership and ten percent were tenancy out farmers. When the total sample size, is taken into consideration 69 percent of the farmers had single ownership, eight percent were tenancy – in farmers, six percent were tenancy – out farmers and five percent had joint ownership.

Table 9.12: Land Ownership

Ownership	Matale		Hambantota		Mannar		Jaffna		Total	
	N	%	N	%	N	%	N	%	N	%
Single owner	31	53	39	71	41	82	36	72	147	69
Jointly owned	9	16	1	2	0	0	1	2	11	5
Leased in	3	5	4	7	0	0	2	4	9	4
Tenancy-in	4	7	2	4	6	12	6	12	18	8
Tenancy-out	6	10	1	2	2	4	4	8	13	6
Permit holder	2	3	4	7	1	2	0	0	7	3
Encroached	1	2	3	5	0	0	0	0	4	2
Other	2	3	1	2	0	0	1	2	4	2
Total	58	100	55	100	50	100	50	100	213	100

Source: HARTI Survey Data, 2016



Source: HARTI Survey Data, 2016

Figure 9.8: Distribution of Operators by Size Class of Land (Number of Big Onion Farmers)

The Figure 9.8 brings to list that a higher percentage (46%) of big onion farmers in Matale district had land extent in between 1-2ac while 27 percent of farmers operated it an extent ranging from 2-5 acres. The higher percentage (38%) of the farmers in Hambantota district had land extents ranging between 0.25-0.5 acres. Majority of big onion farmers (54%) in Mannar district cultivated land extent 0.25 -0.5 acres. As a whole, a higher percentage of farmers (31%) operated land the extent of which ranged between 1-2 acres while 29 percent of the farmers cultivated land extent was in between 0.25 - 0.5 acres. The farmers who cultivated land extends of 2 - 5 acres are 8 percent and this percentage is 4 percent for the land category greater than 5ac.

Table 9.13: Number of Farmers Cultivate in Different Types of Land

Season	Matale		Hambantota		Mannar		Jaffna		Total	
	N	%	N	%	N	%	N	%	N	%
Yala										
Higland	20	48	4	10	21	46	2	5	47	28
Lowland	19	45	12	29	-	-	23	56	54	32
Homegarden	-		4	10	2	4	-	-	6	3
Maha										
Higland	1	2	6	15	14	31	6	15	27	16
Lowland	2	5	2	5	2	4	10	24	16	9
Homegarden	-	-	3	7	6	13	-	-	9	5
Inter highland	-	-	2	5	1	2	-	-	3	2
Inter lowland	-	-	8	19	-	-	-	-	8	5
Total	42	100	41	100	46	100	41	100	170	100

Source: HARTI Survey Data, 2016

According to the Table 9.13, *Yala* season is the major cultivation period of big onion in Matale district and big onion farming was mostly done in upland rather than lowland which was quit low (23ac). *Maha* cultivation was very limited in Matale district. Conversely in Jaffna and Mannar districts, big onion farming was mostly pursued in lowlands in both the yala and maha seasons.

9.3.2 Irrigation

Majority of the big onion farmers (67%) who cultivated in lowland used flood irrigation method while the others (33%) depended on pump water. In the context of the highland cultivation in Matale district, majority of the farmers used pump water as their irrigation method while, 25 percent used flood irrigation and six percent the sprinklers methods. In Hambantota district, higher percentage of farmers (48%) cultivating lowland, used flood irrigation method; 23 percent the sprinklers method and 19 percent used pump water. But highland farmers (75%) mostly resorted to the pump water irrigation. Lowland farmers in Mannar district used only the pump water irrigation while majority of the highland farmers (50%) also followed that. However, 28 percent of farmers in Mannar district used agro-wells for irrigation. Majority of the lowland cultivation farmers (91%) in Jaffna district used pump water as their irrigation method while nine percent used agro-wells. Meanwhile, all the highland cultivation farmers in Jaffna used agro-wells as their irrigation method. As a whole, majority of the farmers cultivating both highlands (57%) and lowland (53%) used pump water as their irrigation method while the second highest (30%) was reported to be resorting to flood irrigation in lowland cultivation. The second highest (26%) method used in highland cultivation was reported to be agro-wells followed by sprinkler irrigation method (10%).

Table 9.14: Irrigation Methods (Percentages of Farmers)

Irrigation Type	Matale		Hambantota		Mannar		Jaffna		Total	
	Lowland	Highland	Lowland	Highland	Lowland	Highland	Lowland	Highland	Lowland	Highland
flood	67	25	48	9	0	0	0	0	30	7
pump water	33	69	19	75	100	50	91	0	57	53
Agro-well	0	0	0	8	0	28	9	100	4	26
sprinklers	0	6	23	8	0	14	0	0	6	10
Domestic well	0	0	0	0	0	6	0	0	0	3
other	0	0	10	0	0	2	0	0	3	1
Total	100	100	100	100	100	100	100	100	100	100

Source: HARTI Survey Data, 2016

9.3.3 Labour

The Table 9.15 presents the total labour cost for each activity of big onion cultivation for the 2015 *Yala* season. For most of the activities in big onion cultivation such as land preparation, crop establishment, fertilizer application, crop management, and application of agrochemicals and also for harvesting, labour is required. The highest labour cost involved for harvesting and processing in the *Yala* 2015, followed by land preparation and water management.

Table 9.15: Labour Cost for Different Activities of Big Onion Production

Activity	2015 *Yala*
Land preparation	29729.00
Crop establishment	21637.00
Fertilizer application	6424.00
Water management	22000.00
Weed management	2586.00
Pest and disease control	6924.00
Harvesting and processing	30471.00
Total Labour Cost (including imputed cost)	**119771.00**

Source: Department of Agriculture, 2015

9.3.4 Seeds

According to the Department of Agriculture, following varieties are recommended for Sri Lankan conditions considering factors such as high yield, seed setting ability, storage adaptability, pungency and colour etc.

Pusa red - Variety was developed at Indian Agricultural Research Institute (IARI), New Delhi, India. It is well adapted to dry zone of Sri Lanka. It takes 90 - 100 days to mature. Average yield is about 20 - 25 mt/ha. High pungency, Light rose in colour bulb.

Rampure - Originated from India. Well adapted to dry zone in Sri Lanka. It takes 85 - 90 days to mature. The yield is about 15-20 mt/ha with better storability. Bulb is light rose in colour and the high pungency.

Agri found light red – This variety developed in India by mass selection and well adapted to dry zone of Sri Lanka to cultivate as a *Yala* crop under irrigation. Bulb is pink in colour and it takes about 90-100 days to mature. Average yield is about 15-20 mt/ha with good storability.

Kalpitiya selection - Bulb colour is slightly rose and have medium pungency. It matures within 85 -90 days.

N53 - This variety takes 90-100 days for maturity and the colour of bulbs are dark red with high pungency.

Nasic red - This is mainly cultivated as vegetable. Bulb is dark red in colour and poor storability. To cultivate one ha of land it requires 7.5 - 8.5 kg of true seeds. If proper nursery techniques and high quality seeds, seed requirement can be reduced to 6-7Kg/ha.

Big Onion True Seed Production

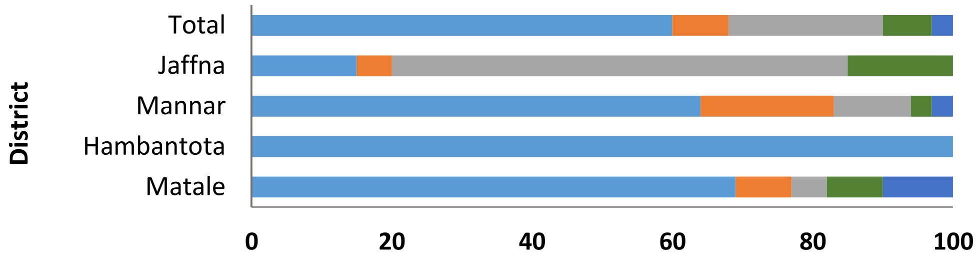
By 2010, Sri Lanka produced 40 percent of seed requirement within the country and the rest was imported (Smantha et.al, 2013). There are two types of locally produced true seeds named "Dambulu Red" and "Galewela Light Red" which have higher germination rates compared to imported seeds. Unavailability of good quality seeds of recommended varieties in adequate quantities is considered as the main constraint for increasing production of big onion in Sri Lanka (ibid).

Furthermore, the quality of the imported big onion true seeds is not up to standard as they reach the country through illegal routes due to export restrictions in India (Edirimanna et.al, 2003). In 2008, 2009 and 2010, Sri Lanka imported 33,377 kgs, 22,686 kgs and 39,210 kgs of big onion seed respectively, from India (Smantha et.al, 2013). The major seed varieties that were imported from India are Nasik Red, Bombe Red and Rampur Red. However, local true seed production is considered as a highly profitable agribusiness. Samantha et.al, in 2013 have found that the profit included imputed cost of production of one kg of true seed in Dambulla area was Rs. 6,580.88 and the same value excluding imputed cost was Rs. 7,947.80. Further, Weerahewa et al in 2010 revealed that big onion yield with local true seeds was 1.32 times higher than that obtained from imported true seeds by estimating production function analysis. Moreover, they have found out that the profitability of big onion cultivation with local true seeds and imported true seeds were Rs. 27.69 and 12.95 per kg, respectively, in the *Yala* 2009 in Matale district, Sri Lanka.

9.3.4.1 Types of Seeds

According the survey, majority of the farmers (69%) in Matale and Mannar (64%) districts used local certified big onion seeds while all the sample farmers in

Hambantota used only local certified big onion seed varieties. However, majority of the farmers (65%) in Jaffna district used imported certified seeds. As a whole, most of the big onion farmers (60%) used local certified seeds, 22 percent depended on imported certified seeds, 8 percent on local uncertified seeds and 7 percent used improved seeds and only 3 percent used hybrid seeds (Figure 9.9).



	Matale	Hambantota	Mannar	Jaffna	Total
Certified Seeds-Local	69	100	64	15	60
Uncertified Seeds-Local	8	0	19	5	8
Certified Seeds-Imported	5	0	11	65	22
Improved	8	0	3	15	7
Hybrid	10	0	3	0	3

Source: HARTI Survey Data, 2016

Figure 9.9: Types of Seeds Used by the Big Onion Farmers (Percentage)

9.3.4.2 Variety of Seeds

In Matale district, Galewela light red was the mostly cultivated seed variety by majority of big onion farmers (49% of the farmers) followed by Nasic red (23%) and Dambulu red (14%) respectively. Dambulu red was the highest cultivated seed variety in Hambantota district representing 81 percent of the farmers followed by Nasic red variety. In Mannar district, 81 percent of the big onion farmers used Rampur red and 14 percent the Dambulu red varieties. About 30 percent of the farmers in Jaffna district used Nasic red seed variety for their cultivation purposes while 27 percent used Sara red and 24 percent Bombe red. By considering total sample, highest percentage of farmers (26%) selected Dambulu red seed variety for their big onion cultivation while 24 percent had chosen Rampur red, 19 percent Nasic red and 14 percent Galewela light red variety.

Table 9.16: Seed Varieties

Seed varieties	Matale		Hambantota		Mannar		Jaffna		Total	
	N	%	N	%	N	%	N	%	N	%
Dambulu Red	6	14	26	81	5	14	2	5	39	26
Rampur Red	2	5	1	3	29	81	5	12	37	24
Nasic Red	10	23	5	16	2	5	12	30	29	19
Galewela Light Red	21	49	-	-	-	-	-	-	21	14
Sara Red	2	5	-	-	-	-	11	27	13	9
Bombe Red	-	-	-	-	-	-	10	24	10	6
Noorwi	2	4	-	-	-	-	-	-	2	1
Kumil	-	-	-	-	-	-	1	2	1	1
Total	**43**	**100**	**32**	**100**	**36**	**100**	**41**	**100**	**152**	**100**

Source: HARTI Baseline Survey Data, 2016

9.3.4.3 Source of Seeds

Around 33 percent of the farmers in Matale district obtained their seed requirement from private companies and 32 percent purchased their seeds at local markets. Only 23 percent of farmers produced their own seeds while 12 percent had them from neighbouring farmers. In Hambantota district all the sample farmers had met their seed requirement totally from the Department of Agriculture. Majority of the farmers (53%) in Mannar district have depended on the Department of Agriculture as their source of seeds while, most of the farmers (69%) in Jaffna district, obtained their seed from private companies. As the whole scenario in concerned it is observed that 39 percent of the big onion farmers produced their seed requirements from the Department of Agriculture, while 32 percent had purchased them from private companies. Local market was the source for about 12 percent while only nine percent produced their own seeds.

Table 9.17: Source of Seeds

Sources	Matale		Hambantota		Mannar		Jaffna		Total	
	N	%	N	%	N	%	N	%	N	%
Self-produced	9	23	-	-	5	14	-	-	14	9
Private companies	13	33	-	-	7	19	27	69	47	32
Neighbouring Farmers	5	12	-	-	3	8	2	5	10	7
Local market	13	32	-	-	1	3	3	8	17	12
Dept. of Agriculture	-	-	32	100	19	53	7	18	58	39
Other	-	-	-	-	1	3	-	-	1	1
Total	40	100	32	100	36	100	39	100	147	100

Source: HARTI Baseline Survey Data, 2016

9.3.4.4 Seed Cost

Of the cost of inputs for big onion farming seed component claimed the highest cost. This was reported as Rs. 34,500/ac in the Matale district constituting 54 percent of the total input cost (including imputed cost), whereas it was 16 percent of the total cost (including imputed cost) in 2015 *Yala* season.

9.3.5 Fertilizer and Pesticides

In big onion production cost of fertilizer and pesticide accounts for 12 percent of the total cost of production (including imputed cost). Chemical fertilizer cost was recorded as Rs. 10,508/ac in Matale district representing 16 percent of the total input cost for 2015 *Yala* season. Cost for pesticides was recorded as Rs. 14,065/ac in Matale district with Rs. 9,135/ac for pest and disease control and Rs. 4930/acre for weed control and weedicide.

Table 9.18: Input Cost for Fertilizer and Agrochemicals in the Matale District- *Yala* 2015

Activity	Cost (Rs.)
Fertilizer application	10,508
Weed control with weedicide	4,930
Pest and disease control	9,135
Total input cost fertilizer and pesticides	24,573

Source: Department of Agriculture, 2015

9.3.6 Machinery

According to the Department of Agriculture, the recorded machinery cost of Rs. 26,997/ac contributed for 13 percent of the total cost of production in Matale district. The higher cost was recorded for water management (Rs. 15,520/ac) representing 57 percent of the total machinery cost.

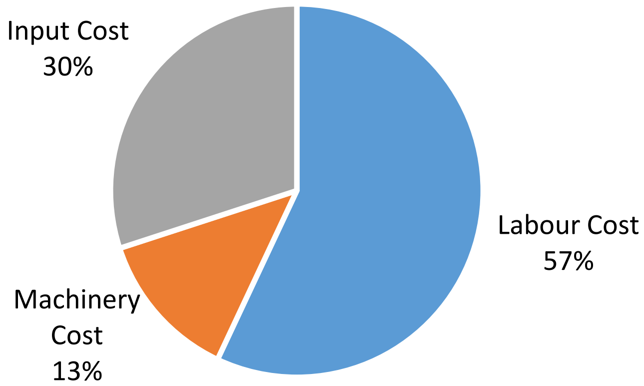
Table 9.19: Total Machinery Cost in the Matale District-*Yala* 2015

Activity	Cost (Rs.)
1st and 2 nd plough with 2 wt	8,347
Water management	15,520
Transport produce to stores	3,130
Total Machinery Cost	26,997

Source: Department of Agriculture, 2015

9.3.7 Total Cost of Production

Labour accounted for the main cost component in the big onion production, representing about 57 percent of the total cost of production (Figure 9.10). Next to labour cost, the other main cost component in 2015 *Yala* in Matale district was the seed cost (30%). Machinery mainly used for the water management activities in big onion cultivation constituted 13 percent of the total cost.



Source: Department of Agriculture, 2015

Figure 9.10: Total Cost (including imputed cost) for Big Onion Cultivation in Matale District (*Yala*-2015) by Activity

In the year 2015 *Yala* season, the big onion cost of production was calculated as Rs. 210,626.00/ac including imputed costs and Rs. 150,654.00/ac excluding imputed cost. Average yield of big onion was around 6,700 per/ac in Matale district during 2015 *Yala* season and unit cost of big onion was Rs. 31.49/kg (Including imputed cost) while it was Rs. 22.53/kg excluding imputed cost (Table 20 & 21).

Table 9.20: Cost of Cultivation per acre of Big Onion (Irrigated) - Matale District- (2015- *Yala*)

Operation	Percent Reported	Cost (Rs./ac)			
		Labour	Machinery	Input	Total
All nursery preparation	100	6030.00	-	2130.00	8160.00
Pre weedicide application	54	1480.00	-	2655.00	4135.00
1st 2nd plough with 2 wt	70	500.00	8347.00	-	8847.00
1st 2nd plough with 4 wt	(30)	-	(8543.00)	-	-
Preparation of beds & ridges	100	21719.00	-	-	21719.00
Transplanting	100	21637.00	-	34500.00	56137.00
Fertilizer application	100	6424.00	-	10508.00	16932.00
Weed control with weedicide	90	2586.00	-	4930.00	7516.00
Weeding & earthling up	(10)	(6543.00)	-	-	-
Pest & disease control	100	6924.00	-	9135.00	16059.00
Water management	100	22000.00	15520.00	-	37520.00
Harvesting & processing	100	28694.00	-	-	28694.00
Transport produce to store	44	1777.00	3130.00	-	4907.00
Total including imputed cost		119771.00	26997.00	63858.00	210626.00
Total excluding imputed cost		60300.00	26496.00	63858.00	150654.00

Source: Department of Agriculture, 2015

Table 9.21: Yield and Returns

Yield and returns	Per/ac
Average yield (kg)	6688.00
Price of produce (Rs./kg)	79.00
Gross income (Rs.)	528352.00
Profit including imputed cost (Rs.)	317726.00
Profit excluding imputed cost (Rs.)	377698.00
Unit cost (including imputed cost-Rs./kg)	31.49
Unit cost (excluding imputed cost- Rs./kg)	22.53

Source: Department of Agriculture, 2015

9.4 Potentials and Constraints of Production

According to Table 9.22, non-avaiability of quality seeds was the major issue reported by big onion farmers in Matale district (22%). Escalating seed prices (16%), absence of a reasonable market price because of intermediation and imports (14%) and obstacles encountered in pursuing cultivation in off-seasons (12%) in that order were the pressing problems, reported by the big onion farmers in Matale.

Table 9.22: Crop Specific Issues

Issues	Matale	Hambantota	Mannar	Jaffna	Total
Pest and disease attacks	1	28	36	19	18
Lack of quality seeds	22	4	1	12	12
Crop damages due extreme climate	2	10	20	14	10
Not having reasonable price	14	2	8	7	9
Water scarcity	4	19	7	7	8
High cost of seeds	16	0	1	9	8
Wildlife damage	0	4	4	23	7
Difficulties to cultivate in off-seasons	12	15	0	0	6
Weakness of the extension services	4	6	8	2	5
Land issues	8	4	1	0	4
Marketing issues	2	2	8	2	3
Escalation of agrochemical prices	13	2	0	0	4
Issues related to the quality of water	0	2	5	3	3
High cost of labour	2	2	1	2	2
Total	100	100	100	100	100

Source: HARTI Baseline Survey Data, 2016

When compared with Matale district situation was totally different in Hambantota.The highest percentage of farmers (28%) in Hambantota, reported crop damages due to pest and disease attack as the main issue followed by scarcity of water

(19%), difficulties to cultivate in off-seasons (15%) and crop damages due to extreme climatic conditions. While crop damages due to pest and disease attacks (36%) was the main issue reported by the big onion farmers in Mannar district and they also faced the concequences of adverce climatic condition (20%). Highest percentage of farmers (22%) in Jaffna district stated that crop damages caused by stray cattle as their main issue followed by crop damages caused by due to pest and disease attacks (19%). As a whole, crop damages due to pest and disease attacks (18%), lack of quality seeds (12%) and crop damages due to extreme climatic events (10%) are the major specific issues faced by the big onion farmers.

9.5 Findings and Recommendation

9.5.1 Findings

Of the cultivated extents of big onion from 2006 to 2015 in main producing areas, Matale district records the largest extent of big onion accounting for about 46 percent and the corresponding figures for Anuradhapura and Mahaweli - H area are 24 percent and 19 percent respectively. Around 93 percent of the big onion production had reached the market from Matale, Anuradhapura and Mahaweli-H areas.

Escalating input prices such as seeds, pesticides and fertilizer is the major issue faced by the big onion farmers. Low quality of the imported seed variety and non-availability of proper storage facilities are other issues pressurizing the big onion farmers. Majority of the big onion farmers in Matale, Hambantota and Mannar have been using certified local seeds for their cultivation while their counterpart in Jaffna depends on certified imported seeds.

9.5.2 Recommendations

Priority needs be accorded to resolve the main issues that act as disincentives. i. e. not receiving a reasonable price for big onion, shortage in quality seeds/planting materials and escalating input prices. Sicne country not having proper mechanism to import quality planting materials it is important to make programs and regulations to seed importation, quality assurance while lowering the seed price.

Effective supportive programmes are a long-felt need to motivate the farmers to sell their products. Specially, because of the perishable nature, this programme should contain a communication component to create awareness among the farmers particularly about latest storing processes. It is also recommended to provide technical and financial support to establish small, medium and large scale storage facilities in major big onion producing areas of the country.

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Chapter Ten

Red Onion

T.P. Munaweera

SUMMARY

There is a huge potential to increase red onion production in Sri Lanka by expanding the extent under cultivation in traditionally growing areas in Nothern and the Eastern parts of the country as well as in newly identified areas. Survey findings related to five major growing districts, Puttalam, Jaffna, Mullaitivu, Trincomalee and Kilinochchi revealed that red onion is mainly cultivated on highlands using ground water and rain water as main water sources. Almost all the farmers have their own land to cultivate and most pronounced land allotment sizes are 1- 2 acre and 2- 5 acre. Use of efficient and water saving techniques leave much to be desired in many districts except Puttalam. Cultivation of red onion is labour intensive and on an average 50 man days are employed to cultivate an acre of land. Main source of seeds are informal sources like self-produced and borrowings from neighbouring farmers. Thus most of them are local uncertified seed types. Majority of sample red onion farmers do not have any awareness on seed variety they had been using for cultivation.

Average cost of production of cultivating an acre of land is Rs. 135,679 and more than 40 percent of this account for planting materials and 24 percent for hired labour. Main issues identified as barriers to enhance the red onion production are pest and disease outbreaks, yield losses due to natural calamities, issues in marketing, non-availability of good quality planting materials and high input cost specially the agrochemicals and labour.

Based on this analysis it is suggested to enhance the red onion production via expansion of land under cultivation and increasing cropping intensity in selected localities. It also pointed out the importance of increasing the timely availability of good quality certified planting materials through research and development. Need of government intervention in stabilizing the price and establishing marketing channels is also highlighted.

CHAPTER TEN

Red Onion

10.1 Overview of the Red Onion Cultivation in Sri Lanka

10.1.1 Introduction

Red onion is one of the important cash crops grown in Sri Lanka and it is a main agricultural crop in family *Alliaceae* and scientifically named as *Allium cepa L.* They are valued for their distinctive pungent or mild flavors and form essential ingredients of the cuisine of many regions in the world. Red onion is commonly planted from bulbs and after the bulb is planted, several leafy shoots grow out from it. Each shoot then produces a small bulb. One of the reasons that red onion has become popular in the tropics is they can be maintained vegetatively avoiding the need to produce true seed. Bulbs from one harvest are planted the following season to produce new bulbs. Also red onion usually tends to flower less readily, making seed production difficult and costly.

The most popular red onion variety cultivated in Sri Lanka is Vethalam and there are few other recommended varieties and cultivars called Jaffna local, Kunduvallari (Vallarai 60), Poovallari (Vallarai 90) and Thinnaveli red. Table 10.1 shows the most suitable cultivation time periods to get optimum yield, duration of the crop and potential yields of most commonly cultivated four red onion varieties. According to field research findings September to December planting produces lower yields for all varieties.

Table 10.1: Major Red Onion Varieties, Their Potential Yield and Planting Time and Crop Duration

Variety	Yield potential	Crop duration	Planting time
Jaffna local	15 -16 mt/ha	60 -65 days	February, May, August
Vethalam	20 – 29 mt/ha	70 – 80 days	February to July
Vallarai 60	15 -20 mt/ha	60 -65 days	February to August
Vallarai 90	42 mt/ha	80 -90 days	August

Source: Department of Agriculture

10.1.2 Major Red Onion Growing Areas and Extent under Cultivation

The major red onion growing areas in Sri Lanka are Jaffna, Vavuniya, Mullaitivu, Trincomalee and Puttalam districts. However, in 1970s prior to the civil war, bulk of red onion production concentrated in the Northern districts, principally Jaffna. As a result of the civil disturbances that plagued the North and East, areas such as Kalpitiya, Matale, Anuradhapura, Polonnaruwa, Mahaweli Systems H, B, and C, Badulla, Monaragala, Nuwara-Eliya and Ratnapura have begun producing red onion. Red onion was produced throughout the year in Jaffna. Similarly, it can be grown throughout the year in the Kalpitiya area of Puttalum district. In most other areas of the North and East red onion is primarily a *Yala* crop.

Table 10.2 shows the production quantities of red onion in major growing areas for last ten years. According to the statistics, nearly 42 percent of the red onion production came from Puttalam district. Second largest producer was Jaffna district; however, prior to the civil war Jaffna accounted for nearly two thirds of the total red onion extent cultivated in the country, and produced nearly three fourths of the total output.

Table 10.2: Red Onion Production (mt) for the Period 2006 -2015 by Major Growing Districts

District	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
Puttalam	28,318	23,218	21,497	19,977	28,166	21,417	34,475	26,558	28,167	25,305	**41.7**
Jaffna	11,817	15,463	11,831	10,076	13,900	16,144	11,830	10,257	16,193	18,073	**22.2**
Vavuniya	5,764	4,354	3,228	5,991	5,723	5,954	5,399	3,077	3,333	2,376	**6.2**
Kilinochchi	1,276	1,276	850	-	1,210	7,309	8,343	926	810	1,278	**5.7**
Mannar	104	92	62	58	157	11,731	466	1,600	429	870	**4.6**
Mullaitivu	3,446	3,446	1,466	-	1,290	1,770	4,696	1,920	2,892	1,826	**4.0**
Other	10,029	9,192	10,352	10,132	11,365	7,799	8,761	11,254	11,213	11,474	**15.5**
Total	**60,754**	**57,041**	**49,290**	**46,234**	**61,811**	**72,124**	**73,970**	**55,592**	**63,037**	**61,202**	**100.0**

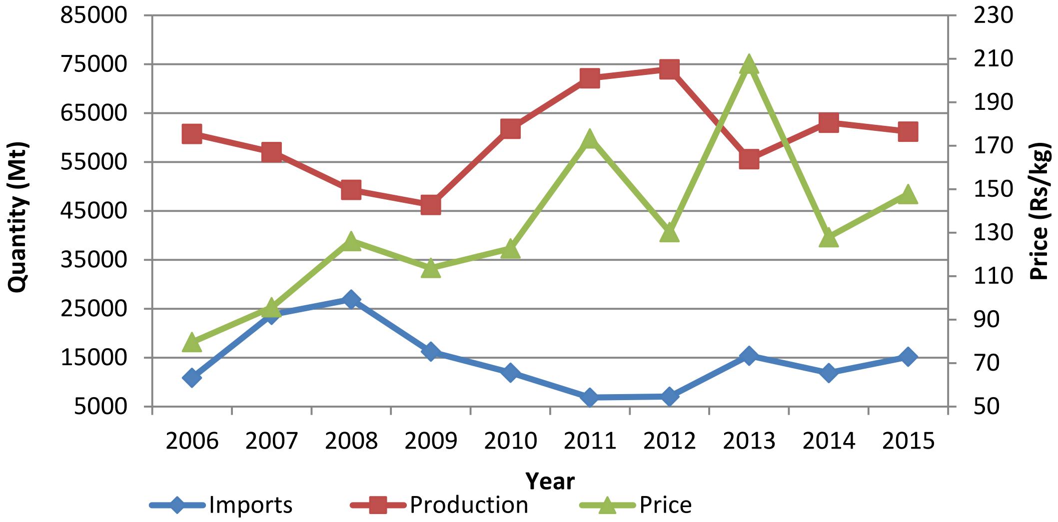
Source: Department of Census and Statistics

10.1.3 Climate and Soil Requirement of Red Onion

Red onion can be grown in a wide range of climatic conditions but it mostly demands a mild climate without excessive rainfall, extreme heat or cold. Cool environment with adequate moisture is more suitable for early growth followed by warm drier conditions for bulb maturation, harvesting and curing. The production of bulb is mainly controlled by photoperiod and temperature. Very short photoperiod discourages the bulb formation and critical day length varies from 11 – 16 hours depending on the cultivar. Red onion can be cultivated in a wide range of soils but well drained sandy loam and sandy clay loam soils are more preferred. The pH requirement ranges 5.8 – 8.0 with the optimum performance around 6.0 – 7.0.

10.1.4 Importance of Red Onion to the Economy

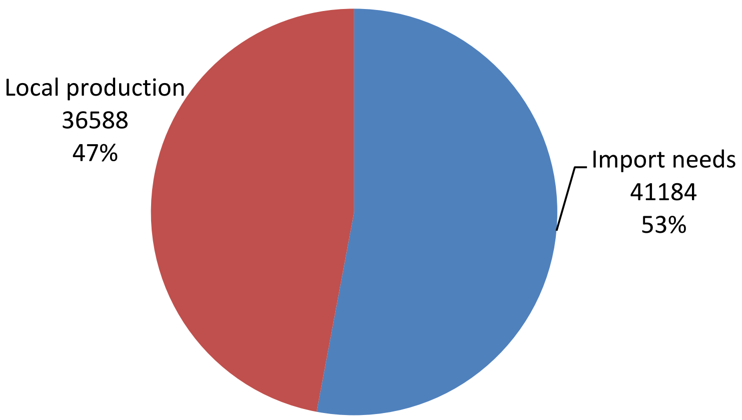
Red onion is important as a condiment, vegetable and a medicine in Sri Lanka. It is a main producing alliaceous crop in addition to the big onion. National requirement of red onion is about 80,000 mt/year. However, annual red onion production in Sri Lanka is around 60,000 mt (Table 10.2), necessitating the import of the shortfall. As illustrated in Figure 10.1 there is a clear relationship between red onion production and import volumes. It is obvious that when national level production goes down government had always increases the import volume to cater the red onion demand in the country.



Source: Department of Census and Statistics

Figure 10.1: Production, Import Quantities and Average Price of Red Onion for the Period of 2006 – 2015

The Department of Census and Statistics in Sri Lanka forecast that the red onion consumption for the year 2016 was around 80,000 mt while, local production would be around 47 percent of the total requirement (Dept. of Census & Statistics, Sri Lanka, 2016). Therefore, more than half of the country's red onion requirement had to be fulfilled through imports (Figure 10.2)



Source: Department of Census & Statistics, 2016

Figure 10.2: Local Production Forecasts and Import Needs for the Year 2016

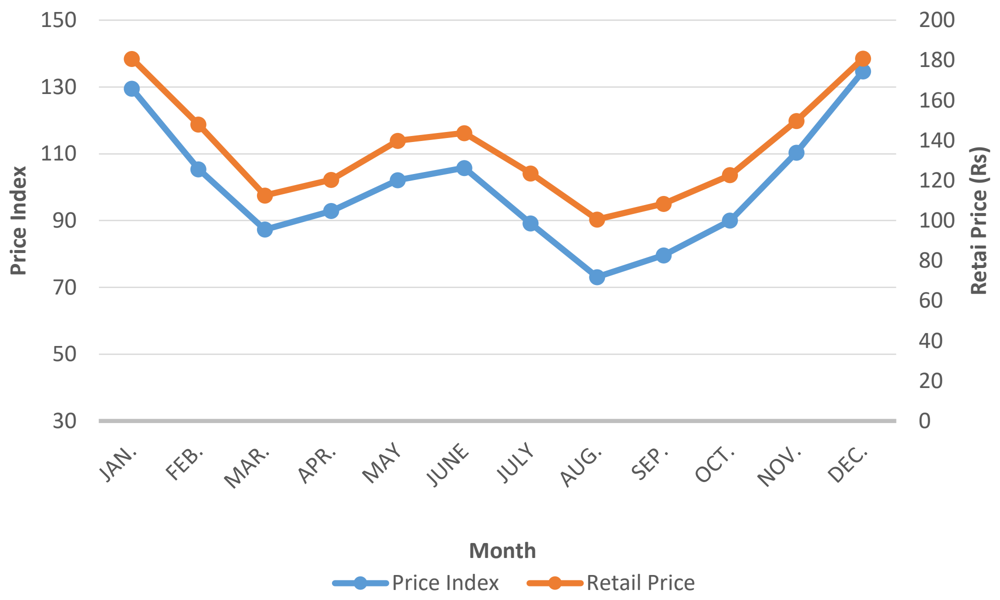
The two varieties of onion, red onion and big onion have traditionally been known to Sri Lankan consumers, as nearly perfect substitutes to each other at the market place. According to 2012/13 household income and expenditure survey, monthly per capita consumption of red onion was around 200 grams, which was 234 grams in 2009/10 survey (Table 10.3). This reduction of per capita consumption over the time was mainly due to the increase in red onion prices; hence consumers substituted red onion with big onion. Figure 10.1 illustrates the average red onion retail price change during last 10 years and it shows an increasing trend. Compared with 2006 retail price, price increase in 2015 was 186 percent.

Table 10.3: Per Capita Consumption of Red Onion over the Years

Year	Grams/Year
2006/07	222.55
2009/10	233.78
2012/13	199.83

Source: Household Income & Expenditure Survey - Dept. of Census & Statistics

The Figure 10.3 illustrates the average retail price and seasonal price index for red onion. As a result of red onion being cultivated as a seasonal crop distinct price fluctuations can be observed in seasonal and off seasonal periods. Highest price was observed in the months of January and December with a slight reduction in prices in the two harvesting periods March –April and August – September.



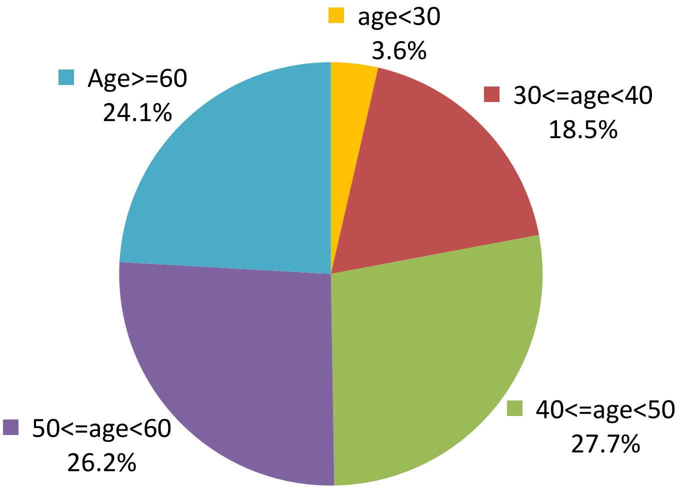
Source: Marketing, Food Policy and Agri-business Division of HARTI

Figure 10.3: Average Retail Prices (1996-2015) and Seasonal Price Index of Red Onion

10.2 Socio-Economic Characteristics of the Sample Red Onion Farmers

10.2.1 Age

The Figure 10.4 illustrates the age distribution of sample red onion farmers. Findings depict that for all five districts more than 75 percent of the sample farmers were above the age group of 40 years. It noteworthy the factor that emerges is the minimal involvement of the young farmers in red onion farming in all surveyed districts. It only a meagre than 4 percent of the sample farmers were in the age category of less than 30 years. Comparatively young farmer sample was observed only in Puttalam district. The feeling of disinclination deplaned by the youth population to take to farming pursuits in the agricultural sector as a whole warrants the serious concern of all the stakeholders since the instancing of this segment of the population from the farm economy can be an enormous disincentive for the food production drive of the country. Migration to developing with centres, lodging for greener pastures overseas their warped perception that farming in the country does not offer them promising opportunities to face the stiff competitiveness in the social set up are some causes need to be addressed to.

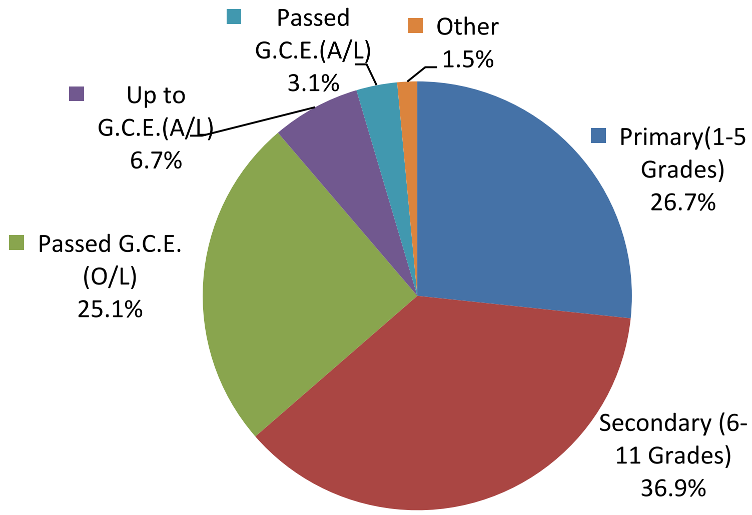


Source: HARTI Survey Data, 2016

Figure 10.4: Age Distribution of Sample Red Onion Farmers

10.2.2 Education

Sample red onion farmers' educational levels that are illustrated in Figure 10.5 and it reveal that most of the farmers (37%) had completed only their secondary education. Considerably a higher proportion (27%) of the sample only had schooling up to grade five or lower grades. Nearly 25 percent of the sample farmers had completed their GCE O/L examination.



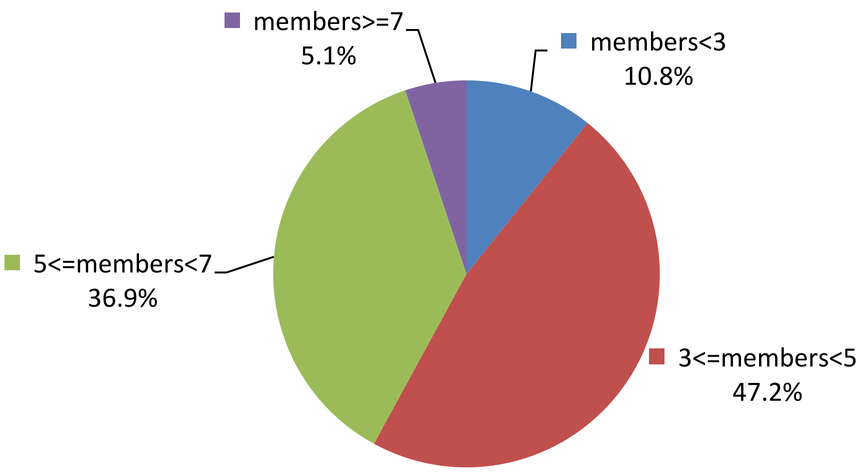
* Category Other includes diploma holders and farmers who does not attend school
Source: HARTI Survey Data, 2016

Figure 10.5: Level of Education among Sample Red Onion Farmers

This situation is common for all five districts. Out of the total of 195 sample farmers only one farmer had no schooling at all and two farmers had studied up to diploma level which was the highest education attainment among the sample farmers.

10.2.3 Family Size

The average household size of all districts as indicated in Figure 10.6 and majority of more than 47 percent is in the category of 3 – 5 members. This is compatible with the national level household size 3.9 reported in Sri Lanka Socio-economic Data Report 2016 published by the Central Bank of Sri Lanka. For all districts over 60 percent of the families have 1-5 members in a household which indicates the emerging labour shortage for future farming activities.



Source: HARTI Survey Data, 2016

Figure 10.6: Household Size Distribution among Sample Red Onion Farming Households

10.2.4 Primary Income

Table 10.4 shows the sources of primary employment among the sample red onion farming households. More than 94 percent of the households rely on agriculture related activity as their major income source and this situation is common in all five surveyed districts.

Table 10.4: Primary Employment of Sample Red Onion Farming Households

Primary employment	No. of farmers	% of farmers
Farming/Animal husbandry	180	94.2
Agricultural labour	1	0.5
Government job	4	2.1
Private sector job	2	1.0
Self-employment	2	1.0
Skilled labour	1	0.5
Other	1	0.5
Total	191	100.0%

Source: HARTI Survey Data, 2016

10.3 Agricultural Inputs

10.3.1 Land

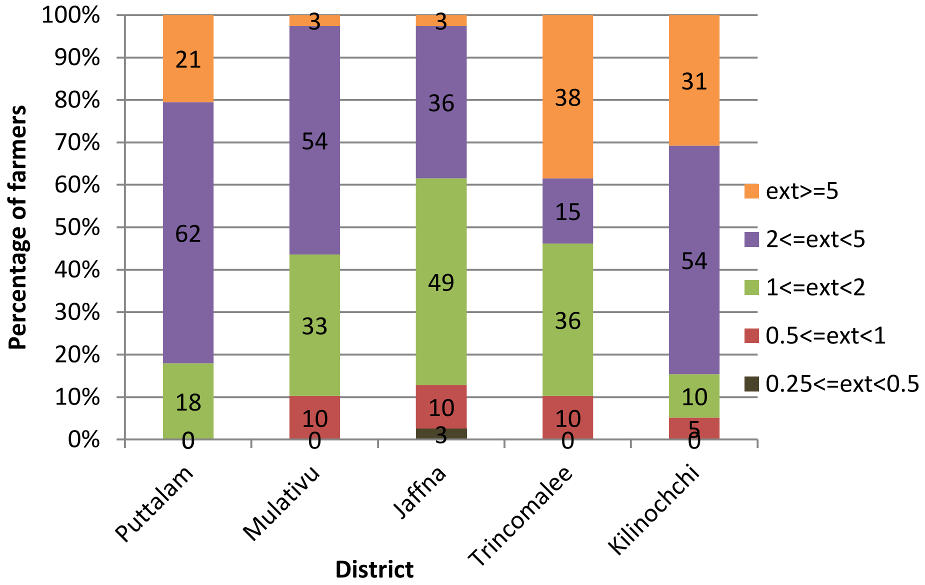
The baseline survey reveals that red onion is mainly a highland crop in all major growing districts in Sri Lanka cultivated in both seasons. Larger extent of land cultivate with the crop in *Maha* season because that period of time has more preferable climatic conditions for red onion in all five districts. Intermediate cultivation and growing it at home garden level is almost negligible (Table 10.5).

Table 10.5: Extent under Red Onion Cultivation in Lowlands and Highlands in Different Seasons in Sample Area

District	Highland				Lowland			
	Yala		*Maha*		*Yala*		*Maha*	
	N	ac	N	ac	N	ac	N	ac
Puttalam	28	47	29	48.63	1	3	1	3
Mullaitivu	10	6	27	20	4	2.5	2	2.13
Jaffna	22	20.09	31	31.91	10	8.88	1	0.13
Trincomalee	28	40.75	39	66.05	-	-	-	-
Kilinochchi	19	16	21	16.75	1	0.5	1	0.5

Source: HARTI Survey Data, 2016

The land size distribution as illustrated in Figure 10.7 brings out the fact that most of the red onion farming households in Puttalam, Mullaitivu and Kilinochchi districts had 2-5 ac lands whilst in Jaffna district most of the households had 1 - 2 ac of land. However, in Trincomalee district the majority of the red onion farmers cultivated with land extents over 5 ac. Only 3 percent of total sample farmers, all in Jaffna district cultivated land extents 0.25 – 0.5 ac.



Source: HARTI Survey Data, 2016

Figure 10.7: Distribution of Operators by Size of Land Class

Ownership of the farmland is an important parameter in implementing new agricultural projects. The land ownership status among the surveyed red onion farmers brought to light that single ownership was the most prominent in all the five districts and rest operated their land under some kind of tenure arrangements including joint ownership, tenancy, and leased. The survey pinpoints that almost all the red onion farmers in Mullaitivu and Kilinochchi districts had their own land to cultivate. While 59 percent of the farmers in Puttalam district, 90 percent of their counterparts in Jaffna district and 87 percent in Trincomalee district had their own agricultural land plot. Tenancy-in and leased – in are the other common land ownership types among the red onion farmers.

In Mullaitivu district single owners cover over 96 percent of the agricultural land plots and 81 percent, 77 percent, 68 percent, 52 percent in Kilinochchi, Puttalam, Jaffna and Trincomalee districts respectively (Table 10.6). Tenancy-in is the second highest ownership type in Trincomalee and Jaffna districts while in Puttalam and Kilinochchi districts second highest type is leased in.

Table 10.6: Distribution of Land by Ownership among Red Onion Farmers in Sample Area

District	Puttalam		Mullaitivu		Jaffna		Trincomalee		Kilinochchi	
	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%
Single owner	116.11	77	93.7	96	54.23	68	109.21	52	122.91	81
Jointly owned	10.5	7	-	-	2.5	3	6.68	3	-	-
Leased in	24	16	-	-	7.95	10	15	7	19	13
Tenancy-in	1	1	2.25	2	13.5	17	73.25	35	9	6
Tenancy-out	-	-	1	1	0.75	1	0.5	0.2	-	-
Permit Holder	-	-	0.25	0.2	-	-	5	2	-	-

Source: HARTI Survey Data, 2016

10.3.2 Irrigation

The source of water for agricultural activities among sample red onion farmers in the surveyed five districts is depicted in Table 10.7. Except Trincomalee and Kilinochchi districts, in Puttalam, Mullaitivu and Jaffna districts red onion farmers relied mainly on two to three water sources for their cultivation. Distinct feature of Jaffna district is more than 94 percent of the land extent was irrigated with tube wells. At the same time, in Puttalam district nearly 79 percent of the cultivated lands had water from tube wells. More than half of the red onion farmers in Kilinochchi district depended on rain water for their cultivation and this implies the susceptibility of those farmers to incidence of climate change. Unlike in other four districts, farmers in Trincomalee district got water for their cultivation from different water sources such as major and minor irrigation, agro-wells, and domestic well etc.

Table 10.7: Land Extent under Different Water Sources among Sample Red Onion Farmers

Water Source	Puttalam		Mullaitivu		Jaffna		Trincomalee		Kilinochchi	
	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%
Rainfed	11.92	8	35.99	37	4.25	5	47.54	23	76.91	51
Agro-well	9.00	6	54.57	56	74.43	94	40.60	19	30.25	20
Tube well	120.94	79	-	-	-	-	-	-	-	-
Major irrigation	-	-	-	-	-	-	50.00	24	21.00	14
Minor irrigation	-	-	-	-	-	-	14.50	10	14.50	10
Domestic well	-	-	-	-	-	-	42.50	20	-	-
Other	10.75	7	6	7	0.5	1	8.00	4	8.25	5
Total	152.61	100	96.56	100	79.18	100	203.14	100	150.91	100

Source: HARTI Survey Data, 2016

Most of the farmers had practised flood irrigation; however more than 70 percent of the farmers in Puttalam district used sprinkler irrigation method both in the *Maha* & the *Yala* seasons.

10.3.3 Labour

Red onion cultivation is labour intensive requiring labour for such activities as land preparation, crop establishment, and harvesting and post-harvest management activities. In all the surveyed districts hired labour was intensively used for the red onion cultivation. As depicted in Table 10.8 on average Jaffna district farmers used the highest number of labour units while in Puttalam district it was the minimum compared to other districts.

Table 10.8: Average Labour Cost Including Family Labour and Units of Hired and Family Labour Used in Red Onion Cultivation in Selected Districts

District	Total labour cost (including family labour) Rs/ac	Total family labour (mdys/ac)	Total hired labour (mdys/ac)
Puttalam	18679	5	33
Mullaitivu	41177	7	60
Jaffna	34285	6	54
Trincomalee	38387	6	51
Kilinochchi	24204	7	48
Total	31512	6	49

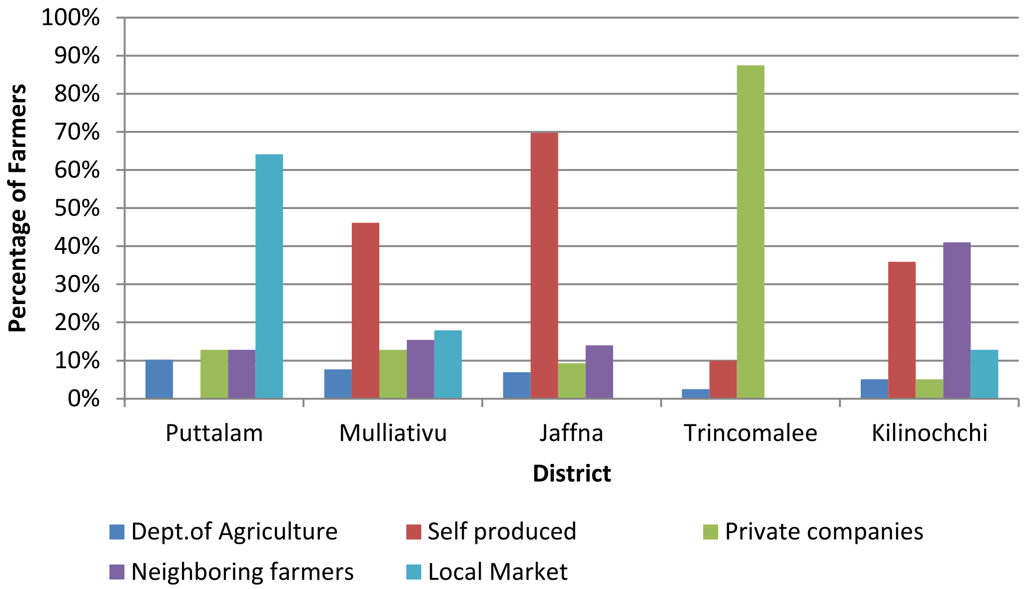
Source: HARTI Survey Data, 2016

10.3.4 Seeds

Quality of seeds determines the quality and quantity of the yield in the crop farming. Department of Agriculture has given recommended varieties for each location and advised to cultivate certified seeds to get a good return on investment.

10.3.4.1 Sources of Seeds

Figure 10.8 illustrates the different sources of acquiring red onion seeds in five major red onion producing districts. In Puttalam district 64 percent of the seeds is sourced through local market and only 10 percent depended on the Department of Agriculture (DOA). The red onion farmers in Mullaitivu district obtained seeds from five different sources as self-produced, which was the highest and the local market, the private companies, DOA and from the neighbouring farmers. More than 70 percent of the farmers in Jaffna district used self-produced seeds while 88 percent of the farmers in Trincomalee districts bought seeds from private companies. More than 40 percent of the farmers in Kilinochchi district relied on the seeds procured from neighbouring farmers and 36 percent used self-produced seeds.

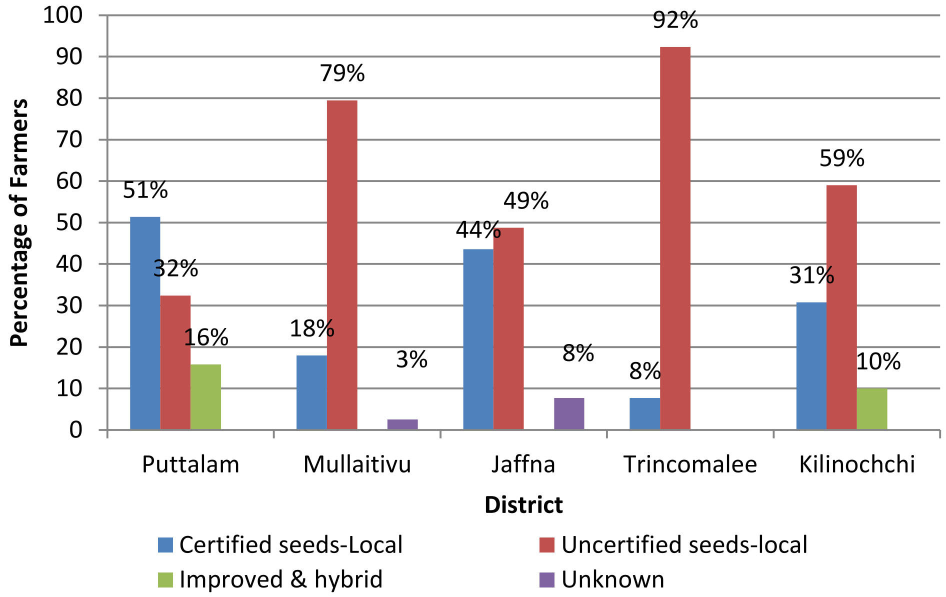


Source: HARTI Survey Data, 2016

Figure 10.8: Source of Seeds for Sample Red Onion Farmers

10.3.4.2 Types of Seeds

In Sri Lanka different types of seeds such as local certified seeds, hybrid varieties, locally produced and imported improved seed varieties are freely available for the farmers. The baseline survey findings revealed that except in Puttalam districts farmers in all other four districts had mainly used locally produced uncertified seeds. This is because, as discussed in the previous section self-produced seeds and seeds borrowed from neighbours are the main sources of seeds. Different types of seeds used by sample farmers are illustrated in Figure 10.9. However more than half of the sample farmers in Puttalam districts and 44 percent in Jaffna used locally produced certified seeds. Since these two districts are the main commercially and intensively red onion cultivating areas, they are more careful in selecting seeds.

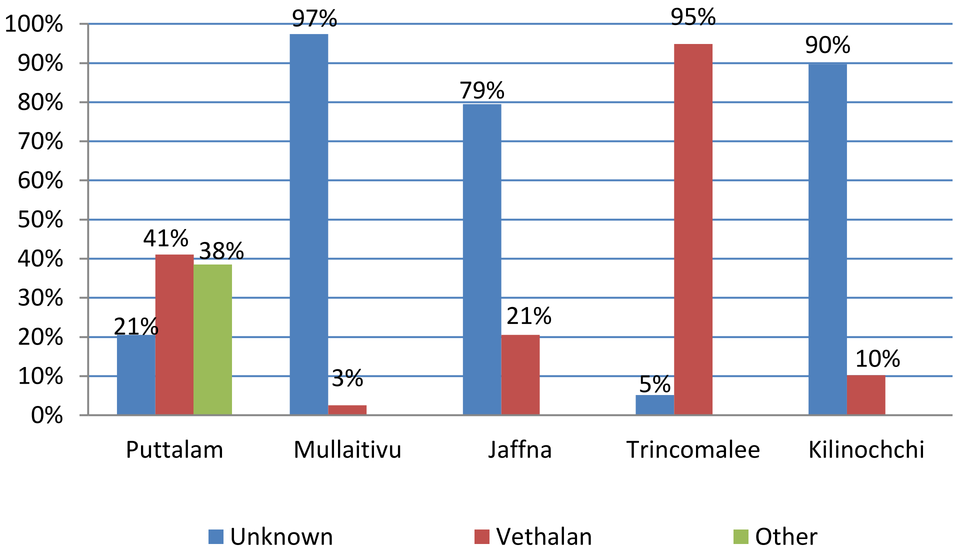


Source: HARTI Survey Data, 2016

Figure 10.9: Type of Seeds Used by Sample Red Onion Farmers

10.3.4.3 Seed Varieties

As illustrated in Figure 10.10 findings revealed that most of the sample farmers were unaware of the variety they cultivated. However, 95 percent of the sample farmers in Trincomalee district used the variety Vethalan. Farmers cultivating Vethalan in Puttalam district amounts to 41 percent and another 38 percent of the farmers had used other unkown locally available varieties.



Source: HARTI Survey Data, 2016

Figure 10.10: Type of Seeds Used by Sample Red Onion Farmers

10.3.5 Fertilizer and Pesticides

Fertilizer and pesticides are an indispensable input in modern agriculture in gaining higher yields. Hence these two inputs claim a considerable proportion of the total cost of production. Almost all sample red onion farmers in selected five districts used both chemical fertilizers and pesticides. More than 93 percent of the sample farmers used a combination of organic and inorganic fertilizers to get maximum results. Most commonly usied type of pesticide in red onion cultivation is fungicides and no insecticide application is practised. More than 90 percent of the sample farmers applied weedicides for weed control supplemented with manual weeding.

Table 10.9 indicates the mean chemical and organic fertilizer costs in five surveyed red onion producing districts. Puttalam district farmers spent considerably a higher amount for fertilizers compared with those other four districts. This is mainly because red yellow latosol soils in most of the areas in Puttalam district have rapid infiltration and low water holding capacities with very low plant nutrients; hence fertilizer requirement in these soils are high (DOA undated).

Table 10.9: Mean Chemical and Organic Fertilizer Costs in Major Red Onion Growing Districts

District	Mean chemical Rs./ac	Mean organic Rs./ac
Puttalam	11,203	22,230
Mullativu	8,247	8,271
Jaffna	9,878	10,019
Trincomalee	7,939	14,622
Kilinochchi	7,453	12,348
Total	8,803	14,965

Source: HARTI Survey Data, 2016

10.3.6 Machinery

Table 10.10 depicts other main cost component in red onio production, machinery. In red onion production machinery is mainly used for land preparation. On an average, machinery cost in all five surveyed districts is around 11,366 Rs/ac however Mullaitivu reported the lowest per unit machinery cost of 9,908 Rs/ac.

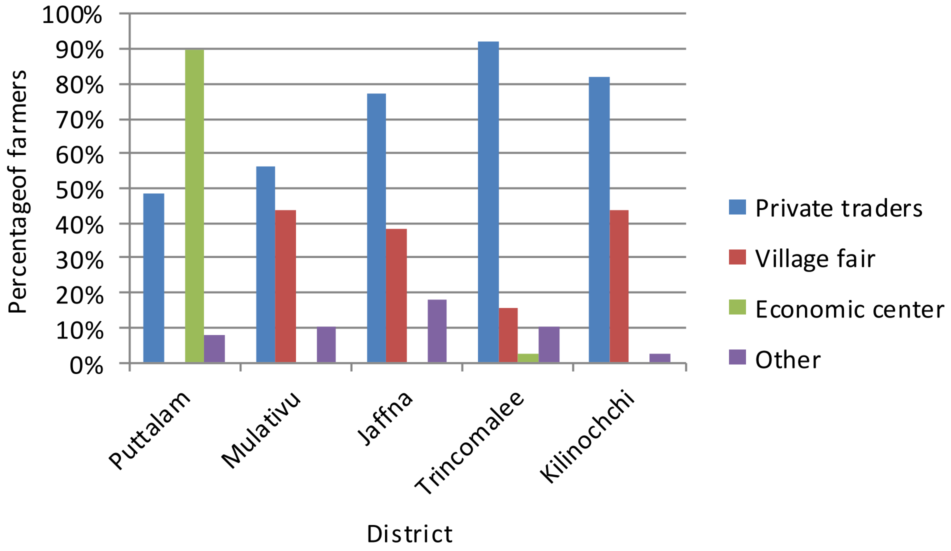
Table 10.10: Mean Machinery Cost in Major Red Onion Growing Districts

District	Mean cost Rs./ac
Puttalam	11,180
Mullaitivu	9,908
Jaffna	11,642
Trincomalee	11,523
Kilinochchi	12,608
Total	11,366

Source: HARTI Survey Data, 2016

10.3.7 Red Onion Marketing

Different marketing channels prevailed in the suryed districts are illustrated in Figure 10.11 and obviously in each district there are only two main dominant channels. In Puttalam district nearly 90 percent of the red onion farmers sold their product to the Norochchole dedicated economic center. Second highest point of marketing in Puttalam district was private traders, who were the source of marketing in all other four districts as well. Second highest place of selling their product in Jaffna, Kilinochchi, Trincomalee and Mulativu district farmers was the village fair.



Source: HARTI Survey Data, 2016

Figure 10.11: Different Channels of Red Onion Marketing

Irrespective of the growing area red onion farmers encountered a series of difficulties at the time of encashing the product. Table 10.11 shows major issues listed by the sample farmers in disposal of the harvest. Main issue pointed out by majority of the farmers (64 percent) in all five districts is not having a fair price for their product.

Conversely, 27 percent of the total sample farmers did not have any issue in marketing their red onion harvest. Farmers in the North and the East claimed absence of a proper marketing channel as a main issue. But this posed no problems in Puttalam district because of a dedicated economic center was located in their area. The other issues pointed out by the farmers were lack of transport facilities to transport the product to market place, delays in payments after selling, severe concern on the quality of the harvest and incapacity to sell their whole harvest at one purchasing centre.

Table 10.11: Marketing Issues Faced by Farmers in Major Red Onion Growing Districts*

Marketing Issues	District										Total	
	Puttalam		Mulativu		Jaffna		Trincomalee		Kilinochchi			
	N	%	N	%	N	%	N	%	N	%	N	%
Not paid a good price	24	62	28	72	24	62	22	56	26	67	124	64
No issues	12	31	10	26	12	31	11	28	7	18	52	27
Absence of marketing channel	-	-	6	15	7	18	12	31	11	28	36	18
Transport issues	4	10	4	10	1	3	5	13	1	3	15	8
Not receiving cash	7	18		-	-	-	3	8	-	-	10	5
Severe concern on quality	3	8		-	-	-	1	3	1	3	5	3
Not buying the whole lot	-	-	1	3	2	5	1	3	2	5	6	3
Quantity insufficient for selling	-	-		-	2	5	1	3	1	3	4	2

* Percentage value totals exceed 100 due to multiple responses
Source: HARTI Survey Data, 2016

10.3.8 Total Cost of Production

The total cost of production of red onion was calculated using 179 data points collected during the survey in the major red onion producing areas. Average production costs per acre were about the same in the North as in the rest of the country (Kalpitiya), as shown in Table 10.12.

Table 10.12: Average Cost of Production in Values for Individual District (Rs/ac)

District	Mean COP Rs./ac
Puttalam	177270.7
Mullativu	108299.1
Jaffna	155950.1
Trincomalee	134126.3
Kilinochchi	104252.6
Average COP	135678.9

Source: HARTI Survey Data, 2016

According to the calculations highest average cost of production was recorded in Puttalam district followed by Jaffna district. Lowest cost of production was observed in Kilinochchi district followed by Mullaitivu district.

According to the breakdown of cost of production into different cost components as showed in Table 10.13, the largest cost factor in red onion production is seeds which accounts for more than 40 percent of the total COP. Technological advances that could reduce costs of production are possible. Red Onion is primarily propagated through seed bulbs, and the seed requirement to cultivate one hectare of Red Onion (Vethalan) is 1.5 -1.75 metric tonnes. In order to obtain this amount of seed bulbs, it is necessary to cultivate about 0.1 hectares of land. In view of above factors, series of experiments were carried out at the Regional Agricultural Research and Development Center at Aralaganwila to investigate the possibility of true seed production and their use as seed material with comparison to the conventional seed material of sets (Sumanaratne *et al* 2002). This is a great achievement because propagation with true seed would reduce the amount of land required to produce seed material and reduce its cost. True seed requirement to cultivate a hectare of land is 5 - 6 kg. However, there are difficulties in producing onion seed in humid tropics.

Table 10.13: Mean Cost of Production of Red Onion with Different Cost Components

Cost component	Mean cost (Rs/ac) N= 179	% of total cost
Family labour	1,186	0.9%
Hired labour	32,228	23.8%
Seed cost	55,331	40.8%
Chemical fertilizer	12,971	9.6%
Organic fertilizer	11,826	8.7%
Weedicide cost	2,909	2.1%
Fungicide cost	2,405	1.8%
Insecticide cost	2,810	2.1%
Machinery cost	13,569	10.0%
Other cost	445	0.3%
Total COP (including family labour)	135,679	100.0%
Total COP (excluding family labour)	134,493	

Source: HARTI Survey Data, 2016

Second highest component in red onion production is labour cost which accounts for 24 percent of the total cost. Based on 2016 survey data average total cost of production including family labour is 135,679 Rs/ac.

10.4 Potentials and Constraints of Production

The Table 10.14 summarizes the issues faced by red onion farmers in selected red onion producing districts. According to the crop specific issues specified by sample farmers, major constraint that confront of most of the farmers was pest and disease outbreaks (26 percent). Damages caused by natural disasters like flood and drought were pointed out as impediments by 16 percent of the total sample. Marketing issues specified as absence of stable proper price and obstacles relate to exisitng marketing channels ranked as the third highest constraint faced by most of the sample farmers. In addition, issues related to inputs such as non availability of good quality planting materials, poor quality of inputs, escalating fertilizer prices and high cost of other inputs were brought out as key issues in red onion cultivation.

So far as the major issues based on district level are concerned pest and disease attacks topped the list in all the five districts. Puttalam district farmers identified escalating fertilizer price as the other main issue. In addition, they highlighted the issue of non-availability of high quality seeds in the planting seasons. Unlike in other districts, 23 percent of the Puttalam district farmers stated land degradation issues like loss of soil fertility and increasing salinity levels, etc. as their on of main issues. Not as in the case of other districts the highest number of respondents in Trincomalee district claimed marketing issue (38 percent) as their pressing problems.

Table 10.14: Major Issues in Red Onion Cultivation

Issue	Puttalam		Mullaitivu		Jaffna		Trincomalee		Kilinochchi		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Pest and disease attacks	13	33	29	74	25	64	7	18	24	62	98	26
Damages from natural disasters	6	15	10	26	19	49	4	10	22	56	61	16
Marketing issues	5	13	12	31	17	44	15	38	5	13	54	15
Lack of quality seeds	9	23	9	23	-	-	1	3	12	31	31	8
Issues related to quality and availability of inputs	6	15	4	10	4	10	7	18	6	15	27	7
Escalating fertilizer prices	13	33	-	-	2	5	5	13	4	10	24	6
High input cost (Pesticide, Labour, Seeds)	7	18	2	5	9	23	4	10	2	5	24	6
Water scarcity	1	3	7	18	8	21	2	5	2	5	20	5
Poor infrastructure facilities	7	18	-	-	2	5	-	-	3	8	12	3
Land degradation issues	9	23	1	3	1	3	-	-	-	-	11	3
Wildlife damages			1	3	-	-	6	15	1	3	8	2

Source: HARTI Survey Data, 2016

10.5 Recommendation and Suggestions

Over more than 50 percent of the local requirement of red onion mainly depend on imports. Hence, annually government incurred an expenditure of billions of rupees to import red onions. Therefore, increasing local production is of utmost importance. Prior to the civil war Jaffna district was the major red onion producer in the country, and now there is an enormous potential to increase the red onion production in Jaffna and the Northern part of the country by giving necessary government support via improving the extension network in those areas.

It is likely that an additional acreage in traditional highland allotments of the major growing areas could be brought under cultivation during the regular planting seasons. On the other hand, cropping intensity also can be increased by cultivating three crops a year particularly in the Jaffna district where climatic condition is favourable for throughout year cultivation. Such increases would certainly ensure an adequate price for the product.

Non-availability of quality planting materials has emerged as major constraint in increasing the red onion production in all the main growing areas. The research findings confirm that most of the farmers had used self-produced seeds and many of them were not aware of the seed variety they used. Therefore it is worth to implement continuous seed propagation programmes backed by research and development programmes to ensure the ready availability of quality seeds on time.

Marketing related issues should be addressed immediately to motivate farmers to increase their crop production. This could be achieved by direct government involvement in developing marketing channels and mechanisms to stabilize the price. This can be facilitated by imposing import restrictions on onion during periods when local productions reach the market and by implementing sliding floor price scheme to encourage storage and off season cultivation.

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Chapter Eleven

Chili

P.C.J de. Silva

SUMMARY

Chili is an important cash crop in Sri Lanka. The varieties of chilies that have been recommended by the Department of Agriculture in Sri Lanka are MI–1, MI-2, KA–2, Arunalu and MI – Hot. However, due to the low profitability in cultivating above recommended varieties the majority of the cultivators prefer high yielding imported hybrid varieties. As a remedy for the demand for high yielding imported hybrid varieties, in 2015 Department of Agriculture introduced its' first-ever hybrid variety named MICH HY 1. It is much suitable for green use and is estimated to provide a yield of 32 tons per hectare. Even though the production of dried chilies has drastically dropped as a whole in the entire country, still the bulk of the production of green chilies comes from Anuradhapura, Monaragala, Ampara, Vavuniya, Kurunegala, Hambantota districts and Mahaweli System H. Nevertheless, Mahaweli System H that was once a major chili producing area in the country has almost completely shifted away from the chili cultivation.

In Sri Lanka, the main issue in chili cultivation, especially dry chili, is the high cost of production. Sri Lankan farmers are unable to compete with the cheap imports in the open market. Since our farmers get only a minimum price for green chili it is not economical for them to produce dry chili. Since it requires several kilos of green chili to produce one kilo of dry chili and when comparing the production cost and cheaper imported dry chili at the market it is difficult to promote farmers to expand chilie cultivation.

CHAPTER ELEVEN

Chili

11.1 An Over View of Chili Cultivation

11.1.1 Introduction

Chili is an assential ingredient in Sri Lankan meals and one of the most important cash crops cultivated in Sri Lanka. It belongs to the *solanaceae* family and chili is botanically named as C*apsicum annum*. It is believed that chili was first cultivated by the people of Central and South America in around 3000BC. Mexico is generally considered as the country where chili originated. It is considered that cultivation of chili was spread over the world after Columbus bringing the seeds to Europe in 1493.

Chili is considered to possess many nutritional values. It is known for its high content of vitamin C which is about twice of the amount contained in citrus fruits. It has been found that even after cooking, it only loses 30 percent of its vitamin C content. Dried chilies are also very high in vitamins and have antibacterial qualities. They contain bio-flavinoids and anti-oxidants that are most commonly contained in apple juice which is effective in protecting the body against cancer. There are different chili varieties which vary both in size as well as in colour. Sweet Chili, Chili Baby Hot, Red Chili, Bell Chili Red/Green, Mexican Hot Chili and Jalapeno Chili are some common varieties.

The varieties of chilies which have been recommended by the Department of Agriculture in Sri Lanka are MI–1, MI-2, KA–2, Arunalu, MI – Hot. However due to the low profitability in cultivating above recommended varieties, majority of the cultivators prefer high yielding imported hybrid varieties. As a remedy for the demand for high yielding imported hybrid varieties the Department of Agriculture introduced its first ever hybrid variety named MICH HY 1 in 2015. It is much suitable for green use and it is estimated to provide a yield of 32 tons per hectare (DOA, undated).

11.1.2 Major Growing Areas and Extent under Cultivation

Anuradhapura, Monaragala, Ampara, Vauniya, Kurunegala, Hambantota districts and Mahaweli System H are the major and traditional areas of chili cultivation in Sri Lanka (Table 11.1 and 11.2). Even though the production of dried chilies has drastically dropped as a whole in the entire country still the bulk of the production of green chilies comes from most of the above areas. Nevertheless, the Mahaweli System H that was once a major chili producing area in the country has almost completely shifted away from the chili cultivation.

Following table (Table 11.1 and 11.2) shows the present situation of chili production in the country, district wise.

Table 11.1: Chili Production in Major Growing Districts (mt)

District	2010	2011	2012	2013	2014	2015
Puttalam	7,033	4,864	13,502	13,191	13,987	9,006
Kurunegala	1,348	1,234	1,020	5,422	4,157	1,427
Ratnapura	1,520	1,966	1,139	992	1,147	1,283
Kandy	2,020	1,408	1,938	2,030	2,305	1,695
Matale	2,580	2,193	2,000	2,429	2,158	2,059
Badulla	1,516	1,658	1,556	2,658	2,827	2,399
Monaragala	5,148	5,111	7,711	9,190	8,524	12,644
Anuradhapura	14,318	9,322	17,804	17,867	16,404	9,514
Polonnaruwa	1,112	727	1,374	1,137	1,344	1,113
Ampara	1,027	783	802	1,061	1,088	917
Hambantota	4,019	3,523	3,005	3,466	3,483	3,484
Others	7,362	8,857	9,690	11,732	14,343	17,326
Total	49,003	41,646	61,541	71,175	71,767	62,867

Source: Department of Census & Statistics

Table 11.2: Chili Extent under Cultivation (ha)

District	2010	2011	2012	2013	2014	2015
Puttalam	1,403	1,386	1,519	1,532	1,617	1,043
Kurunegala	1,205	1,139	970	911	786	979
Ratnapura	481	657	432	385	424	357
Kandy	425	316	366	527	511	464
Matale	622	537	472	507	434	407
Badulla	682	673	634	849	901	832
Monaragala	1,053	914	1,097	1,286	1,193	1,116
Anuradhapura	2,835	2,540	3,527	2,974	2,478	2,299
Polonnaruwa	234	111	222	205	229	200
Ampara	452	368	322	371	381	322
Hambantota	997	942	857	966	1,042	854
Others	2,873	3,760	4,311	3,923	3,982	4,155
Sri Lanka	13,262	13,342	14,728	14,437	13,978	13,029

Source: Department of Census & Statistics

11.1.3 Climate and Soil

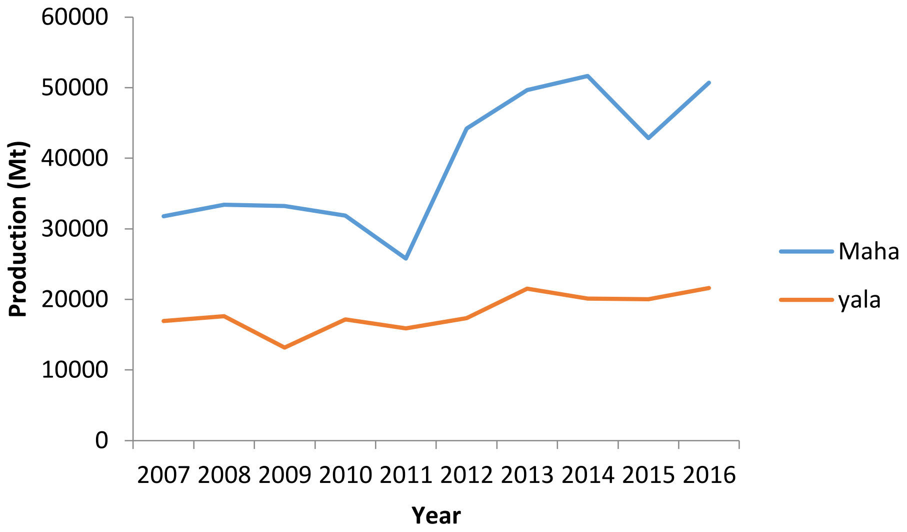
Chili grows well in warm weather. However, it is cultivated even in winters in frost free areas. Chili cultivation requires deep, loamy, fertile soils rich in organic matter and well drained soils with adequate soil moisture for satisfactory growth. The major chili producing areas of Sri Lanka are in the dry zone of the country which covers mostly the Southeast, East, and Northern parts. The dry zone receives between 1200 and 1900mm of rain annually from October to January.

11.1.4 Importance of the Crop to the Economy

11.1.4.1 Production

Today the production of chili in the country is almost limited to green chili. According to market information, production of dried chili is even less than five percent of the country's total requirement. Production has drastically come down over the years since the farmers have found that production of dry chilies is not economically viable and the production costs are unbearably escalating and the cheaper imports come in abundance to the market from India. The dry chili requirement is almost completely met with the imports basically from India. It is reported that out of India's total export of chili, a huge percentage which is close to half of India's total exports comes to Sri Lanka.

Following Figure 11.1 shows the information on chili production in the country in both the *yala* and the *maha* seasons during the period of 2007- 2016.

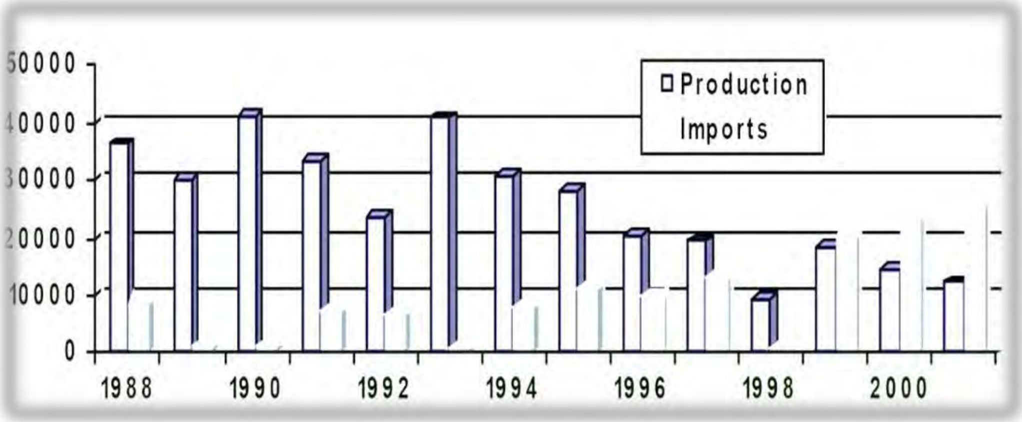


Source: Department of Census and Statistics

Figure 11.1: Production of Chili (mt) 2007-2016

11.1.4.2 Imports

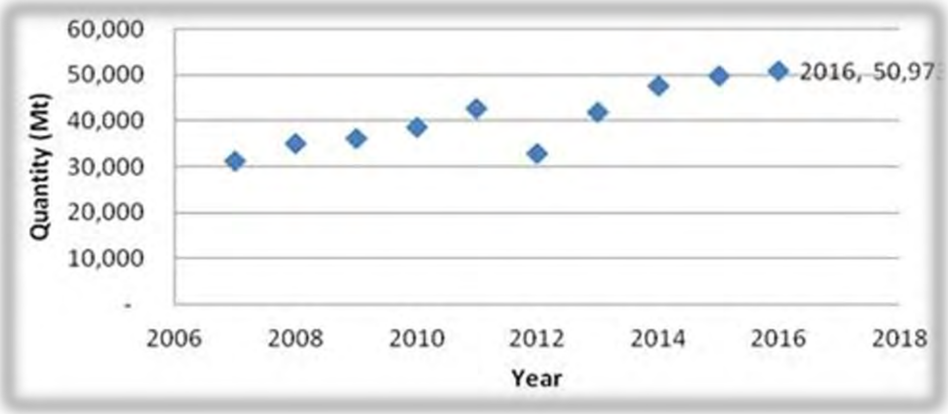
As Figure 11.2 illustrates imports of chilies have been escalating remarkably since late 1980s, in parallel to the collapse of local chili production.



Source: http://www.christiealwis.com

Figure 11.2: Production and Imports of Chili (1988-2001)

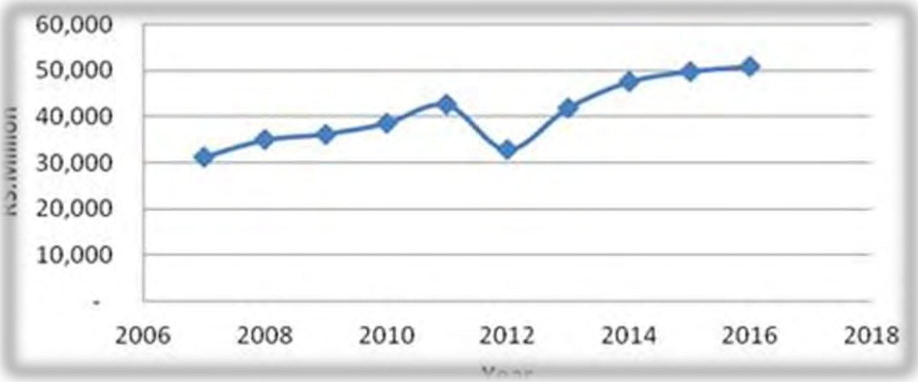
More recent figures with regard to chili imports are shown in Figure 11.3. Accordingly the country's high dependency on chili imports cost a huge amount of foreign exchange drain annually.



Source: Department of Census and Statistics

Figure 11.3: Import of Chili (mt)-(2007-2016)

The change of the food pattern and resultant high demand for green chilies seem to have encouraged the farmers to produce green chili which they find more profitable and much convenient to produce. Also the inability to compete with cheaper imported dried chilies has significantly affected farmers to keep away from dried chili production. The overall chili production of the country decreasing over the years and as a result imports have constantly increased as shown above with the same effect on the cost of import.

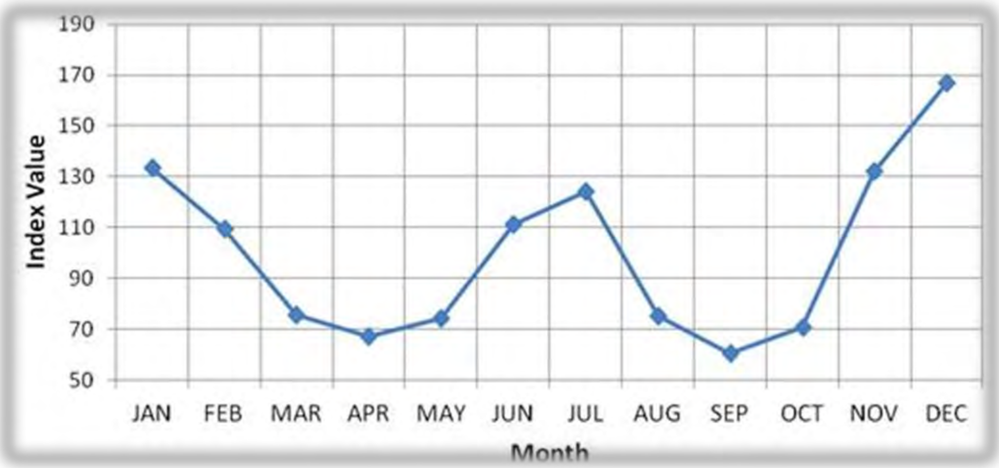


Source: Department of Customs

Figure 11.4: Annual Cost of Chili Importation

11.1.4.3 Price Variation

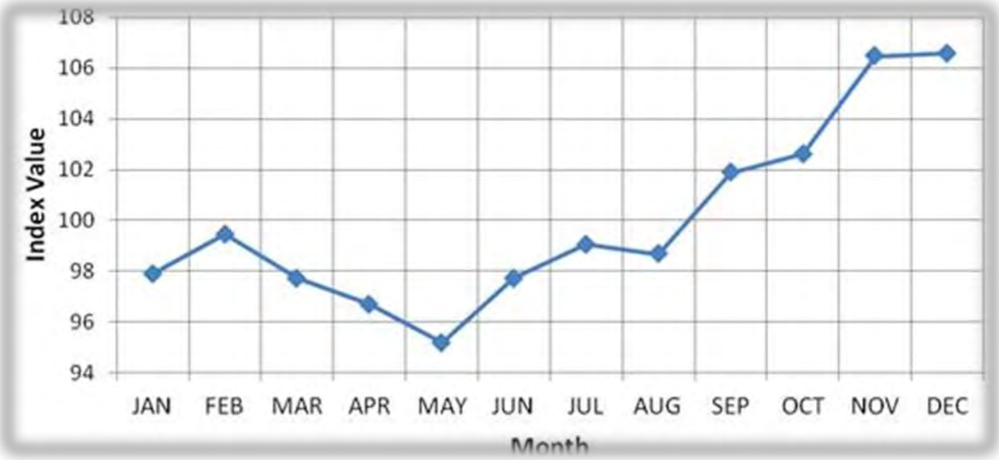
Figure 11.5 and 11.6 respectively show the price variation for green and the dried chili. It is obvious that, chili being a seasonal crop, much of the production is coming in the *maha* season. As in Figure 11.5, green chili price usually tends to remain low until the m*aha* harvest come to the market from late December, while during the early *maha* season which is considered as the off season (from October to December) price of chili takes an upward trend. Off season is normally the nursery period and the initial stage of the cultivation of chili. However, with the harvesting start from January price starts to drop gradually and start to rises again during June – July and November – December period.



Source: Marketin Food Policy and Agri- business Division/HARTI

Figure 11.5: Seasonal Price Index of Green Chilies

As illustrated in Figure 11.6 price index of the dry chilies does not shows much seasonal variation sicne it mostly depend on the imports. However, it also shows slight price drop in harvesting season.



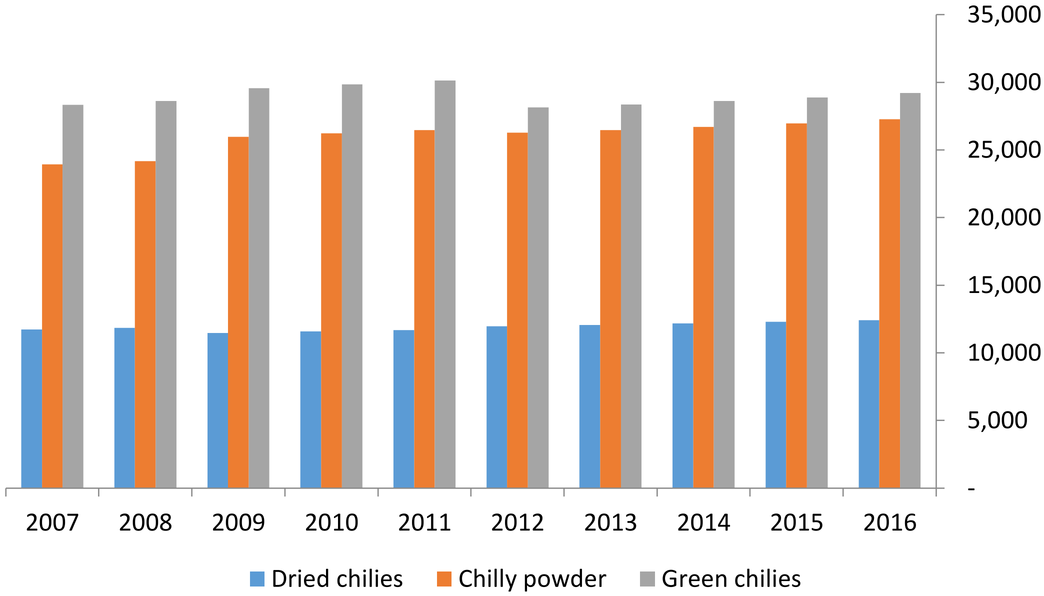
Source: Marketin Food Policy and Agri- business Division/HARTI

Figure 11.6: Seasonal Price Index of Dry Chilies

11.1.4.4 Consumption

The average per capita consumption of chili both dried and chili powder was 1.90kg per annum according to the Household Income and Expenditure Survey of the Department of Census and Statistics 2013. The country's annual requirement of dried and green chili is 50000 mt and 30000 mt respectively according to the statistics given in the hand book, "Food Production National Programme 2016-2018" published by Presidential Task Force on National Food Production.

Figure 11.7 presents the data of Household Income and Expenditure Survey of Department of Census and Statistics on the annual requirement of country's dried, green and the chili powder.



Source: Department of Census and Statistics

Figure 11.7: Chili Requirements for Consumption (mt) 2007-2016

11.1.4.5 Marketing

In major producing areas most of the farmers sell their chili harvest to the nearby wholesale market or Dedicated Economic Centre (DEC). From there it goes to the Colombo and other wholesale markets and *pola* markets which operate at regional levels and the periphery to the retailers at the end of the marketing channel. Recently a supermarket marketing Chanel has been imerged and some farmers have built up connections with that and sell best part of their produce to supermarkets at a higher price. However, selling at farmgate is not prominent with chili. Nevertheless, there were a few instances where certain supermarkets and traders having links with some selected farmers who produce for them in keeping with agreements.

Table 11.3 shows the marketing margins of chili. Accordingly, it is clear that compared to producer price the retailer price is so high that the market margin of the retailer often gets close or even goes beyond 150 percent of the producer price of chili.

Table 11.3. Marketing Margins of Chili (Rs/Kg) 2006-2016

Year	Producer Price (1) (Rs/kg)	Wholesale Price(2) (Rs/kg)	Retail Price(3) (Rs/kg)	W- P (2-1) (Rs/kg)	R-W (3-2) (Rs/kg)	R-P (3-1) (Rs/kg)	W-P/1*100 %	R-W/2*100 %	R-P(3-1)1*100 %
2006	41.39	51.72	106.94	10.33	55.22	65.55	25	107	158
2007	46.45	48.36	111.16	1.90	62.80	64.70	4	130	139
2008	103.67	122.61	216.40	18.94	93.79	112.73	18	76	109
2009	87.79	94.05	180.44	6.25	86.39	92.65	7	92	106
2010	82.75	93.40	205.29	10.65	111.89	122.54	13	120	148
2011	130.50	138.01	253.27	7.51	115.26	122.77	6	84	94
2012	81.97	98.63	211.46	16.66	112.83	129.49	20	114	158
2013	84.80	108.26	232.02	23.46	123.76	147.22	28	114	174
2014	132.51	185.75	317.92	53.24	132.17	185.41	40	71	140
2015	193.11	256.77	429.81	63.66	173.05	236.71	33	67	123
2016	194.36	206.21	384.99	11.85	178.78	190.63	6	87	98

Source: Marketing Food Policy and Agri-business Division/HARTI

11.2 Socio-Economic Characteristics of the Sample Farmers

11.2.1 Demographic Information of the Farmer Households

11.2.1.1 Family Size

When the family size of the surveyed chili farming households considered irrespective of the districts it was apparent that majority of the households have families of four members or fewer (Table 11.4). The number of households having family members between three and four is the highest (50%) in all four surveyed districts. According to the demographic data of the survey it is observed that in general the demographic situation and behaviour of the entire sample is more or less similar irrespective of the district demarcations.

Table 11.4: Family Members

No. of family members	District								Total	
	Anuradhapura		Ampara		Puttalam		Batticaloa			
	No.	%	No.	%	No.	%	No.	%	No.	%
<3	8	20.5	3	7.7	6	15.4	6	15.4	23	14.7
3<=<5	23	59.0	20	51.3	17	43.6	18	46.2	78	50.0
5<=<7	8	20.5	13	33.3	14	35.9	14	35.9	49	31.4
>=7	0	0.0	3	7.7	2	5.1	1	2.6	6	3.8
Total	39	100.0	39	100.0	39	100.0	39	100.0	156	100.0

Source: HARTI Survey Data, 2016

11.2.1.2 Age of the Chilie Farmers

In considering the age distribution of the farmers cultivating chili (Table 11.5) most of the farmers are middle or upper middle aged. This is rather substantiated by the fact that as many as 82 percent of chili farmers were 40 years or more of age. A crucial factor that emerges with this is the tendency of youth moving away from farming pursuits. This needs profounder attention of the stakeholders.

Table 11.5: Age Distribution of the Chilie Farmers

Age Category (years)	District								Total	
	Anuradhapura		Ampara		Puttalam		Batticaloa			
	No.	%	No.	%	No.	%	No.	%	No.	%
<30	1	2.6	1	2.6	0	0.0	0	0.0	2	1.3
30<= <40	9	23.1	4	10.3	5	12.8	8	20.5	26	16.7
40<= <50	10	25.6	14	35.9	12	30.8	14	35.9	50	32.1
50<= <60	11	28.2	11	28.2	16	41.0	13	33.3	51	32.7
>=60	8	20.5	9	23.1	6	15.4	4	10.3	27	17.3
Total	39	100.0	39	100.0	39	100.0	39	100.0	156	100.0

Source: HARTI Survey Data, 2016

11.2.1.3 Level of Education

Table 11.6 shows the level of education of the sample farmers had achieved.

Table 11.6: Level of Education of the Sample

Level of Education	District				Total
	Anuradhapura	Ampara	Puttalam	Batticaloa	

	No.	%	No.	%	No.	%	No.	%	No.	%
Primary(1-5 Grades)	5	12.8	10	25.6	15	38.5	12	30.8	42	26.9
Secondary (6-11 Grades)	10	25.6	16	41.0	20	51.3	15	38.5	61	39.1
Passed G.C.E. (O/L)	18	46.2	10	25.6	1	2.6	5	12.8	34	21.8
Up to G.C.E.(A/L)	3	7.7	2	5.1	2	5.1	2	5.1	9	5.8
Passed G.C.E.(A/L)	3	7.7	1	2.6	0	0.0	0	0.0	4	2.6
Not attended school	0	0.0	0	0.0	1	2.6	5	12.8	6	3.8
Total	39	100.0	39	100.0	39	100.0	39	100.0	156	100.0

Source: HARTI Survey Data, 2016

The majority i.e. 66 percent of the sample farmers had received education only up to grade 11. Almost 27 percent of the respondents in entire sample had only received primary education up to grade 5.

11.2.1.4 Primary and Secondary Sources of Income

As shown in the Table 11.7, primary source of income of almost 95 percent of chili farmers in all the four districts where the suevey was conducted was farming/animal husbandry. Due to the homogeneous nature of the sample farmers, they had a same level of dependency towards farming and animal husbandry as well.

Table 11.7: Primary Employment of the Chilie Farmers

Primary Employment	District								Total	
	Anuradhapura		Ampara		Puttalam		Batticaloa			
	No.	%	No.	%	No.	%	No.	%	No.	%
Farming/Animal husbandry	35	94.6	34	94.4	36	92.3	36	94.7	141	94.0
Agricultural labour	1	2.7	1	2.8	0	0.0	1	2.6	3	2.0
Government job	1	2.7	1	2.8	0	0.0	0	0.0	2	1.3
Self-employment	0	0.0	0	0.0	2	5.1	0	0.0	2	1.3
Foreign employment	0	0.0	0	0.0	0	0.0	1	2.6	1	0.7
Skilled labour	0	0.0	0	0.0	1	2.6	0	0.0	1	0.7
Total	37	100.0	36	100.0	39	100.0	38	100.0	150	100.0

Source: HARTI Survey Data, 2016

11.3 Agricultural Input Use in Chiie Cultivation

11.3.1 Land

Table 11.8 brings out the fact that largest extent of the land iultivated with chilie is under single ownership possession and 85 percent and 79 percent respectively in Puttalam and Batticaloa districts come under this category. This is the situation in Ampara also nevertheless encroached and permit holder lands are significant in Anuradhapura district. Ampara and Batticaloa districts have considerable share of tenancy land for chili cultivation.

Table 11.8: Land Ownership

District	Ownership	No. of farmers	No. of holdings		Total extent(ac)	
		No.	No.	%	No.	%
Anuradhapura	Single owner	34	87	39.37	114.25	38.60
	Jointly owned	2	3	1.36	8.75	2.96
	Leased in	2	2	0.90	5	1.69
	Tenancy-out	1	1	0.45	1.5	0.51
	Permit holder	16	54	24.43	61.5	20.78
	Encroached	16	29	13.12	65.75	22.21
	Mortgaged	1	2	0.90	0.75	0.25
	Other	11	43	19.46	38.5	13.01
	Total		221	100	296	100
Ampara	Single owner	31	71	58.68	76.12	46.35
	Jointly owned	5	6	4.96	8.37	5.10
	Leased in	3	4	3.31	15	9.13
	Tenancy-in	4	5	4.13	8.5	5.18
	Tenancy-out	6	9	7.44	22.5	13.70
	Permit holder	6	12	9.92	14.75	8.98
	Encroached	7	8	6.61	6	3.65
	Mortgaged	3	3	2.48	7.5	4.57
	Other	2	3	2.48	5.5	3.35
	Total		121	100	164.24	100
Puttalam	Single owner	39	113	83.70	171.5	85.43
	Jointly owned	4	4	2.96	4	1.99
	Leased in	1	1	0.74	3	1.49
	Tenancy-out	6	6	4.44	10	4.98
	Permit holder	3	4	2.96	4	1.99
	Encroached	7	7	5.19	8.25	4.11
	Total		135	100	200.75	100
Batticaloa	Single owner	39	74	82.22	37.75	78.65
	Jointly owned	1	1	1.11	0.5	1.04
	Tenancy-in	14	14	15.56	9.5	19.79
	Encroached	1	1	1.11	0.25	0.52
	Total		90	100	48	100

Source: HARTI Survey Data, 2016

Table 11.9 shows the size of land cultivated by the sample farmers. Every sample farmer cultivates at least ½ acre or more extent of land. Significantly higher percentage, 74 percent of the total sample farmers cultivate an extent of more than 2 acres according to the tabulated data. In Batticaloa district apparently those who cultivate lesser extents are highest in number while it is opposite in Anurahapura district.

Table 11.9: Extents of Land Cultivated by the Sample Chili Farmers

District	Land class(ac)	No. of farmers	%	Extent(ac)	%
Anuradhapura	2<= <5	5	12.82	17.25	5.83
	>=5	34	87.18	278.75	94.17
	Total	39	100.00	296.00	100.00
Ampara	1<= <2	1	2.56	1.00	0.61
	2<= <5	27	69.23	84.74	51.60
	>=5	11	28.21	78.50	47.80
	Total	39	100.00	164.24	100.00
Puttalam	1<= <2	4	10.26	5.50	2.74
	2<= <5	22	56.41	68.50	34.12
	>=5	13	33.33	126.75	63.14
	Total	39	100.00	200.75	100.00
Batticaloa	0.5<= <1	14	35.90	10.50	21.88
	1<= <2	22	56.41	30.25	63.02
	2<= <5	3	7.69	7.25	15.10
	Total	39	100.00	48.00	100.00
Total	0.5<= <1	14	8.97	10.50	1.48
	1<= <2	27	17.31	36.75	5.18
	2<= <5	57	36.54	177.74	25.07
	>=5	58	37.18	484.00	68.27
	Total	156	100.00	708.99	100.00

Source: HARTI Survey Data, 2016

11.3.2 Irrigation

The survey data reveals that chili cultivations in sample districts practiced more in *Maha* season than in the *Yala* and this is because chilie is mostly cultivate under rainfed conditions. Most of the farmers used flood irrigation and very few in Puttalam, Batticloa and Ampra districts have used sprinkler irrigation systems.

11.3.3 Labour

Chili is comparatively a labour intensive crop. Especially harvesting requires large amount of labour and payment is made per Kilogram plucked. The payment for a plucked Kilogram of chilie is varies among districts. In Batticaloa district during the peak harvesting period harvesting cost rate is higher than in less yielding period. As the price of chili falls during this peak harvesting period it becomes a double blow to the producers.

Table 11.10 shows the avearge cost of production of an acre of chili including and excluding family labour and the table also provides the cost of family labour.

Table 11.10: Average Cost of Production and Cost on Family Labour (Rs/ac)

	Mean Cost (Excluding Family Labour)	Mean Cost(Including Family Labour)	Cost on Family Labour
Anuradhapura	91,112.14	105,713.70	14,601.70
Ampara	36,821.09	47,743.66	10,922.57
Puttalam	50,197.62	72,969.76	22,772.14
Batticaloa	132,037.88	145,568.89	13,531.00
Average	75,978.30	92,596.43	16,618.13

Source: HARTI Survey Data, 2016

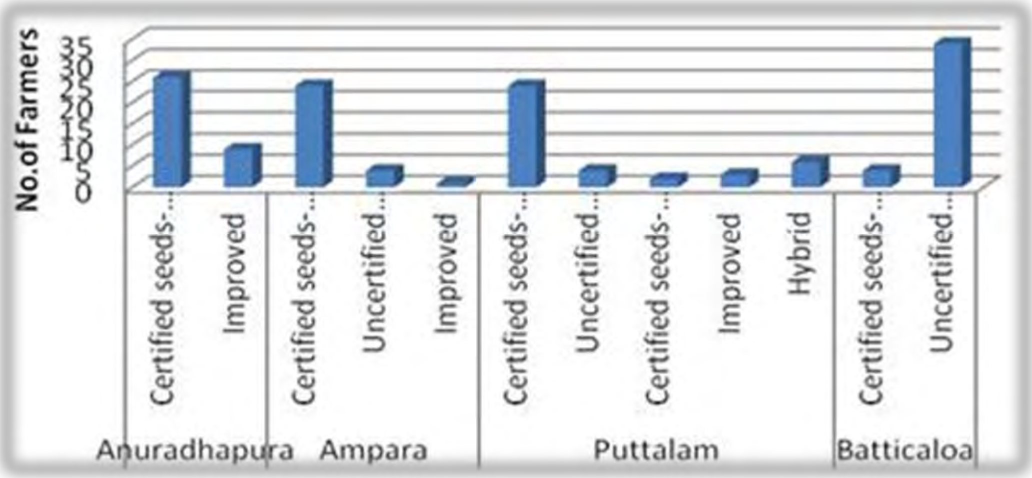
Cost of production values shows that large number of family labour is involved in chili cultivation. In addition to that, the average hired labour cost calculated for the whole four sample districts is Rs. 18,022/ac. By considing both family and hired labour components chili cultivation requires a considerable extent of labour involvement.

11.3.4 Fertilizer and Pesticides

Survey revealed that fertiliser and pesticides claim a considerable share of the total cost of production in chili. Pesticide cost is higher during the *maha* season with the increasing pest and disease attacks with high rainfall. Survey findings revealed that in farmers in Batticaloa district is used larger quantities of cow dung as organic fertilizer. This is mainly due to the absence or shortage of organic substances in the particular soil coming under the chili cultivation (De Silva, 2018). Further, cultivation of one acre of chili in the same sample area one and a half lorry loads of cow-dung is used costing Rs. 18,000/=. In addition study finds that cost of agrochemical including organic fertilizer is Rs. 87 660/- per acre on an average.

11.3.5 Seeds

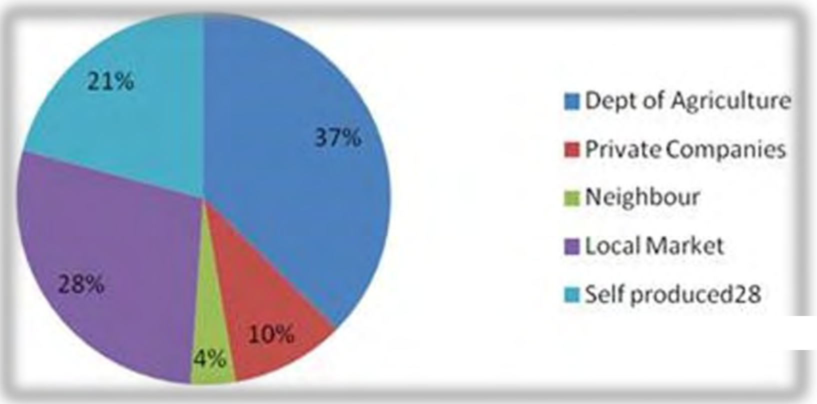
Figure 11.8 shows the types of seeds cultivated by the sample farmers and majority of the farmers in all fourr districts cultivated local seed varieties. When compared with the number of farmers who cultivated certified seeds only a fewer percentage cultivated uncertified seeds in all other three districts except in the Batticaloa district where more than 90 percent of the sample farmers cultivated a variety of seed named PC 1 uncertified and not recommended by the Department of Agriculture. Nevertheless farmers who cultivate this variety in Batticaloa district are convinced that it is the most suitable and profitable variety for them as the soil in the area does not respond much for other varieties.



Source: HARTI Survey Data, 2016

Figure 11.8: Types of Seeds Cultivated

According to the Figure 11.9 around 20 percent of farmers cultivate chili with the seeds produced by the DOA. However, except in Batticaloa district where the majority of farmers cultivate their own seeds, in other districts majority of the farmers depend on local market or private companies for their seeds requirement.



Source: HARTI Survey Data, 2016

Figure 11.9: Source of Seed Cultivated

11.3.6 Total Cost of Production

Table 11.11 shows total average cost of production of chili in all the four sampled locations according to each land category. Accordingly, in each district it appears that family labour makes a huge difference in the total cost of production. It is also clear that smaller the extent of land cultivated bigger is the share of family labour to the cost as a percentage.

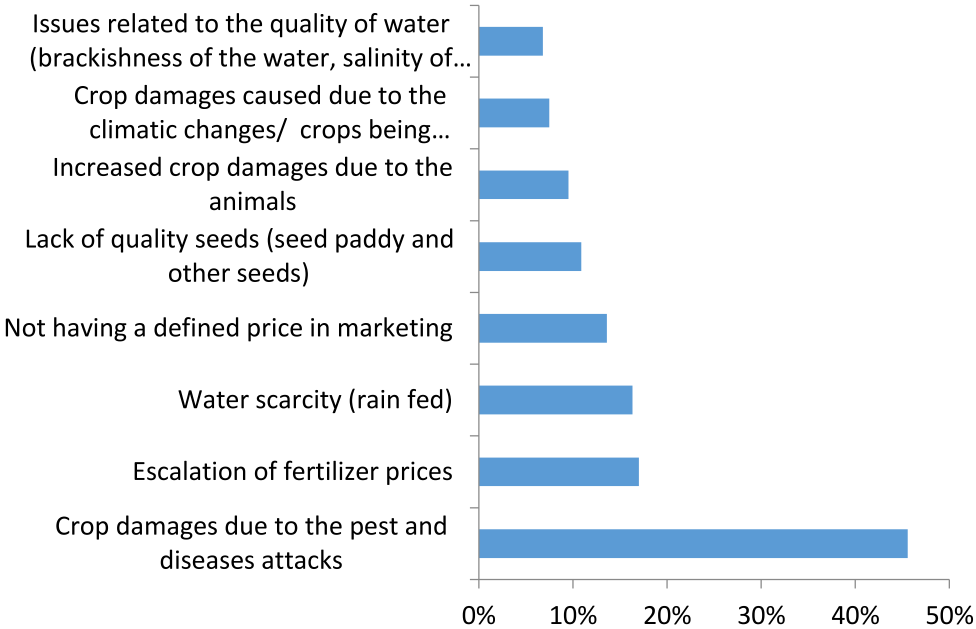
Table 11.11: Total Cost of Production based on Land Category (Rs/ac)

Ext. Group	Machinery Cost	Input Cost	Excluding Family Labour	Including Family Labour
<0.25	7058.82	31740.76	112591.25	226220.06
0.25 - 0.5	31750.00	60498.12	175790.23	349409.29
0.5 - 1	20535.25	59067.73	109308.89	221048.58
1 - 2	12816.95	76054.86	113922.32	149775.11
2 - 5	15250.00	74708.50	116925.41	122871.07
>5	2500.00	553380.00	583380.00	586240.00

Source: HARTI Survey Data, 2016

11.4 Constraints in Chilie Production

As discussed earlier in this chapter, production of chili in Sri Lanka at present caters mainly to the domestic green chili demand. Dry chili requirement of the country is almost totally imported. In case of dry chili, production has considerably dropped due to the inability of competing with the cheap imports. High cost of production, as result of several combined factors is the main constraint to chili production. The Figure 11.10 shows the production related constraints faced by the chilie farmers.



Source: HARTI Survey Data, 2016

Figure 11.10: Issues Faced by Chili Farmers

The main problem for the farmers in Batticaloa district in particular was not receiving extension support, since the majority of the farmers cultivated a variety uncertified or not recommended by the DOA. High cost of inputs has been the common major issue for farmers in all four districts and water related issues is a much concerned factor for a considerable percentage of farmers in Anuradhapura district.

As for marketing of chili, the farmers complained a great deal about not receiving a satisfactory price even when the retail price in the market is high. Some farmers found fault with the traders grouping themselves and maliciously manoeuvring to keep the prices low, pre ranting the farmers from a good price at times. With supporting this 43 percent of the total sample agrees that they do not get a fair price for their produce. This was the case for 68 percent in Puttalam district. Apart from that there are some issue with transportation and the concern on quality standards of the produce.

11.5 Findings and Recommendations

11.5.1 Findings

In Sri Lanka the main issue related to chili cultivation (especially dry chili) is high cost of production. Sri Lankan farmers are unable to compete with the cheap imports in the open market. Even for green chili farmers get a minimum price hence it is not economical for them to produce dry chili when compareing the price of imported dry chilie and quantity of green chili required to produce one kilogram of dry chilie.

One of the main reasons for high cost of production in green chilie is the excessive use of input, mainly agrochemicals since farmers are compelled to use excessive quantities of agrochemicals unnecessarily. Not having peoper extension facility also hinders the economical production of green chilies.

11.5.2 Recommendations

Baseline survey findings reiterates the necessity of a better extension service to help the farmers the high cost of production, increase the profit margin of the farmers as well as strengthen their ability to compete with cheaper imports. Further research and development of more local high yielding varieties which suit the different climatic and soil types is required. Making funds available for required research and development activities oriented towards increasing chili production in the country is of pivotal importance.

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Chapter Twelve

Potato

R.P. Vidanapathirana

SUMMARY

Potato is a highly attractive cash crop of the farmers in the upcountry farming system due to its high net return. The Ministry of Agriculture organized the "National Food Production Programme" in 2015 with a view to attaining self-sufficiency in selected agriculture commodities and curtailing imports of food items. For potato, the high cost for seed materials, low quality seeds and non-availability of seeds in time are the major problems. Under the National Food Production Programme it is aimed to produce high quality G_0, G_1 (2,500 mt) and G_2 (12,500) potato seeds. This chapter consists of the baseline information of the sample potato farmers in major potato producing districts (Nuwara Eliya, Badulla and Jaffna) in the country.

According to the total cultivated potato extent recorded during last ten years' period (2006-2015), about 75 percent of the extent recorded in the Badulla district, while it was recorded as 23 percent in the Nuwara Eliya district. Other producing areas mainly Jaffna contributed for two percent. Two main peak producing seasons are found in Badulla district between February to April (*Maha* harvest) and from October to November (*Yala* harvest). The main production from Nuwara Eliya district reaches the market from April to June (*Maha* harvest) and from October to December (*Yala* harvest).

Considering the total availability of potato in the country, about 60 percent comes from imports and due to this, potato cultivation has faced strong competition. The quantity of imports, during the last 10 years had increased considerably. Considering the total imports recorded in 2013, the majority of the imports (about 63 percent) had arrived from Pakistan, followed by India (26 percent). Imports of potatoes are the major problem for the farmers, while it is the major solution for the consumers. Therefore, tariff and non-tariff policy is the main policy of the government which determines the potato production in the country.

Considering the demographic information of potato farmers in the baseline survey, the highest percentage of (50 percent) households consisted of 3-5 family members including both parents and children. The largest proportion of respondents (40 percent) falling into the age category of more than 50 years and less than 60 years of age. The higher proportion (32 percent) of the total sample population had secondary education (grade 6 to 11). Also, 29 percent of the total sample had education up to G.C.E. (O/L) and 28 percent had primary education (grade 1-5).

The ownership of landholdings of potato farmers in the baseline survey, most of them were single owners in all three districts (66 percent in Nuwara Eliya; 61 percent in Badulla and 59 percent in Jaffna). According to the land size distribution in the total sample, about 41 percent of the potato farmers operate cultivation in land class of 0.5-1 acres and there were 39 percent farmers with land class of 0.25-0.5 acres.

Survey results indicated that the highest percentage of the potato farmers practice cultivation of potato largely on highlands in *Maha* season recorded as 52 percent. This was significant in Badulla (45 percent) and Jaffna (88 percent) districts. A total of 27 percent farmers also do cultivation on lowlands in *Yala* season. This was prominent in the Nuwara Eliya district (44 percent).

It was observed that most of the potato growers in the up country depend on natural precipitation while growers in the coastal districts (Jaffna) use irrigation. It was reported for about 37 percent farmers in the Badulla district and 42 percent farmers in the Nuwara Eliya district, rain-fed was the main source of water. The main source of water used by Jaffna farmers was agro-wells which were recorded as 72 percent.

In the market, there are different types of seeds available for farmers. In both Nuwara Eliya (60 percent) and Badulla (63 percent) districts, the most of the farmers have used locally produced certified seeds. However, in Jaffna district, about 64 percent of the farmers have used imported certified seeds. Most of the farmers have used "Granola" seed variety (92 percent in Nuwara Eliya and 90 percent in Badulla) whereas most of farmers (61 percent) in Jaffna district have used "Red la Soda" variety, followed by "Sasi" variety (27.5 percent).

Considering the crop specific issues faced by the potato farmers as a whole, most of them reported that (24 percent) they do not receive a better price when selling potato. About 14 percent of the farmers reported high price of seeds as the second main issue. Thirteen percent total farmers reported that lack of quality potato seeds.

Potato is one of the crops that require inputs intensively for its cultivation. Potato demands a heavy investment during the cropping period in which seed material alone accounts for about 40-50 percent of the cost of production. Seed, fertilizer and agro-chemicals together accounted for about 60 percent of the total cost of production which are mainly derived from foreign sources. The cost of production of potato in Sri Lanka is relatively high when compared to the other countries in the region.

In the survey the farmers reported that high price of seeds and lack of quality potato seeds as main crop specific issues. The price of imported seeds is high compared to locally produced seeds. Most of those available seeds are in G_6 and G_7 stage seeds which have low productivity and the low quality seeds compared to G_0 and G_1 seeds. Therefore, it is important to produce high quality G_0, G_1 and G_2 potato seeds. It is also important to establish seed storage facilities in major growing areas.

Lack of long term potato import policy is also a problem. Changes of tariff (duty) rates decrease the stability of production. The significant step has been taken in this direction by the government of Sri Lanka, by controlling or limiting the imports of potato in ad-hoc basis. The tariff rates and tax system are frequently changed. Therefore, long term import policies are required for further improvement.

In case of potatoes, there is an adverse environmental consequence by encouraging widespread production in environmentally fragile upcountry areas; contributing to serious degradation and soil erosion. Therefore, when expanding potato cultivation, environment impact should be taken into consider especially in up country producing areas.

There should be a right balance of development strategies for the improvement of potato production and marketing system in Sri Lanka. Therefore, researchers, statisticians, academicians and policy makers have to play a major role in formation and implementation of new balance strategies for upgrading of production and marketing system of potatoes in the country.

Research and development facilities should be improved and the local farmers should be aware of the importance of using research and development facilities. Then the quality of the seeds, cultivation methods and also the marketing systems can be developed for a better and quality production.

CHAPTER TWELVE

Potato

12.1 Overview of Potato Cultivation

12.1.1 Introduction

There are over 4,000 edible varieties of potato, mostly found in the Andes of South America. Potato (*Solanum tuberosum* L.) is one of the most commonly grown tuber crops all over the world after rice and wheat in terms of human consumption. More than a billion people worldwide eat potato, and global total crop production exceeds 300 million metric tons. The potato is an important commodity in the countries of South Asia. Because of the crop's short vegetative cycle, potato plays an important role in the region's food security. The potato in Asia and especially in the South Asia region has experienced the world's highest annual growth rate in production over past three decades (FAO, 2016).

Potato is a critical crop in terms of food security in the face of population growth and increased hunger rates. Both potato production and consumption are accelerating in most of the developing countries and it is expected that the trend will continue for the years to come. The two emerging Asian economies viz. China and India together contribute to nearly 1/3rd of the global potato production today. Potato is preferred in these densely populated countries largely because of its high productivity, flexibility in terms of fitting into many prevailing cropping systems, and stable yields under conditions in which other crops may fail.

Potato crop was introduced to Sri Lanka by Samuel Bekar in 1850. It is well grown in the wet and intermediate zones (WU, IU) of the up country in both seasons and in some parts of the dry zone (DL3) during *Maha*. Potato cultivation is mainly dependent on imported potato seeds, Granola and Desiree are the two main imported seed varieties cultivated by more than 60 percent of the potato farmers. Among the local varieties developed by the Department of Agriculture, the variety called Hillstar which is much resistant to blight is getting popular among farmers. Other varieties recommended by the Department of Agriculture are Desiree, Sante, Raja, Granola, Kondor, Isna and Golden star. Potato seed production using micro-propagation or tissue culture technique started in 1999 at the Agricultural Research Station in Sitaeliya which supplies the total demand of tissue culture plants for the seed potato production programmes. The varieties multiply are Desiree, Isna, Hillstar and Granola. At present, Research divisions (Sitaeliya and Bandarawela), government seed farms (Sitaeliya, Mipilimana, Piduruthalagala, Udaradella, Kandapola, Bopaththalawa) and private sector contract growers together supply around 8-10 percent of the seed potato requirement through in-vitro propagation technique.

Considering the total availability of potato in the country, about 60 percent comes from imports mainly from India and due to this, potato cultivation has faced a strong competition. Though the potato cultivation yields high productivity, harmful effects such as soil erosion and environment pollution assume serious proportions.

Potato is the most popular cash crop of the upcountry farmers due to its high net return. In Nuwara Eliya district, potato cultivation is mainly pursued as a cash crop, while in Badulla district it is the means of livelihood of small scale farmers.

The government's agriculture policy is anchored to the strategy of making the country self-sufficient in maize, soya beans, chilies, big onions, and potatoes by 2018 through crop diversification and productivity improvement while gradually shifting from subsistence agriculture to agri-business with access to export markets by 2020 (Central Bank of Sri Lanka, 2015).

Meanwhile, the Ministry of Agriculture organized the “National Food Production Programme” in 2015 with a view to attaining self-sufficiency in selected agriculture commodities and curtailing imports of food items. For potato, the high cost for seed materials, low quality seeds and non-availability of seeds on time are the major problems. Under the National Food Production Programmes it is aimed at producing high quality G_0, G_1 (2,500 mt) and G_2 (12,500 mt) of potato seeds and also, to establish seed storage facilities in Seethaeliya, Keppetipola and Boralanda areas. Under this programme, the districts of Kandy, Matale, Kegalle (75 ha), Mullaitivu, Killinochchi and Mannar (350 ha), Putalam (55 ha) and Badulla (1,035 ha) have been identified as suitable areas for the expansion of potato cultivation (Ministry of Agriculture, 2015).

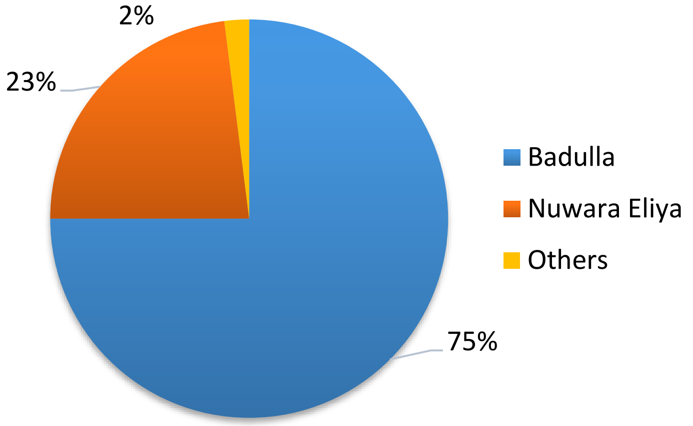
12.1.2 Major Growing Areas and Extent under Cultivation

Badulla and Nuwara Eliya districts are the major potato growing districts in the country. Considering the total cultivated extent recorded during the last ten year period (2006-2015) (Annex Table 12.1 and Figure 12.1), about 75 percent of the extent under potato was recorded in Badulla district, while it was 23 percent in Nuwara Eliya district. Of the other producing areas mainly Jaffna accounted for only two percent of the extent.

In Badulla district, potato is cultivated in paddy fields (lowlands) and on highland during *Yala* and *Maha* seasons respectively. This area experiences a rainfall of 1,500-2,250 mm annually with 70 percent RH and 15^0C–22^0C range in temperature. Welimada and Uva Paranagama are the main potato growing areas in Badulla district.

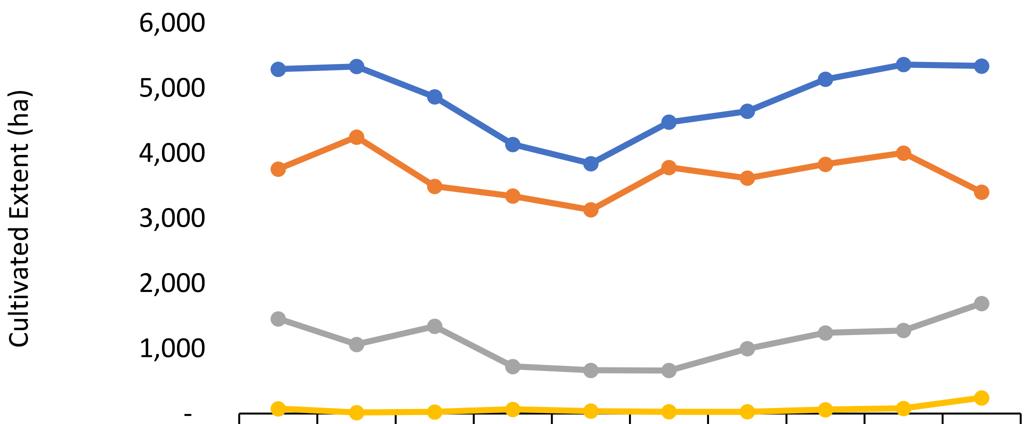
Potato is extensively cultivated in the district of Nuwara Eliya in two major seasons, *Maha* and *Yala* where annual rainfall is >2,500 mm and temperature ranges between 10^0C-15^0C with relative humidity of 80 percent. In Nuwara Eliya district, Lindula, Thalawakele, Kandapola, Ragala and Pattipola are the main potato cultivation areas.

Jaffna is the other district where the potato is grown in lesser extents during *Maha* season. The cultivation has dropped to only 1-2 percent in the recent years.



Source: Department of Census and Statistics, 2015

Figure 12.1: Average Extent of Potato in Major Producing Districts (2006-2015)



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Badulla	3,76	4,25	3,49	3,34	3,13	3,78	3,61	3,83	4,00	3,40
Nuwara Eliya	1,45	1,06	1,34	725	668	664	999	1,24	1,27	1,69
Other	76	17	28	68	41	31	30	62	83	245
National	5,29	5,33	4,86	4,13	3,84	4,48	4,64	5,13	5,36	5,34

Source: Department of Census and Statistics, 2015

Figure 12.2: Cultivated Extent of Potato (2006-2015)

12.1.3 Climate and Soil

Potato is well grown in wet and intermediate zones (WU, IU) of the up country in both seasons and in some parts of the dry zone (DL3) during *Maha* at temperatures between 24^0 C and 32^0 C and rainfall of >2,500mm, as well as in Puttalam and Jaffna districts during *Maha*. The optimum day temperature required for potato is $20\text{-}25^0$C and temperature difference between day and night should be 10^0C. Well-drained latosals, regosols and non-calcic brown soils are generally unsuitable for potato cultivation (http://www/doa.gov.lk).

The climate of Nuwara Eliya district is ideally suited for seed potato production. The peak periods of planting are during the months of August-September (*Yala* planting) and February-March (*Maha* planting). Planting cannot be done in May, June and July because of the heavy winds and rain. Similarly, production in December and January is restricted because of the night frost in these two months.

In the existing climatic conditions in Jaffna, only one crop a year is possible. Potatoes are planted in November after heavy rains in October. Cool night temperature during December and January help in tuber initiation and formation, resulting in fairly high yields.

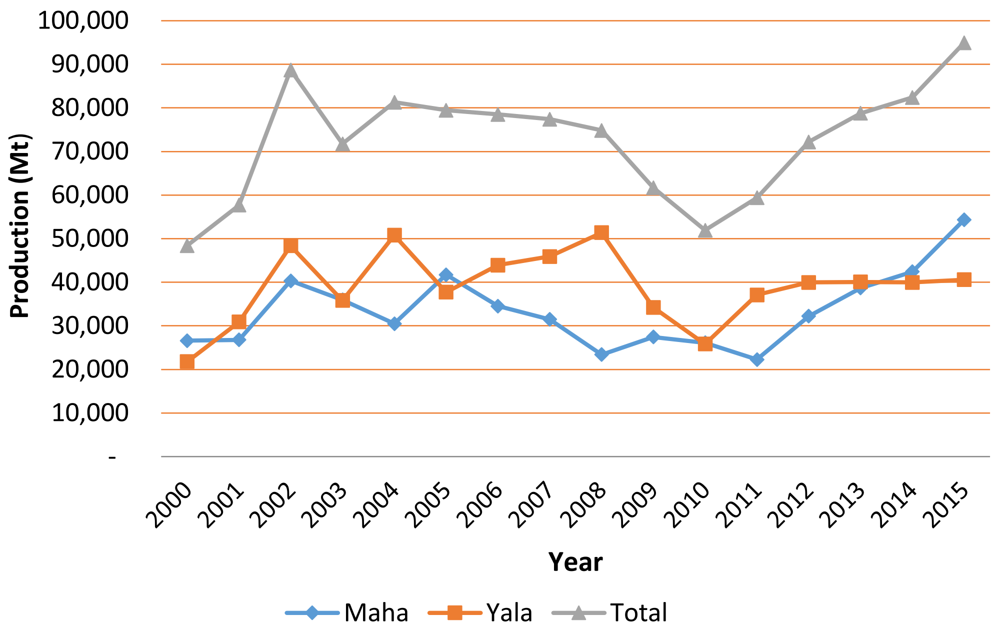
12.1.4 Importance of the Crop to the Economy

Government policy towards this sector varied widely over the years due to the pressure from different groups including growers, policy makers, consumers and other interested groups. When compared with neighbouring countries, productivity of paddy in Sri Lanka is at an acceptable level while the other crops are not so. This is mainly due to inadequate use of quality seed and planting material, low level of technological innovation, lack of mechanization and inappropriate use of land, water, fertilizer, chemicals as well as inappropriate cultivation and harvesting practices. Therefore, the government has taken several measures to enhance productivity and production of potato through improving research and development, agricultural extension, enhancing irrigation facilities, promoting use of improved varieties and new technology and providing incentives and subsidies.

In favour of potato producers, the government imposed a high duty or imposed restrictions on issuing licenses for importers in some years. Conversely, in other years, government relaxed the duty and a more liberalized market is maintained to increase the welfare of the consumers. Therefore, tariff and non-tariff policy is the main policy of the government which determines the potato production in the country. The country's agricultural policy continued to focus on increasing domestic food production to enhance food security, reduce import expenditure, and promote agricultural exports. With a view to reducing the imports of some food commodities while encouraging local production of such food commodities, the Specific Commodity Levy (SCL) on imports of selected commodities was increased.

12.1.4.1 Production

As shown in the Annex Table 12.2 and Figure 12.3, the potato production has increased from 2000 to 2002 and from 2002 it had shown a decreasing trend up to 2010/11 *Maha* season. According to the Annual Report (Central Bank of Sri Lanka, 2008), the decline in potato production in the country in 2008 was caused largely by shortage of quality potato seeds during the time of cultivation and increase in prices of imported potato seeds. It had also declined further in 2011 due to the impact of adverse weather conditions during 2010/11 *Maha* season. However, from 2011 up to 2015, it had shown an increasing trend due to increased production in the *Maha* season and paddy farmers had shifted into field crop cultivation in the *Yala* season due to the limited supply of water for paddy cultivation and minimizing of the imports. Further, this progress of production was supplemented by factors such as the continuation of the government fertilizer support scheme, the availability of sufficient water supply and remunerative prices together with effect of increase in the Special Commodity Levy (SCL) on import of some commodities to promote local substitutes. The fertilizer subsidy programme for other crops was announced from May, 2011 as an incentive for farmers to expand their cultivating capacity from one crop to multiple crops and to encourage productivity of agriculture. For the period of 2000-2015, the highest production of 94,895 mt was recorded in 2015.



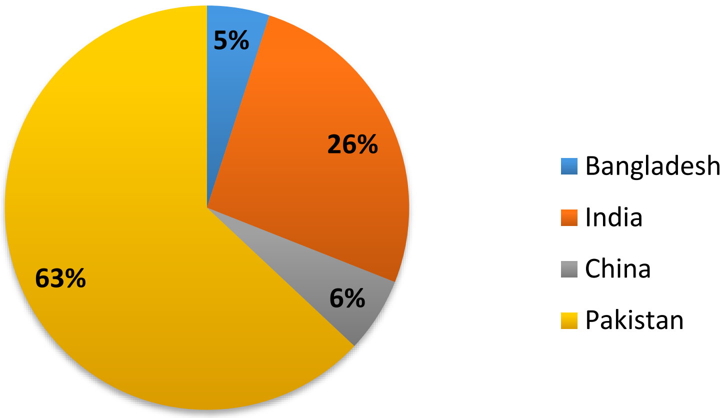
Source: Department of Census and Statistics, 2015

Figure 12.3: Production of Potato (2006-2015)

12.1.4.2 Imports

Potato is imported to meet the growing demand in the country especially during the off producing periods. Imports become the main supply to market during the months of June, July and January. Relatively cheap imports mainly from India create a competitive market for the local potato products. However, the local production of potato had hardly been competitive. Therefore, price protection in form of an import duty is provided for potato as one of the important measures taken by the government to protect farmer. During off-season, potato market is liberalized to meet the domestic demand.

Considering the total imports recorded in 2013, majority of the imports (about 63 percent) had arrived from Pakistan, followed by India (26 percent). Also, about six percent and five percent of the imports were received from China and Bangladesh respectively.



Source: Sri Lanka Customs, 2013

Figure 12.4: Imports of Potato based on Countries of Imports (2013)

Import of potatoes is the major problem for farmers, while it is the major solution for consumers. The quantity of imports, during last 10 years had increased considerably as shown in the Table 12.1. Further, the value of the imports and unit prices of potatoes (CIF) have significantly increased. Therefore, an increasing trend of all these import variables causes difficulties to local potato production and marketing system. Potato imports in 2015 were 142,182mt, which accounted for 60 percent of the local requirement. The value of imports was recorded as Rs. 4,801 million with a CIF price of Rs. 33.77/kg in 2015.

Table 12.1: Quantity, Value of Imports and CIF Price of Potato and Potato Seeds during 2006-2015

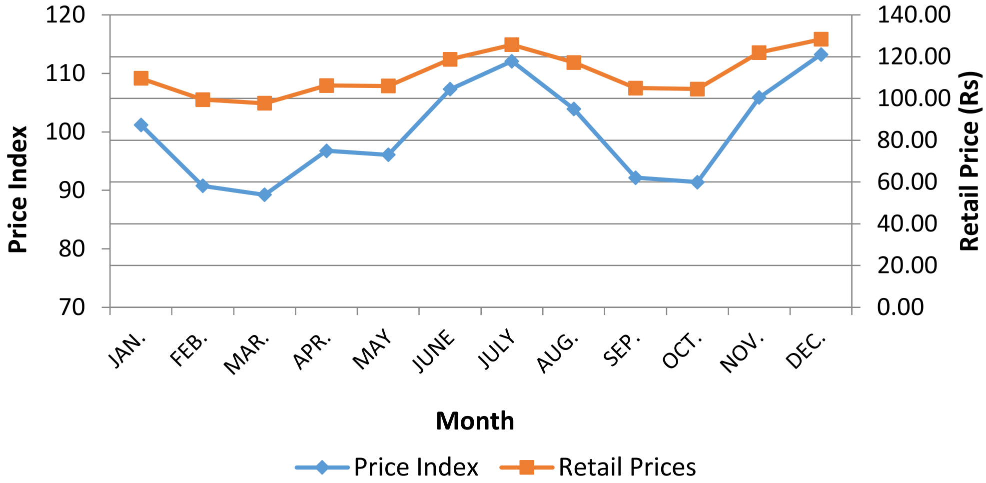
Year	Potato			Potato Seeds		
	Quantity (mt)	Value (000' Rs.)	CIF Price	Quantity	Value	CIF Price
2006	46,556	1,081,203	23.22	2,245	185,041	82.42
2007	85,929	2,210,497	25.72	1,782	198,812	111.57
2008	99,353	2,552,926	25.70	1,208	131,958	109.24
2009	99,622	2,647,910	26.58	1,010	106,391	105.34
2010	129,879	4,167,941	32.09	1,015	94,555	93.16
2011	130,511	3,943,024	30.21	1,097	116,620	106.31
2012	110,823	2,893,360	26.11	1,926	236,325	122.70
2013	123,204	4,820,000	39.12	1,464	201,380	137.55
2014	118,220	4,676,726	39.56	1,817	233,862	128.71
2015	142,182	4,801,442	33.77	2,485	318,042	127.98

Source: Sri Lanka Customs, 2015

Considering the potato seed imports during last ten year period, it has shown a decreasing trend from 2006-2011. However, from 2012 to 2015, it had shown an increasing trend and the highest quantity of imports was recorded in 2015 as 2,485mt.

12.1.4.3 Price Variation

As potato is a seasonal crop, price fluctuation within a year follows a pattern of increasing prices during off season and a decreasing price in harvesting season. According to the seasonal price index, main price peak is observed during the months of June to August and again another peak during the months of November and December. Meanwhile, prices reach the minimum during the months of September to October and February to May due to peak producing seasons both in Badulla and Nuwara Eliya districts.



Source: Marketing Food Policy and Agri-business Division/HARTI, 2015

Figure 12.5: Average Retail Prices (1996-2015) and Seasonal Price Index of Potato

12.1.4.4 Consumption

Potato consumption has rise due to increasing industrialization and participation of women in job market and that created a demand for processed, ready-to-eat convenient food, particularly in urban areas.

Consumption of potato as a vegetable in Sri Lankans has increased with availability of potato at the market by means of local production and imports. According to the latest consumption survey in 2012/13 by the Department of Census and Statistics, per capita consumption of potato was 6.08 kg/year. Consumption among the high income groups is relatively more and it increases with the increasing income. However, per capita consumption in different sectors; urban, rural; estate does not show much differences.

Table 12.2: Per Capita Consumption of Potato over the Years

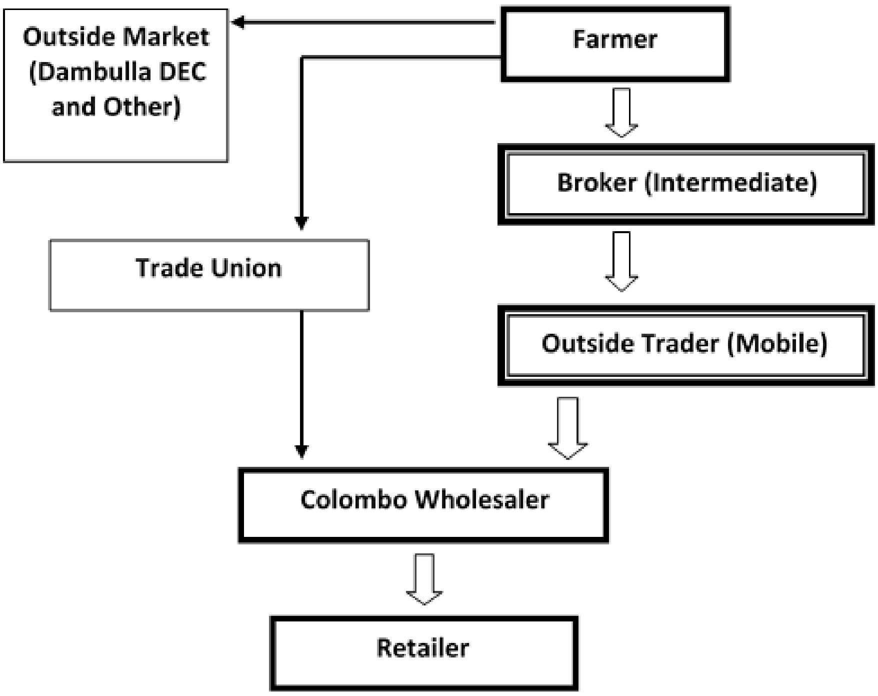
Year	grams/year
2005	4966.0
2006/07	5586.4
2009/10	5800.8
2012/13	6087.0

Source: Department of Census and Statistics, 2015

12.1.4.5 Marketing

Marketing Channels

The major assembling markets are located in the city of Nuwera Eliya, Badulla, Welimada and other few rural and urban centers of Kandapola, Ragala, Maturata, Kappetipola, Walapane and Mandaramnuwara. These key assembling markets in major producing areas send their collections to terminal wholesale markets of Colombo, Dambulla and Kandy while sending some stocks to other small regional markets. Bandarawela, Keppetipola DEC and Nuwara Eliya are the major producer-wholesale meeting points that facilitate potato marketing.

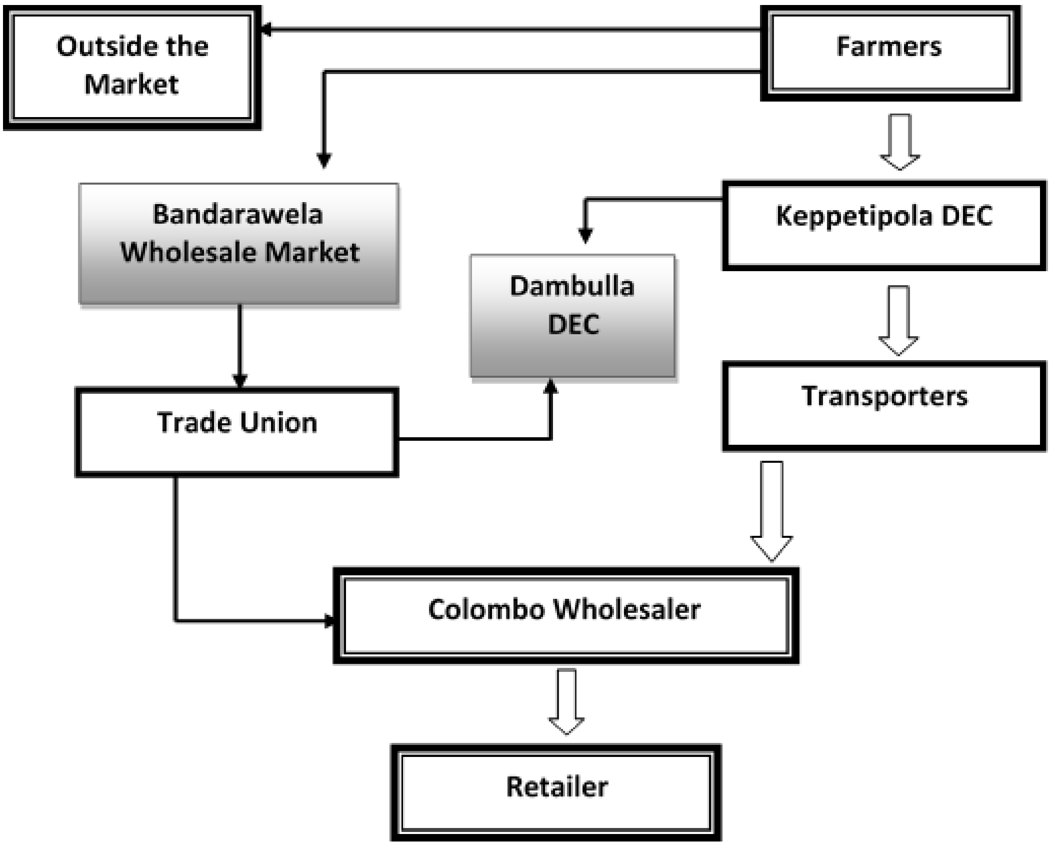


Source: HARTI Survey Information, 2016

Figure 12.6: Marketing Channels of Potato Supplies from Nuwara Eliya

In Nuwara Eliya district, there are two types of major marketing channels which supplies potatoes to Colombo. About 30 percent of the production moves through the transporters' union to Colombo wholesale market. Another 40 percent of the production reaches through collectors to the Colombo wholesale market. Rest of the production moves to outside markets such as Dambulla DEC (Priyadarshana, et al. 2011).

In Badulla district, there are two major marketing channels which supplies potatoes to Colombo. About 30 percent of the producers supply their production to Keppetipola DEC and from there potatoes are supplied to Colombo wholesale market through transporters. Another 30 percent of the production is supplied to Bandarawela wholesale market. From there, potatoes are moved to Dambulla DEC and Colombo wholesale market (Priyadarshana, et al. 2011).



Source: HARTI Survey Information, 2016

Figure 12.7: Marketing Channels of Potato Supplies from Badulla

A Review of Market Margins

The Table 12.3 presents the producer's share, wholesaler's gross margin and retailer's gross margins for Nuwara Eliya potato during the period of 2006-2015. According to that, the producer's share of Nuwara Eliya potato ranged between 59 -71 percent. Wholesalers charge 10 percent as a service charge. As a result of the farmer protection programme, tariff rate was increased during the harvesting season. Therefore, farmers were able to earn a higher income. Retailers' gross margin was about 26 percent and wholesalers' about 14 percent in 2015.

Table 12.3: Producer's Share and Gross Price Margin of Local Potato (Nuwara Eliya)

Year	Farm-gate Price	Wholesale Price	Retail Price	Price Margin			3/1	2/1
	1	2	3	Farmer 1/3*100	Wholesaler (2-1)/3*100	Retailer (3-2)/3*100		
2006	52.97	60.48	74.92	70.70	10.02	19.27	1.41	1.14
2007	53.73	66.11	81.31	66.08	15.23	18.69	1.51	1.23
2008	56.78	66.63	84.35	67.31	11.68	21.01	1.49	1.17
2009	68.33	81.76	104.15	65.61	12.89	21.50	1.52	1.20
2010	71.17	84.22	108.18	65.79	12.06	22.15	1.52	1.18
2011	80.99	95.80	123.00	65.85	12.04	22.11	1.52	1.18
2012	76.65	93.39	123.94	61.84	13.51	24.65	1.62	1.22
2013	79.55	98.55	134.90	58.97	14.08	26.95	1.70	1.24
2014	87.87	104.49	139.68	62.91	11.90	25.19	1.59	1.19
2015	86.11	105.46	142.40	60.47	13.59	25.94	1.65	1.22

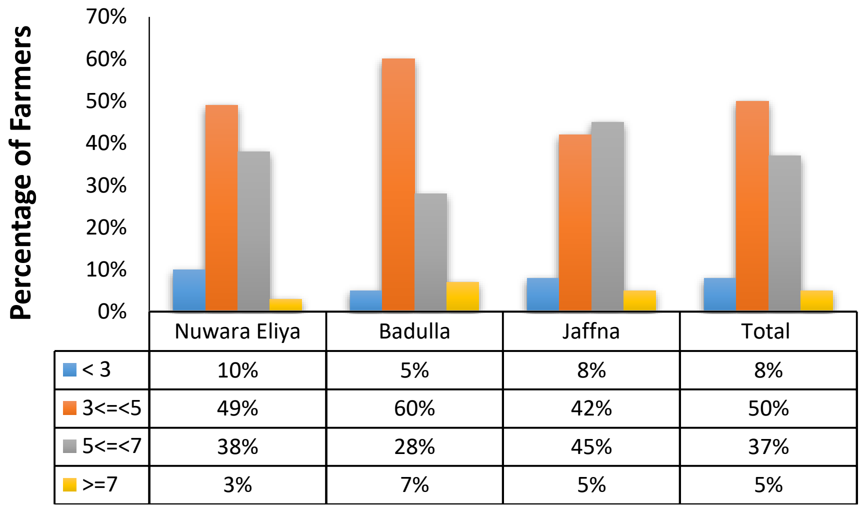
Source: Marketing Food Policy and Agribusiness Division/HARTI, 2015

12.2 Socio-economic Characteristics of the Sample Farmers

12.2.1 Demographic Information of the Farmer Households

12.2.1.1 Family Size

In the total sample (119) of potato growing farmers, the highest percentage of (50 percent) households consisted of 3-5 members including both parents and children. There were 37 percent of households with 5-7 family members. When considering the number of household members in each district, 49 percent of the households in Nuwara Eliya and 60 percent households in Badulla district consisted of 3-5 members whereas it was recorded that about 45 percent of the households in Jaffna district had 5-7 members in each household.

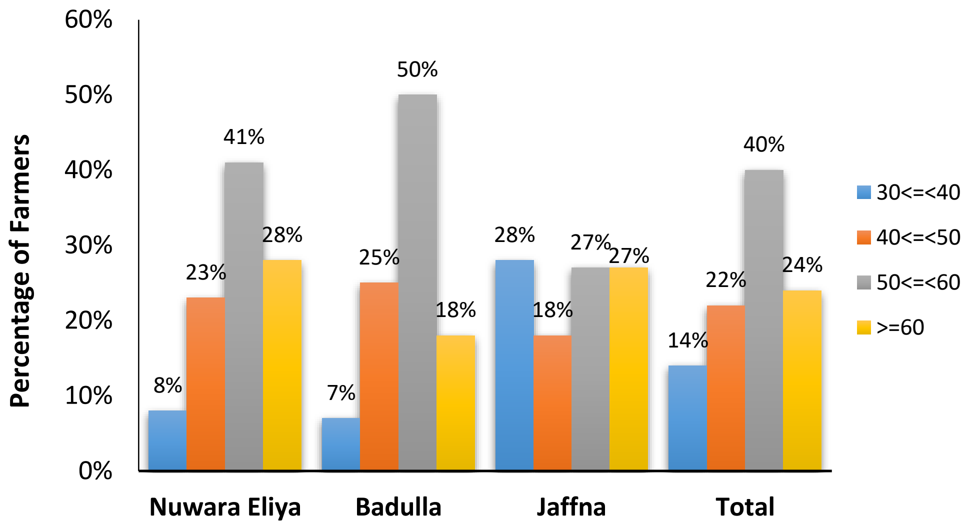


Source: HARTI Survey Data, 2016

Figure 12.8: Number of Family Members in the Potato Growing Households

12.2.1.2 Age Categories

It is important to take age into consideration when designing strategies because age could affect willingness to adopt new technologies. The age of the head of household respondents ranged from age<30 to age>=60 with the largest proportion of respondents (40 percent) falling into the age category of more than 50 years and less than 60 years of age. According to the age categories of the respondent farmers in each district, about 41 percent of the farmers in Nuwara Eliya and about 50 percent of the farmers in Badulla district belong to the age group of more than 50 years and less than 60 years. In Jaffna district, there were 27 percent of farmers representing the age group of 50-60 years and also 27 percent of farmers with the age of more than 60 years.



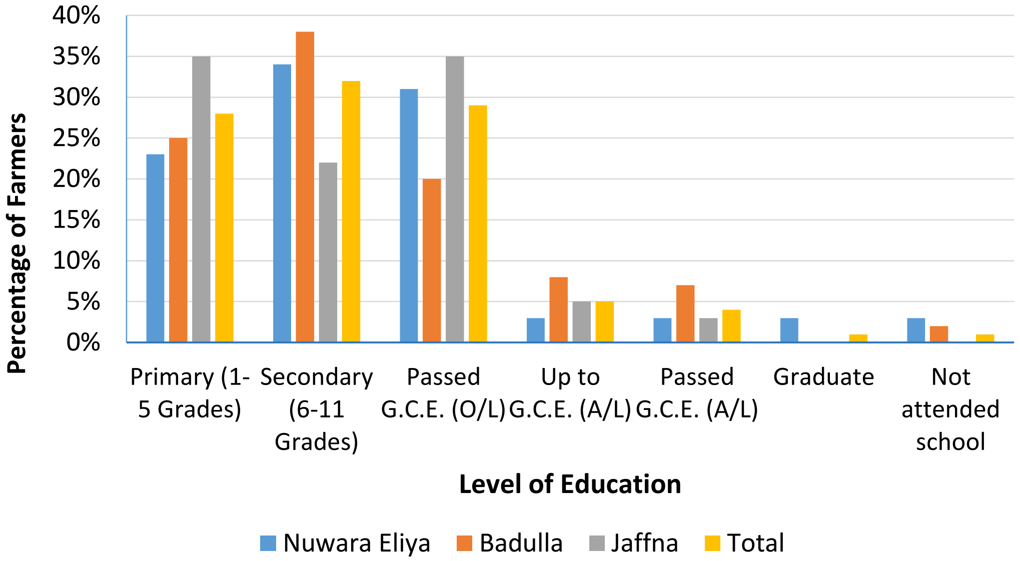
Source: HARTI Survey Data, 2016

Figure 12.9: Age Distribution of Head of Households of Potato Farmers

12.2.1.3 Level of Education

Figure 12.10, shows the differences in educational attainments of the heads of households of potato growing farmers in the respective districts according to which a higher proportion (32 percent) of the total sample population had secondary education (grade 6 to 11). Further, 29 percent of the total sample had education up to G.C.E. (O/L) and 28 percent had only primary education (grade 1-5).

Considering the level of education at district level, the secondary education was the highest level of education of the farmers in the Nuwara Eliya district (34 percent) and the farmers in Badulla district (38 percent). In Jaffna district, about 35 percent of the sample farmers had education up to G.C.E. (O/L) while 35 percent of the farmers had primary education (grade 1-5).



Source: HARTI Survey Data, 2016

Figure 12.10: Level of Education of Head of Households of Potato Farmers

12.2.1.4 Primary and Secondary Sources of Income

In all three districts primary occupation of the majority of the sample farmers (96 percent) were agriculture.

Table 12.4: Income Source of Head of Households of Potato Farmers

Primary Occupation	Nuwara Eliya		Badulla		Jaffna		Total	
	N	%	N	%	N	%	N	%
Farming/Animal husbandry	34	94	40	100	38	95	112	96
Agricultural labour	0	0	0	0	1	3	1	1
Government job	0	0	0	0	1	2	1	1
Self-employment	1	3	0	0	0	0	1	1
Skilled labour	1	3	0	0	0	0	1	1
Total	36	100	40	100	40	100	116	100

Source: HARTI Survey Data, 2016

12.3 Agricultural Inputs

12.3.1 Land

Table 12.5 depicts the ownership of landholdings of potato farmers in the three districts. A total of 66 percent of the farmers were single owners of their cultivating lands. This was highest in the Nuwara Eliya district (79 percent). There were 61 percent of farmers in Badulla district and 59 percent farmers in Jaffna district reported as single owners. There were only a few percentage of farmers those who possess jointly owned, leased in and tenancy ownership in all the three districts.

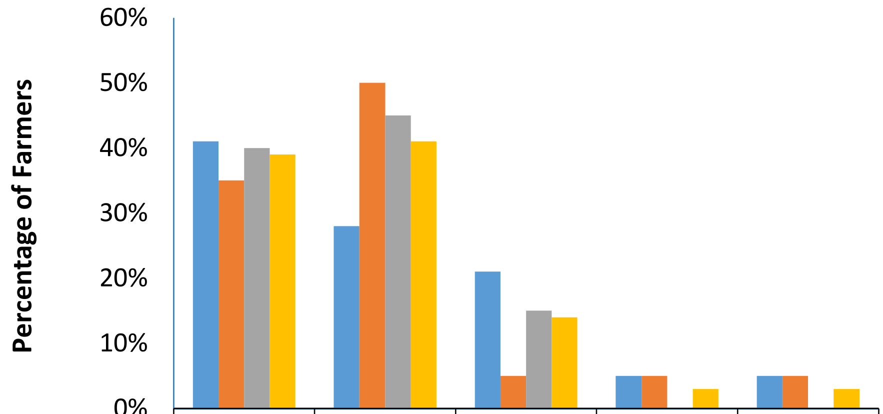
Table 12.5: Distribution of Landholdings by Ownership

Ownership	Nuwara Eliya	Badulla	Jaffna	Total

	N	%	N	%	N	%	N	%
Single owner	38	79	35	61	36	59	109	66
Jointly owned	5	11	4	7	2	3	11	7
Leased in	2	4	6	11	3	5	11	7
Tenancy-in	0	0	0	0	12	20	12	7
Tenancy-out	1	2	0	0	6	10	7	4
Permit holder	1	2	5	9	0	0	6	4
Encroached	0	0	4	7	0	0	4	2
Mortgaged	0	0	2	3	0	0	2	1
Rented out	1	2	1	2	2	3	4	2
Total	48	100	57	100	61	100	166	100

Source: HARTI Survey Data, 2016

It is important to understand the land size distribution of the sample farmers in respective districts. In the total sample about 41 percent of the potato farmers operate cultivation in land class of 0.5 - 1 acres and there were 39 percent of farmers with land size ranging from 0.25 - 0.5 acres. In the Nuwara Eliya district, most of the farmers (41 percent) owned land extent less than 0.25 to between 0.25 - 0.5 acres and the second highest land class size was between 0.5 to less than 1 acre. In Badulla district, it was recorded that about 50 percent of potato farmers belongs to land size class of 0.5 to 1 acre and 35 percent of farmers to 0.25 to 0.5 acres of land size. In the Jaffna district, about 45 percent of the farmers operated with the land class of 0.5-1 acre, while 40 percent of the farmers 0.25 – 0.5 acres of lands.



	0.25<=<0.5	0.5<=<1	1<=<2	2<=<5	>=5
Nuwara Eliya	41%	28%	21%	5%	5%
Badulla	35%	50%	5%	5%	5%
Jaffna	40%	45%	15%	0%	0%
Total	39%	41%	14%	3%	3%

Source: HARTI Survey Data, 2016

Figure 12.11: Distribution of Operators by Size Class of Land (Extent)

The highest percentage of the potato farmers (52 percent) practised cultivation of potato largely on highlands in *Maha* season. In Badulla 45 percent of the farmers, 88 percent in Jaffna and 33 percent in Nuwara Eliya persuade cultivation on highlands in *Maha* season. A total of 27 percent of farmers also cultivated potato in lowlands in *Yala* season. Prominently in Nuwara Eliya district (44 percent) and Badulla district (31 percent), farmers cultivated potatoes in lowlands in *Yala* season after harvesting paddy.

Table 12.6: No. of Families Cultivate in Different Types of Land

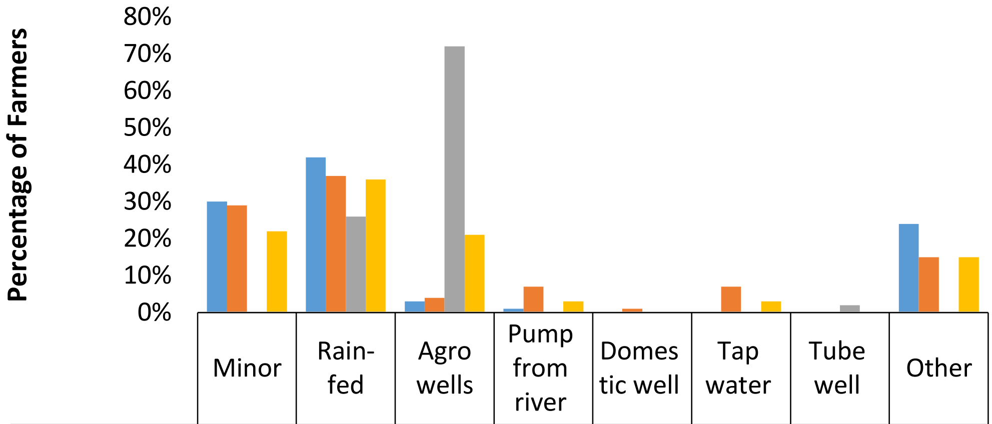
Season	Nuwara Eliya		Badulla		Jaffna		Total	
	N	%	N	%	N	%	N	%
Yala								
Highland	3	6	8	11	1	2	12	7
Lowland	21	44	23	31	0	0	44	27
Homegarden	1	2	2	3	0	0	3	2
Maha								
Highland	16	33	33	45	35	88	84	52
Lowland	6	13	3	4	4	10	13	8
Homegarden	1	2	4	5	0	0	5	3
Inter highland	0		1	1	0	0	1	1
Total	48	100	74	100	40	100	162	100

Source: HARTI Survey Data, 2016

12.3.2 Irrigation

Most of potato growers in the up country depend on natural precipitation while growers in the coastal districts (Jaffna) use irrigation. Most of the farmers in Nuwara Eliya and Badulla depended on rain-fed conditions and minor irrigation for their cultivation. About 37 percent farmers in Badulla and 42 percent farmers in Nuwara Eliya relied on rain water as sources of water. For 29 percent of the farmers in the Badulla district and 30 percent of the farmers in the Nuwara Eliya district, minor irrigation was the second main source of water. The main source of water used by 72 percent of the Jaffna farmers was agro-wells, followed by rain-fed method (26 percent).

Most of the potato farmers cultivated in lowlands in *Yala* season and on highlands in *Maha* season in the Nuwara Eliya and Badulla districts. In Nuwara Eliya district, for both seasons they used flooding as the main irrigation method; 67 percent of the farmers cultivated in lowlands in the *Yala* season and 38 percent on highlands in the *Maha* season. In Badulla district it was reported that 39 percent of the farmers who cultivated in lowlands in *Yala* season had used flooding as main irrigation method whereas on highlands in *Maha* season, most of the farmers (50 percent) depended on water from irrigation canals. In Jaffna district, the majority of farmers cultivated potato mainly on highlands in *Maha* season and majority of them depend on (71 percent) agro-wells.



	Minor	Rain-fed	Agro wells	Pump from river	Domestic well	Tap water	Tube well	Other
Nuwara Eliya	30%	42%	3%	1%	0%	0%	0%	24%
Badulla	29%	37%	4%	7%	1%	7%	0%	15%
Jaffna	0%	26%	72%	0%	0%	0%	2%	0%
Total	22%	36%	21%	3%	0%	3%	0%	15%

Source: HARTI Survey Data, 2016

Figure 12.12: No. of Farmers based on Source of Water

Table 12.7: No. of Lowland Farmers based on Irrigation Method

Irrigation Method	Nuwara Eliya		Badulla		Jaffna		Total	
	N	%	N	%	N	%	N	%
2015/16 *Maha*								
Flood	3	60	1	33	1	25	5	38
Pump water	2	40	2	67	3	75	6	46
Domestic well	0	0	0	0	0	0	2	15
Total	5	100	3	100	4	100	13	100
2015 *Yala*								
Flood	14	67	9	39	0	0	30	58
Pump water	6	29	4	17	0	0	10	19
Domestic well	0	0	1	4	0	0	1	2
Sprinklers	0	0	2	9	0	0	2	4
Irrigation canals	1	5	7	30	0	0	9	17
Total	21	100	23	100	0	0	52	100

Source: HARTI Survey Data, 2016

Table 12.8: No. of Highland Farmers based on Irrigation Method

Irrigation Method	Nuwara Eliya		Badulla		Jaffna		Total	
	N	%	N	%	N	%	N	%
2015/16 *Maha*								
Flood	3	19	2	6	2	6	8	9
Pump water	6	38	11	32	7	20	28	30

Domestic well	0	0	0	0	1	3	1	1
Sprinklers	0	0	4	12	0	0	5	5
Agro well	1	6	0	0	25	71	26	28
Tube well	2	13	0	0	0	0	2	2
Irrigation canals	4	25	17	50	0	0	23	25
Total	16	100	34	100	35	100	93	100
2015 *Yala*								
Flood	1	33	0	0	0	0	1	8
Pump water	1	33	2	25	1	100	4	33
Sprinklers	0	0	1	13	0	0	1	8
Irrigation canals	1	33	5	63	0	0	6	50
Total	3	100	8	100	1	100	12	100

Source: HARTI Survey Data, 2016

12.3.3 Labour

For most of the activities in potato cultivation such as land preparation, crop establishment, fertilizer application, crop management, application of agrochemicals and also for harvesting labour is required. The total labour cost for each activity are presented in the Table 12.9, according to which the highest labour cost was incurred for crop establishment and land preparation in both districts during 2014/15 *Maha* and 2015 *Yala* seasons, followed by the cost of water management.

As given in Table 12.9, in both seasons, the total labour cost is higher in the Nuwara Eliya than in Badulla district.

Table 12.9: Labour Cost for Different Activities of Potato Production

Activity	Nuwara Eliya		Badulla	
	2014/15 *Maha*	2015 *Yala*	2014/15 *Maha*	2015 *Yala*
Land preparation	11,637	10,125	7,165	9,289
Crop establishment	23,480	28,397	20,957	23,246
Fertilizer application	12,481	13,195	5,016	6,555
Water management	24,220	24,440	14,848	19,224
Weed management	11,635	15,155	10,121	9,539
Pest and disease control	5,604	11,811	14,220	12,339
Harvesting	20,258	24,494	20,732	24,903
Total Labour Cost (including imputed Cost)	109,315	127,617	93,059	105,095

Source: Department of Agriculture, 2015 and 2016

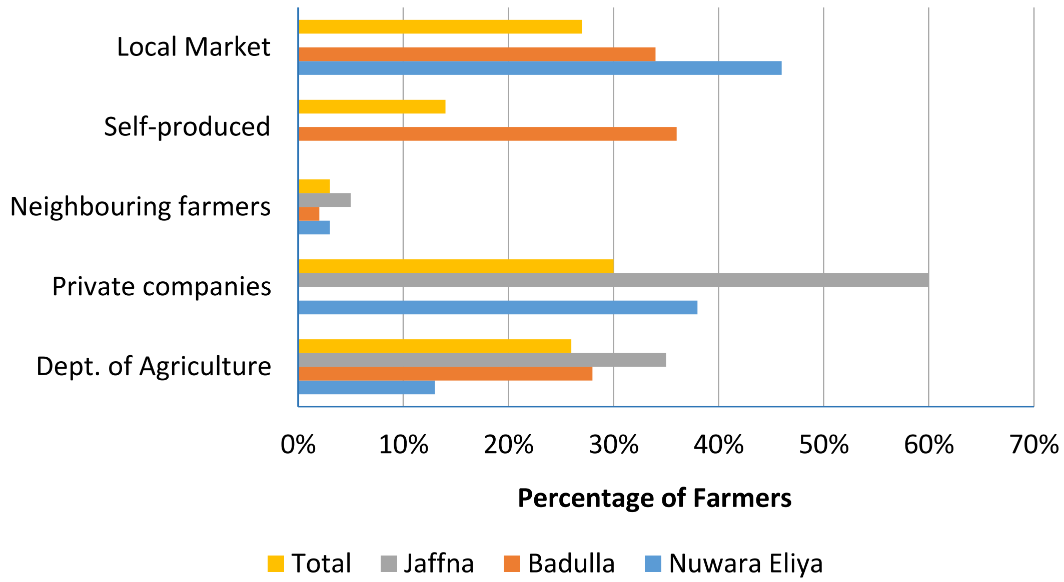
12.3.4 Seeds

Locally produced seed potatoes in Nuwara Eliya are stored in seed potato stores in Nuwara Eliya and Rahangala. The stores in Nuwara Eliya can keep seed for a longer period of time compared with Rahangala because of climatic conditions. The seed purchased in June and July are stored in trays up to November-December and sent to the major potato producing areas such as Jaffna. In Rahangala stores, seed potatoes are stored in bulk to a height of one meter but no forced ventilation is provided.

Normally farmers store their seed potatoes in boxes and keep them in their homes where ventilation is very low, causing high temperatures and heavy losses in storage.

12.3.4.1 Source of Seeds

Considering the cost for inputs, seed cost is the highest input cost for potato cultivation and the farmers use different sources to purchase seeds. In Nuwara Eliya highest percentage of farmers had purchased seeds from local market (46 percent) and from private companies (38 percent). In Badulla district about 36 percent of the farmers used self-produced seeds (36 percent) while about 32 percent and 28 percent of the farmers had purchased seeds from local market and seeds produced by the Department of Agriculture. In Jaffna district, majority of the farmers (60 percent) had purchased seeds produced by private companies.

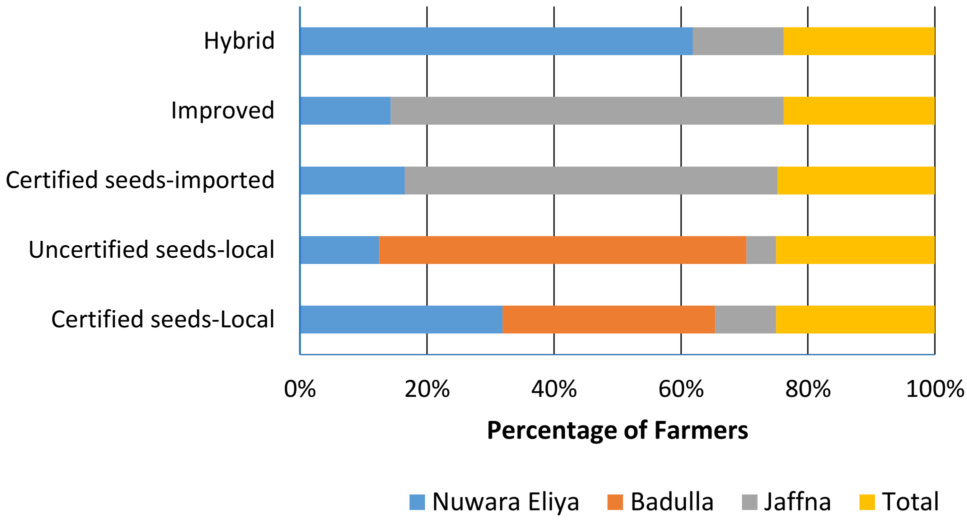


Source: HARTI Survey Data, 2016

Figure 12.13: Source of Potato Seeds

12.3.4.2 Types of Seeds

Different types of potato seeds are available for farmers in the market. In both Nuwara Eliya (60 percent) and Badulla (63 percent) districts, most of the farmers had used locally produced certified seeds. In Badulla district, 37 percent of the farmers used locally available uncertified seeds. However, in Jaffna district, about 64 percent of the farmers had used imported certified seeds.

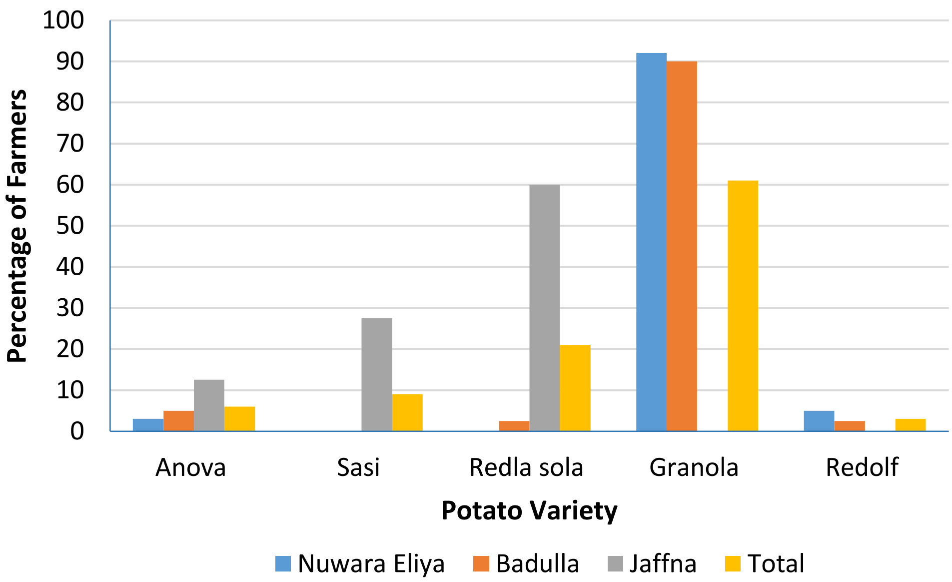


Source: HARTI Survey Data, 2016

Figure 12.14: Type of Potato Seeds Use in Major Producing Districts

12.3.4.3 Variety of Seeds

About 61 percent of the total potato farmers had relied on "Granola" seed variety. When considering the district-wise variation, majority of the potato farmers in Nuwara Eliya (92 percent) and Badulla (90 percent) districts used "Granola" seed variety. Whereas majority of farmers (61 percent) in Jaffna district had used "Red la Soda" variety, followed by "Sasi" variety (27.5 percent).



Source: HARTI Survey Data, 2016

Figure 12.15: Variety of Potato Seeds used in Major Potato Producing Areas

12.3.4.4 Seed Cost

So far as the cost of inputs is concerned, seed cost is the highest input cost for potato cultivation. The cost for seeds was reported as Rs. 158,360/acre in Nuwara Eliya representing 42 percent of the total cost, whereas it was Rs. 128,450/acre (45% of the total cost) in Badulla district in 2015 *Yala* season.

Table 12.10: Seed Cost in the Major Producing Districts

District	2014/15 *Maha*	2015 *Yala*
Nuwara Eliya	164,450	158,360
Badulla	152,315	128,450

Source: Department of Agriculture, 2015 and 2016

12.3.5 Fertilizer and Pesticides

Of the total cost of production, input cost for fertilizer and agrochemicals also assumes higher proportions representing 19 percent in Nuwara Eliya and 14 percent in Badulla (2015 *Yala* season). Chemical fertilizer cost was recorded as Rs. 54,220/acre in Nuwara Eliya district and Rs. 23,949/acre in Badulla district in 2015 *Yala* season. Agrochemicals cost, Rs. 19,716/acre in Nuwara Eliya and Rs. 16,122/acre in Badulla in 2015 *Yala* season. Fertilizer and agrochemical costs are higher in Nuwara Eliya than in Badulla.

Table 12.11: Cost for Fertilizer and Agrochemicals in the Major Producing District

District	Fertilizer Cost		Agrochemical Cost	
	2014/15 *Maha*	2015 *Yala*	2014/15 *Maha*	2015 *Yala*
Nuwara Eliya	34,253	54,220	12,154	19,716
Badulla	22,204	23,949	17,315	16,122

Source: Department of Agriculture, 2015 and 2016

12.3.6 Machinery

According to the Department of Agriculture, the machinery cost was recorded as 3-5 percent of the total cost of production in both districts. The cost for machinery was recorded as Rs. 18,677/acre in the Nuwara Eliya district and Rs. 9,265/acre in the Badulla district in 2015 *Yala* season.

Table 12.12: Machinery Cost Including Imputed Cost

District	2014/15 *Maha*	2015 *Yala*
Nuwara Eliya	23,171	18,677
Badulla	8,380	9,265

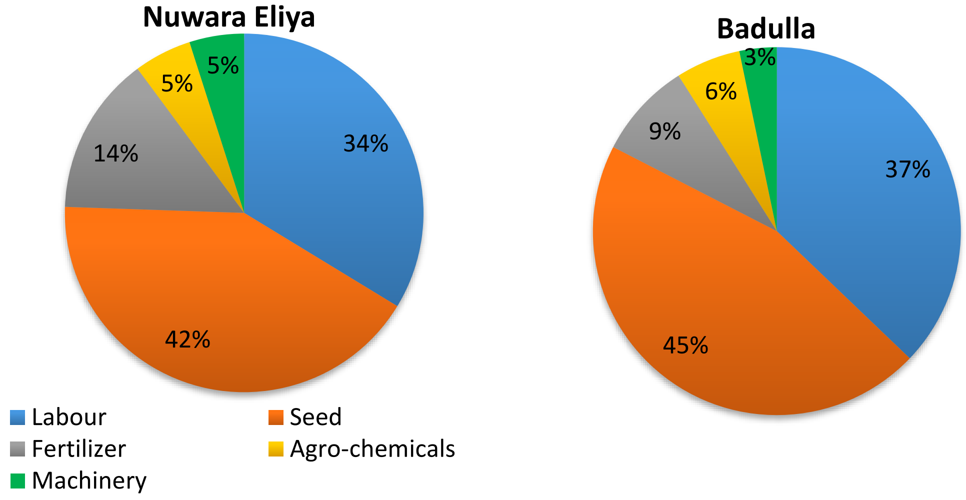
Source: Department of Agriculture, 2015 and 2016

12.3.7 Total Cost of Production

Potato is one of the crops that require inputs intensively for its yield potential. Potato demands a heavy investment during the cropping period in which seed material alone accounts for about 40-50 percent of the total cost of production. According to the Department of Agriculture, the cost incurred on seed potato alone is reported to be about Rs. 158,360/acre in Nuwara Eliya and Rs. 128,450/acre in Badulla in 2015 *Yala* season (Table 12.13 and 12.14). The other important input is labour and cost of it was recorded as Rs. 127,617/acre in Nuwara Eliya and Rs. 105,095 in Badulla district in 2015 *Yala* season. The cost for fertilizer is relatively high requiring Rs. 54,220/acre (Nuwara Eliya) and Rs. 23,949/acre (Badulla) in 2015 *Yala*.

Seed, fertilizer and agro-chemicals together accounted for about 60 percent of the total cost of production. These inputs are mainly derived from foreign sources. Potato farming had been a profitable venture due to high protection given to this sector which allows the farmer to make a high return on his investment on a small piece of land. The cost of production of potato in Sri Lanka is relatively high when compared to that of the other countries in the region. Local producers have had difficulty in competing with cheap imports. In recent years, the cost of production, estimated at around Rs. 35.00 - 45.00 per kg, has remained extremely high and poor yield has eroded the profitability of this crop.

As given in Figure 12.6, in 2015 *Yala* season, the highest cost component was indicated as seed cost (42% in Nuwara Eliya and 45% in Badulla), followed by labour cost (34% in Nuwara Eliya and 37% in Badulla) and fertilizer cost (14% in Nuwara Eliya and 9% in Badulla).



Source: HARTI Survey Data, 2016

Figure 12.16: Cost of Production of Potato as a Percentage of Different Components

As shown in the Tables 12.13 and 12.14, the total cost of production for potato including family labour was Rs. 343,343/acre (2014/15 *Maha*) and Rs. 378,590/acre (2015 *Yala*), while excluding family labour it was Rs. 292,988/acre (2014/15 *Maha*) and Rs. 319,139/acre (2015 *Yala*) in the Nuwara Eliya district. In the Badulla district, the total cost including family labour was Rs. 293,273/acre (2014/15 *Maha*) and Rs. 282,881/acre (2015 *Yala*), while excluding family labour it was Rs. 217,825/acre (2014/15 *Maha*) and Rs. 105,095/acre (2015 *Yala*).

Table 12.13: Cost of Cultivation per acre of Potato by Type of Inputs in Nuwara Eliya under Irrigated Condition

Input	2014/15 *Maha*		2015 *Yala*	
	Rs./acre	%	Rs./acre	%
Labour	109,315	32	127,617	34
Seed	164,450	48	158,360	42
Fertilizer	34,253	10	54,220	14
Agro-chemicals	12,154	4	19,716	5
Draught power machinery equipment	23,171	7	18,677	5
Total cost - including imputed cost	343,343	100	378,590	100
Total cost - excluding imputed cost	292,988		319,139	

Source: Department of Agriculture, 2015 and 2016

Table 12.14: Cost of Cultivation per acre of Potato by Type of Inputs in Badulla under Irrigated Condition

Input	2014/15 *Maha*		2015 *Yala*	
	Rs./acre	%	Rs./acre	%
Labour	93,059	32	105,095	37
Seed	152,315	52	128,450	45
Fertilizer	22,204	8	23,949	8
Agro-chemicals	17,315	6	16,122	6
Draught power machinery equipment	8,380	3	9,265	3
Total cost - including imputed cost	293,273	100	282,881	100
Total cost - excluding imputed cost	217,825		105,095	

Source: Department of Agriculture, 2015 and 2016

12.4 Constraints of Production

Considering crop specific issues faced by the potato farmers as a whole, most of them reported that (24 percent) they did not receive a fair price for their produce. It was the main issue highlighted by the farmers in Badulla (28 percent), Jaffna and Nuwara Eliya (15 percent). About 14 percent of the farmers reported high price of seeds as the second main issue. Also, 13 percent of the total farmers claimed shortage of quality potato seeds as a problem. Considering the district wise data farmers in Nuwara Eliya reported shortage (16 percent) and high price of quality seeds (16 percent) was the second main issue for them. The farmers in Jaffna district reported that lack of quality seeds (16 percent) and crop damages due to adverse climatic condition (16 percent) as the second main crop specific issues.

Table 12.15: Crop Specific Issues

Issue	Nuwara Eliya	Badulla	Jaffna	Total

	N	%	N	%	N	%	N	%
Not having a fair price in marketing	17	15	26	28	28	31	71	24
High price of seeds	18	16	12	13	13	14	43	14
Lack of quality seeds	18	16	6	7	15	16	39	13
Escalation of agrochemical price	14	12	27	29	3	3	44	15
Pest and disease attacks	14	12	3	3	10	11	27	9
Crop damages due to adverse climate	4	3	1	1	15	16	20	7
Damage caused by wildlife	8	7	4	4	-	-	12	4
Water scarcity	8	7	3	3	-	-	11	4
Issues in quality of agrochemicals	4	3	4	4	1	1	9	3
Weaknesses in the extension service	-	-	1	1	1	1	2	1
High cost of labour	1	1	2	2	3	3	6	2
Fertilizer scarcity	2	2	1	1	1	1	4	2
Issues in marketing channel	4	3	-	-	-	-	4	1
High cost of transport	-	-	2	2	-	-	2	1
Lack of knowledge on new technology	2	2	-	-	-	-	2	1
Issues with organic fertilizer	1	1	-	-	1	1	2	1
Total	115	100	92	100	91	100	298	100

Source: HARTI Survey Data, 2016

12.5 Findings and Recommendations

12.5.1 Findings

Considering the total requirement and availability of potato in the country, about 60 percent comes from imports mainly from India causing a stiff competition in potato cultivation. Despite the high productivity of potato cultivation, soil erosion and environmental pollution persist as harmful effects.

Badulla and Nuwara Eliya districts are the major potato growing districts in the country with about 75 percent of the extent recorded in Badulla district, and 23 percent in Nuwara Eliya district. Other producing areas, mainly Jaffna contributes only about two percent of the total extent. Two peak producing seasons are between February to April (the *Maha* harvest) and from October to November (the Y*ala* harvest) in Badulla district. The main production from Nuwara Eliya district reaches the market from April to June (the *Maha* harvest) and from October to December (the *Yala* harvest).

Potato cultivation requires inputs intensively. Seed potato is the main input claiming more than 50 percent of the capital investment in potato farming. The annual seed requirement is around 10,000 mt in the country. At present, Research Divisions (Sitaeliya and Bandarawela), government seed farms (Sitaeliya, Mipilimana, Piduruthalagala, Udaradella, Kandapola, Bopaththalawa) and private sector contract growers together supply around 8-10 percent of the seed potato requirement through in-vitro propagation technique.

During the period 2011-2015, potato production had shown an upward trend due to continuation of the government fertilizer support scheme, availability of sufficient water supply and remunerative prices together with the effect of increase in the

Special Commodity Levy (SCL) on the import of some commodities to promote local substitutes. During the period from 2000-2015, highest production of 94,895 mt was recorded in 2015.

As potato is a seasonal crop, the price peak is observed during the months of June to August and again during the months of November and December. Meanwhile, the drop to a minimum during the months of September to October and February to May due to peak producing in both Badulla and Nuwara Eliya districts.

Bandarawela, Keppetipola DEC and Nuwara Eliya are the major producer-wholesale meeting points that facilitate potato marketing. In 2015, for Nuwara Eliya potato, the producer's share was 60 percent, retailers' gross margin was about 26 percent and wholesalers' Gross margin was about 14 percent.

When the demographic information of potato farmers is taken into consideration, the highest percentage of (50 percent) households consisted of 3-5 family members including both parents and children. The largest proportion of respondents (40 percent) belonged to the age category between 50 and 60 years. The higher proportion (32 percent) of the total sample population had receiving secondary education (grade 6 to 11) and 29 percent of the total sample had education up to G.C.E. (O/L) and 28 percent had primary education (grade 1-5).

With regard to ownership of lands, a total of 66 percent of the farmers were single owners of their cultivating lands. This was the highest in the Nuwara Eliya district (79 percent). It is important to understand the land size distribution of the sample farmers. In the total sample about 41 percent of the potato farmers operated their cultivation on land the extent to which was 0.5-1 acre and there were 39 percent of farmers with land class of 0.25-0.5 acres.

Most of the potato farmers cultivate in lowlands in the *Yala* season and on highlands in the *Maha* season in the Nuwara Eliya and Badulla districts. Potato farmers (52 percent) practised cultivation of potato largely on highlands in the *Maha* season. A total of 27 percent of farmers persuade cultivation on lowlands in the *Yala* season.

Most of the potato growers in the up country depend on rain-fed condition while growers in the coastal districts (Jaffna) use irrigation. Most of the farmers in Nuwara Eliya and Badulla relied on rain-fed condition and minor irrigation for their water needs. The main source of water used by Jaffna farmers (72 percent) was agro-wells. In Nuwara Eliya and Badulla districts, for both seasons most of the farmers had used flood water as the main irrigation method.

In Nuwara Eliya, most of the farmers purchased their seed requirement at the local market (46 percent). In Badulla district about 36 percent of the farmers used self-produced seeds, and in Jaffna district, the majority of the farmers (60 percent) purchased seeds produced by the private companies.

At the market, the farmers can gain access to different types of seeds. In both Nuwara Eliya (60 percent) and Badulla (63 percent) districts, most of the farmers used locally produced certified seeds. However, in Jaffna district, about 64 percent of the farmers relied on imported certified seeds.

The larger segment of the potato farmers in Nuwara Eliya (92 percent) and Badulla (90 percent) districts used “Granola” seed variety, whereas the majority of farmers (61 percent) in Jaffna district used “Red la Sola” variety, followed by “Sasi” variety (27.5 percent).

Considering the crop specific issues faced by the potato farmers as a whole, most of them reported that (24 percent) did not receive a fair price for their produce. The next issue for about 14 percent of the farmers was the high price of seeds and for another 13 percent of the total farmers it was the shortage of quality seeds.

As far the cost of inputs, seed cost is the highest input cost for potato cultivation (42 percent in Nuwara Eliya and 45 percent in Badulla), followed by labour cost (34 percent in Nuwara Eliya and 37 percent in Badulla) and fertilizer cost (14 percent in Nuwara Eliya and nine percent in Badulla).

12.5.2 Recommendations

The farmers reported that high price and shortage of quality potato seeds poses the main crop specific issues. The price of imported seeds is high compared to locally produced seeds. Most of those available seeds are in G_6 and G_7 stage seeds which have low productivity and low quality compared to G_0 and G_1 seeds. Therefore, producing high quality G_0, G_1 and G_2 potato seeds are of paramount importance.

The absence of a long term potato import policy is a debate that discourages the farmers to make a solid investment for the furtherance of their cultivation. Intermittent changes in tariff (duty) rates adversely affect the stability of production frustrating the farmers’ efforts to develop their farming pursuits further. A significant step has been taken in this direction by the government, by controlling or limiting the imports of potato on an ad-hoc basis.

In case of potatoes, there is an adverse environmental effect by encouraging widespread production in environmentally fragile upcountry areas; contributing to serious degradation and soil erosion. Therefore, in any expansion programme for potato cultivation, environment impact should be taken into consideration specially in up country producing areas.

There should be the correct balance of development strategies for the improvement of potato production and marketing system in Sri Lanka. The researchers, statisticians, academicians and policy makers have to make a concerted effort in formation and implementation of new balanced strategies for the upgrading of production and marketing system of potatoes in the country.

Potato farmers have to face many crucial issues at the marketing stage. Most of the farmers highlighted that they did not receive a good price. Hence maximum support should be given to the domestic potato farmers by the wholesalers and intermediates. As a venture with promising potentials that can ensure finer returns on investment for the farmers the stakeholders should go all out with research and development to improve the cultivation on a wider scale and minimize the imports.

Research and development facilities should be improved and the local farmers should be aware of the importance of using such facilities. Then the quality of the seeds, cultivation methods and also the marketing systems can be developed for a better and quality production.

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Chapter Thirteen

Sesame

H.J.C. Jayasooriya

SUMMARY

Sesame is an oil crop that used as a raw material in various industries due to its inherent nutritional and medicinal value. Despite sesame being cultivated both in *Yala* and *Maha* seasons it is generally known as a *Yala* crop due to high yield potential during *Yala* season. Sri Lanka is self-sufficient in sesame. However, the country also imports sesame for several industrial requirements. Five recommended sesame varieties available in Sri Lanka are MI-1, MI-2, MI-3, Uma and Malee. Since the crop prefers dry climatic conditions, it is popular as a chena crop mainly in Dry Zone. Major sesame growing district is Anuradhapura followed by Monaragala, Hambantota, Badulla and Kurunegala districts.

To understand the socio-economic characteristics, potentials and constraints associated with sesame cultivation, 116 sasame farmers were surveyed in three major sesame cultivating districts namely Anuradhapura, Monaragala and Mannar. Considering the demographic information in all the major cultivation areas majority of farmers who are pursing farming as their main source of income are elderly famers. Majority of the farmers cultivate sesame in larger land extents where more than 70 percent of the farmers cultivate lands more than 5 ac. Farmers usualy cultivating larger extents of seseame because of its minimal requirement of field operations, less prone to wild animal damages and potential for higher market margin. While majority of farmers cultivate sesame as a minor irrigated crop in Anuradhapura district, it is cultivated under rain-fed condition and using agro wells in Monaragala and Mannar districts respectively.

Sesame cultivation requires lower level of nutrient and pest and disease management. Hence more than 70 percent of the farmers did not apply any chemicals as fertilizer or pesticides. Fermers facing dififculities in finding DOA certified seeds thus majority of farmers in Anuradhapura and Monaragala districts had used uncertified seeds and the farmers were not aware of the seed variety they have used. However, in Mannar district more than 50 percent of the farmers had used certified seeds.

The survey results confirm that the present average yield of sesame (0.49 t/ha) is well below the potential yield which varies from 0.9 to 1.8 t/ha. Out of all the sample districts highest productivity was recorded in Anuradhpura district which was 0.75 t/ha. Considering the cost of production, the highest was recorded in Monaragala district while lowest was recorded in Anuradhapura district. Detail analysis shows that the highest contributor for the cost of production is the machinery cost. Considering the marketing methods majority of the farmers sell their hrvest to private traders or collectors.

Water scarcity found to be the major constraint associated with sesame cultivation which is followed by wild animal damages and difficulty to obtain a fair market price. Since sesame has the ability to increase its average yield recommendations focus more

on increasing the productivity of sesame by strengthening the seed production programme thus the farmers will have increased access to recommended high yielding varieties. Further it is recommended to establish a mechanism to ensure a reasonable price for farmers through a collective approach of public and private sector.

CHAPTER THIRTEEN

Sesame

13.1 Overview of the Crop

13.1.1 Introduction

Sesame also called as Gingelly in the common language is scientifically named *Sesamum indicum.* This crop is considered as an oil crop because it's mainly used for oil extraction purposes in Sri Lanka. The sesame oil has many nutritional and medicinal values and it has been used in preparing a range of foods and medicines in Sri Lanka from ancient era. Nevertheless, it is also used in confectionary industry to prepare sweet snacks from processed sesame seeds.

Sesame is grown in both *Yala* and *Maha* seasons in different areas of the country. However, *Yala* season i.e. starting from March to April provides the optimum climatic conditions for sesame to result in higher yields so that generally it is known as a *Yala* crop. Depending on the other crops cultivated and the climatic conditions during a particular season, some farmers cultivate sesame in *Maha* season especially on highlands.

In Sri Lanka four DOA recommended varieties of sesame are available and in adition there are number local varieties that cultivate widely by farmers. Table 13.1 shows the characteristics of the sesame varieties recommended by the Department of Agriculture.

Table 13.1: Characteristics of Recommended Sesame Varieties

Variety	Seed colour	Oil content (%)	Maturation time (days)	Potential yield
MI-1	Black	45	80-90	0.9 t/ha
MI-2	Black	45	80-85	1 t/ha
MI-3	White	48-49	85-90	1 t/ha
Uma	White	50	70-75	1.5 t/ ha
Malee	Light brown	53	80-85	1.8 t/ha

Source: Generated by author using Henegedara, et al., 2005, p189 and DOA, 2017

13.1.2 Major Growing Areas and Extent under Cultivation

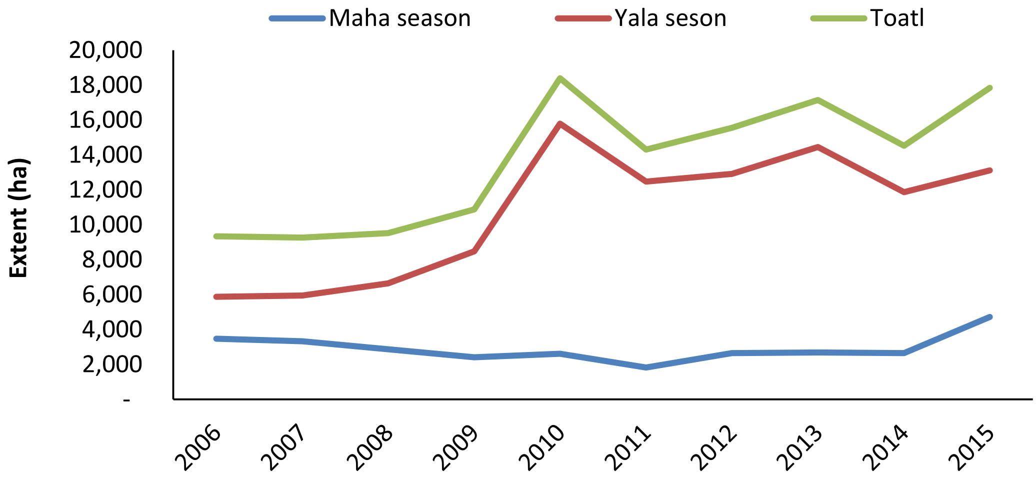
According to the statistics of district wise average land extent of sesame cultivation during the period of 2006-2015, major growing areas of sesame cultivations are shown in Table 13.2.

Table 13.2: Average Extent of Sesame in Major Growing Areas (ha)

District	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	%
Anuradhapura	3,454	3,224	4,257	6,546	13,597	10,409	10,930	11,654	9,109	9,600	60.5
Monaragala	1,113	1,581	1,004	849	714	680	886	1,803	1,785	1,036	8.4
Hambantota	1,251	1,111	727	687	790	426	571	639	738	762	5.6
Badulla	448	411	1,069	628	603	619	1,014	275	278	2,038	5.4
Kurunegala	899	738	405	466	466	543	410	710	683	1,946	5.3
Puttalam	607	459	375	330	433	287	271	339	358	355	2.8
Jaffna	64	341	725	394	729	264	240	314	277	408	2.7
Vavuniya	299	219	236	418	410	55	103	398	335	503	2.2
Ratnapura	357	378	333	277	300	269	256	196	206	182	2.0
Mullaitivu	88	88	44			211	316	67	5	397	1.1
Others	749	709	326	277	344	531	548	739	740	595	4.1
Sri Lanka	9,337	9,261	9,512	10,881	18,397	14,304	15,558	17,145	14,524	17,841	100

Source: Department of Census and statistics

Further, Table 13.2 shows the percentage wise distribution of the extent of land under sesame in major growing areas. Anuradhapura, Monaragala, Hambantota, Badulla and Kurunegala respectively accounted for 60.5%, 8.4%, 5.6%, 5.4% and 5.3% from the total average land extent under sesame cultivation during the period 2006 to 2015. Thereby, these five districts hold 85 percent of the total sesame extent in Sri Lanka where all the other districts collectively hold the rest of 15 percent. When considering the fluctuation of total extent under sesame, it has shown an increasing trend on an average from 2006 to 2015. The highest total extent of 18,397 ha was recorded in the year 2010 (figure 13.1).



Source: Department of Census and statistics

Figure 13.1: District wise Distribution of Percentage Contribution of the Extent

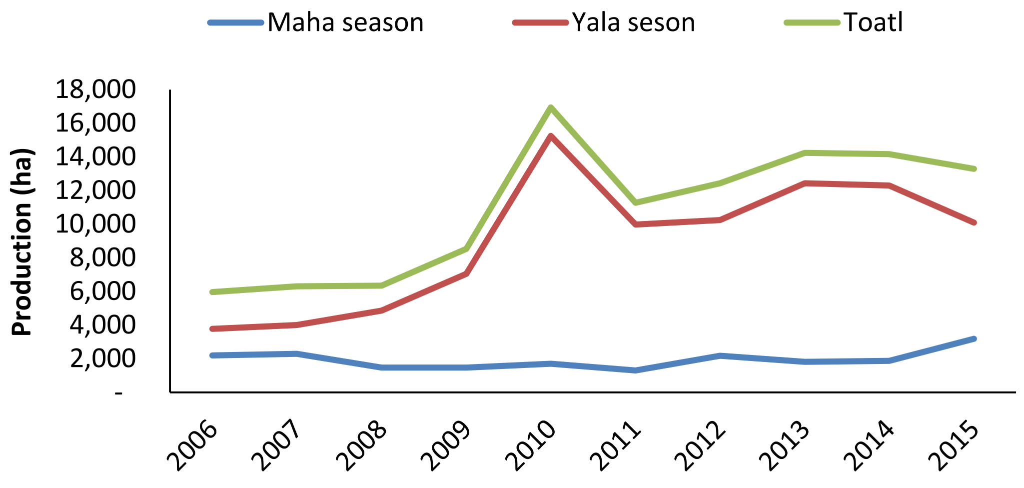
Average production of sesame in major producing areas is depicted in Table 13.3, which reveals Anuradhapura, Monaragala, Badulla, Hambantota and Kurunegala as the highest producing districts which contributing for 87 percent of the total production of the country.

Variation of average production of sesame also shows more or less similar pattern until the year 2014 and the highest production of 16,947 tons was recorded in 2010 (Figure 13.2). Hereafter the production had shown a decreasing trend despite the increase in extent as a result of loss of yield caused by unexpected climatic conditions that prevailed during the reference period, especially the high incidences of rainfall in the 2015/16 *Maha* season.

Table 13.3: Total Quantity and Value of Imports and Exports of Sesame

Item	Product	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Quantity imports (t)	Gingelly	27	56	165	23	26	181	82	75	289	110
	Gingelly Oil	2,270	1,271	455	196	135	293	322	346	475	432
Total Value of imports (000'Rs)	Gingelly	1,051	2,322	10,129	2,740	3,513	20,298	12,225	10,756	44,279	17,235
	Gingelly Oil	275,724	184,752	63,757	28,611	5,731	20,630	37,429	43,359	56,069	53,741
Total Quantity exports (t)	Gingelly	2,051	666	261	1,406	8,407	384	2,025	6,507	3,496	3,886
	Gingelly Oil	33	37	25	34	29	27	19	20	22	22
Total Value of exports (000'Rs)	Gingelly	138,741	66,313	38,963	186,243	1,003,437	56,890	323,008	1,359,539	806,297	633,980
	Gingelly Oil	12,054	15,094	17,902	21,843	12,565	18,442	14,079	16,991	16,786	18,490

Source: Department of Customs



Source: Department of Census and statistics

Figure 13.2: District wise Distribution of Percentage Contribution of the Production

When the average productivity of sesame in major growing areas during the period of 2006 to 2015 is taken in to account highest value of 0.89 t/ha was recorded in Anuradhapura District and Monaragala, Badulla, Hambantota and Kurunegala had the values of 0.71 t/ha, 0.75 t/ha 0.59 t/ha and 0.86 t/ha respectively (Table 13.3).

13.1.3 Climatic and Soil Requirement for Sesame

Sesame is considered as a crop which requires dry conditions. It can produce an optimum yield with an average rainfall of 500-600 mm and it prefers a temperature above 25^{0}C. Further, it requires a dry condition in the time of grain filling and harvesting. This crop also can tolerate mild droughts for short duration. Although, sesame prefers sandy loam soils, it can cultivate in vast range of soil conditions except water logging situations. Another advantage of sesame crop is it can produce optimum yield even in slightly less fertile soil conditions. With all these promising characteristics, sesame is popular as a *chena* crop among the farmers mostly in the dry zone areas. In addition, characters such as ability to manage with minimum effort, relatively less susceptible to the damages of wild animals especially from wild elephants, less threat from weeds especially due to the broadcasting crop establishment, relatively less prone to pests and diseases and ability to get a yield without fertilizer applications have promoted farmers to cultivate sesame as a *chena* crop or in the paddy lands when and where water is not sufficient to perform paddy cultivation (DOA, 2017; Henegedara, et al., 2005).

13.1.4 Importance of the Crop to the Economy

13.1.4.1 Consumption

Total production of sesame per year varies around 15000 tons and the total requirement of the country is around 5000 tons. Therefore, Sri Lanka is self-sufficient with respect to the sesame requirement. In addition to this another portion is used for processing, especially for producing sesame oil. Rest of the production is exported.

Accurate value about Per-capita consumption of sesame can be found for year 2003/04, in which 4.14 grams of sesame had been consumed by a person per month according to the consumer finance and socio economic survey in 2003/04 as cited in Henegedara, *et. al.,* in 2005. But, sesame is also used as sesame oil, and with respect to the sesame oil, per capita consumption is 2.95 ml per person per month (Department of Census and Statitstics, 2015).

13.1.4.2 Trends in Imports and Exports

Although the country has achieved self-sufficiency in sesame, both sesame and sesame oil are imported. As shown in Table 13.4, sesame oil imports have come down and it was 432 tons in 2015, whereas 110 tons of sesame seeds had been imported in the same year. These imports are for the purpose of some specific firms for their requirements.

Table 13.4: Total Quantity and Value of Imports and Exports of Sesame

Item	Product	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Total Quantity imports (t)	Gingelly	27	56	165	23	26	181	82	75	289	110
	Gingelly Oil	2,270	1,271	455	196	135	293	322	346	475	432
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	Gingelly Oil	33	37	25	34	29	27	19	20	22	22
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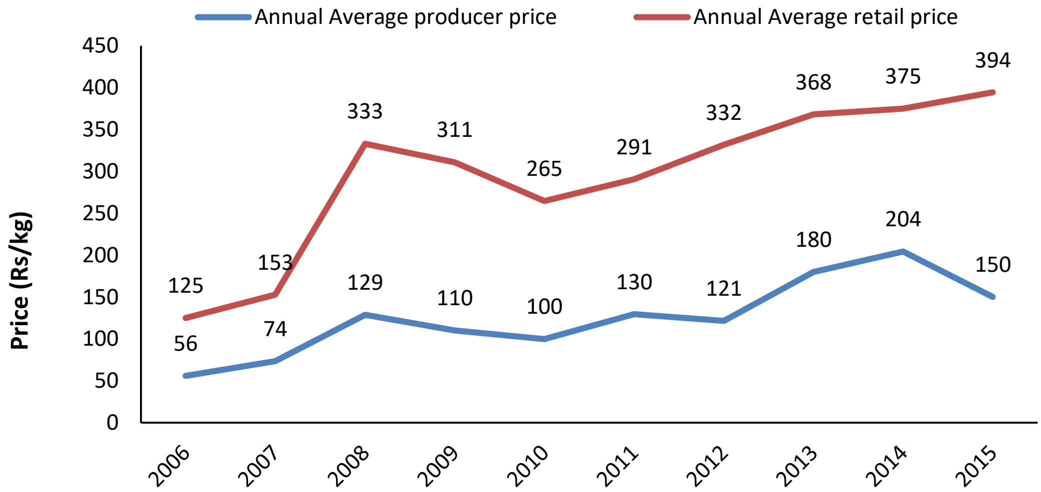
	Gingelly Oil	12,054	15,094	17,902	21,843	12,565	18,442	14,079	16,991	16,786	18,490

Source: Department of Customs

Conversely, Sri Lanka currently exports both sesame and sesame oil and it was able to earn foreign exchange income of over Rs. 652 million in 2015 (Table 13.4) by exporting 3886 tons of sesame seeds and 22 tons of sesame oil.

13.1.4.3 Price Variations, Price Behaviour

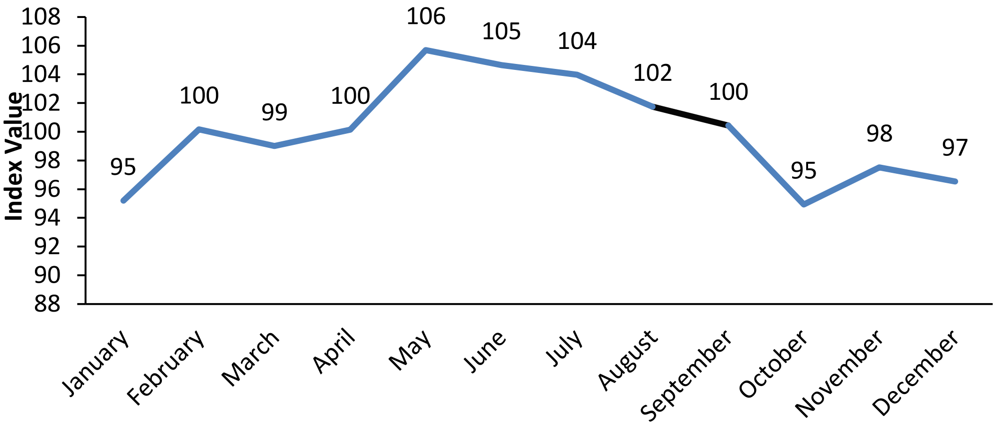
Annual average producer price showed an increasing trend until 2014 and in 2015 it dropped to Rs. 150 from Rs. 204 (Figure 13.3). However annual average retail price had been continuously increasing during the reference period and in 2015 it rose up to Rs. 394 despite the reduction of producer price in the same year.



Source: Department of Census and Statistics

Figure 13.3: Variation of Annual Average Producer Price and Annual Average Retail Price of Sesame

According to the seasonal price index analysis shown in the Figure 13.4, for the three-year period of 2013 to 2015, the month of May recorded the highest retail price which was nearly six percent more than the average price. In addition, during the period from May to August a higher price was observed, whereas January and October had the lowest price which marked a five percent decrease compared to the average price of the three-year period, where lower prices were observed during October to April.



Source: Department of Census and Statistics

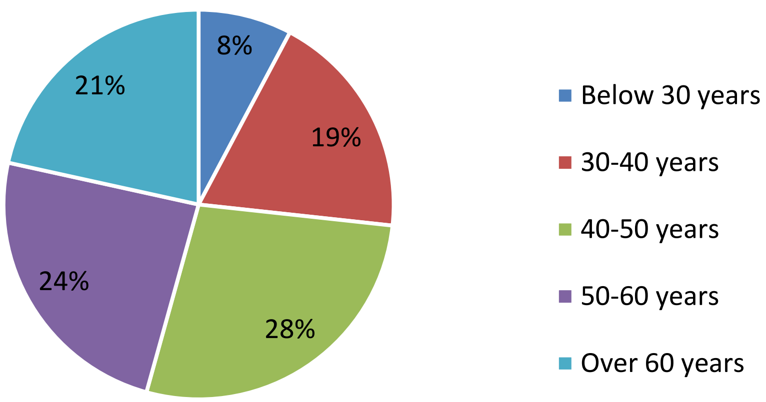
Figure 13.4: Seasonal Price Index of Sesame (for the period of 2013 to 2015)

13.2 Socio-Economic Characteristics of the Sample Farmers

13.2.1 Demographic Characteristics of the Sample

Age Distribution

With respect to sesame cultivation, primary data was collected from a total of 116 farmers in three districts namely 39 farmers from Anuradhapura, 39 farmers from Monaragala and 38 farmers from Mannar. Distribution of farmers' age is shown in Figure 13.5.



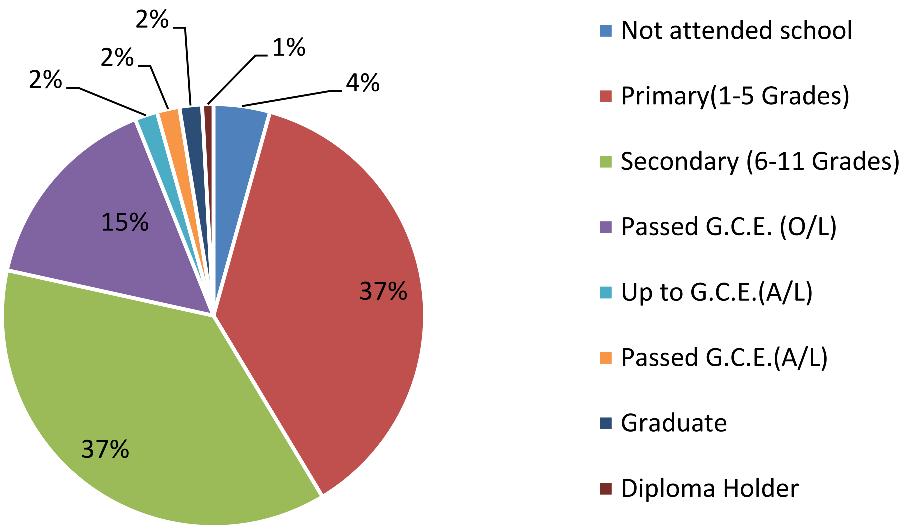
Source: HARTI Survey Data 2016

Figure 13.5: Age Distribution of Sample Farmers

According to that, 71 percent of the sample famers were in the age between 30 to 60 years and, the highest percentage of 28 percent were in the age of 40 to 50 years. However, nearly one fifth of the sample was over 60 years of age; evidence of the aged farmer population. This distribution pattern is more or less similar for all the three districts.

Education level

According to the level of education of the respondent farmers, distribution of the sample is shown in figure 13.6. Equal number of farmers i.e. 37 percent each had received primary and secondary education. Another 15 percent had schooled up to G.C.E. O/L. The number of farmers educated up to diploma and graduate level is almost negligible. The level of education in sampel farmers can be considered as at a fairly satisfactory level. No signified variaon could be identified in the pattern of distribution in the three districts, in respect of education level.

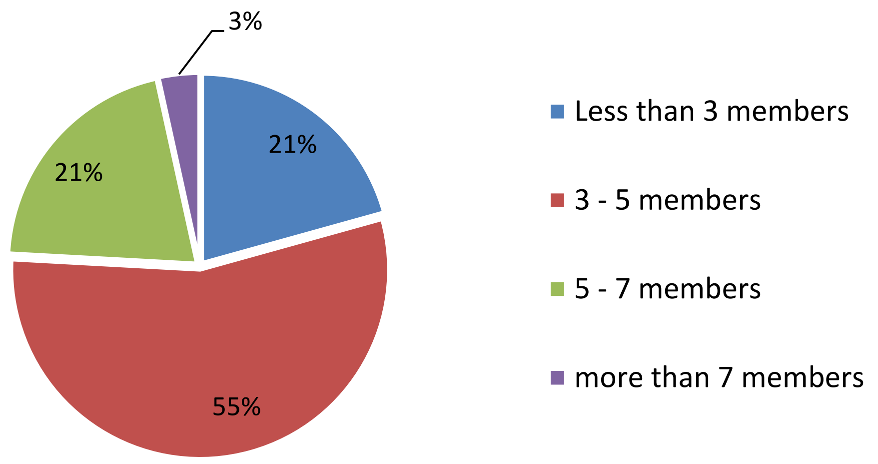


Source: HARTI Survey Data 2016

Figure 13.6: Distribution of Sample Farmers According to Level of Education

Family size Distribution

Results revealed that, the majority (55%) of the sample farmers had 3-5 members in their families. Another 21 percent had 5-7 members (Figure 13.7). This shows an ideal condition to boost the family labour support to the sesame cultivations. Although sesame crop is not a labour intensive crop, labour requirement for harvesting is fairly high. No change in the pattern of distribution is perceived among the three districts with respect to the family size data.

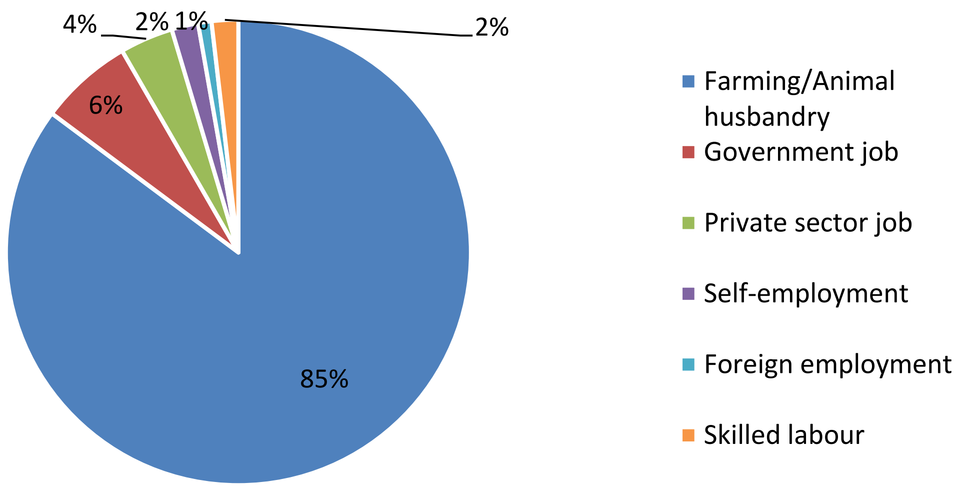


Source: HARTI Survey Data, 2016

Figure 13.7: Distribution of the Sample Farmers According to the Family Size

13.2.2 Economic Characteristics of the Sample Population

Considering the primary income earning activity/primary employment of the sample farmers', the majority (85%) is pursue farming/animal husbandry as their main income earning activity (Figure 13.8). Data transpires that, of the total sampled respondents interviewed, 15 percent had other means of livelihood as their main source of income but they are too engaged in farming. There was no significant difference in employment status among districts.



Source: HARTI Survey Data, 2016

Figure 13.8: Distribution of the Sample Farmers According to the Primary Employment

13.3 Agricultural Inputs

13.3.1 Land

Land Types and Size of the Land Holdings

According to the information recorded in the survey, most of the sesame cultivated lands in Anuradhapura and Monaragala were highlands (in yala season) respectively account for 88 percent and 72 percent of the total lands recorded in the survey whereas in Mannar, 58 percent of highlands were cultivated in late *Maha* season (Table 13.5)

Table 13.5: Variation of the Lands According to the Type of Lands

Land type	Anuradhapura	Monaragala	Mannar	Total
Yala - Highland	87.5	71.7	40.0	66.7
Yala - Homegarden	0.0	4.3	2.5	2.4
Maha - Highland	5.0	23.9	57.5	28.6
Inter-seasonal Highland	7.5	0.0	0.0	2.4
Total	100.0	100.0	100.0	100.0

Source: HARTI Survey Data 2016

Sesame cultivated lands in the sample area were analyzed in terms of the size of land holdings. Accordingly, total landholdings were categorized into five land classes as shown in Table 13.6. The highest percentage (71 percent) was recorded in the class which included lands larger than 5 ac. Next was 2 to 5 ac land class (25 percent). Evidently sesame cultivations are being pursued by the majority of the farmers on a comparatively larger scale in all three districts in the sample. The factors that encouraged farmers to cultivate on a comparatively larger scale are, comparatively manageable cultivation operations in sesame as against most of the other field crops; being cultivated mostly under *chana* lands with minimum labour; less prone to wild animal threats; and higher margin that could be obtained in the market, may have influenced the farmers to take to sesame cultivation.

Table 13.6: Distribution of the Lands According to the Size of Land Holdings

Land Size	% From Total Extent			
	Anuradhapura	Monaragala	Mannar	Total
0.5 to 1 ac	0	0	0.9	0.2
1 to 2 ac	0.6	2.0	11.7	4.1
2 to 5 ac	10.9	44.8	26.4	24.7
More than 5 ac	88.5	53.2	61.0	71.0
Total	100	100	100	100

Source: HARTI Survey Data 2016

Ownership of the Sesame Cultivated Landholdings

Type of land ownership is another important aspect that needs to understand under the section of agricultural inputs. According to the results as shown in Table 13.7, most of the lands (355 ac) were single owned and accounted for 58 percent of the total land extent. Interestingly next highest class of ownership was encroached lands which was 17 percent of the total recorded land extent in the survey.

Table 13.7: Distribution of the Lands According to the Type of Ownership

Ownership	No. of holdings	Total extent	% of total extent
Single owner	269	354.99	57.6
Jointly owned	9	7.5	1.2
Leased in	10	16.6	2.7
Tenancy-out	2	2	0.3
Tenancy-in	4	55	8.9
Permit holder	34	41.75	6.8
Encroached	47	106.4	17.3
Mortgaged	3	4	0.6
Other	14	28.5	4.6
Total	392	616.74	100

Source: HARTI Survey Data 2016

13.3.2 Irrigation

Although sesame is considered as a crop preferring dry or rain fed conditions according to the Table 13.8 majority (44 percent) of the farmers in Anuradhapura had used minor irrigations as the main source of water for their cultivations. In addition, 39 percent of the farmers use rain water as main source of water for sesame cultivation. In contrast majority of the farmers in Monaragala (69 percent) performed their cultivations of sesame under rain fed conditions. However, in Mannar, highest recorded water source was agro-wells (49 percent) followed by rainwater (35 percent).

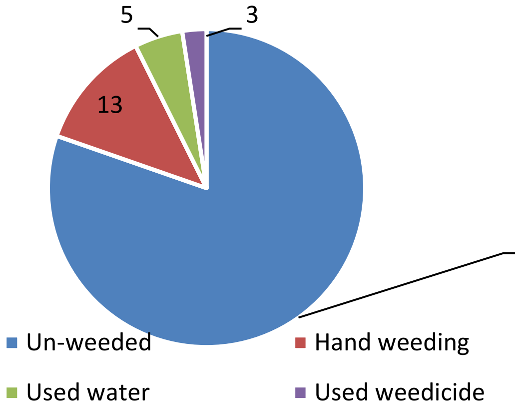
Table 13.8: Distribution of the Lands According to the Type of Ownership

Water source	% of land holdings			
	Anuradhapura	Monaragala	Mannar	Total
Major irrigation	3.2	1.7	13.6	5.1
Minor irrigation	43.9	14.8	0	25.5
Rainfed	39.2	68.7	35.2	46.9
Agro-well	7.9	5.2	48.9	16.3
Tube well	0	1.7	0	0.5
Pipe borne water	5.3	5.2	0	4.1
Other	0.5	2.6	2.3	1.5
Total	100	100	100	100

Source: HARTI Survey Data 2016

13.3.3 Fertilizer and Pesticides

Sesame does not require intensive pest, disease and nutrient management. But, farmers had got used to apply agro chemicals as in other crops. With respect to weed management, the majority (84 percent) did not apply any kind of weed management technique and only about 13 percent resorted hand weeding and another five percent used water to control weeds (Figure 13.9).



Source: HARTI Survey Data 2016

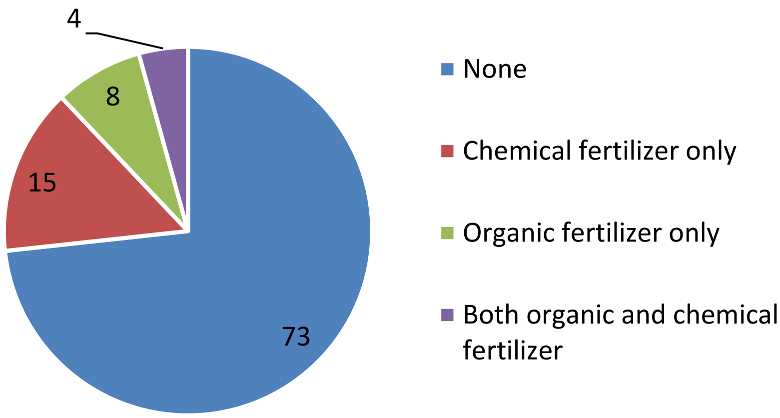
Figure 13.9: Weed Control method in Sesame Cultivation

Source: HARTI Survey Data 2016

Figure 13.10: Use of Insecticides in Sesame Cultivation

Figure 13.10 shows the pattern of insecticide use in sesame cultivations in sample areas. According to that, 90 percent of the farmers had not applied any insecticide for their cultivations. This showed that the sesame crop hardly needs any pesticide.

Since sesame can produce optimum yield with the least amount of external nutrient inputs, the majority (73 percent) of the farmers had not applied any fertilizer for their cultivations. However, 15 percent of farmers had applied chemical fertilizer and another eight percent had applied organic fertilizer for their cultivations (Figure 13.11).



Source: HARTI Survey Data 2016

Figure 13.11: Variation of Fertilizer Usage for Sesame Cultivation

13.3.4 Seeds

As in the case of many other field crops (OFCs) sesame farmers also confront the problem of finding quality seeds. In Anuradhapura, and Monaragala, a majority of farmers (70 percent and 64 percent respectively) had used uncertified seeds. However, in Mannar, 53 percent of the farmers had used certified seeds (Table 13.9)

Table 13.9: Type of Seeds Used by Sample Farmers

Seed Type	Percentage of farmers			
	Anuradhapura	Monaragala	Mannar	Total
Certified seeds	29.7	36.1	52.6	39.6
Uncertified seeds	70.3	63.9	47.4	60.4
Total	100.0	100.0	100.0	100.0

Source: HARTI Survey Data 2016

Survey data shows a clear variation among the districts with respect to the source of seeds they used. As shown in Table 13.10, in Anuradhapura, majority (67 percent) had used self-produced seeds followed by 21 percent who used seeds produced by the Department of Agriculture. In Monaragala, self-produced seeds and seeds brought from local markets had recorded more or less a similar percentage (38 percent and 35 percent respectively). In contrast, Mannar farmers recorded the highest percentage (about 32 percent) for seeds brought from private companies followed by self-produced seeds and seeds brought from local markets (about 29 percent).

In comparison to Monaragala and Mannar, Anuradhapura farmers had used a high percentage of seeds produced by the Department of Agriculture. This variation could be attributed to several reasons: (a) they cultivate sesame in paddy lands in *Yala* season where paddy was not cultivated (b) more support and guidance by the extension staff of the DOA for the sesame cultivation as an attentive crop (c) provision of DOA produced certified seeds through their extension programmes.

Table 13.10: Source of Seeds Used by the Farmers in Sample Area

Source of seeds	% of farmers			
	Anuradhapura	Monaragala	Mannar	Total
Department of Agriculture	21	8	8	12
Self-produced	67	38	29	45
Private companies	5	11	32	16
Neighbouring farmers	5	8	3	5
Local Market	3	35	29	22
Total	100	100	100	100

Source: HARTI Survey Data, 2016

Table 13.11 shows the information about the seed varieties used by the sample farmers. Accordingly, 33 percent, 51 percnet and 76 percent of farmers respectively in Anuradhapura, Monaragala and Mannar had cultivated varieties maintained by themselves and they were unaware of the name of the variety. Majority (62 percent) of Anuradhapura district farmers used black seed varieties (either MI-1 or MI-2) and 32 percent of Monaragala district farmers cultivated white seed varieties (either MI-3 or Uma or Malee).

Table 13.11: Variation of Seed Varieties Used by the Farmers in Sample Area

Seed Variety	Percentage of farmers			
	Anuradhapura	Monaragala	Mannar	Total
Not known/ farmer maintained	33	51	76	54
Black seed (MI-1 / MI-2)	62	16	16	32
White seed (MI-3 / Uma / Malee)	5	32	8	15
Total	100	100	100	100

Source: HARTI Survey Data 2016

13.4 Production and Productivity

According to the production figures of 2015 *Maha* season and 2015/16 *Yala* season obtained during the survey, average yield (productivity) of sesame in sample areas was calculated. Table 13.12, shows the productivity of three districts in terms of the land size, according to which the, average of the productivity of all land classes were 0.49 t/ha. This value is far below the potential yield which varies from 0.9 to 1.8 t/ha. The survey results confirm that the highest productivity (0.75 t/ha) was recorded in 1-2 ac category in Anuradhapura district. For Monaragala district the highest productivity (0.62 t/ha) was in 0.5-1 ac category. Highest productivity of 0.63 t/ha of Mannar district was recorded in 2-5 ac land category. However, a clear pattern could not be observed with respect to the productivity against the land classes.

Table 13.12: Variation of the Productivity of Sesame in Sample Districts

Land class	Productivity (t/ha)			
	Anuradhapura	Monaragala	Mannar	Total
0.5 to 1 ac	Not reported	0.62	0.46	0.54
1 to 2 ac	0.75	0.49	0.35	0.53
2 to 5 ac	0.53	0.49	0.63	0.55
Average for all land classes	0.48	0.42	0.44	0.49

Source: HARTI Survey Data 2016

13.5 Cost of Production

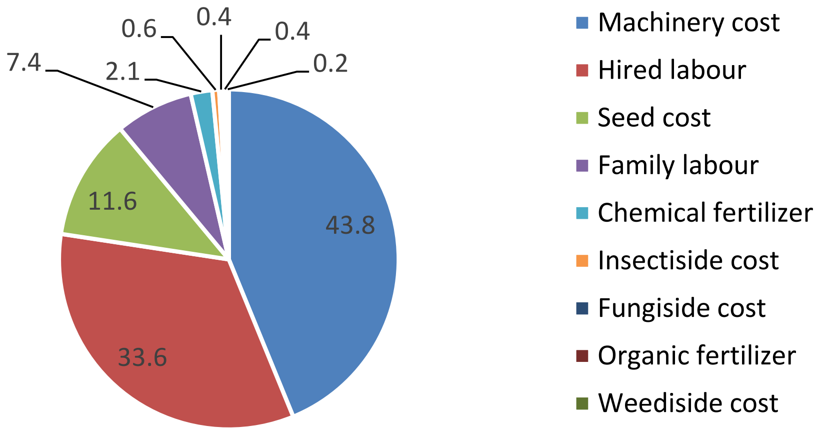
According to the cost of production analysis, Monaragala marks the highest cost of production which is Rs. 15,310 per acre (including family labour). In contrast, Anuradhapura has the lowest cost (Rs. 7,340 per acre - including family labour) and these data are tabulated in Table 13.13.

Table 13.13: Cost of Production for Sesame in Sample Area

	Anuradhapura	Monaragala	Mannar	Total
Total cost including family labour (Rs/ac)	7,340	15,310	11,335	11,222
Total cost excluding family labour (Rs/ac)	6,991	13,950	10,502	10,388

Source: HARTI Survey Data 2016

More detailed analysis of the different cost components was considered in calculating the total cost of production as shown in Figure 13.12. Accordingly, the highest contributing cost component of total cost of production was machinery cost that representing 44 percent of the total cost of production. Next highest component was the hired labour which accounted for 34 percent. Seed cost was the third highest cost component of the total cost of production.



Source: HARTI Survey Data 2016

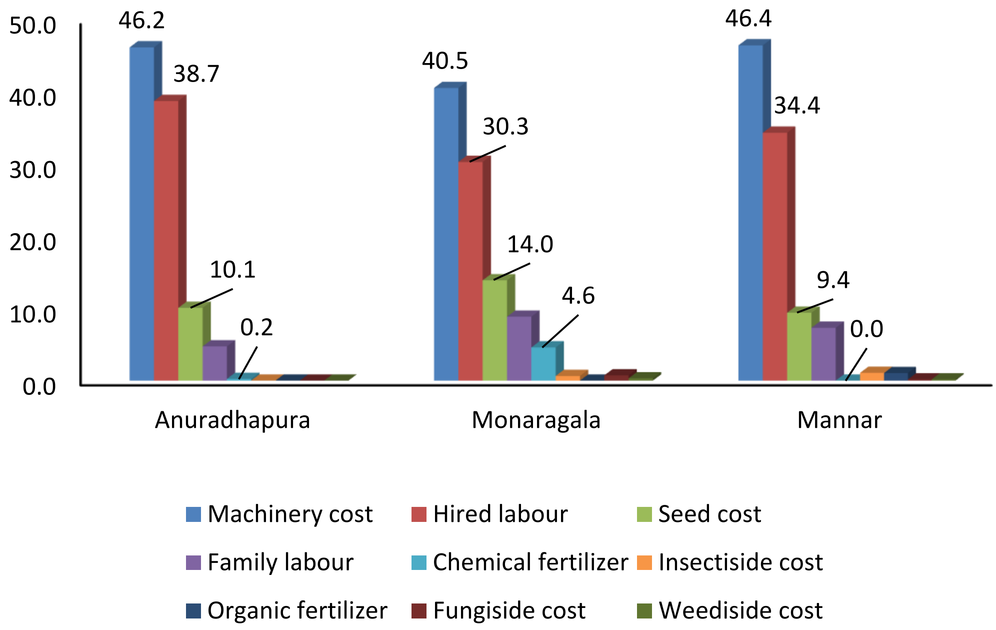
Figure 13.12: Value of Sub Components of the Total Cost of Production of Sesame

As described earlier, in Anuradhapura district sesame was mainly cultivated in paddy lands and it was established just after harvesting the paddy yield so that the land cleaning and preparation was easier and less costly. In contrast Monaragala farmers used to cultivate mainly in *chena* and adjoining highlands in *Yala* season, where cost for land preparation and weed management was higher than that at to Anuradhapura.

Figure 13.13, displays the breakdown of different cost components in district wise where percentage contribution of machinery cost to the total cost of production was higher (46 percent) in Anuradhapura district compared to Monaragala (40 percent). Most of the lands were made use of to cultivate sesame in Anuradhapura since there the soil is rich with residual nutrient left over after the paddy farming in the *Maha* season.

The percentage value of chemical fertilizer in Anuradhapura district was less than one percent whereas the corresponding figure for Monaragala as 4.6 percent since the farmers used more chemical fertilizer than their counterparts in Anuradhapura.

However, the use of chemical fertilizers in sesame cultivation in selected districts is minimal.



Source: HARTI Survey Data 2016

Figure 13.13: Variation of the Value of Sub Components of Cost of Production

13.6 Marketing

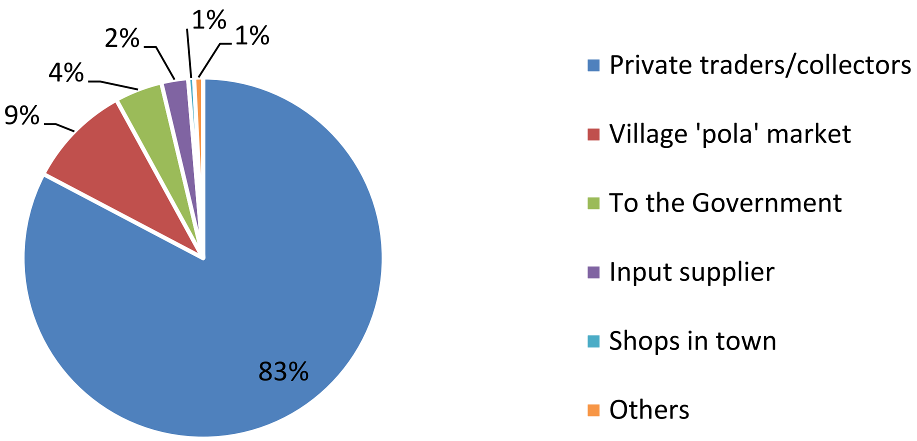
In relation to the marketing aspects of sesame, farmgate price (producer price) had shown a variation among the districts as indicated in Table 13.14. Both Monaragala and Mannar prices were higher than the prices at Anuradhapura. The prices are mainly related to the variety and the quality of the products.

Table 13.14: Variation of Sesame Prices in Sample Area

	Mean Producer Price (Rs)	
	2015/16 *Maha*	**2015 *Yala***
Anuradhapura	115.00	116.45
Monaragala	156.36	142.03
Mannar	159.05	132.22

Source: HARTI Survey Data 2016

When considering the major selling options of the sesame farmers (Figure 13.14) in all the three districts, private traders and collectors had the highest frequency (83 percent). Next to that, the village fair (9 percent) was the popular marketing channel for the sesame farmers. This pattern of marketing methods was more or less similar in all the surveyed districts.

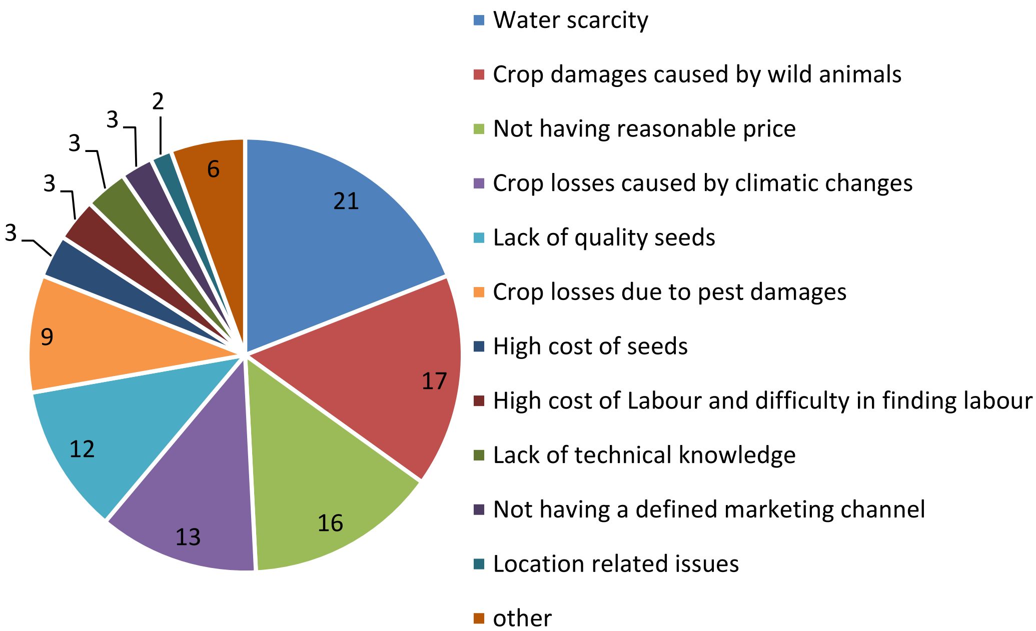


Source: HARTI Survey Data 2016

Figure 13.14: Mode of Marketing

13.7 Potentials and Constraints of Production

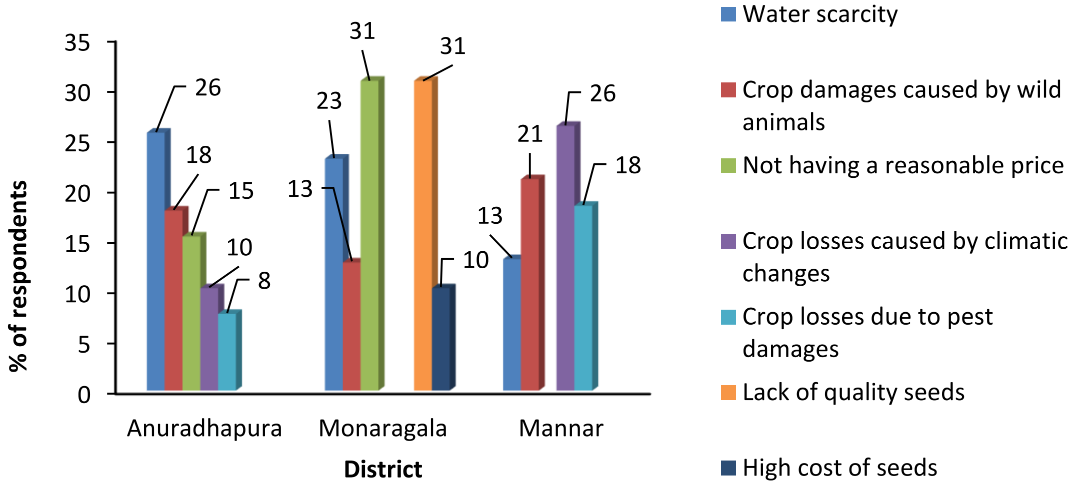
An analysis of the responses of the respondents about the impediments that adversely affected on sesame cultivation is depicted in the Figure 13.15. They were mostly constrained by the scarcity of water (21 percent) and secondly because of the crop damages caused by wild animals (17% percent). The next issue they complained was their inability to get a fair price for the products (16 percent).



Source: HARTI Survey Data 2016

Figure 13.15: Main Constraints Faced by Sesame Farmers in the Sample

In addition, district wise changes of the constraints faced by the farmers were also analyzed and displayed in Figure 13.16. Accordingly, farmers of the Mannar District had not complained about the price. In contrast absence of a reasonable fair price and shortage of quality seeds were the main problems for Monaragala farmers. Another important change that could be noticed from Figure 13.15 is 26 percent of the farmers in Mannar had complained about the crop losses caused by the climate related disasters. The main problem for Anuradhapura farmers was the scarcity of water (26 percent).



Source: HARTI Survey Data, 2016

Figure 13.16: District Wise Variation of Constraints Faced by Sesame Farmers

13.8 Recommendation and Suggestions

It is suggested to formulate long term policy plan to enhance the productivity of sesame cultivation. This plan needs to focus on strengthening the seed production programme of the Department of Agriculture so that the farmers could gain access to high yielding recommended varieties. Further it is essential to strengthen the farmer knowledge by creating awareness among the farmers on the optimum agronomic conditions. It is also important to implement crop diversification programmes to expand the sesame cultivation on a wider scale, specially make use of unutilized lands particularly the paddy lands could not be cultivated in *Yala* season due to water scarcities.

It is suggest ensuring a reasonable price and marketing mechanism to purchase farmers' production without a delay in the harvesting season through a collective approach by the public and the private sector.

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Chapter Fourteen

Black Gram

I.K. Edirisinghe

SUMMARY

Black gram (*Vigna mungo*) is one of the important grain legumes in the rain-fed farming systems in dry and the intermediate zones of Sri Lanka. The recommended variety by the Department of Agriculture is MI-1 and the average yield is 2.5mt/ha. The annual average land extent under black gram and annual average production in Sri Lanka during the period 2006 to 2015 were 9,379ha and 8,845mt respectively and the extent had increased slightly over the years. It is a seasonal crop and *Maha* season is the major production season and it is successfully cultivated in the districts of Anuradhapura, Polonnaruwa, Vavuniya, Mannar, Kurunegala, Puttalam, Kilinochchi, Mullaitivu, Batticaloa and Jaffna. However, recent figures illustrate that large quantities of black gram are imported annually and it is not exported from Sri Lanka on a commercial basis.

The survey had been conducted in three districts; Kurunegala, Vavuniya and Monaragala and the total sample size was 129 farmers. The majority had mainly depended on farming as their livelihood. However, the participation of youth in black gram cultivation was very low. Further, nearly two thirds of the farmers had lands with five or more than five acres and nearly one third had two or less than five acres. Most of the farmers had more than one land plot under different land ownerships and the majority of land plots had single ownership followed by encroached lands. Majority of the farmers in the sample had used more than one source of water to irrigate their farm lands: in Kurunegala, the highest number cultivate black gram under rain-fed conditions followed by major and minor irrigations, in Vavuniya, using agro-wells followed by major irrigation and cultivation under rain-fed conditions and in Monaragala, under rain-fed conditions followed by minor irrigation and using agro-wells.

Both hired and family labour had been used by the majority of the farmers in the sample for cultivation and none of the farmers in the sample had paid for organic fertilizer. Data shows that farmers had spent more on insecticides, weedicides and fungicides than on fertilizer on an average cost of Rs. 990.41/ac, Rs. 954.40/ac and Rs. 128.96/ac respectively. The cultivation was mainly with local seeds and uncertified local seeds play a similar role as certified seeds. Despite the farmers claim that they had used local seeds, 83 percent of the farmers in the sample were not able to name the seed type correctly. In Kurunegala district, the highest number of farmers had used seeds from the Department of Agriculture followed by self-produced seeds and in Vavuniya, it was the seeds from the Department of Agriculture. In Monaragala, it was self-produced seeds followed by seeds from local markets. The average seed cost was Rs. 2,535.21/ac. The average machinery cost was Rs. 6,910.04/ac. The total cost of productions of black gram including family labour and excluding family labour were Rs. 17,058.78/ac and Rs. 15,918.23/ac respectively. Of the costs, the highest cost component was machinery (41 percent) followed by hired labour (25 percent), seed (15 percent) and family labour (7 percent). The majority of the farmers had sold more than 75 percent of their production.

The main problems faced by the black gram farmers were threats of wild animals such as peacocks, monkeys, wild boars and wild elephants followed by crop damages due to pest and diseases, price volatility, crop damages due to extreme weather events and the shortage of quality seeds. In addition, lack of pesticides (fungicide, insecticide, weedicide) at the market, labour issues such as high cost of labour and non-availability of labour, water scarcity and lack of capital at the initial stages of farming were among the other issues.

CHAPTER FOURTEEN

Black Gram

14.1 Overview of the Crop

14.1.1 Introduction

Black gram (*Vigna mungo*) is one of the important grain legumes in the rain-fed farming systems in the dry and the intermediate zones of Sri Lanka (FCRDI, 2016). It is one of the most popular pulses in India, specially in the vegetarian diet, and it has been introduced in comparatively recent times elsewhere in the tropics, mainly by the Indian migrants. Black gram is locally known as *Undu* in Sinhala and as *Ulundu* in Tamil.

Black gram is one of the rich sources of vegetable protein and some essential minerals and vitamins for the human body (FCRDI, 2016). The recommended variety by the Department of Agriculture (DOA) is MI-1 (recommended before 1965) and the average yield is 2.5 mt/ha. However, the national average yield of black gram was far behind the research yield (FCRDI, 2016).

14.1.2 Extent under Cultivation, Production Trends and Major Growing Areas

The annual average extent under black gram cultivation in Sri Lanka during the period from 2006 to 2015 was 9,379 ha whereas the annual average production was 8,845 mt (Table 14.1). The average yield for the period 2006 to 2015 was 955kg/ha. However, it was lower than the potential average yield of the recommended variety by the DOA. Of the period, the highest annual extent and the annual production were recorded in 2015 as 12,305 ha and 11,902 mt respectively and the highest average yield was recorded in 2008 as 1,139 kg/ha.

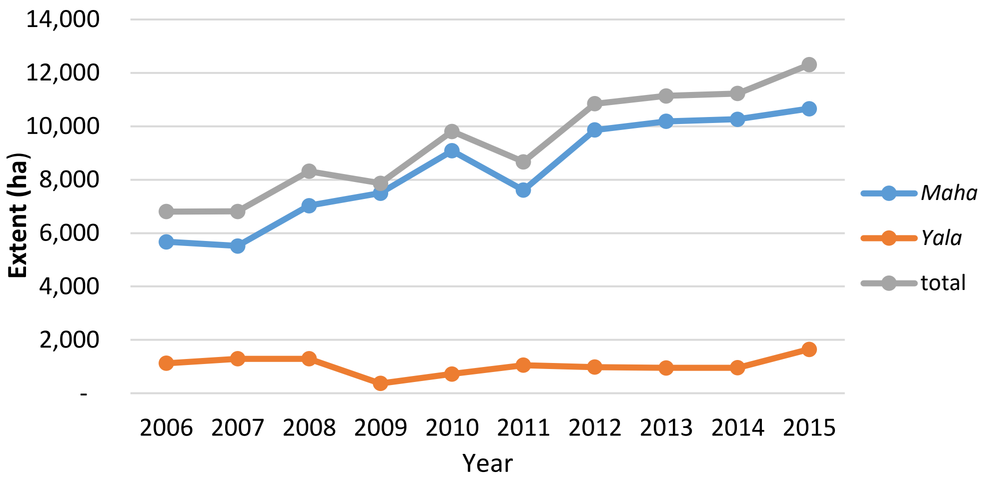
Black gram extent in Sri Lanka had increased slightly over the years and the extent had increased from 6,804ha in 2006 to 12,305 ha in 2015 (Figure 14.1 and Table 14.1). Further, it is a seasonal crop and the *Maha* is the major production season (Figure 14.1). Nearly 80 percent of the black gram crop cultivated during the *Maha* season was a rain-fed upland crop and rest was grown in the *Yala* in paddy fields with supplementary irrigation. In line with the extent, production too, showed an increasing trend for the period 2006-2015 (Figure 14.2). The production of 7,470 mt in 2006 had increased to 11,902 mt in 2015 (Table 14.1). However, a significant drop in production as well as in extent was noted in 2011 (Figures 14.1 and 14.2). The annual average yield for the period 2006 to 2015 was 955 kg/ha.

Table 14.1: Extent, Production and Average Yield of Black Gram (2006-2015)

Year	Extent (ha)			Production (mt)			Average Yield (kg/ha)		
	Maha	***Yala***	**Total**	***Maha***	***Yala***	**Total**	***Maha***	***Yala***	**Total**
2006	5,674	1,130	6,804	6,141	1,329	7,470	1,082	1,176	1,098

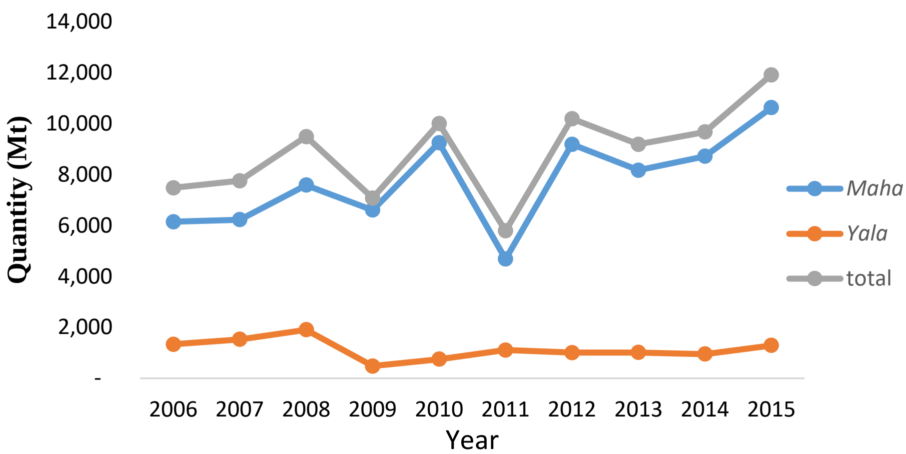
2007	5,516	1,297	6,813	6,218	1,529	7,747	1,127	1,179	1,137
2008	7,025	1,293	8,318	7,577	1,900	9,477	1,079	1,469	1,139
2009	7,496	372	7,868	6,595	476	7,071	880	1,280	899
2010	9,081	727	9,808	9,241	750	9,991	1,018	1,032	1,019
2011	7,611	1,057	8,668	4,677	1,106	5,783	615	1,046	667
2012	9,860	982	10,842	9,175	1,005	0,180	931	1,023	939
2013	10,183	955	11,138	8,160	1,015	9,175	801	1,063	824
2014	10,264	962	11,226	8,705	952	9,657	848	990	860
2015	10,657	1,648	12,305	10,614	1,288	11,902	996	782	967
Average (2006-2015)	8,337	1,042	9,379	7,710	1,135	8,845	938	1,104	955

Source: Department of Census and Statistics



Source: Department of Census and Statistics

Figure 14.1: Extent of Black Gram



Source: Department of Census and Statistics

Figure 14.2: Production of Black Gram

Presently, black gram is successfully cultivated in the districts of Anuradhapura, Polonnaruwa, Vavuniya, Mannar, Kurunegala, Puttalam, Kilinochchi, Mullaitivu, Batticaloa and Jaffna (FCRDI, 2016). However, of the extent and production, 87 percent confined to five districts (Figures 14.3 and 14.4). With reference to the extent, Anuradhapura, Vavuniya and Mannar dominated the list and represented 57 percent, 13 percent and seven percent of the extent under black gram cultivation respectively (Figure 14.3). With reference to the production, Anuradhapura, Vavuniya and Mannar districts led the list and contributed 55 percent, 12 percent and nine percent to the national black gram production respectively (Figure 14.4).

Source: Department of Census and Statistics

Source: Department of Census and Statistics

14.1.3 Climate and Soil

Black gram is a drought resistant crop and it can be grown under low moisture and fertility conditions. It is not suitable for wet tropics and areas with heavy rainfalls. Therefore, the optimum temperature for black gram cultivation is $25^{o}C$ - $35^{o}C$ and the maturity period should coincide with the dry weather conditions for high yield and quality seeds. Black gram can be grown on well-drained sandy to loam soils and the optimum soil pH is 6-7. Therefore, suitable climatic zones are the dry and the intermediate zones (FCRDI, 2016).

14.1.4 Importance of the Crop to the Economy

i. Consumption

Per capita consumption of black gram shows an increasing trend in Sri Lanka during 2006 - 2013. In 2006/07, the per capita consumption was 58.92 g and it had increased to 90.6 g in 2012/13 (Table 14.2).

Table 14.2: Per Capita Consumption of Black Gram

Year	Quantity (grams/year)
2006/07	58.92
2009/10	69.36

2012/13	90.6

Source: Household Income and Expenditure Survey, Department of Census and Statistics

ii. Domestic Marketing

Of the period, 2011-2015, the annual average producer price and the annual average retail price of black gram were reported as Rs. 146.03/kg and Rs. 283.01/kg respectively (Table 14.3). Further, according to the monthly price fluctuations, black gram has not showed significant price differences throughout a year (Figure 14.5). The lowest and the highest producer prices reported for the period 2011-2015 were Rs. 132.50/kg in December and Rs. 161.72/kg in September respectively (Table 14.3). In addition, the lowest and the highest retail prices reported for the same period was Rs. 271.91/kg in May and Rs. 299.05/kg in December respectively (Table 14.3).

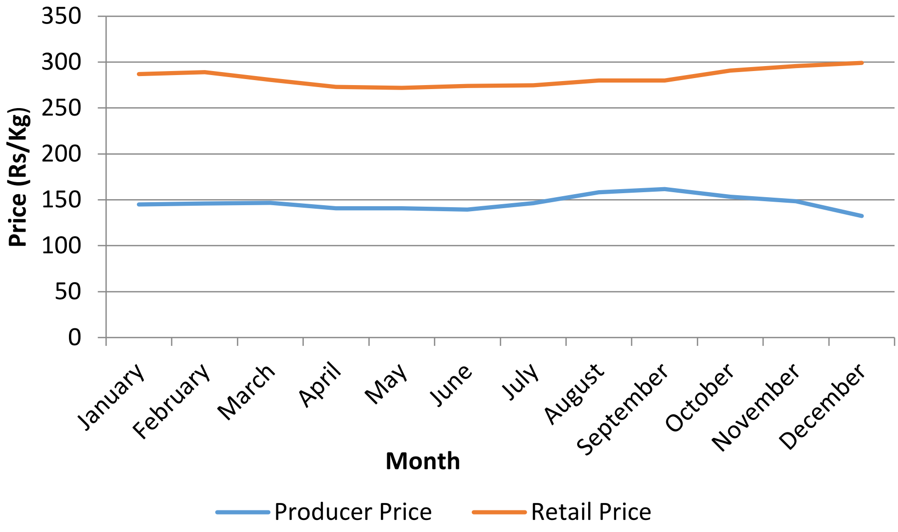
Table 14.3: Monthly Average Producer and Retail Prices of Black Gram

Month	Average (2011-2015)	
	Producer Price (Rs/Kg)	Retail Price (Rs/Kg)
January	145.00	286.97
February	145.95	288.80
March	146.56	280.67
April	140.77	272.93
May	140.69	271.91
June	139.26	274.06
July	146.43	274.53
August	158.10	280.01
September	161.72	279.76
October	153.19	290.55
November	148.34	295.59
December	132.50	299.05
Annual Average	146.03	283.01

Source: Department of Census and Statistics and Marketing, Food Policy and Agri-business Division of HARTI

iii. External Trade

Until early nineties large quantities of black gram were exported to various countries and no imports were recorded. However, recent figures illustrate that large quantities of black gram are imported annually (FCRDI, 2016). At present, black gram is not exported from Sri Lanka on a commercial basis. According to the Department of Customs, in 2009, 3,349mt of black gram worth Rs. 311 million had been imported to the country to bridge the gap between the national production and requirement and it was 658mt worth Rs. 104 million in 2015. In 2009, the main importing countries were Thailand, Singapore and Myanmar.



Source: Department of Census and Statistics and Marketing, Food Policy and Agri-business Division of HARTI

Figure 14.5: Monthly Domestic Prices of Black Gram (2011-15)

14.2 Socio-Economic Characteristics of the Sample

Three districts, Kurunegala, Vavuniya and Monaragala were selected for the survey and data were collected from 129 black gram farmers in all three districts. Further, five Agrarian Services Centres from Kurunegala district (Kelepattuwa, Mahawilachchiya, Nikaweratiya, Oyamadu and Pemaduwa) and one from Vavuniya (Settikulam) and one from Monaragala (Buttala) were selected for the survey.

14.2.1 Demographic Characteristics

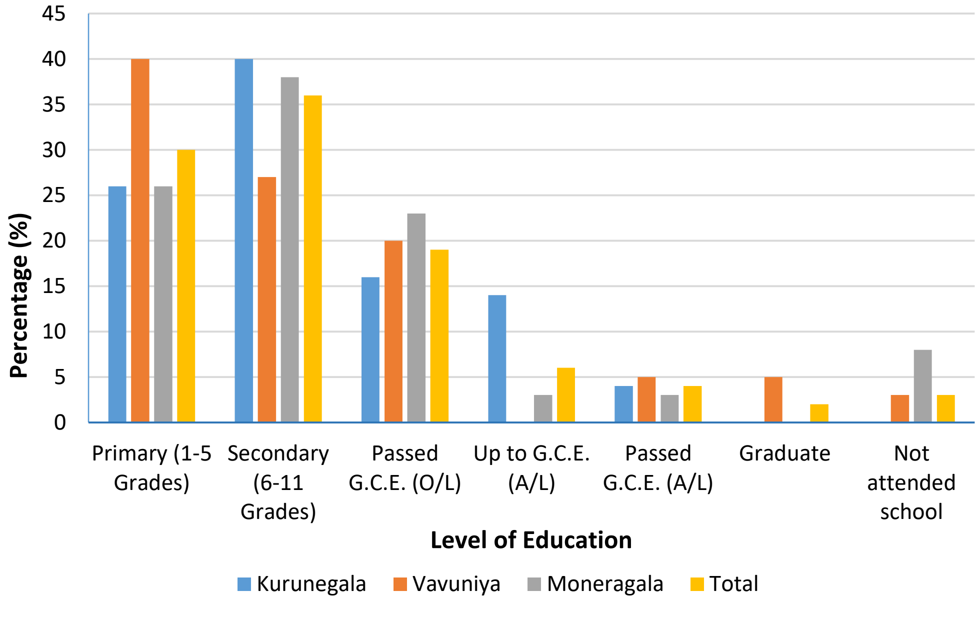
The majority of the farmers (35%) were in the age group 50-60 years followed by the age group 40-50 years (26%). Only three percent of the farmers were in the age group less than 30 years (Table 14.4). Therefore, the black gram cultivation was more popular among the middle-aged farmers and the participation of youth in black gram cultivation was very low. In addition, of the three districts, more senior citizens engaged in black gram cultivation in Kurunegala (22%) and Vavuniya (22%) districts than in Monaragala district (5%).

Table 14.4: Age Groups

Age Group (Years)	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
< 30	1	2	2	5	1	3	4	3
30 < 40	9	18	9	22	6	15	24	19
40 < 50	13	26	8	20	13	33	34	26
50 < 60	16	32	12	30	17	44	45	35
≥60	11	22	9	22	2	5	22	17
Total	50	100	40	100	39	100	129	100

Source: HARTI Survey Data, 2016

Just over one third of the farmers in the sample had achieved secondary level education and nearly one third had gone only up to primary level. Only four percent of the farmers had been successful at the G.C.E. Advanced Level examination, while 25 percent had passed the G.C.E. Ordinary Level examination. Of the sample, two farmers from Vavuniya had obtained degrees and only three percent of the farmers in the entire sample had no schooling (Figure 14.6). Therefore, the levels of education of the farmers in the sample were at a satisfactory level.



Source: HARTI Survey Data, 2016

Figure 14.6: Level of Education

Half of the sample had three to four members in their families and 28 percent of the farmers had five to six members. Only 17 percent and five percent of farmers had less than three members and more than seven members in their families respectively (Table 14.5). This indicates that the majority of farm families have average family size.

Table 14.5: Family Size

Number of Family Members	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
< 3	7	14	5	13	10	26	22	17
3 – 4	26	52	21	52	17	44	64	50
5 - 6	14	28	11	27	11	28	36	28
≥ 7	3	6	3	8	1	3	7	5
Total	50	100	40	100	39	100	129	100

Source: HARTI Survey Data, 2016

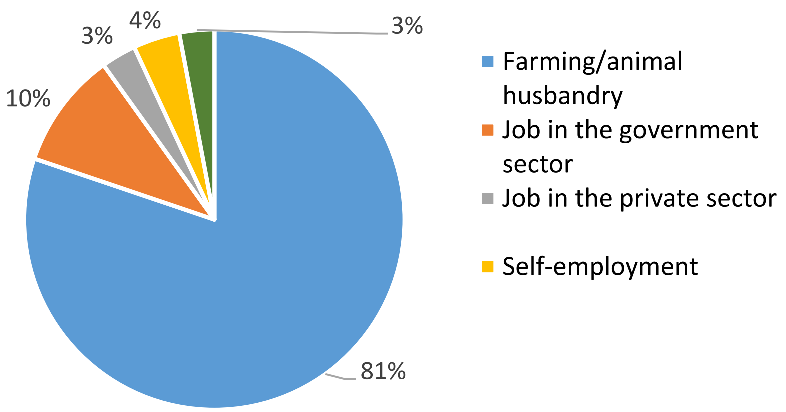
14.2.2 Economic Characteristics

At the time of the survey, 13 black gram farmers (10%) reported that they did not have any source of income and 90 percent in the sample revealed their economic activities. Therefore, the economic activities are described with reference to only 116 black gram farmers (Table 14.6). The majority in the sample (81%) were primarily farmers either doing crop cultivation and/or animal husbandry. Only 13 percent mainly depended on their occupations in the government or the private sector. Another seven percent relied on either self-employment or skilled labour. Therefore, the majority in the sample mainly depended on farming (Figure 14.7).

Table 14.6: Primary Income Generating Activity of the Black Gram Farmers

Primary Income Generating Activity	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
Farming/animal husbandry	35	75	31	82	28	90	94	81
Job in the government sector	8	17	2	5	1	3	11	10
Job in the private sector	1	2	1	3	1	3	3	3
Self-employment	2	4	2	5	1	3	5	4
Skilled labour	1	2	2	5	0	0	3	3
Total	47	100	38	100	31	100	116	100

Source: HARTI Survey Data, 2016



Source: HARTI Survey Data, 2016

Figure 14.7: Primary Income Generating Activity of the Black Gram Farmers

14.3 Agricultural Inputs

14.3.1 Land

Nearly two thirds of farmers had lands with five or more than five acres under black gram cultivation and nearly one third had lands with two or less than five acres under this crop and a few (5%) had less than two acres of lands (Table 14.7). Therefore, the majority of the black gram farmers in the sample had done their cultivation on a large scale (more than two acres).

Table 14.7: Extent under Cultivation

Extent under Black Gram Cultivation (acres)	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
0.5 - <1	0	0	1	2	0	0	1	1
1- < 2	2	4	3	8	0	0	5	4
2 - < 5	18	36	18	45	3	8	39	30
≥ 5	30	60	18	45	36	92	84	65
Total	50	100	40	100	39	100	129	100

Source: HARTI Survey Data, 2016

Most of the farmers in the sample had more than one land plot under different land ownership as 129 farmers growing this crop in 211 land plots. This was more common in Kurunegala and Monaragala districts as 50 farmers had 94 land plots and 39 farmers had 71 land plots respectively. However, it was a different scenario in Vavuniya district as 40 farmers had only 46 land plots (Table 14.8). Of the total sample, just over half of the lands belonged to farmers under single ownership. However, it was 85 percent in Vavuniya district and only 30 percent in Monaragala district. Nearly one third of the lands under black gram cultivation were encroachments and this was specific to Monaragala district where 55 percent of land plots were encroached lands. Vavuniya district reported no encroached lands and 27 percent of land plots in Kurunegala district were encroached.

Table 14.8: Farmlands Ownership

Type of Ownership	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
Single owner	47	50	39	85	21	30	107	51
Jointly owned	2	2	0	0	3	4	5	2
Leased in	2	2	0	0	1	1	3	1
Tenancy-in	3	3	5	11	0	0	8	4
Tenancy-out	7	7	0	0	1	1	8	4
Permit holder	7	7	0	0	2	3	9	4
Encroached	25	27	0	0	39	55	64	30
Other	1	1	2	4	4	6	7	3
Total	94	100	46	100	71	100	211	100

Note: Multiple responses

Source: HARTI Survey Data, 2016

Other types of land ownerships such as jointly owned, leased in, tenancy-in, tenancy-out and permit holder were not common among the farmers in the sample (Table 14.8). Therefore, it can be concluded that most of the farmers in the sample had several land plots under different land ownerships and the majority of land plots under black gram cultivation had single ownership followed by encroachments.

14.3.2 Irrigation

Most of the farmers in the sample had used more than one source of water to irrigate their farm lands. In Kurunegala district, the highest number of farmers (42%) grew black gram under rain-fed conditions followed by major (26%) and minor (21%) irrigations (Table 14.9). In Vavuniya district, the highest number of farmers (35%) did black gram using agro-wells followed by major irrigation (30%) and rain-fed (23%) cultivation (Table 14.9). In Monaragala district, the highest number of farmers (61%) cultivated black gram under rain-fed conditions followed by minor irrigation (21%) and using agro-wells (11%). In addition, the other water sources used by the farmers were drinking water wells, pipe-born water, pumping water from river and tube wells. However, the number of farmers who relied on these sources was negligible to be considered seriously (Table 14.9).

Table 14.9: Source of Water for Cultivation

Source of Water	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
Rain-fed	43	42	17	23	39	61	99	41
Major irrigation	27	26	22	30	1	2	50	21
Minor irrigation	21	21	7	9	10	16	38	16
Agro-well	4	4	26	35	7	11	37	15
Drinking water well	5	5	0	0	1	2	6	3
Pipe-born water	2	2	0	0	3	5	5	2
Pumping water from river	0	0	2	3	1	2	3	1
Tube well	0	0	0	0	1	2	1	<1
Other	0	0	0	0	1	2	1	<1
Total	102	100	74	100	64	100	240	100

Note: Multiple responses

Source: HARTI Survey Data, 2016

14.3.3 Labour

Of the 129 farmers in the total sample, responses given by only 112 farmers, excluding the outliers, were used to analyze the labour cost. Both hired and family labour had been used by the majority of the farmers for cultivation. However, there was a few numbers of farmers who had used either family labour only or hired labour only in cultivation as well.

14.3.4 Fertilizer and Pesticides

As mentioned above, of the 129 farmers in the total sample, responses by only 112 farmers, excluding the outliers, were used to analyze the cost of fertilizer, weedicide and insecticides. None of the farmers in the sample had paid for organic fertilizer in cultivating black gram. Some farmers had not paid for inorganic fertilizer as well in the data collected season.

Data shows that farmers had spent more on weedicides, insecticides and fungicides than on fertilizer. At the same time, some farmers had not paid for weedicides, insecticides and fungicides at all in cultivating black gram. The average cost of using insecticides, weedicides and fungicides were Rs. 990.41/ac, Rs. 954.40/ac and Rs. 128.96/ac respectively.

14.3.5 Seeds

The majority of farmers (91%) had used local black gram seeds for their cultivation. However, of them, 54 percent had used uncertified local seeds while the others had used certified local seeds (Table 14.10). Therefore, black gram cultivation in Sri Lanka mainly depends on local certified and uncertified seeds.

Table 14.10: Type of Seeds Used

Type of Seeds	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
Local - Certified Seeds	24	48	26	65	4	10	54	42
Local - Uncertified Seeds	21	42	9	23	33	85	63	49
Not reported	5	10	5	13	2	5	12	10
Total	50	100	40	100	39	100	129	100

Source: HARTI Survey Data, 2016

Though most of the farmers had said that they were using local seeds, 83 percent of the farmers in the sample were unaware of the name the seed variety. Only eight percent of the farmers had named the black gram seed variety they were using and the types were *Kalu Undu*, MI-1, *Wel Undu*, *Panduru Undu and Kuththu* (Table 14.11).

Table 14.11: Type of Seed Variety Used

Type of Seed Variety	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
Variety not known	44	88	28	70	35	90	107	83
Kalu undu	0	0	4	10	0	0	4	3
MI-1	3	6	0	0	0	0	3	2
Wel undu	0	0	0	0	1	3	1	1
Panduru undu	0	0	0	0	1	3	1	1
Kuththu	0	0	1	2	0	0	1	1
Not reported	3	6	7	18	2	5	12	10
Total	50	100	40	100	39	100	129	100

Source: HARTI Survey Data, 2016

In Kurunegala district, the highest number of farmers (40%) had used seeds from the Department of Agriculture followed by self-produced seeds (38%). Only 14 percent had relied on private companies and local markets. In Vavuniya district also, the highest number of farmers (48%) had used seeds from the Department of Agriculture. However, 33 percent had relied on private companies and local markets. In contrast, in Monaragala district, the highest number of farmers (69%) had used self-produced seeds followed by seeds from local markets (23%). Further, the Department of Agriculture was not a common source for seeds for the black gram farmers in Monaragala district as only three percent had bought seeds from the Department of Agriculture (Table 14.12).

Table 14.12: Source of Seeds Used

Source of Seeds	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
Department of Agriculture	20	40	19	48	1	3	40	31
Self-produced	19	38	2	5	27	69	48	37
Private companies	2	4	9	23	0	0	11	9
Neighbouring farmers	1	2	1	3	1	3	3	2
Local market	5	10	4	10	9	23	18	14
Not reported	3	6	5	13	1	3	9	7
Total	50	100	40	100	39	100	129	100

Source: HARTI Survey Data, 2016

With respect to the seed cost, some farmers had not spent on seeds as they had used self-produced seeds and seeds from neighbouring farmers. The average seed cost was Rs. 2,535.21/ac (the analysis was based on responses given by only 112 farmers, excluding the outliers).

14.3.6 Machinery

Data shows that some farmers had not used machinery at all in cultivating black gram. Therefore, the machinery cost incurred by the farmers ranged between Rs. 0.00-17,250.00/ac. The average machinery cost was Rs. 6,910.04/ac (the analysis was based on responses given by only 112 farmers, excluding the outliers).

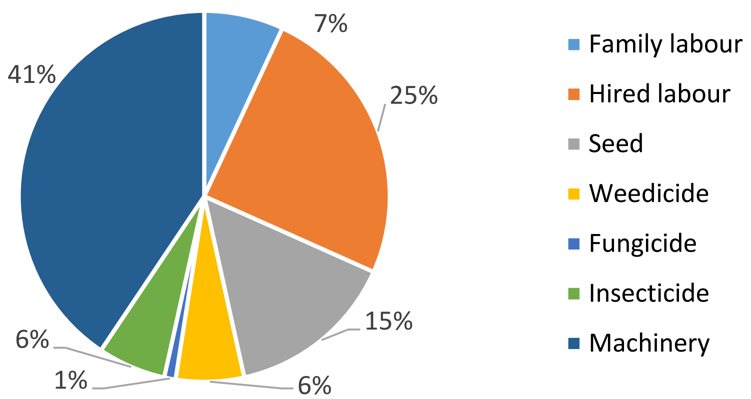
14.3.7 Total Cost of Production

The total cost of productions of black gram including family labour and excluding family labour were Rs. 17,058.78/ac and Rs. 15,918.23/ac respectively (Table 14.13). As explained in previous sub-sections, the other costs included in the total were cost of seed, chemical fertilizer, weedicides, fungicides, insecticides and machinery. The highest cost component was machinery (41%) followed by hired labour (25%), seed (15%) and family labour (7%). Of the total cost, fungicides, inorganic or chemical fertilizer cost and the other costs were not significant while, weedicides and insecticides had contributed six percent each to the total cost of production (Table 14.13 and Figure 14.8).

Table 14.13: Cost of Production

Type of Cost	Cost (Rs./ac)			
	Mean		Std. Dev.	Maximum
	Value	%		
Family labour	1,140.55	7	2,000.86	11,500.00
Hired labour	4,282.08	25	4,013.72	20,950.00
Seed	2,535.21	15	1,425.17	7,500.00
Chemical fertilizer	58.84	0	281.53	2,500.00
Organic fertilizer	0.00	0	0.00	0.00
Weedicide	954.40	6	1,822.21	9,600.00
Fungicide	128.96	1	386.59	2,500.00
Insecticide	990.41	6	1,179.81	7,680.00
Machinery	6,910.04	41	4,352.07	17,250.00
Other	58.28	0	166.38	1,000.00
Total cost including family labour	17,058.78	100	6,642.65	33,775.00
Total cost excluding family labour	15,918.23		6,494.00	33325.00

Note: The analysis was based on responses given by only 112 farmers, excluding the outliers.
Source: HARTI Survey Data, 2016



Source: HARTI Survey Data, 2016

Figure 14.8: Cost of Production

14.4 Production, Consumption, Storing and Selling

All the farmers in the Kurunegala district sample reported that the family consumption was less than 25 percent of their production. With regard to storing the harvest, all the farmers except two had stored less than 25 percent of their production. A farmer in the category of land extent 0.5 - <1ac and another farmer in the category of land extent ≥ 5ac had stored more than 75 percent of their production. At the same time, 42 farmers had sold out more than 74 percent of their production. Therefore, these 42 farmers had both consumed and stored only less than 26 percent of their production. Further, the majority of the farmers had sold more than 75 percent of their production (Table 14.14 and Figure 14.9).

Table 14.14: Production, Consumption, Storing and Selling of Black Gram – Kurunegala District

Extent (acres)	No. of Farmers	Production			Way of Using (No. of Farmers)								
					Consumption (of the Total Production)			Storing (of the Total Production)			Selling (of the Total Production)		
		Total Extent (ac)	Total Production (kg)	Avg. Yield (kg/ac)	< 25%	25-<50%	≥ 75%	< 25%	25-<50%	≥ 75%	< 25%	50-<75%	≥ 75%
0.5 - <1	3	1.5	515	343.33	3	0	0	2	0	1	1	0	2
1- < 2	10	12.7	8,910	701.57	10	0	0	10	0	0	1	0	9
2 - < 5	20	53.0	18,202	343.43	20	0	0	20	0	0	0	0	20
≥ 5	12	96.5	35,535	368.24	12	0	0	11	0	1	0	1	11
Total	**45**	**163.7**	**63162**	NA	**45**	0	0	**43**	0	**2**	**2**	**1**	**42**

Source: HARTI Survey Data, 2016

All the 39 farmers in Vavuniya except five reported that the family consumption was less than 25 percent of their production. Of the five, four farmers in the category of land extent 2 - < 5ac reported that their family consumption was more than 74 percent of their production and one farmer in the category of land extent 1- < 2ac reported that the family consumption ranged between 50-74 percent. With regard to storing the harvest, all the 39 farmers had stored less than 25 percent of their production.

Table 14.15: Production, Consumption, Storing and Selling of Black Gram – Vavuniya District

Extent (acres)	No. of Farmers	Production			Way of Using (No. of Farmers)									
					Consumption (of the Total Production)			Storing (of the Total Production)			Selling (of the Total Production)			
		Total Extent (ac)	Total Production (kg)	Avg. Yield (kg/ac)	< 25%	50-<75%	≥ 75%	< 25%	25-<50%	≥ 75%	< 25%	25-<50%	50-<75%	≥ 75%
< 0.25	1	0.13	10	76.92	1	0	0	1	0	0	0	0	1	0
0.5 - <1	4	2.25	1,200	533.33	4	0	0	4	0	0	0	0	0	4
1- < 2	7	7.50	3,630	484.00	6	1	0	7	0	0	0	2	0	5
2 - < 5	20	54.65	16,380	299.73	16	0	4	20	0	0	4	0	0	16
≥ 5	7	51.00	7,200	141.18	7	0	0	7	0	0	0	0	1	6
Total	**39**	**115.53**	**28,420**	NA	**34**	**1**	**4**	**39**	0	0	**4**	**2**	**2**	**31**

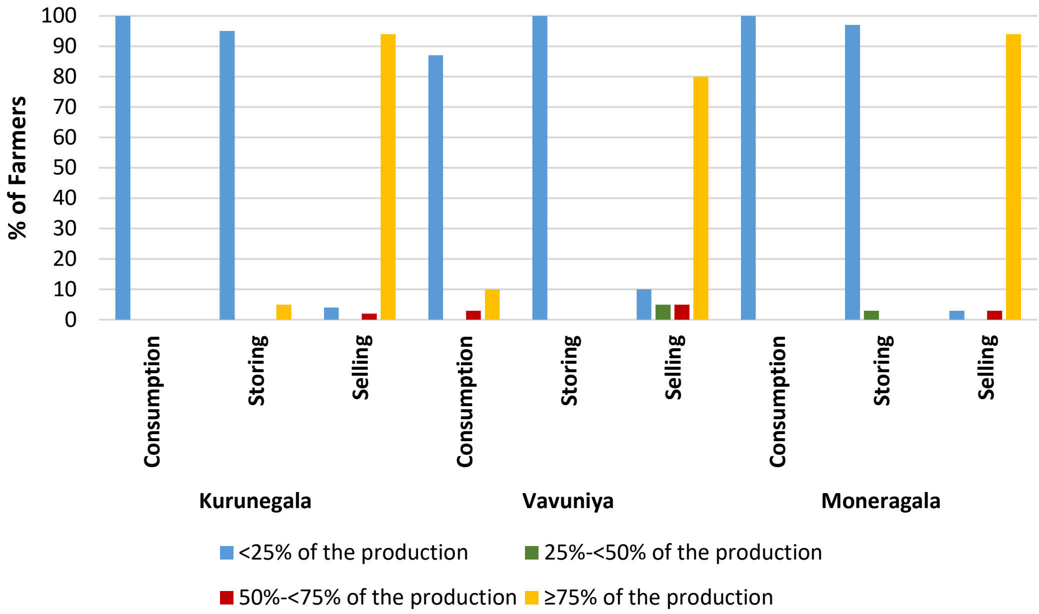
Source: HARTI Survey Data, 2016

Table 14.16: Production, Consumption, Storing and Selling of Black Gram – Monaragala District

Extent (acres)	No. of Farmers	Production			Way of Using (No. of Farmers)								
					Consumption (of the Total Production)			Storing (of the Total Production)			Selling (of the Total Production)		
		Total Extent (ac)	Total Production (kg)	Avg. Yield (kg/ac)	< 25%	25-<50%	≥ 75%	< 25%	25-<50%	≥ 75%	< 25%	50-<75%	≥ 75%
0.5 - <1	1	0.5	400	800.00	1	0	0	1	0	0	0	0	1
1- < 2	2	2.0	575	287.50	2	0	0	1	1	0	0	1	1
2 - < 5	12	34.5	15,150	439.13	12	0	0	12	0	0	0	0	12
≥ 5	23	245.0	61,053	249.20	23	0	0	23	0	0	1	0	22
Total	**38**	**282.0**	**77,178**	NA	**38**	0	0	**37**	**1**	0	**1**	**1**	**36**

Source: HARTI Survey Data, 2016

Therefore, 31 farmers had sold more than 75 percent of their production while four farmers in the category of land extent 2- < 5ac had sold less than 25 percent. Two farmers in the category of land extent 1- < 2ac had sold 25-<50 percent of their production while a farmer in the category of land extent < 0.25ac and another farmer in the category of land extent ≥5ac had sold 50-74 percent of their production. Therefore, in Vavuniya district the majority sold more than 75 percent of their production. Unlike in other two districts, four farmers had consumed more than 75 percent of their production as well (Table 14.15 and Figure 14.9).



Source: HARTI Survey Data, 2016

Figure 14.9: Consumption, Storing and Selling of Black Gram

All the 38 farmers in Monaragala reported that the family consumption was less than 25 percent of their production. With regard to storing the harvest, all the farmers except one had stored less than 25 percent of their production. A farmer in the category of land extent 1- < 2ac had stored between 25-49 percent of their production. Therefore, the majority had sold more than 75 percent of their production (Table 14.16 and Figure 14.9).

14.5 Cultivating Seasons and Farm-gate Prices

Confirming the national data, the survey data too show that black gram is a seasonal crop and *Maha* is the major production season (87%). Only 13 percent and four percent of farmers had cultivated black gram in *Yala* and intermediate seasons respectively (Table 14.17). However, intermediate cultivation was noted only in Kurunegala and Monaragala districts. Nearly 87 percent of farmers who had cultivated during *Maha* season had cultivated on highlands. In *Yala* season, it had been mainly cultivated as a lowland crop (59%). However, in Monaragala district, it was entirely on highlands in *Yala* season (Table 14.17).

Table 14.17: Cultivating Seasons and the Type of Land

Season and Type of Land	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
Yala								
Highland	1	11	2	50	4	100	7	41
Lowland	8	89	2	50	0	0	10	59
Total	***9***	***100***	***4***	***100***	***4***	***100***	***17***	***100***
	(50)	***(18)***	***(40)***	***(10)***	***(39)***	***(10)***	***(129)***	***(13)***
Maha								
Highland	31	82	31	84	35	95	97	87
Lowland	5	13	1	3	1	3	7	6
Home garden	2	5	5	13	1	3	8	7
Total	***38***	***100***	***37***	***100***	***37***	***100***	***112***	***100***
	(50)	***(76)***	***(40)***	***(93)***	***(39)***	***(95)***	***(129)***	***(87)***
Intermediate								
Highland	2	50	0	0	1	100	3	60
Lowland	2	50	0	0	0	0	2	40
Total	***4***	***100***	***0***	***0***	***1***	***100***	***5***	***100***
	(50)	***(8)***	***(40)***	***(0)***	***(39)***	***(3)***	***(129)***	***(4)***

Note: The total sample size is presented in parenthesis in the 'No.' column and the percentage to the total sample is presented in parenthesis in the '%' column.
Source: HARTI Survey Data, 2016

Farm-gate price in 2015/16 *Maha* was higher than that of 2015 *Yala* in all the study locations. The average farm-gate price of three districts in the *Yala* ranged between Rs. 136.67-169.00/kg and it was Rs. 168.86-216.79/kg for the *Maha* season. Data also indicates that, of the three districts, the highest prices had been received by the farmers in Kurunegala district followed by Vavuniya and Monaragala districts (Table 14.18).

Table 14.18: Farm-gate Prices Received by the Black Gram Farmers

District	2015 *Yala*				2015/16 *Maha*			
	Mean (Rs./kg)	Minimum (Rs./kg)	Maximum (Rs./kg)	SD (Rs./kg)	Mean (Rs./kg)	Minimum (Rs./kg)	Maximum (Rs./kg)	SD (Rs./kg)
Kurunegala	169.00	100.00	250.00	49.99	216.79	80.00	250.00	42.20
Vavuniya	156.25	95.00	230.00	56.18	192.71	100.00	265.00	43.31
Monaragala	136.67	80.00	180.00	51.32	168.86	110.00	240.00	34.62

Source: HARTI Survey Data, 2016

14.6 Constraints of Production

Table 14.19 shows that, of the total sample, the main problems faced by the farmers were the threats of wild animals such as peacocks, monkeys, wild boars and wild elephants (34%) followed by crop damages due to pest and diseases (20%), inability to get a stable price for the produce mainly due to intermediators and imports (9%), crop damages due to adverse climatic events (8%) and shortage of quality seeds (8%).

Table 14.19: Challenges Faced by the Black Gram Farmers

Challenges	Districts						Total	
	Kurunegala		Vavuniya		Monaragala			
	No.	%	No.	%	No.	%	No.	%
Wildl animal damage	8	12	25	37	32	53	65	34
Pest and desease attacks	11	17	22	33	6	10	39	20
Not having a stable price	8	12	0	0	9	15	17	9
Impact of adverse climate	4	6	11	16	1	2	16	8
Lack of quality seeds	7	11	3	4	5	8	15	8
Lack of pesticides	9	14	0	0	0	0	9	5
Labour Issues	6	9	1	1	0	0	7	4
Water scarcity	1	2	3	4	2	3	6	3
Lack of capital	1	2	0	0	2	3	3	2
High input prices	4	7	1	1	1	4	7	4
Issues in the purchasing of seeds	4	7	0	0	0	0	4	3
Poor extension service	0	0	0	0	1	2	1	1
Issues in the quality of agrochemicals	1	2	0	0	0	0	1	1
Lack of knowledge on new technologies	0	0	1	1	0	0	1	1
Non availability of lands to cultivate	1	2	0	0	0	0	1	1
Total	65	100	67	100	60	100	192	100

Note: Multiple responses
Source: HARTI Survey Data, 2016

In Kurunegala district, the main issue was crop damages due to pest and diseases (17%) followed by the non-availability of effective pesticides (fungicide, insecticide, weedicide) at the market (14%), the threats of wild animals (12%) and absence of a stable price for the produce mainly due to intermediators and imports (12%). Main three issues in Vavuniya district were also the threats of wild animals (37%), crop damages due to pest and diseases (33%) and crop damage due to the climatic changes (16%). In Monaragala district, the threats of wild animals (53%) was a significant issue and the other main problems were absence of a stable price for produce mainly due to intermediators and imports (15%) and crop damages due to pest and diseases (10%). In addition, unavailability of pesticides (fungicide, insecticide, weedicide) at the market (5%), labour issues such as high cost of labour and non-availability of labour (4%), water scarcity (3%) and lack of capital at the initial stages of farming (2%) were among the other issues (Table 14.19).

14.7 Recommendations and Suggestions

In the National Food Production Programme 2016-18, the government has identified specific activities to increase the production of black gram in future. These activities include increasing the cultivable extent to increase production, popularising usage of certified seeds and developing self-seed production, improving the quality of harvests and reduce cost of production through introduction of farm machinery, harvesting and processing equipment. The other strategies suggested are protection of soil moisture and minimising soil erosion through the application of soil conservation methods, introducing a guaranteed price scheme and a stable marketing network, popularising black gram cultivation as a third seasonal crop, establishment of storage facilities and popularisation of value added foods.

With respect to the suggested activities, strategies to increase land extent under black gram cultivation are of crucial significance as land extent under black gram had increased only slightly over the years. However, a study has to be launched as a short-term measure to identify the extra extent of land that could be opened up for black gram growing. Conversely, productivity can be improved by introducing new high yielding varieties and improved technology as well. Popularising the usage of certified seeds is also important as a significant number of farmers at present had used uncertified local seeds. Enhancing the self-seed production on a systematic base with advice from the extension staff also would not be a difficult task as a significant number of farmers had got used to such seeds. A mechanism to introduce farm machinery for the farmers to purchase them on easy payment terms or hire them at reasonable rates is also a need since the cost of machinery is the highest component in the cost of production. One of the issues highlighted by the farmers was the absence of a stable price for produce mainly due to intermediators and imports. Therefore, introducing a guaranteed price scheme and a stable market network would be at immense benefit to the farmers. Since the majority of the farmers had sold more than 75 percent of their production, it is advisable to establish storage facilities and popularise value-added foods to encourage farmers. Popularising black gram cultivation as a third seasonal crop would also be a good course of action as the intermediate cultivation is not popular among farmers at present.

The farmers in the study locations reportedly complained of another issue that they are confronted with as the farmers as in many other villages also is the crop damages by wild animals such as peacocks, monkeys, wild boars and wild elephants leaving nothing for the farmer. Therefore, immediate focus is recommended that this issue to be explored at the highest level for practical solutions.

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Chapter Fifteen

Cowpea

M.P.N.M. Dias

SUMMARY

Cowpea is a crop which can be grown in hardy environmental conditions especially with minimum irrigation facilitices. Therefore, it has a huge potential to increase the cowpea cultivation mainly in dry zone areas of Sri Lanka. According to the cultivated land extent Ampara, Monaragala, Anuradhapura, Kurunegala and Puttalam districts are the major cowpea producing areas in the country. Average cowpea yield in 2016 is recorded as 1.67mt/ha.

According to the survey findings total cost of cowpea production including family labour is 19173.70 Rs/ac. From the total cost 30 percent is calculated for the hired labour and 29 percent for the machineries. Major issue faced by the cowpea farmers in surveyed areas is the increase of crop damages by wild animals. Majority of the farmers had marketing issues due to fluctuations of market prices.

Based on the survey findings it is suggested to develop a comprehensive plan to popularize cowpea cultivations in dry zone, introduce farm machineries for the farmers to reduce the labour cost, educate the farmers about high yielding varieties and take necessary actions to minimize the crop damages by wild animals to increase the cowpea production in the country.

CHAPTER FIFTEEN

Cowpea

15.1 Overview of the Crop

15.1.1 Introduction

Cowpea (*Vigna unguiculata*) is one of the main pulses in the world which is supposed to have originated in Africa and now it is widely grown in tropics and subtropics. Nigeria, Niger and Mali are the world's major cowpea producing countries. It is cultivated in Central and South African countries, Eastern Europe, Australia, United States and in Asian countries. Cowpea is also referred to as Southern pea, Black eye pea, Crowder pea, Lubia, Niebe, Coupe or Frijoles. There are different varieties with different colours such as red, white, green or brown.

Cowpea is a herbaceous legume which grows annually. It is well adapted to hardy environmental conditions. Cowpea can be cultivated as a monocrop or as a mixed crop under irrigated or non-irrigated conditions. It is mainly used for human consumption in various forms such as boiled or cooked. Young pods and leaves are also used as vegetable. In some areas in the world cowpea is cultivated as forage crop for livestock or green manure crop.

Cowpea is an important legume crop in Sri Lanka as an inexpensive source of protein. The varieties of cowpea grown in Sri Lanka are MI35, Waruni, Wijaya, Dhawala and Bombay. The specific characters of each variety are summarized in Table 15.1.

Table 15.1: Specific Characters of Cowpea Varieties in Sri Lanka

Variety	MI35	Wijaya	Waruni	Dhawala	Bombay
Growth habit	Semi erect	Erect and determinate	Erect and determinate	Semi erect	erect
Flowering period (days after planting)	45	40-45	40	40-45	40-45
Flower colour	White	Bluish Purple	Bluish purple	White	Purple
Seed size and colour	Small seeds in pure cream	Large seeds in light brown	Medium size seeds in reddish brown	Large seeds in cream colour with black eye	Large seeds in speckled grey brown
Weight of 1000 seeds (g)	70	100	115	170	180
Average yield (kg/ha)	1350	1600	1650	1600	1450

Source: Department of Agriculture

15.1.2 Major Growing Areas and Extent under Cultivation

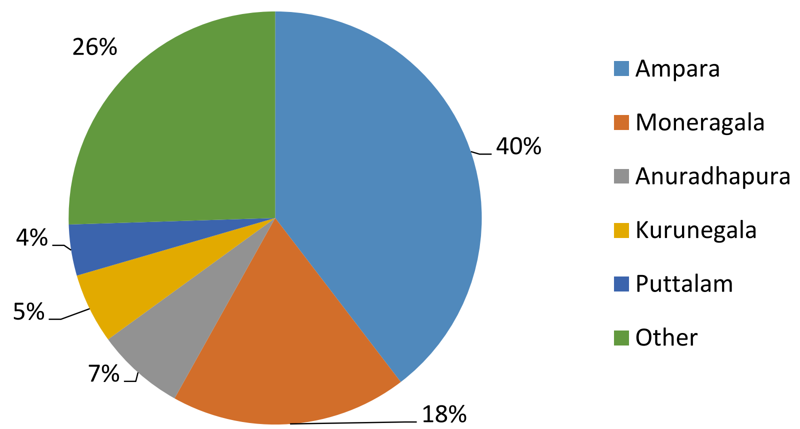
During the last ten years, the land extent under cowpea in Sri Lanka, mainly cultivated in *Maha* season marked an average land extent around 67 percent and in *Yala* season it was around 33 percent. Respectivel average production in *Maha* season was 66 percent and in *Yala* season it was 34 percent. (Table 15.2)

Table 15.2: Cultivated Extent and Production of Cowpea in Last Ten Years

Year	Cultivated Extent				Production (mt)			
	Yala		*Maha*		*Yala*		*Maha*	
	ha	%	ha	%	mt	%	mt	%
2007	4403	41.4	6231	58.6	4151	38.2	6704	61.8
2008	4496	37.0	7655	63.0	4354	36.4	7598	63.6
2009	2951	25.8	8488	74.2	3423	25.4	10062	74.6
2010	3014	27.7	7856	72.3	3466	29.9	8143	70.1
2011	3092	33.3	6186	66.7	3830	36.6	6642	63.4
2012	3714	33.6	7327	66.4	5329	36.0	9483	64.0
2013	3565	33.0	7251	67.0	4708	33.2	9477	66.8
2014	3686	32.1	7794	67.9	4832	32.0	10287	68.0
2015	3171	34.5	6029	65.5	5035	41.0	7237	59.0
2016	2935	35.7	5285	64.3	4930	35.9	8811	64.1
Average	3502.7	33.3	7010.2	66.7	4405.8	34.3	8444.4	65.7

Source: Department of Census and Statistics

Cowpea plant is well adapted to the hardy environmental conditions and the plant grows well in soils with low moisture content. In Sri Lanka cowpea is mainly cultivated in dry zone and intermediate zone. Of the total extent of land under cowpea cultivation in Sri Lanka Ampara district recorded the highest land extent representing 40 percent of the total extent. It is also cultivated in Monaragala (18%), Anuradhapura (7%), Kurunegala (5%) and Puttalam (4%) districts (Figure 15.1). In all other districts cultivated extent was about 26 percent.



Source: Department of Census and Statistics

Figure 15.1: Major Cowpea Growing Areas in Sri Lanka

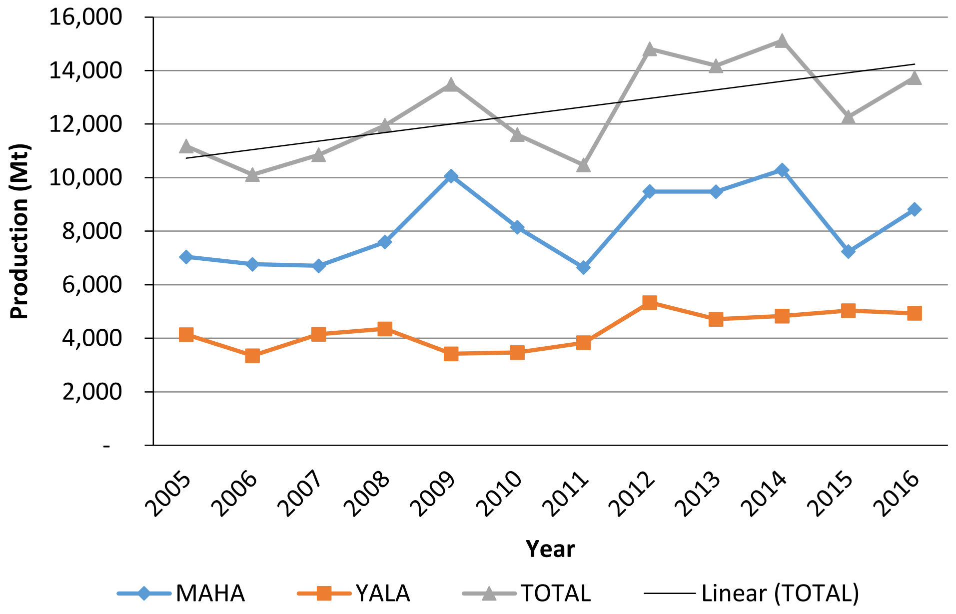
15.1.3 Climate and Soil Requirement

Cowpea is a warm weather crop which grows at temperature between 20⁰C to 30⁰C. It is drought resistant and most suitable for dry zone cultivation. Cowpea can be grown well on a wide variety of soils. Most suitable soil types are well drained sandy loams or sandy soils with pH 6-7.

15.1.4 Importance of the Cowpea to Economy

15.1.5 Production

Figure 15.2 illustrates the country's cowpea production in the last 12 years. The highest production was recorded in *Maha* season. During this period total cowpea production had shown an increasing trend. The highest production was recorded in year 2014.



Source: Department of Census and Statistics

Figure 15.2: Cowpea Production in Sri Lanka (2005 – 2016)

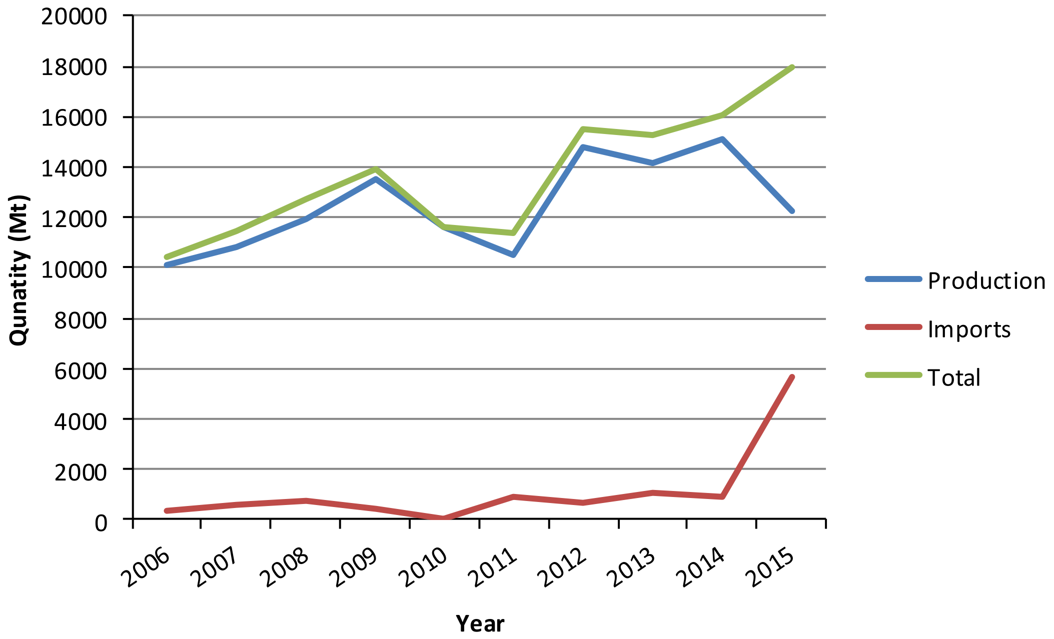
15.1.6 Cowpea Imports

In Sri Lanka Cowpea is mainly used as a human food rich with protein. Due to the insufficient production in the country a considerable quantity was imported to meet the demand. Import quantities, import costs and the production figures of cowpea for the last ten years are tabulated in the Table 15.3. The imports of cowpea were more or less similar in this period except in 2015 where 5678mt were imported which comparatively recorded a very sharp increment. However, total demand had upped in last five years from 2011.

Table 15.3: Imported Amount of Cowpea in Last 10 Years

Year	Quantity	Value	
	(mt)	('000 Rs.)	Unit Price (Rs./kg)
2006	349	8769	25.13
2007	575	9619	16.73
2008	745	40338	54.14
2009	429	31563	73.57
2010	45	2568	57.07
2011	905	76818	84.88
2012	667	71711	107.51
2013	1109	114797	103.51
2014	946	98874	104.52
2015	5678	596632	105.08

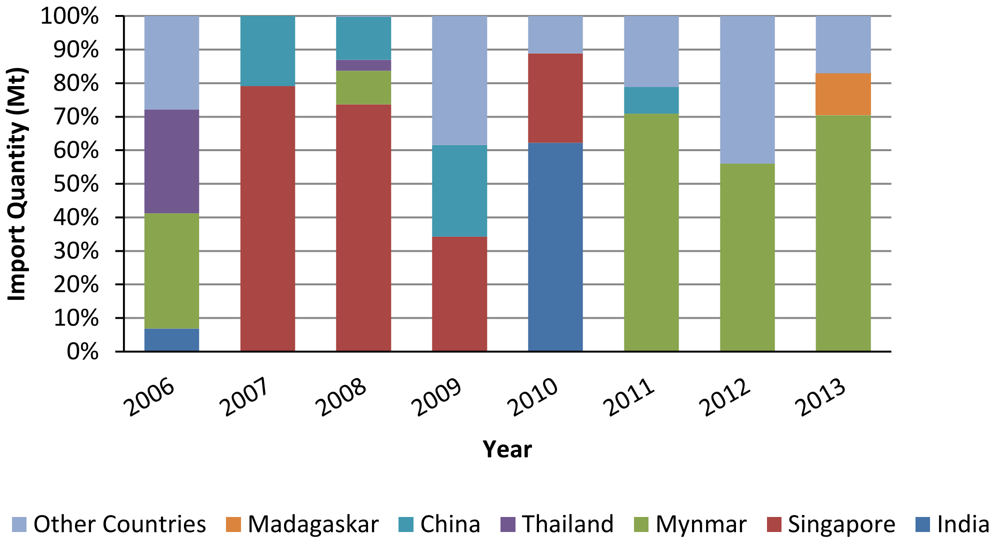
Source: Department of Customs



Source: Department of Customs

Figure 15.3: Total Production and Imports of Cowpea for the Period of 2006 - 2016

As shown in Figure 15.4, before year 2010 cowpea was imported mainly from Singapore. From 2011 the highest quantity (more than 50%) of cowpea had been imported from Myanmar.

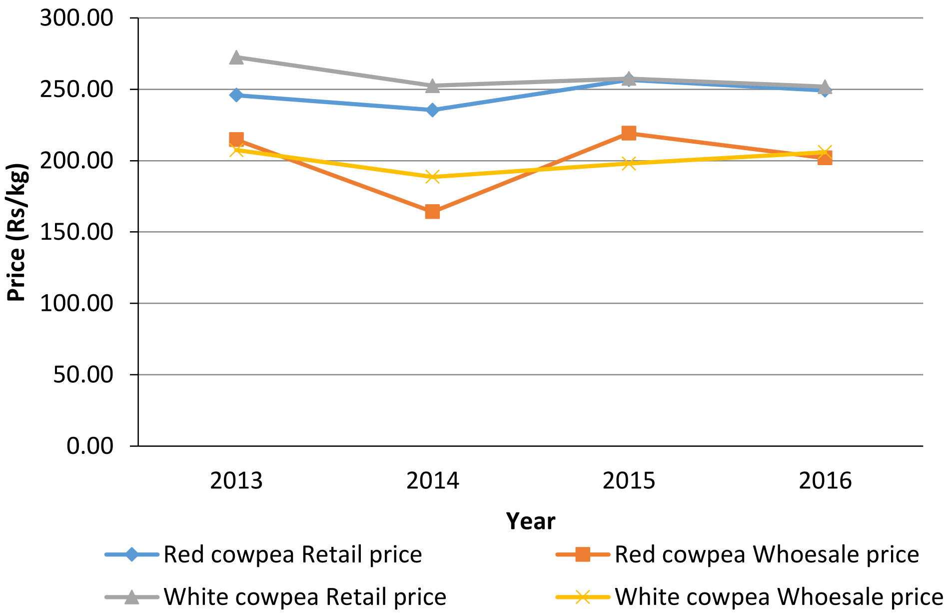


Source: Department of customs

Figure 15.4: Imports of Cowpea by Country of Origin

15.1.7 Price Variations

There are two commonely cultivating cowpea types in Sri Lanka as red and the white cowpea. In the local market price of red cowpea is slightly higher than that of the white type. But, both types are equally consumed. Figure 15.5 illustrates the yearly price variation in both white and red cowpea in the last four years.



Source: Department of Census and Statistics, Marketing, Food Policy & Agri business division of HARTI

Figure 15.5: Price Variations of Cowpea (2013 – 2016)

15.1.8 Marketing of Cowpea

Marketing channel of cowpea which presented producer to consumer is consisting of producers, regional collectors, regional wholesalers in Pettah market and consumers. Any value addition is not done in any party of the marketing channel, whilst only keeping a small amount of profit when going through through the channel. The retail price is consisted by adding a profit margin in each stage of the marketing channel to the producer price when it comes through the producer to consumer's hand. Following flow chart (Figure 15.6 & 15.7) gives an indication of the marketing channel for cowpea.

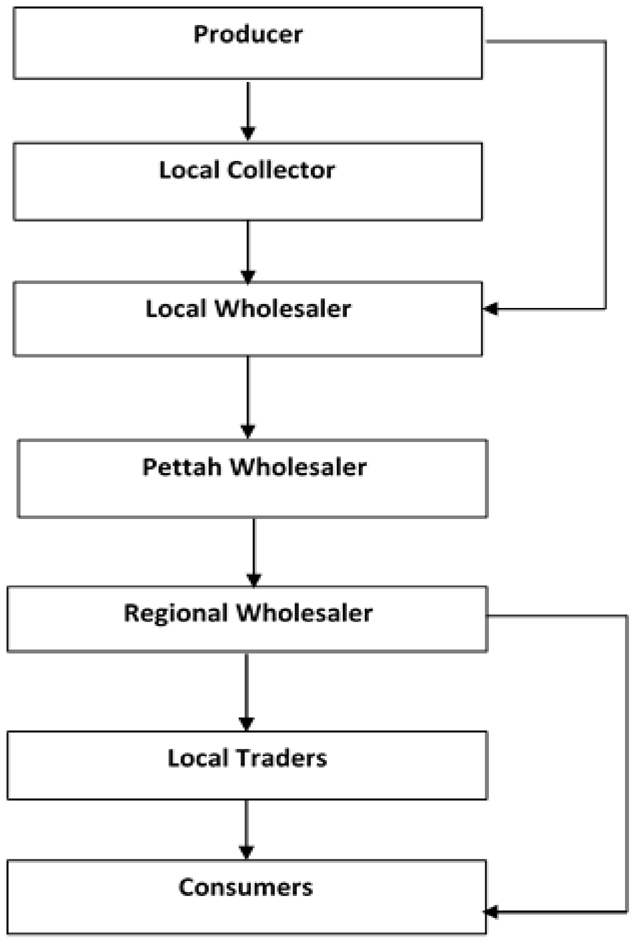


Figure 15.6: Marketing Chanel - Pettah Market

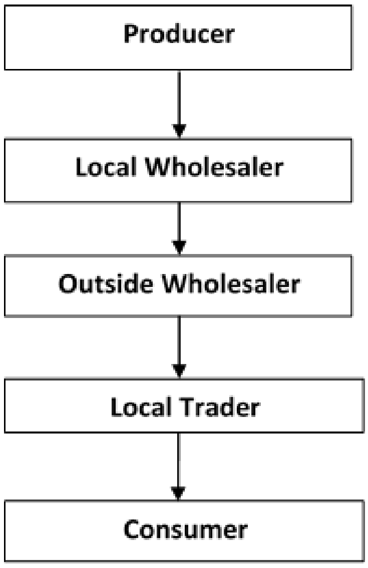


Figure 15.7: Marketing Channel - Ampara, Monaragala, Batticaloa, & Anuradhapura Districts

15.1.9 Per Capita Consumption

Cowpea seed is a rich source of protein for human as well as livestock. It contains 24.8 percent of protein, 63.6 percent of carbohydrates, 6.3 percent of fiber, and 1.9 percent fat and little amount of other nutrients. According to the Table 15.4, per capita consumption of cowpea in all sectors was lower in 2003/2004 than in 1978/1979.

Table 15.4: Per Capita Consumption of Cowpea per Annum by Sectors

	Per capita Consumption (kg)			
Year	Urban	Rural	Estate	All Sectors
1978/79	0.57	0.6	1.31	0.65
1981/82	0.34	0.34	1.63	0.67
1986/87	0.17	0.17	0.42	0.25
1996/97	0.11	0.11	0.2	0.35
2003/04	0.18	0.18	0.12	0.3

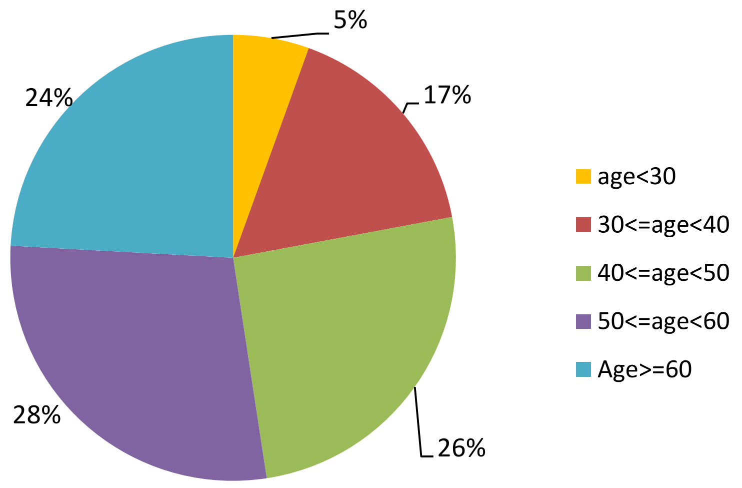
Source: Consumer Finance and Socio Economic Survey, various issues, Central Bank of Sri Lanka.

15.2 Socio Economic Characteristics of the Sample Farmers

15.2.1 Demographic Characteristics of the Farmer Households

15.2.1.1 Age

The age groups of cowpea cultivating farmers in the surveyed districts are shown in the Figure 15.8. Among the sample farmers about 75 percent belonged to the age group of over 40 years. Survey results revealed that the involvement of younger farmers (below the 40 years) in the cowpea production was minimal as 25 percent.

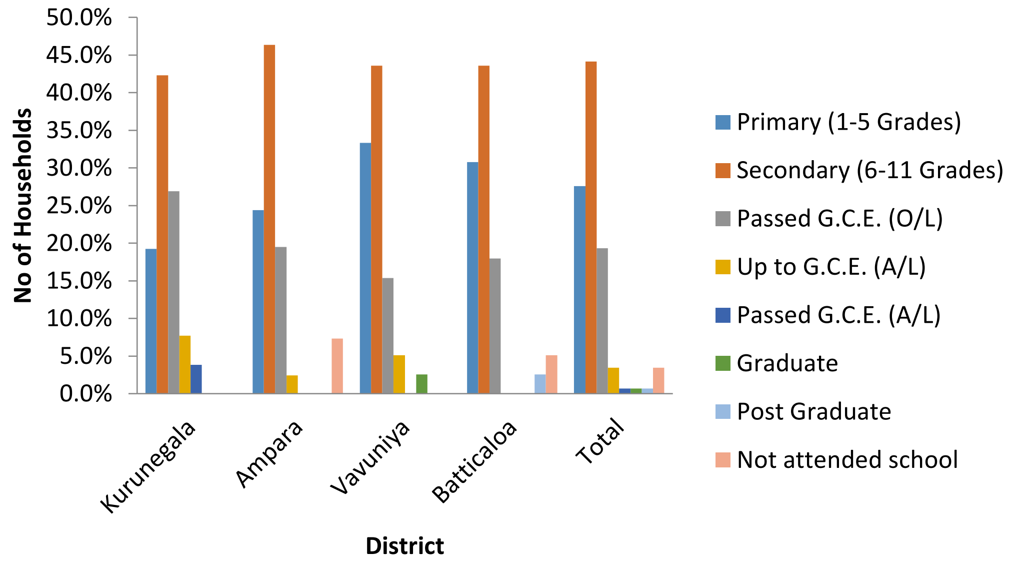


Source: HARTI Survey Data, 2016

Figure 15.8: Age Distribution of Cowpea Farmers

15.2.1.2 Level of Education

According to the survey findings, majority of the farmers in each district had received their education up to the level of GCE (O/L). There was only one degree holder in Vavuniya district and one post graduate degree holder in Batticaloa district. Among the total sample farmers (145) only five farmers had not received any formal education. Educational level of sample cowpea farmers is shown in the Figure 15.9.

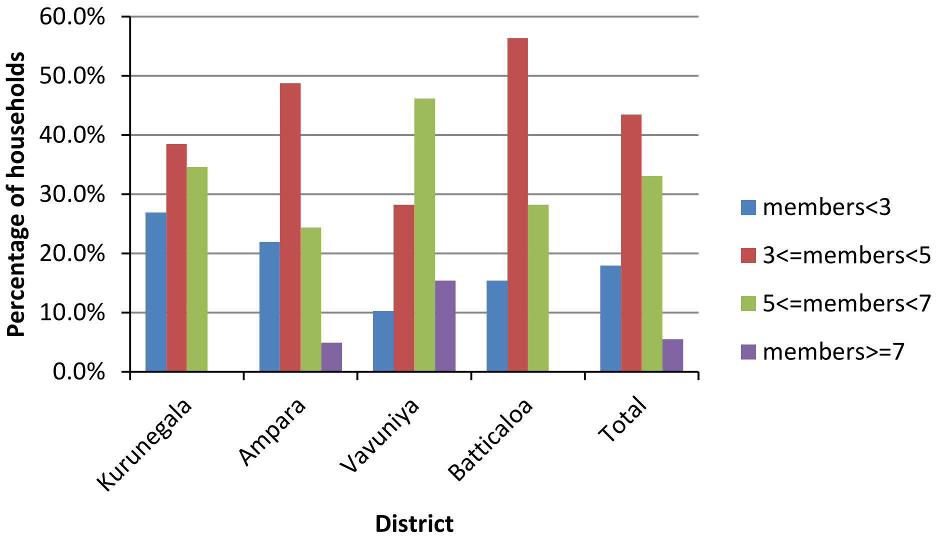


Source: HARTI Survey Data, 2016

Figure 15.9: Educational Level of Cowpea Farmers

15.2.1.3 Family Size

As shown in the Figure 15.10, majority of the sample farm families around 43 percent consisted of 3 to 5 members. Thirty three percent farm families had 5 to 7 members and only 18 percent of the sample had fewer than three members. In Ampara and Vavuniya districts 6 percent of the families consisted of members over seven. Family size has direct relationship with the labour involvement in agriculture. A striking feature that emerges here and which needs further exploration is the presences of comparatively larger families whose members can provide labour which always in an expensive component of the cost of production.

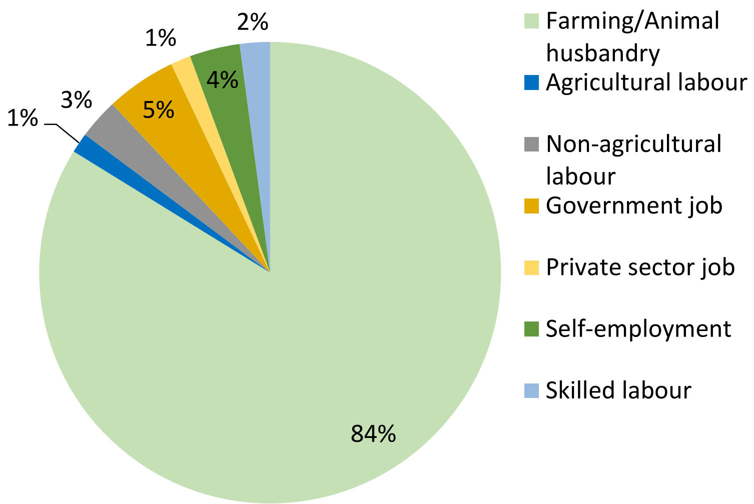


Source: HARTI Survey Data, 2016

Figure 15.10: Number of Family Members in Cowpea Cultivating Households

15.2.2 Economic Characteristics of the Sample Population

The Figure 15.11 illustrates the income sources of cowpea farmers. The majority of the farmers, around 84 percent in four districts pursue farming or animal husbandry as their main income source. In addition, five percent and four percent of farmers' main income source is government sector employment and self employment respectively.



Source: HARTI Survey Data, 2016

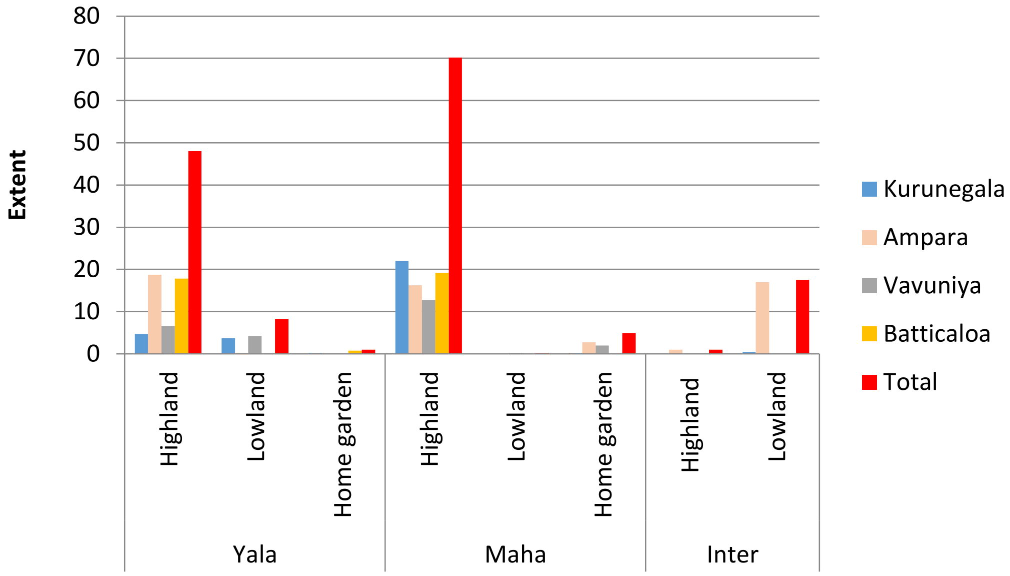
Figure 15.11: Income Sources of Cowpea Farmers

15.3 Agricultural Inputs

15.3.1 Land

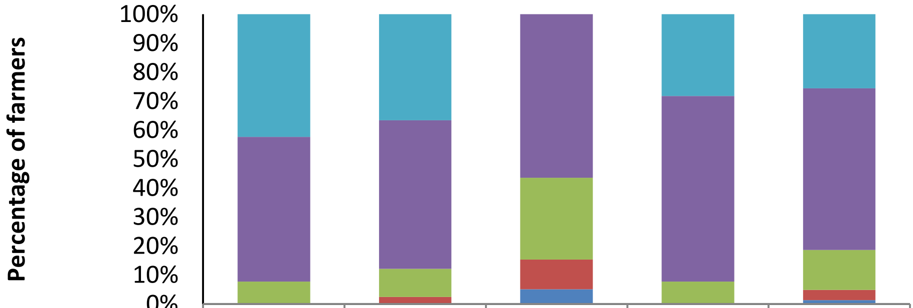
Cowpea can be cultivated at any time period of the year as it is drought resistant and requires less water. According to the survey results, cowpea is cultivated in uplands, lowlands as well as in home gardens. As shown in Figure 15.12, in the surveyed districts cowpea is mainly cultivated on highlands in *Maha* season however cultivation is not practiced in lowlands in *Maha* season because of paddy cultivation. During the survey period in yala season also cowpea was mainly cultivated more uplands. For the purpose of home consumption, some farmers had cultivated cowpea in home gardens in both *Yala* and *Maha* seasons. Cowpea cultivation in intermediate season is comparatively not considerable except in the case of lowlands in Kurunegala district and highlands in Ampara districts.

In each district nearly half of the selected cowpea farmers had cultivated cowpea in 2 to 5 acres, except the farmers in Vavuniya district, 42 percent in Kurunegala, 37 percent in Ampara and 28 percent in Batticaloa farmed lands over 5 acres. In Vavuniya district around 40 percent of the farmers had crop lands less than two acres. Land size distribution of the cowpea farmers in each district is shown in Figure 15.13. So far as cultivation of cowpea is concerned in the surveyed districts what brings to sharper focus in the need to expand the extent of land under cowpea at least as a smallholdings business supplemented with the related extension component for furtherance of the cowpea cultivations.



Source: HARTI Survey Data, 2016

Figure 15.12: Cowpea Cultivation in Highlands, Lowlands and Home Gardens in Different Seasons



	Kurunegala	Ampara	Vavuniya	Batticaloa	Total
ext>=5	42.3	36.6		28.2	25.5
2<=ext<5	50.0	51.2	56.4	64.1	55.9
1<=ext<2	7.7	9.8	28.2	7.7	13.8
0.5<=ext<1		2.4	10.3		3.4
0.25<=ext<0.5			5.1		1.4

Source: HARTI Survey Data, 2016

Figure 15.13: Percentage Distribution of Cowpea Farmers by Size Class of Land

As for the land ownership of cowpea farmers in surveyed districts, in each district majority of the farmers possessed single ownership for their lands. In Vavuniya district 95 percent farmers worked in their own lands and the rest had tenancy in lands. The highest number of encroached farmers and permit holders were observed in Ampara district. Land ownerships of the cowpea farmers in surveyed districts are shown in Table 15.5.

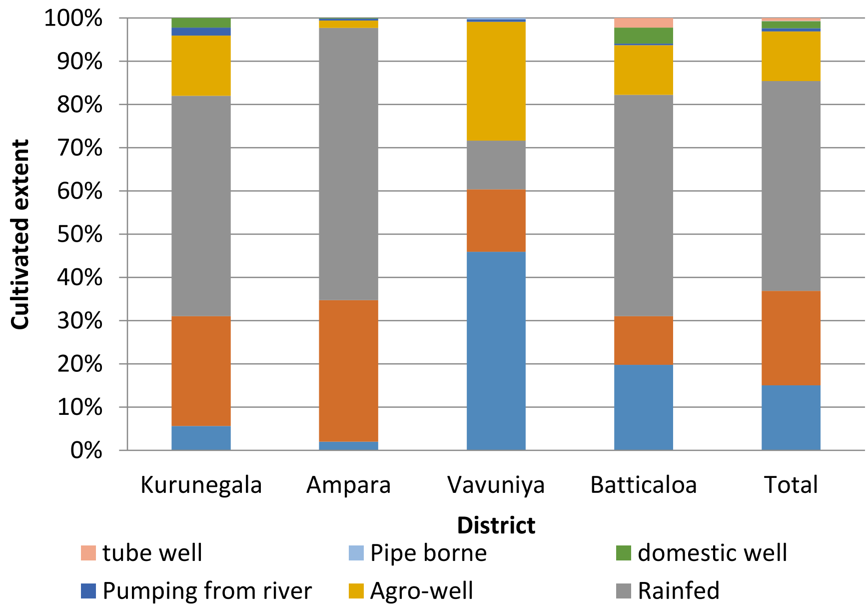
Table 15.5: Land Ownership of Cowpea Farmers in Surveyed Districts

Land Ownership	Kurunegala		Ampara		Vavuniya		Batticaloa	
	N	%	N	%	N	%	N	%
Single owner	24	51	30	49	39	95	34	60
Jointly owned	5	11	1	2	-	-	2	3
Tenancy-in	2	4	2	3	2	5	14	25
Tenancy-out	5	11	2	3	-	-	-	-
Permit holder	2	4	10	16	-	-	6	10
Encroached	4	9	12	20	-	-	1	2
Mortgaged	2	4	1	2	-	-	-	-
Other	3	6	1	2	-	-	-	-
Leased in	-	-	2	3	-	-	-	-

Source: HARTI Survey Data, 2016

15.3.2 Irrigation

Cowpea can be cultivated both under irrigated and rainfed conditions. The crop responds positively to irrigation but it also flourishes under dry climatic conditions. Figure 15.14 shows the different water sources used by the cowpea farmers in the surveyed districts.



Source: HARTI Survey Data, 2016

Figure 15.14: Different Water Sources used by Cowpea Farmers

Except in Vavuniya district, majority of the farmers cultivated cowpea as a rainfed crop. In Vavuniya district majority of the farmers depended on irrigation water supplied through major irrigation schemes. In each district a small number of farmers used water from minor irrigation systems as well as from agro wells.

15.3.3 Labour

In the average total cost of cowpea production, the highest cost component is gone for labour. Table 15.6 summarizes the labour cost for different farming activities involved in cowpea farming in the surveyed areas.

Table 15.6: Labour Cost for the Different Activities in Cowpea Farming

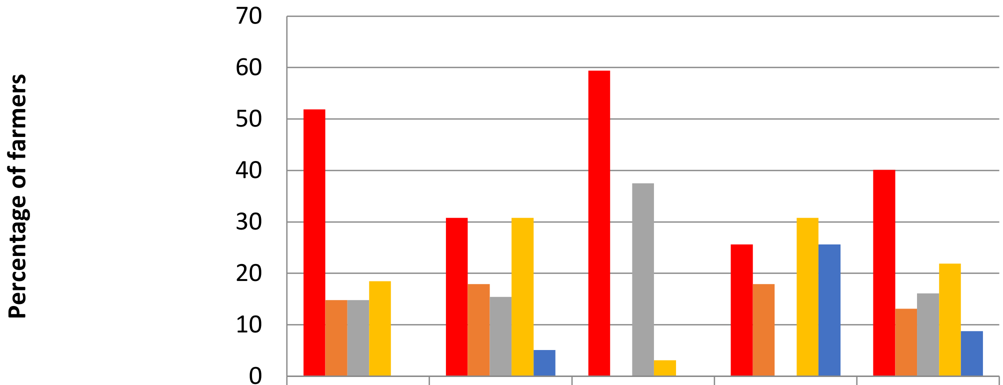
Activity	Family labour	Hired labour	Exchange labour
Land preparation	2032.89	1273.09	254.62
Crop establishment	1305.04	886.48	15.75
Fertilizer application	1044.41	93.23	-
Crop management	2097.79	1324.76	192.73
Agro chemicals	758.74	93.20	-
Harvesting	3037.19	1364.28	387.00
Other	4776.46	144.17	128.16
Total	**15052.52**	**5179.22**	**978.25**

Source: HARTI Survey Data, 2016

15.3.4 Seeds

15.3.4.1 Source of Seeds

According to the survey findings, majority of the farmers purchased seeds from the Department of Agriculture mainly due to the special programme launched, distributing seeds with a 50 percent subsidy, which influenced 52 percent of Kurunegala, 31 percent of Anuradhapura, 59 percent of Vavuniya and 26 percent of Batticaloa farmers to purchase the seeds from DOA. Further the Department of Agriculture had loanched a special training programme ont self-production of seeds as a solution to the problem of low quality and unavailability of seeds. As a soulution to the issue of poor keeping quality duet to lack of storage facilities DOA has distributed ‘air tight bins’ among farmers to store seeds. As an outcome of the seed self-production programme, farmers are able to produce better seeds for themselves. Thereby out of the total farmers, 13 percent produced seeds themselves. Expect that 16 percent out of the total sample bought seeds from private companies and local markets, and some farmers in Batticaloa and Ampara districts relied on the neighboring farmers for seeds.



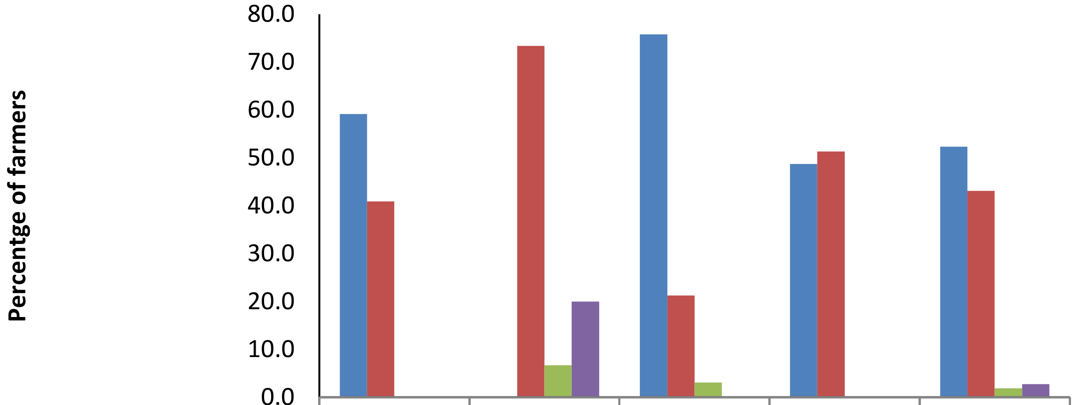
	Kurunegala	Ampara	Vavuniya	Batticaloa	Total
Dept.of Agriculture	51.9	30.8	59.4	25.6	40.1
Self produced	14.8	17.9		17.9	13.1
Private companies	14.8	15.4	37.5		16.1
Local market	18.5	30.8	3.1	30.8	21.9
Neighbouring farmers		5.1		25.6	8.8

Source: HARTI Survey Data, 2016

Figure 15.15: Source of Seeds for Cowpea Cultivated Farmers in Surveyed Areas

15.3.4.2 Type of Seeds and Variety of Seeds

Majority of the farmers have used local seeds due to their perception that local seeds were better than imported seeds and further considering the adaptability of these seeds to the local climatic conditions and soil. Figure 15.16 presents the type of seeds used by surveyed cowpea farmers.



	Kurunegala	Ampara	Vavuniya	Batticaloa	Total
	No.of farmers				
Certified seeds-local	59.1		75.8	48.7	52.3
Uncertified seeds-local	40.9	73.3	21.2	51.3	43.1
Certified seeds-imported		6.7	3.0		1.8
Improved		20			2.8

Source: HARTI Survey Data, 2016

Figure 15.16: Types of Seeds used by Cowpea Farmers

There are two types of local seeds as certified and uncertified. Most of the farmers used certified local seeds, revealing the awareness of the selection of seeds. Out of total sample only two percent of the farmers used imported certified seeds and only three percent depended on improved seeds for their cultivation. Eventhoug, almost all the farmers in the study locations had no clear understanding about the name of the variety they cultivated. Some of the farmers identified the varieties in terms of the colour as red, green or white cowpea.

15.3.5 Fertilizer and Pesticides

Cowpea is a crop that can be cultivated with minimum management practices as it is resistant for stress environmental conditions. As shown in Table 15.7 the majority of the sample farmers didn't apply any fertilizer for their cultivations. Twenty three percent used chemical fertilizers and another 23 percent used both chemical and organic fertilizers for their cowpea cultivations.

Table 15.7: Type of Fertilizer Application to the Crop

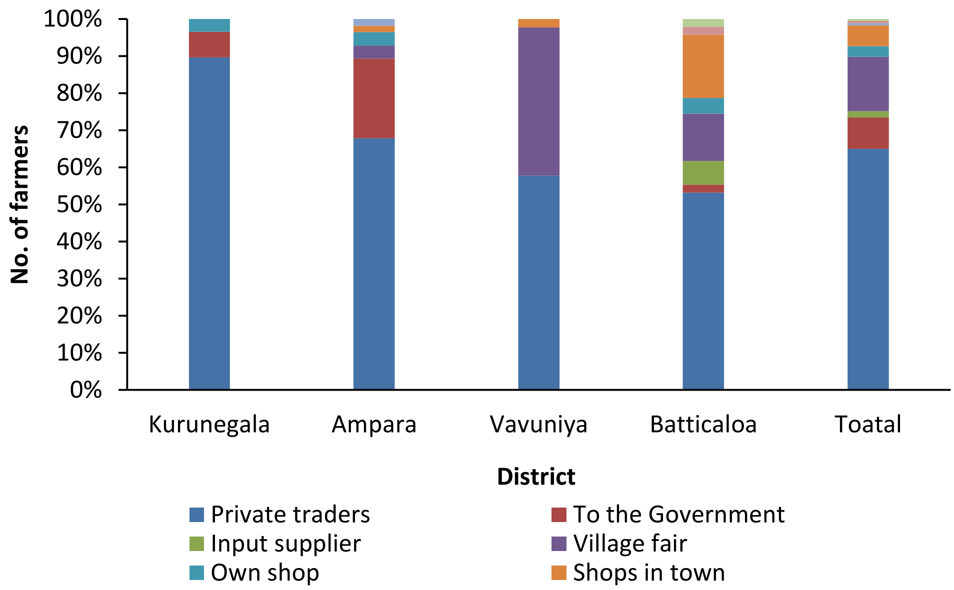
Fertilizer Application	No. of Farmers									
	Kurunegala		Ampara		Vavuniya		Batticaloa		Total	
	N	%	N	%	N	%	N	%	N	%
Chemical fertilizer only	12	46	7	17	9	23	5	13	33	23
Organic fertilizer only					3	8	8	21	11	8
Both organic and chemical	3	12	2	5	9	23	19	49	33	23
None	11	42	32	78	18	46	7	18	68	47

Source: HARTI Survey Data, 2016

15.4 Marketing of Cowpea

15.4.1 Marketing Channels of Cowpea

According to the survey findings, majority of the farmers in each district sell cowpea harvest to private traders. In Kurunegala district, 90 percent of the farmers sell their harvest to private traders and others are selling their product to the government institutes and direct consumers through their own outlets. Marketing method of cowpea farmers in each districts are illustrate in Figure 15.17.



Source: HARTI Survey Data, 2016

Figure 15.17: Marketing Methods of Cowpea in Surveyed Areas

15.4.2 Marketing Issues Faced by Cowpea Farmers

The Table 15.8 shows marketing issues faced by the cowpea farmers in the surveyed areas. In every district the major issue was not having proper market price for cowpea. When compared with Ampara, Vavuniya and Batticloa, issues related to marketing of the cowpea severty of this issue is less in Kurunegala district. In Vavuniya district 31 percent of the farmers found it harder to find a marketing channel to sell their yield. Twenty eight percent of the farmers in Batticloa district had transport issues and seven percent of the farmers had problems associated with the quality of their product at the time of marketing.

Table 15.8: Marketing Issues Faced by Cowpea Farmers

Marketing Issue	Percentage of Farmers				
	Kurunegala	Ampara	Vavuniya	Batticaloa	Total
Not paid a good price	46	40	43	35	40
Absence of marketing channel	-	5	31	17	14
Severe concern on quality	6	15	4	2	7
Not receiving cash	-	-	-	2	0
Transport issues	-	6	-	28	9
Not buying the whole lot	3	8	-	6	5
No issues	45	26	22	8	25

Source: HARTI Survey Data, 2016

15.5 Total Cost of Production for Cowpea

Calculated average total cost of production for the sample is shows in the Table 15.9. Accordingly average total cost for the farming of one acre of cowpea including family labour was Rs. 19173.70 and it was Rs. 15945.28 excluding family labour. Of the different cost components, the highest cost was for labour representing 30 percent for hired labour and 17 percent for family labour. In addition, 29 percent of the cost was accounted for machinery and 12 percent for the seeds. Cost for the other inputs such as fertilizers, pesticides accounted for 13 percent of the total cost.

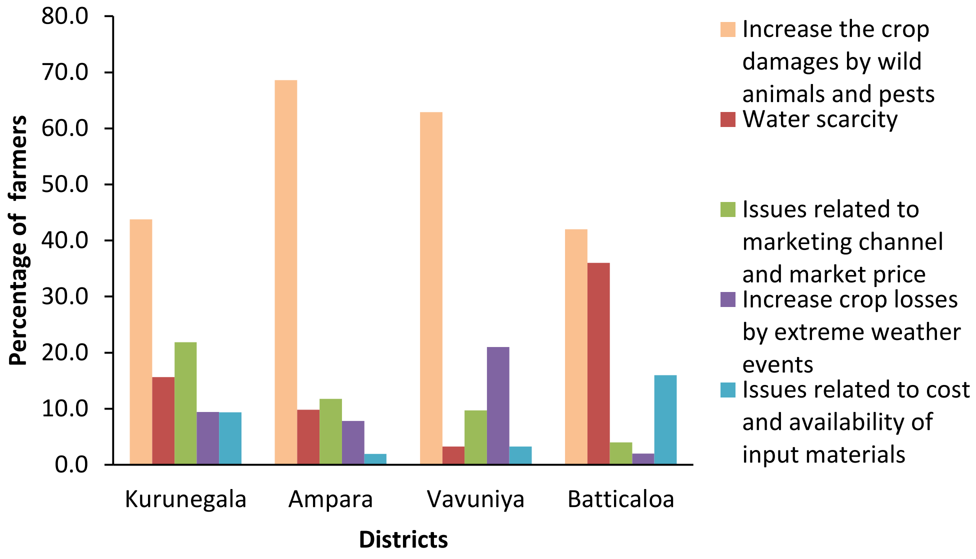
Table 15.9: Different Components of Cost of Production

Component	Total Cost (Rs/ac)	Total Cost (%)
Family labour	3228.43	17
Hired labour	5688.21	30
Seed cost	2238.98	12
Chemical fertilizer	671.34	4
Organic fertilizer	30.77	0
Weedicide cost	186.38	1
Fungicide cost	227.88	1
Insecticide cost	1336.35	7
Other cost	23.85	0
Machinery cost	5541.52	29
Total cost including family labour	19173.70	100
Total cost excluding family labour	15945.28	

Source: HARTI Survey Data, 2016

15.6 Potentials and Constraints of Cowpea Production

The Figure 15.18 shows the crop specific issues faced by cowpea farmers in each surveyed district. According to the evaluation, the major issue that impeded the farmers in each district was the increase of crop damages by wild animals and pests. Damages by wild animals were most pronounced in Ampara (69%) and Vavuniya (63%) districts compared with those in Batticaloa and Kurunegala. Scarcity of water was identified as the next major issue faced by farmers in these areas especially in Batticaloa. Market price fluctuations were hindrance to some of the farmers in marketing their produce. Unexpected adverse climatic conditions particularly heavy rainfalls increasing the moisture conditions of soil at times damaged the cowpea plants resulting in a drop in the yields. In addition to these barriers farmers experienced, the input related issues; cost, non-availability of seeds, fertilizer, pesticides and labour.



Source: HARTI Survey Data, 2016

Figure 15.18: Major Issues faced by Cowpea Farmers in Surveyed Districts

15.7 Recommendations and Suggestions

The increasing demand and price of cowpea in the market, call for the focus at the highest level to map out a comprehensive plan of action to develop cowpea farming in the country. Using the adaptability to grow under drought conditions with less water requirement there should be programmes to popularize cowpea in the dry zone areas which offer ideal conditions to enhance this crop as a major pulse.

According to the survey findings eventhough many high yielding cowpea varieties had been introduced by Department of Agriculture more than 95 percent of the farmers were unaware of the cultivated cowpea varieties. This implies the necessity of educating the farmers about those improved varieties to increase the productivity of their cultivations.

From the farmers' perspective, damages caused by wild animals are identified as a very crucial issue in cowpea cultivations. This is truly hindrances and makes the farmers completely helpless and intervention of the stakeholders at higher levels is at pivotal importance in seeking a tangible solution.

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Chapter Sixteen

Finger Millet

M.D.S. Lurdu

SUMMARY

Finger millet is a crop that has been cultivated under rainfed conditions especially during *Maha* season; however, it also has been cultivated in *Yala* season as well with irrigated conditions. Compared to other cereal crops, finger millet, which has a high nutritional and medicinal value, is also a suitable local food supplement which can be used to reduce rural malnutrition. Recent research reveals that the crop has medicinal properties that can be used to reduce high blood glucose levels, combat cholesterol and many other diseases.

Eighty-six percent of finger millet farmers have used indigenous seeds for their cultivation. In general, 95 percent of farmers interviewed were not able to tell the seed variety that they have used for cultivation in a particular season. Nearly 77 percent of them have used their own seeds for cultivation and there is a room to increase the productivity and farmers' income by introducing new high yielding finger millet varieties.

Increase of wild animal damages, water shortage and unexpected rains, unavailability of quality seed materials and lack of financial capacity during early stage of planting, higher labour cost and lack of proper extension service are the main issues raised by the respective farmers and there is significant potential for improving the finger millet cultivation by addressing said issues.

CHAPTER SIXTEEN

Finger Millet

16.1 An Overview of the Finger Millet Crop

16.1.1 Introduction

"Finger Millet" (*Eleusine corancana L.*) is an important crop in the rural agricultural community in comparison with the other cereal crops cultivated in Sri Lanka, except paddy due to its high nutritional properties and medicinal values.

Finger millet was considered as a prominent crop, among other food crops cultivated in the past and it has been mentioned that finger millet had been an important item of the staple food in 13th century in Sri Lanka (Endagama, 1998).

It is more suitable as a local food substitute to minimize malnutrition at rural level. According to the revealed information in recent research, finger millet can be used to reduce blood sugar level, to control cholesterol and for many other diseases due to its medicinal value. In 100g of finger millet seeds conatin 363 kilo calories as energy, 10 g of Proteins, 12 mg of Ca (Calcium), 4.5 g of fat, 130 mg of Fe (Iron), 2.5 mg of P (Phosphorus), 130 mg of Keratin and 2 mg of vitamin C (DHAN Foundations, 2014).

Finger millet is popular as a chena crop grown under rain-fed conditions, mainly cultivated in *Maha* season in dry zone chenas and with irrigation in *Yala* season. During past several years, cultivated land extent of finger millet and the production had increased. Out of total land extent under finger millet cultivation 30 percent located in Anuradhapura district followed by 19 percent in Monaragala district and 10 percent in Hambanthota district (Department of Census and Statistics, 2016).

Sri Lanka mainly imports finger millet from India and a stock of 1,017 mt at a cost of Rs. 46 million was imported in 2015 (Department of Customs, 2016). There is a huge potential to promote finger millet cultivation in Sri Lanka as a local crop with its nutritional and medicinal values. Necessary steps have been included to increase the production of finger millet and other food crops in the national agricultural policy.

16.1.2 Major Growing Areas and Extent under Cultivation

In Sri Lanka, finger millet cultivating lands are mainly spread in the dry zone areas such as in Anuradhapura, Moneragala, Hambantota and Ampara districts and also lesser extents in wet zone districts such as Badulla, Nuwara-Eliya and Kegalle.

Total finger millet cultivated land extent in Sri Lanka was 5,910 ha in 2006 and within ten years it had increased by 18 percent and in 2015, it was recored as 6950 ha. An increasing trend of finger millet cultivating lands was obsereved during past decade. Out of total finger millet cultivating lands in 2015, 2100 ha were cultivated in Anuradhapura district followed by 1,288 ha in Monaragala district and 696 ha in Hambantota district (Table 16.1).

Table 16.1: Major Finger Millet Cultivation Districts and Cultivated Land Extent (ha)

	Land Extent (ha)									
District	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Sri Lanka	5,910	5,408	6,079	5,902	6,565	5,282	5,195	5,952	7,415	6,950
Anuradhapura	1,178	1,256	1,605	1,551	1,703	1,025	1,175	1,454	2,328	2,100
Monaragala	725	837	967	905	998	1,029	1,019	1,144	1,449	1,288
Hambantota	614	628	553	598	615	553	549	574	726	696
Kurunegala	407	474	444	459	613	466	356	614	532	469
N'Eliya	254	274	374	383	471	351	307	314	323	452
Rathnapura	271	304	323	297	341	304	281	338	358	319
Badulla	394	346	312	364	355	345	338	292	304	246
Other	1,467	1,289	1,501	1,345	1,469	1,209	1,170	1,222	1,395	1,380

Source: Department of Census and Statistic, 2016

16.1.3 Climate and Soil

Finger millet is a dwarf plant with a fibrous root system that spreads to the deep of the soil. It has a high adaptability to the dry zone climate with 20-35 inch annual rainfall and lands with an altitude of over 4000ft from the sea level. Though it is cultivated in *Maha* season under rain fed condition it can be cultivated in *Yala* season in paddy lands under supplementary irrigation. Well drained, fertile loam soil and reddish brown soils with rich in decomposed organic matter are suitable for finger millet cultivation. Proper land preparation is a must in the farming of the finger millet seeds. "Oshadha" variety introduced in 2007 and "Ravana" variety that was introduced in 2002 are used as the DOA recommended seed varieties for finger millet cultivation.

Finger millet is cultivated as a monocrop as well as a mix crop, but the yield differs according to the cultivation method. Usually 6 - 8 kg of seeds is needed to cultivate a hectare of land when it is cultivated as a monocrop sown by broadcasting and harvest can be obtained within 3-4 months after planting. Generally two to three tons of fingermillet harvest can be harvested from one hectare of land under normal consition.

Agrochemical such as fertilizer, herbicides and fungicides are rearely used in finger millet cultivation. Fertile soil (with high organic matter) in Chena's yields a good harvest. As basal dressing 65 kg of Urea, 55 kg of Tripple Super Phosphate and 82.5 Kg of Murate of Potash per hectare of land is recommended by DOA followed with 130 kg of Urea as top dressing after one month of seed planting (DOA, undated).

16.1.4 Importance of the Crop to the Economy

The Table 16.2 shows an increasing trend of finger millet production in Sri Lanka. The production had increased from 4,849 mt in 2000 to 8,916 mt in 2015 registering and increase of 84 percent. The average finger millet yield also had increased gradually during the period 2000 -2015 on an average of 73 percent.

Table 16.2: Finger Millet Production and Average Yield in Sri Lanka (2000-2015)

Year	Production (mt)			Average Yield (kg/ha)		
	Maha	***Yala***	**Total**	***Maha***	***Yala***	**Total**
2000	4,285	564	4,849	759	643	741
2001	3,774	422	4,196	757	649	744
2002	3,663	408	4,071	758	631	743
2003	4,544	725	5,269	729	646	716
2004	4,026	643	4,669	953	725	913
2005	5,531	916	6,447	1,112	744	1,039
2006	5,424	872	6,296	1,134	772	1,065
2007	4,566	891	5,457	1,060	809	1,009
2008	5,413	1,093	6,506	1,078	1,035	1,070
2009	5,571	862	6,433	1,109	982	1,090
2010	6,209	1,098	7,307	1,121	1,071	1,113
2011	4,275	1,147	5,422	1,018	1,059	1,027
2012	5,008	976	5,984	1,165	1,088	1,152
2013	5,782	1,229	7,011	1,208	1,056	1,178
2014	7,630	1,223	8,853	1,210	1,102	1,194
2015	7,407	1,509	8,916	1,250	1,472	1,283

Source: Department of Census and Statistic, 2016

For the period of 2006 - 2012 import quantities of finger millet shows and increasing trend and after 2013 it shows slight gradual decline (Table 16.3). However, when compared with the 2006 import figures import volume drop in 2012 is around 47 percent. Despite the reduction of the quantity of finger millet imports from 2013 to 2015, cost of imports is ever increasing. The importation cost for finger millet was Rs. 22.9 million in 2006, but that cost was increased upto Rs. 46 million in 2015 and it is more than double of the 2006 value.

Annual importation cost indicates the necessasity of promoting the finger millet cultivation in Sri Lanka to produce the quantity required to meet local demand in order to save huge amount of foreign exchange. Further, there is a huge potential to develop the economy of rural farmers though expansion of finger millet crop sector in the country.

Table 16.3: Import of Finger Millet to Sri Lanka (2006-2015)

Year	Quantity (mt.)	Value ('000 Rs.)
2006	1,933	22,934
2007	2,602	38,004
2008	2,881	68,079
2009	3,272	92,674
2010	2,052	59,704
2011	3,622	105,386
2012	2,049	90,113
2013	1,158	59,159
2014	1,281	66,365
2015	1,017	46,178

Source: Department of Custom

According to the price information, in 2015 the average retail price of one kg of finger millet was 273 percent. It shows a significant increase when compared with the monthly average price of Rs. 49.00 in year 2006. Similarly, there is a high market value for finger millet flour in the market and the value was rs. 161.00 in 2006 while Rs. 332.41 in year 2015. Eventhough there is a high market price for finger millet products in the market, farmgate price of finger millet is low as Rs. 93.40/kg in 2015 (Census and Statistics, 2016).

16.1.5 Government Policy towards Finger Millet

A high potential prevails to increase the finger millet production in Sri Lanka when considering the prevalent condition of this crop and the government policy has brought to sharper focuse to boost the finger millet production while increasing the land extent devoted for the crop under the National Food Promotion Programme of 2016-2018. The government envisages reaching the target of total cultivating land extent under finger millet to 6176 ha aiming self-sufficiency in finger millet production.

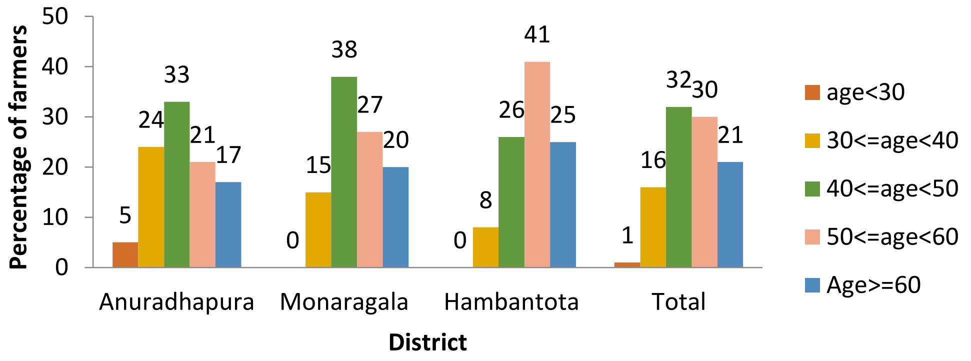
16.2 Socio-economic Characteristics of the Sample Farmers

This section discusses the socio-economic features of surveyed finger millet farmers in Anuradhapura, Moneragala and Hambantota districts.

16.2.1 Demographic Information of the Farmer Households

16.2.1.1 Age Distribution

This study reveals that middle aged and elderly farmers are more involved in finger millet farming than young farmers. The majority of farmers (83%) belonged to the age catgory of 40-60 yearse. Involvement of young farmers in finger millet farming was less and only 17 percent out of the total sample were below 40 years of age (Figure 16.1).



Source: HARTI Survey Data, 2016

Figure 16.1: Age Distribution of the Finger Millet Farmers

16.2.1.2 Education Status

The Table 16.4 shows education level of the finger millet farmers in the study area. The level of education of the respondents indicates that majority of the farmers had ranged between primary to secondary education and there was one graduate farmer in Anuradhapura district. About 24 percent and 47 percent of the sample farmers had limited their education to primary and secondary education respectively. About 21 percent of the sample farmers had been successful at G.C.E. (O/L) and only five percent had educated up to G.C.E. (A/L).

Table 16.4: Level of Education of the Sample Farmers

	District							
	Anuradhapura		Moneragala		Hambantota		Total	
Level of Education	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Primary (1-5 Grades)	7	17	11	28	11	28	29	24
Secondary (6-11 Grades)	22	52	14	35	21	54	57	47
Passed G.C.E. (O/L)	7	17	11	28	7	18	25	21
Up to G.C.E. (A/L)	4	10	2	5	0	0	6	5
Graduate	1	2	0	0	0	0	1	1
Not attended school	1	2	2	5	0	0	3	2
Total	42	100	40	100	39	100	121	100

Source: HARTI Survey Data, 2016

16.2.1.3 Primary Occupation

Of the sample finger millet farmers 95 percent were income earners. According to data in the Table 16.5 majority of the farmers (85%) were involved in farming or animal husbandry as their main source of income, and another 12 percent were state sector employees and the rest employed in the private sector. There were more state sector employees in Anuradhapura (24%) and Monaragala (11%) districts than in Hambantota district.

Table 16.5: Distribution of Finger Millet Farmers by Primary Occupation

Primary Employment	District						Total	
	Anuradhapura		Moneragala		Hambantota			
	N	%	N	%	N	%	N	%
Farming/Animal husbandry	30	73	30	86	38	97	98	85
Government employment	10	24	4	11	0	0	14	12
Private sector employment	1	2	1	3	1	3	3	3
Total	41	100	35	100	39	100	115	100

Source: HARTI Survey Data, 2016

16.2.1.4 Land type and Planting Season

It is evident from the Table 16.6 that finger millet had been cultivated in *Yala*, *Maha* and intermediate seasons in uplands, lowlands and home gardens. The total extent under finger millet cultivated by the sample farmers in three districts was 185.08 ac and 95 percent was uplands grown during *Maha* season. Sample farmers in Monaragala district had grown finger millet in 80.25 ac of uplands during the *Maha* season. However, findings revealed that finger millet mainly cultivated in uplands during *Maha* season under rainfed conditions.

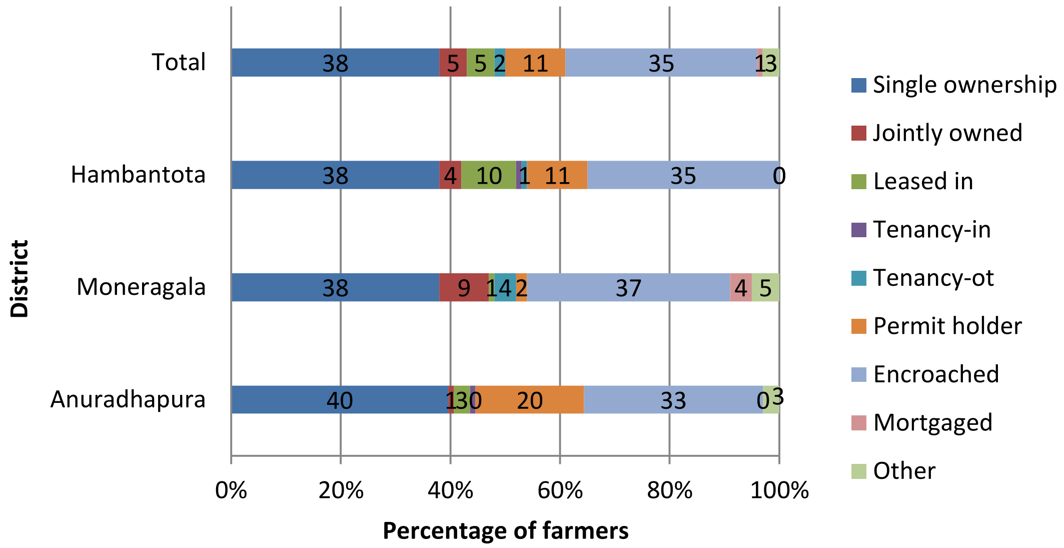
Table 16.6: Total Extent under Finger Millet Cultivation

Season and land type	Anuradhapura		Moneragala		Hambantota		Total	
	N	Ex. (ac)	N	Ex. (ac)	N	Ex. (ac)	N	Ex. (ac)
Yala - Upland	2	2.5	0	0	0	0	2	2.5
Maha -Upland	37	49	38	80.25	34	45.83	109	175.08
- Lowland	1	1	0	0	0	0	1	1
-Home garden	0	0	0	0	3	3	3	3
Inter -Upland	2	1.5	0	0	1	1	3	2.5
Total	42	54	38	80.25	38	49.83	118	185.08

Source: HARTI Survey Data, 2016

16.2.1.5 Distribution of Finger Millet Farmers by Land Ownership

As evident from the Figure 16.2, 73 percent of farmers grew finger millet either their own lands or encroached lands. In addition, 11 percent of the farmers had used permit lands to cultivate finger millet. Among the districts, few numbers of farmers (9%) the Monaragala district grew finger millet in the lands with shared ownership whereas cultivation in leased lands was common in Hambantota district.

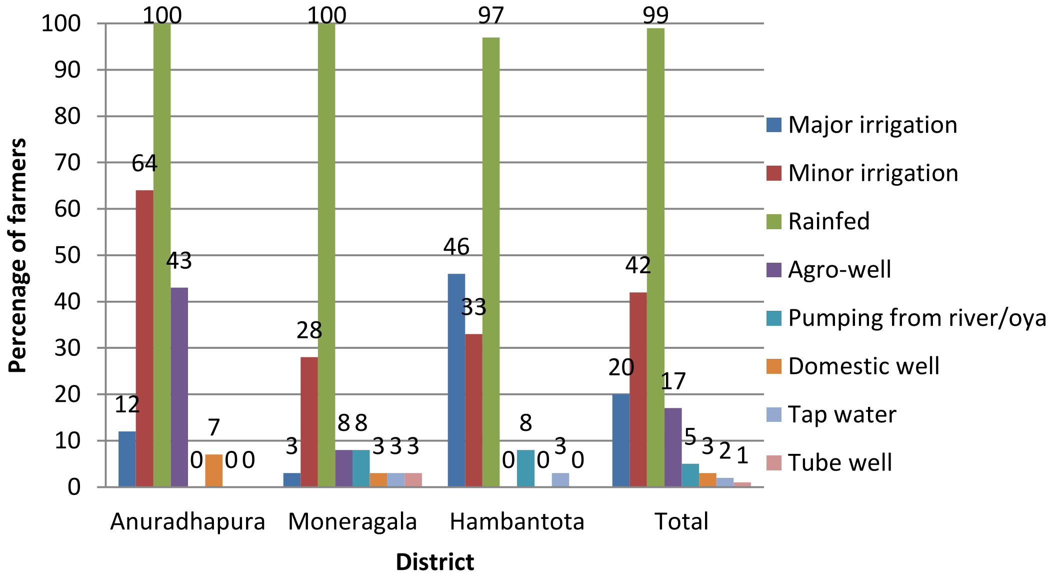


Source: HARTI Survey Data, 2016

Figure 16.2: Distribution of Finger Millet Farmers by Land Ownership

16.2.1.6 Source of Water for Finger Millet Cultivation

In all cultivation areas, finger millet is mostly grown under rain-fed conditions amounting to 97 percent of the farmers in Hambantota and 100 percent of the farmers in the other two districts. Major irrigation, minor irrigation and agro wells were among the alternative water sources available to them (Figure 16.3).



Source: HARTI Survey Data, 2016

Figure 16.3: Distribution of Finger Millet Farmers by Source of Water

16.3 Agricultural Inputs

16.3.1 Seed

The table 16.7 shows that two types of seeds were in use for the cultivation of finger millet in the selected districts. Accordingly, 86 percent of the total farmers had used local seeds which are not certified by the DOA whereas only 13 percent farmers had used certified seeds. More farmers from Anuradhapura district (33%) had used certified seeds when compared with the other two districts.

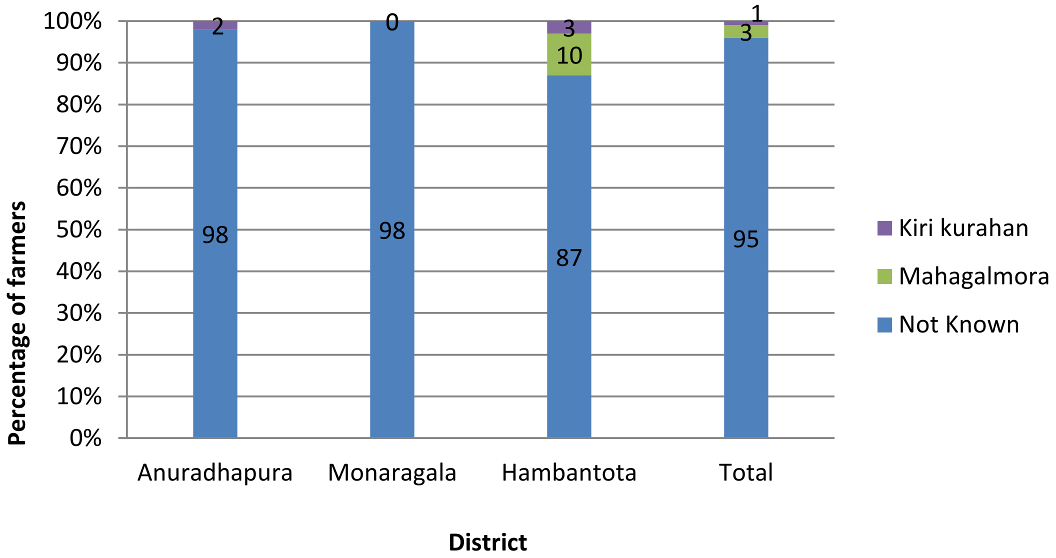
Table 16.7: Distribution of Finger Millet Farmers by Seed Varieties Used

Seed Type	Anuradhapura		Moneragala		Hambantota		Total	
	N	%	N	%	N	%	N	%
Certified seeds-Local	14	33	0	0	1	3	15	13
Uncertified seeds-local	28	67	38	97	34	97	100	86
Other	0	0	1	3	0	0	1	1
Total	42	100	39	100	35	100	116	100

Source: HARTI Survey Data, 2016

16.3.2 Seed Varieties

As illustrated in the Figure 16.4, 95 percent of the farmers were not aware on the seed variety they used. However, around three percent have cultivated the traditional seed the variety called "Mahagalmora" and remaining two percent had used the variety "Kiri kurahan". The reason behind the poor knowledge on seed varieties was the use of self-produced seeds for generations with no any advancement in seed technologies.

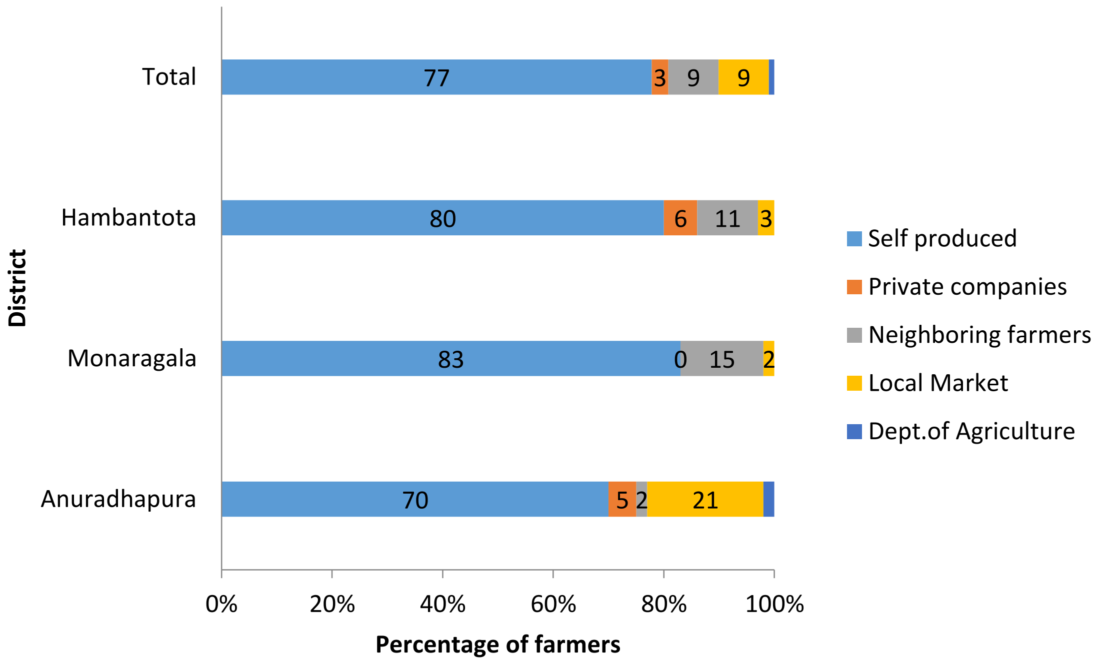


Source: HARTI Survey Data, 2016

Figure 16.4: Distribution of Finger Millet Farmers by Seed Varieties Used

16.3.3 Sources of Seeds

Of the sample 77 percent of the farmers had used self-produced seeds even though they aware that use of self-produced seeds for a longer period would result in low yield. In addition, 18 percent of the farmers had used seeds brought from neighboring farmers and the local market. Despite the huge potential for the promotion of finger millet cultivation in the study areas, lack of quality seeds has constrained the process as revealed through the farmer discussions.



Source: HARTI Survey Data, 2016

Figure 16.5: Distribution of Finger Millet Farmers by Source of Seeds

16.3.4 Land Size under Finger Millet Cultivation and Yield

Table 16.8 explains the distribution of farmers by land size categories under finger millet cultivation, their average extents and the production. Among the surveyed farmers in Anuradhapura district, 60 percent were in the land size category of 1 - 2 ac. Their average land size was 1.2 ac and the average yield was around 412 kg/ac. The corresponding figures for the Hambantota district were 51 percent of the farmers with the average land size of 1.1 ac and the average yield of 635.3 kg/ac. The data shows that Hambantota performed better than Anuradhapura. While in Moneragala district prominent finger millet land size category was 2 – 5 ac and the average extent and the yield amounted to 2.6 ac and 400 kg/ac respectively.

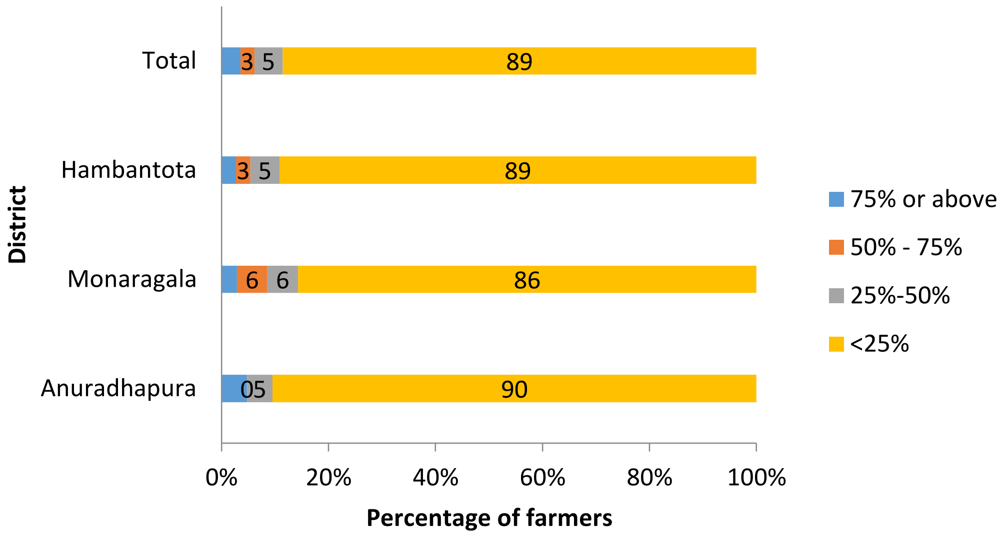
Table 16.8: Distribution of Farmers by Land Size Categories, Average Extents and Production

District	Land class (ac)	% of Farmers	Avg. Ext. (ac)	Total Production (Kg)	Yield (kg/Ac)
Anuradhapura	0.25<=ext<0.5	2	0.25	180.00	720.00
	0.5<=ext<1	19	0.59	2141.00	450.74
	1<=ext<2	60	1.20	12351.00	411.70
	2<=ext<5	19	2.38	7810.00	411.05
	Total	**100**	1.29	**22482.00**	
Moneragala	0.5<=ext<1	9	0.50	1350.00	900.00
	1<=ext<2	34	1.13	5834.00	432.15
	2<=ext<5	51	2.60	18725.00	400.53
	ext>=5	6	6.00	3300.00	275.00
	Total	**100**	2.11	**29209.00**	
Hambantota	0.25<=ext<0.5	8	0.28	525.00	632.53
	0.5<=ext<1	14	0.50	1440.00	576.00
	1<=ext<2	51	1.13	13659.00	635.30
	2<=ext<5	27	2.45	11185.00	456.53
	Total	**100**	1.33	**26809.00**	
Total	0.25<=ext<0.5	4	0.27	705.00	2,611.11
	0.5<=ext<1	14	0.55	4931.00	8,965.45
	1<=ext<2	49	1.16	31844.00	27,451.72
	2<=ext<5	31	2.51	37720.00	15,027.88
	ext>=5	2	6.00	3300.00	550.0
	Total	**100**	**1.55**	**78500.00**	

Source: HARTI Survey Data, 2016

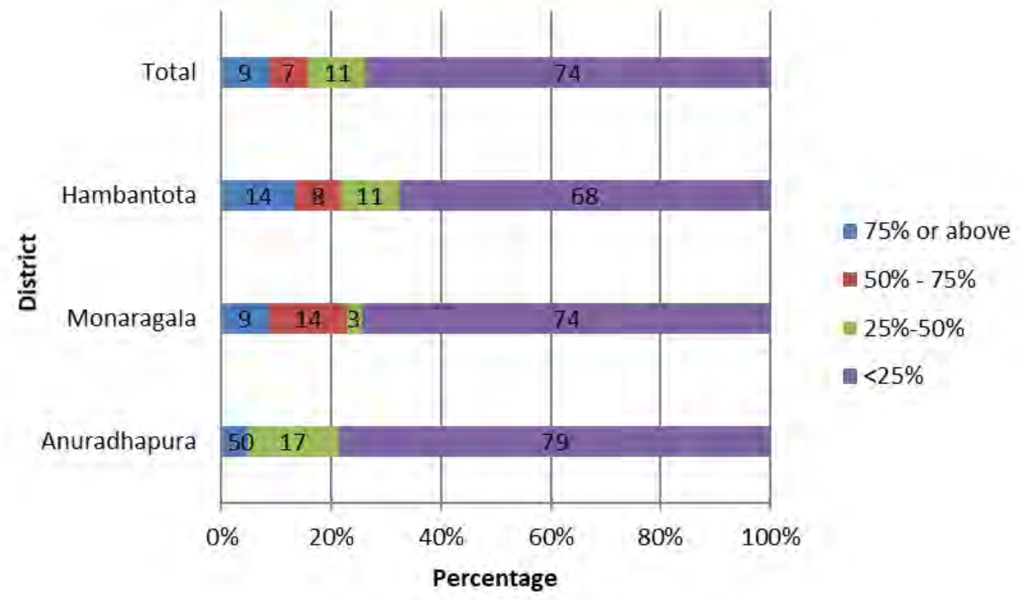
16.3.5 Marketing and Consumption

Finger millet or kurakkan received more or less the same place as rice in the ancient Sri Lankan diet. Currently, the situation is different, the farmers have prioritized the market needs than consumption needs. Almost all the farmers in three survey districts surplus is sold after allocating for next years' seed requirement and consumption needs from the harvest. The majority of farmers (89%) in these three districts (Anuradhapura -90%, Monaragala -71% and Hambantota - 79%) had kept less than 25 percent out of the entire harvest for consumption and for seeds. Study also revealed that 50 percent of the sample farmers had sold over 75 percent of the harvest. By district level, the respective figures are, 67 percent in Anuradhapura and 57 percent in Monaragala. But in Hambantota district 41 percent of the farmers have sold 50%-75% of the harvest whereas 27 percent of the farmers have sold less than 25 percent of the harvest. The Figures 16.6 to 16.8 depict the share of consumption, storage and sales out of the entire harvest.



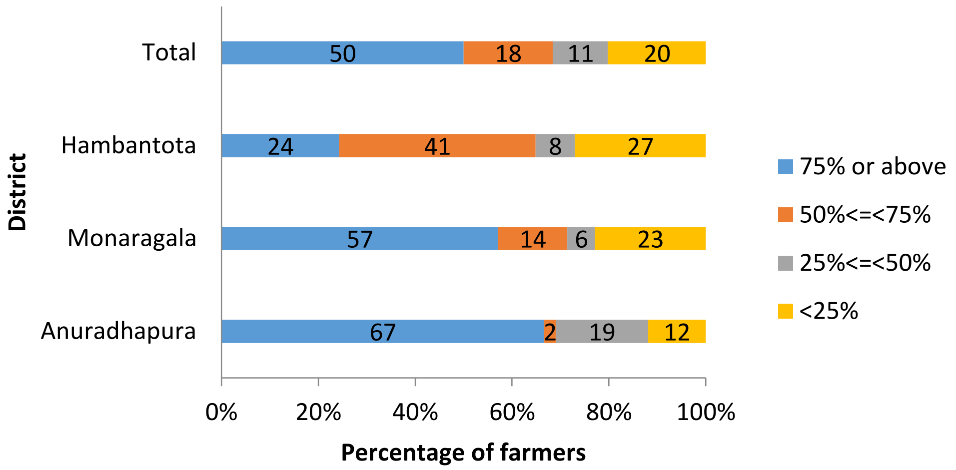
Source: HARTI Survey Data, 2016

Figure 16.6: Share of Consumption from the Harvest



Source: HARTI Survey Data, 2016

Figure 16.7: Share of Storage from the Harvest



Source: HARTI Survey Data, 2016

Figure 16.8: Share of Sales from the Harvest

16.3.6 Cost of Production of Finger Millet

The study revealed that finger millet is a crop that incurs a low cost of production. Generally, finger millet is a labour intensive rain-fed crop. Survey data also depicts that the entire farming community in the sample from Anuradhapura and Moneragala districts and 97 percent of the farmers from Hambanthota district had cultivated finger millet under rain-fed conditions with self-produced seeds. The only activity that incurred a cost was land preparation if machinery was used. Thus, finger millet is a crop that can be locally grown at a minimum cost. According to the breakdown of the cost of production into different cost components as showed in the Table 16.9, largest cost factor in finger millet production is labour. Other cost components are minimal except machinery is used.

Table 16.9: Mean Cost of Production of Finger Millet with Different Cost Components

Cost component	Mean cost (Rs/ac)
Family labour	4,089.85
Hired labour	4,967.51
Seed cost	707.11
Chemical fertilizer	488.55
Organic fertilizer	20.69
Weedicide cost	401.67
Fungicide cost	12.07
Insecticide cost	12.36
Other cost	16.67
Machinery cost	3,556.91
Total cost including family labour	14,273.38
Total cost excluding family labour	10,183.53

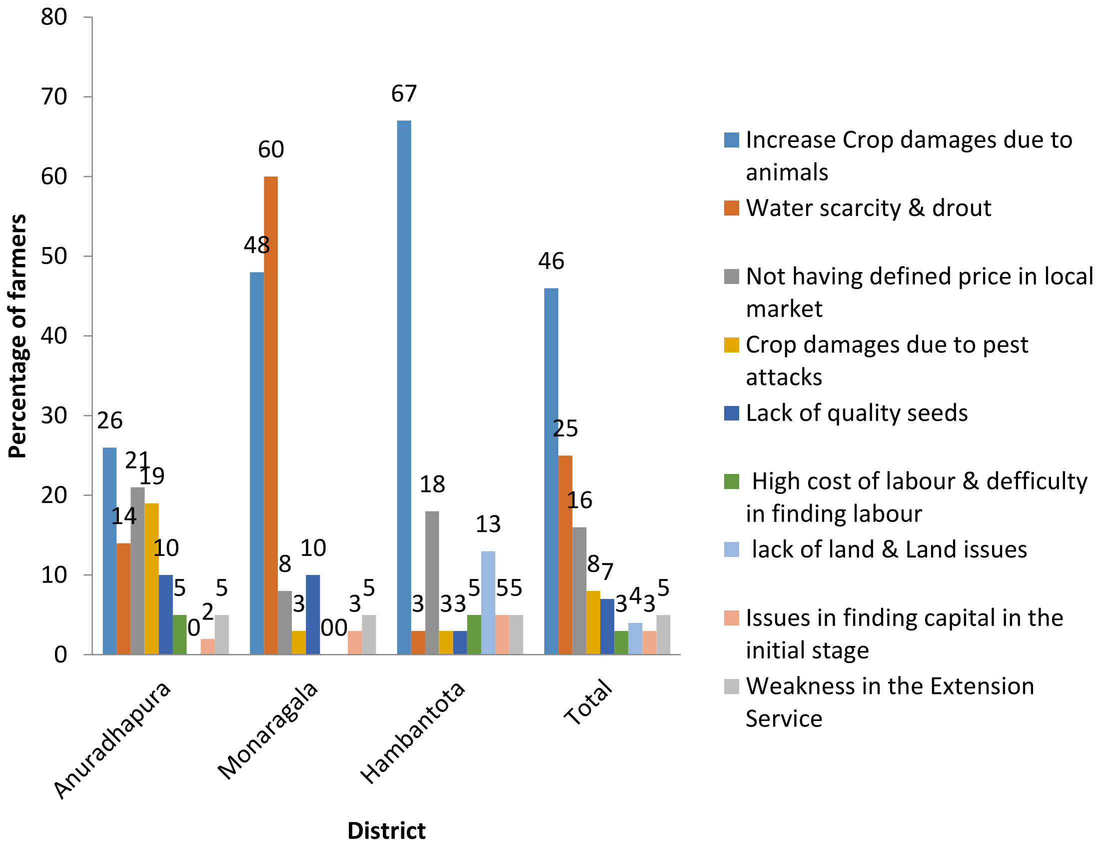
Source: HARTI Survey Data, 2016

16.3.7 Price Distribution

According to the data of the Department of Census and Statistics, average monthly retail price of the finger millet flour retained at Rs. 332/kg in the year 2015, however, the producer price was Rs. 93.40/kg. The maximum prices prevailed at study locations during 2015/16 *Maha* season for 1kg of finger millet were Rs. 240/= in Anuradhapura, Rs. 190/= in Monaragala and Rs. 240/= in Hambanthota. The minimum retail prices recorded in respective districts were Rs. 60/=, Rs. 45/= and Rs. 80/= accordingly. The average prices of respective districts were Rs. 94.51, Rs. 101.76 and Rs. 26.61.

16.4 Potentials and Constraints of Finger Millet Production

The Figure 16.9 illustrates the problems related to finger millet production in surveyed districts.



Source: HARTI Survey Data, 2016

Figure 16.9: Problems Relating to Finger Millet Production.

Main issues highlighted by the respondent farmers were listed below;

1. Loss of Yield due to Threats from Wild Animals

Threats from wild elephants are the predominant and most common problem in finger millet cultivation in the study areas as they are located close to forest areas. Farmers are in the opinion of electric fence is not a proper solution for this problem as crop losses increases day by day with the elephants moving across the electric fences that are not functioning. Peacock and iguana populations in Hambantota and Monaragala districts have increased during the past decades. The two main reasons according to environmentalists and wild life officials are prohibition of hunting these animals and hunting of their predators like fox and wolf by the people. This has aggravated the crop losses due to animals and resulted in a decline in the harvest from finger millet cultivation.

2. Water Scarcity and Unexpected Rains during Dry Period

In general, finger millet is a crop grown up expecting *Maha* season rains. Not receiving of expected rains and unexpected drought during the season had affected both the crop growth and the yield. Even though the cost of production is comparatively low in finger millet cultivation, adverse weather conditions cause spread of diseases, particularly in Anuradhapura and Monaragala districts where almost all the farmers grew the crop under rain-fed conditions. Certain farmers in Hambantota district had tackled the problem of water scarcity through irrigating the crop with water from different water sources like tube wells, agro wells and other water sources.

3. Lack of Quality Seeds and High Price of Seeds

In general, about 95 percent farmers are of the opinion that there are quality issues of the harvest owing to the use of self-produced seeds. Due to both high cost of improved varieties such as 'Oshadha' and 'Ravana' and lack of awareness among the farmers on these varieties had perpetuated the continuous use of self-produced seeds of low yielding traditional varieties. The low quality harvest thus had rendered a lesser price to the producers.

4. Low Price for the Harvest in Local Market

Owing the low quality of the harvest farmers had failed to derive attractive benefits from the cultivation of finger millet. Even though the greater portion of the harvest was sold, the farmers are not satisfied with the income received. Despite the average price of finger millet flour being Rs. 300-332/kg, farmers received a small margin, a result of lack of value addition and efficient marketing channels.

5. Pests and Diseases

Blast and stem borer attack can be identified as the common pest and disease occurrences associated with finger millet cultivation in the study locations. As a less attentive crop, weed control in finger millet cultivation had become difficult. This had led to incidences of disease but the application of weedicides incurs a huge cost.

6. High Labour Cost and Scarcity of Labour

Being a labour intensive crop, finger millet cultivation has currently faced with the problem of labour scarcity. Labour scarcity in study locations prevails owing to smaller family sizes from 3 to 5 members and lack of using labour saving technologies like many other crops.

7. Land Ownership Issues and Land Use

Many farmers do finger millet cultivation on encroached lands. In certain instances farmers are not granted permission for the cultivation during the following seasons. This discontinuation by the government has led to farmers to abandon the cultivation. The problem is common for many other legumes such as green gram and cowpea particularly in Hamabantota district.

8. Lack of Capital for Initial Activities

Finger millet farmers in the study areas cultivated paddy as well. Finding the initial capital cost required for initial labour intensive activities has become a key problem to the farmers.

9. Inefficient Extension Service

The farmers stated that finger millet was a crop that had failed to receive adequate attention of the officials like paddy and vegetables. Lack of introduction of novel cultural practices, inadequate attention of research, poor dissemination of relevant research information and lack of interventions to educate farmers on proper water management practices are the key problems faced by farmers. Therefore, an efficient extension service can play a significant role in promoting finger millet cultivation in the study areas.

16.5 Conclusions and Suggestions

Conclusions

In the ancient times, cultivation of finger millet went hand in hand with paddy cultivation and currently it has received an increased attention for the reasons of its medicinal and nutritional values as well as its huge potential for expansion under local conditions. Owing to the increased attention of the present government to promote finger millet production in the country, this baseline survey was undertaken and it revealed that the crop can be promoted in the study locations through addressing the key questions as suggested below.

Suggestions

1. Proper maintenance of electric fences adjacent to farmlands in Anuradhapura and Monaragala districts.
2. Implementation of a programme to control threats from wild elephants and peacock population in Hambantota and Monaragala districts.
3. Launching of finger millet breeding programmes
4. Promoting small scale irrigation systems; tube wells, agro wells, lift irrigation systems
5. Popularization of high yielding varieties to avoid uncertainty and assure higher yields.
6. Introducing less labour demanding methods for harvesting and processing.
7. Strategic intervention towards increasing profit margins through formal marketing channels and value addition. This needs to be assured through farmer organizations and farmer groups to supply products to the super markets and urban sales centers.

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Chapter Seventeen

Turmeric

D. Thushara P.S. Dharmawardhana

SUMMARY

Turmeric is scientifically known as *Cucurma domestica* and *Cururma longa* which belongs to family Zingiberaceae. It is used as a spice originated in South and South-East Asia. As a spice, it is used as flavouring and colouring agent. Economically valuable part of turmeric plant is rhizome and curcumin is the chemical compound which is responsible for the yellow colour of turmeric. Anti-inflammatory compounds and bioactive compounds with powerful medicinal properties are the major valuable compounds found in turmeric. Major turmeric producing countries in the world are India, China, Myanmar, Bangladesh, Pakistan, Taiwan, Indonesia, Sri Lanka, Nepal and Nigeria. Madurasi Manjal, Gunter, Puna, Alleppy and Hite are the turmeric varieties cultivated worldwide.

Turmeric is cultivated in the low country wet zone and the intermediate zone of Sri Lanka. Kurunegala, Gampaha, Kalutara, Kandy and Matale are the major cultivating districts of this crop. This study encountered the cost of production for one kilogram of turmeric as Rs. 19/= without family labour and it is Rs. 24/= with family labour. Findings of the study revealed, there are many problems encountered in turmeric cultivation in Sri Lanka. Unavailability of defined marketing channel and not having a reasonable price for turmeric are the major problems in cultivating this crop. Importation of turmeric during harvesting periods adversely impacts on price which goes down. Adverse climatic conditions unfavourably impacts as well on crop growth and rhizome formation process in turmeric. Poor know-how on new cultivation techniques, processing methods especially including value addition, high cost of inputs and low use of fertilizer are other constraints which hinder the turmeric cultivation and production in Sri Lanka.

Introduction of high yielding turmeric varieties including consumer preferable ones is one of the major potentials that Sri Lankan turmeric cultivation must have. Value addition of raw turmeric is another potential that enhances profit by farmer's side and thereby, international market would be targeted its share. Limitation of low quality turmeric importation and increase taxes for turmeric importation have special role in balancing the turmeric market in Sri Lanka. It is timely requirement to identify potentials and overcome prevailing constraints in turmeric cultivation in Sri Lanka in order to achieve its self-sufficiency.

CHAPTER SEVENTEEN

Turmeric

17.1 Overview of the Crop

17.1.1 Introduction

Turmeric originated in South and South-East Asia and belongs to family Zingiberaceae. It is scientifically known as *Cucurma domestica and Cururma longa.* Turmeric as a spice plays an important role as flavouring and colouring agent in Sri Lankan food. In Ayurvedic and Chinese medicine turmeric is used as a common ingredient and also it is mostly used as a disinfectant in India. Turmeric contains natural anti-inflammatory compounds, bioactive compounds with powerful medicinal properties and it increases anti-oxidant capacity of the body and lowers the risk of heart diseases.

In the world context, major turmeric producing countries are located in Asian, Western and Eastern African regions. India is the leader in turmeric production in Asian region followed by China, Myanmar, Bangladesh, Pakistan, Taiwan, Indonesia, Sri Lanka and Nepal. Nigeria is the leading country in African context. Recently, Caribbean Islands and Latin American countries have also contributed a portion to the world turmeric production (Epasinghe, Kusum Kumara and Weerakkody, 2013).

Per capita consumption of turmeric in Sri Lanka is 28.79 g/month in 2016 (Department of Census and Statistics, 2016). Turmeric plant grows to a height of 2-3 feet and arising from its rhizomes are broad leaves. The underground rhizome is the economically valuable portion of the plant. Curcumin, the chemical compound found in turmeric varies from yellow to orange colour and deeper and darker the colour is the higher quality of turmeric.

17.1.1.1 Nutrient Composition of Turmeric

Indian turmeric varieties have three percent to nine percent curcumin and in the Pitambar variety, it is around 12.5 percent. Curcumin percentage lies in between four to six in local turmeric varieties that are cultivated in Sri Lanka. The colour of turmeric is coming from the curcumin component. Deposited starch in underground stem is the main component in turmeric. The Table 17.1 depicts nutritional composition of 100 g of turmeric and it shows that turmeric is rich in many nutritive values.

Table 17.1: Nutrition Composition of Turmeric

Compound	Nutritive Value in 100 g of Turmeric
Energy (K.cal)	312
Carbohydrate (g)	67.14
Protein (g)	9.68
Total Lipids (fat)	3.25
Fibers (g) – Dietary Fiber	22.7
Vitamin C (mg)	0.7
Vitamin E (mg)	4.43
Sodium (mg)	27
Potassium (mg)	2080
Calcium (mg)	168
Iron (mg)	55
Magnesium(mg)	208

Source: United States Department of Agriculture, (2016)

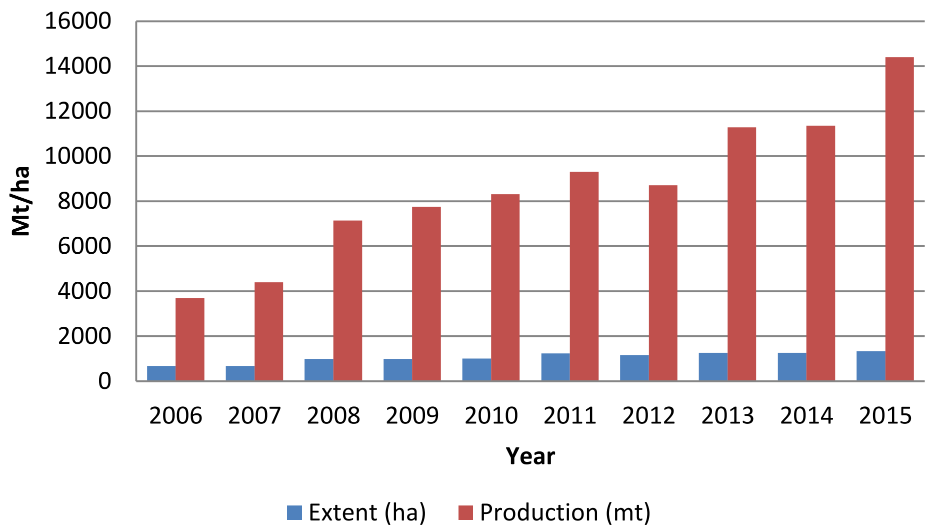
17.1.1.2 Turmeric Varieties

Though Sri Lankan turmeric growers cultivate many varieties, these varieties have not been identified correctly. In Sri Lanka, the varieties that are cultivated are a combination of both local and imported varieties. ʻʻMadurasi Manjalʼʼ, "Gunterʼʼ and ʻʻPunaʼʼ are the famous Indian varieties which have been cultivated by a majority of local farmers. Therefore, the qualities of these varieties are higher than Sri Lankan turmeric. ʻʻMadurasi Manjalʼʼ turmeric fetches a higher price in the international market. ʻʻAlleppyʼʼ and ʻʻHiteʼʼ varieties are used for colouring purpose when making fabrics (Epasinghe, Kusum Kumara and Weerakkody, 2013).

17.1.2 Major Growing Areas, Production and Extent under Cultivation

In Sri Lanka, turmeric is grown in the low country wet zone and the intermediate zone as a mono crop and as an inter-crop under coconut cultivations. Major cultivating districts are Kurunegala, Gampaha, Kalutara, Kandy and Matale.

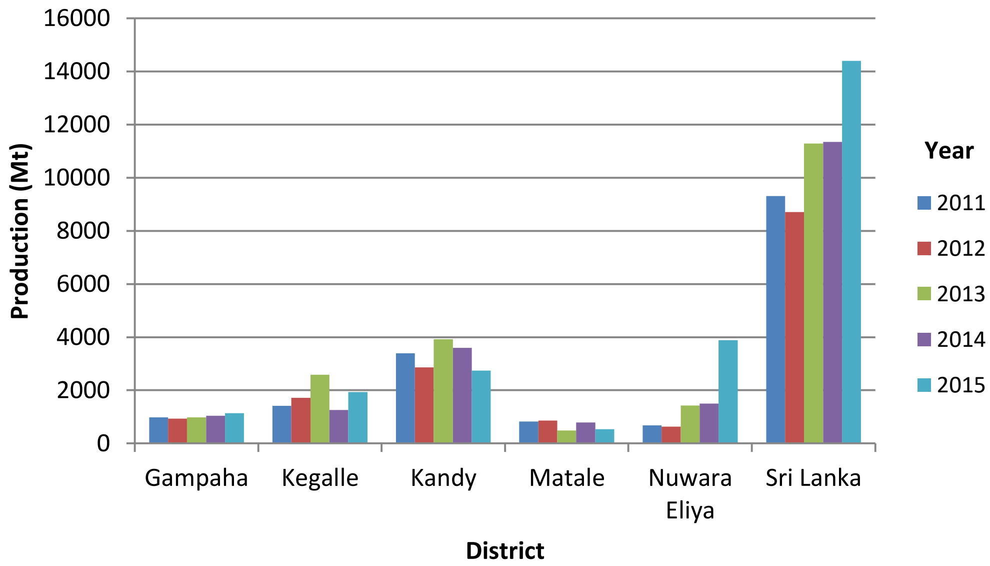
As depicted in Figure 17.1, there is a gradual rise in turmeric production from 2006 to 2015. In the year 2015, total turmeric production in Sri Lanka was 14396 mt and the average harvest was 10.8 mt/ha.



Source: Hector Kobbekaduwa Agrarian Research and Training Institute, (2006- 2015)

Figure 17.1: Turmeric Production and Extent in Sri Lanka (2006-2015)

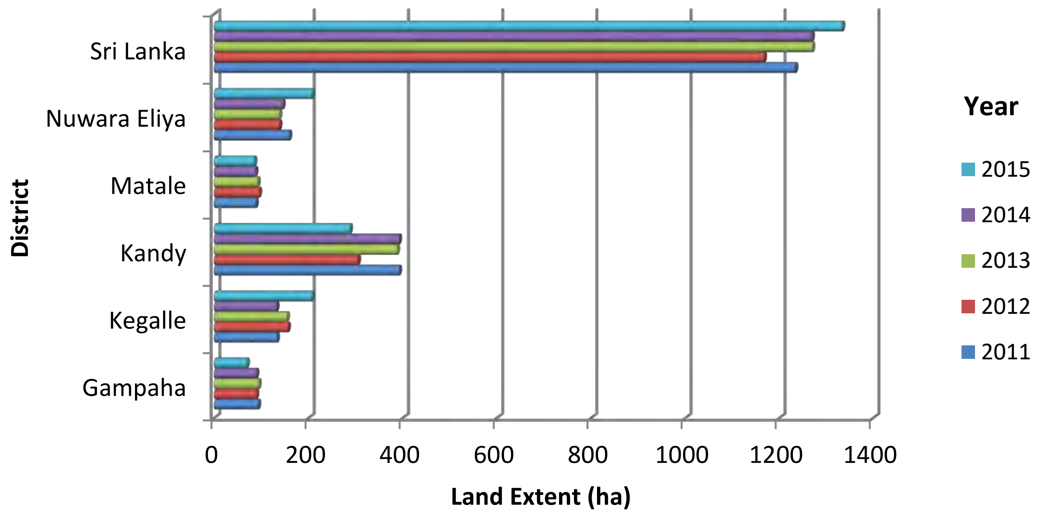
In 2006, cultivated land extent was 674 ha and it increased up to 1134 ha in 2015. It is a 49.4 percent rise in the cultivated land extent. In 2006, total turmeric production was 3690 mt which increased to 14396 mt in 2015. There is a significant rise in productivity from 2006 to 2015. The productivity of turmeric in Sri Lanka increased from 5.47 mt/ha in year 2006 to 10.8mt/ha in year 2015 and it is a 49.4 percent increase. District wise turmeric production in Sri Lanka from 2011 to 2015 is illustrated in the Figure 17.2.



Source: Hector Kobbekaduwa Agrarian Research and Training Institute, (2011-2015)

Figure 17.2: District wise Turmeric Production (mt) in Sri Lanka (2011-2015)

Nuwara Eliya contributed 27 percent to the total turmeric production of the country with a harvest of 3886 mt in 2015. Kandy and Kegalle achieved 19 percent and 13 percent of the total production respectively for the same year. Other than these districts, the turmeric farmers in Matara, Gampaha, Matale and Badulla districts also contributed their sizeable share of production to the national total. According to Figure 17.3, major turmeric growing districts of Kandy, Kegalle and Nuwara Eliya have a large extent of land under turmeric cultivation for the period of 2006-2015.



Source: Hector Kobbekaduwa Agrarian Research and Training Institute, (2011-2015)

Figure 17.3: District wise Land Extent (ha) of Turmeric Cultivation in Sri Lanka (2011-2015)

17.1.3 Climate and Soil

Turmeric can be cultivated in many soil types but the most suitable is well-drained sandy loam soils rich in organic matter. This crop can be grown on lands up to 1500 meter mean sea level and requires 1500 mm or higher rainfall. Under irrigated conditions turmeric is grown as a mixed crop even in the dry zone. In wet zone areas, it is also grown as an inter-crop in coconut cultivated lands. For the optimum growth, the crop requires a temperature range between 20 ^{0}C - 35 ^{0}C and a soil pH range between 5.5 and 6.5 (Department of Export Agriculture, 2017).

17.1.4 Importance of the Crop to the Economy

17.1.4.1 Imports and Exports of Turmeric in Sri Lanka

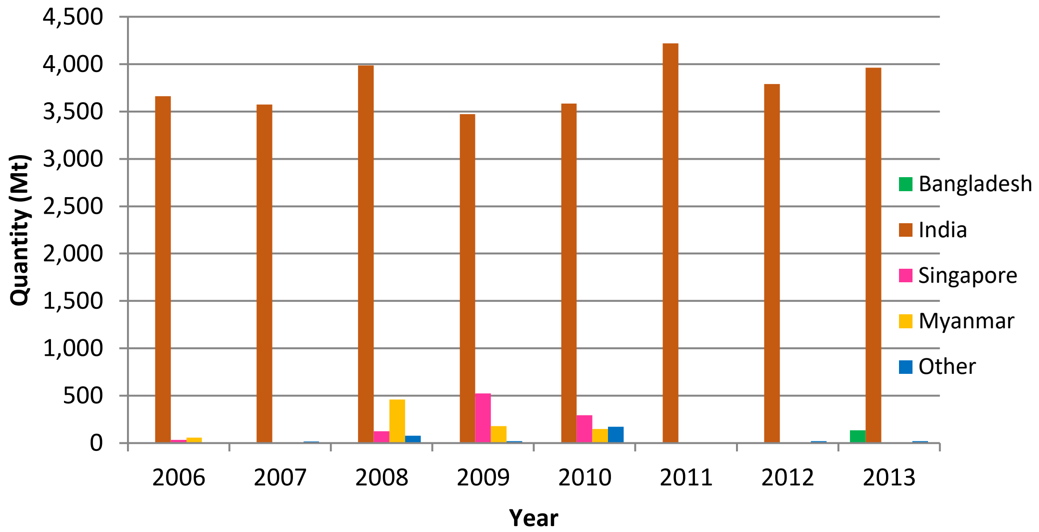
Dried turmeric rhizomes and powdered turmeric are the commercial components of turmeric that are both exported overseas and also imported to Sri Lanka. As depicted in the Table 17.2, imports were higher than exports of turmeric from 2006 to 2015. Rapid fluctuations were noticed in turmeric exports for the given period. Despite the rapid fluctuations in exports a consistency was observed in imports.

Table 17.2: Imports and Exports of Turmeric in Sri Lanka (2006-2015)

Year	Imports	Exports
	Quantity (mt.)	Quantity (mt.)
2006	3,752	24
2007	3,590	43
2008	4,647	55
2009	4,192	19
2010	4,197	13
2011	4,267	31
2012	3,808	29
2013	4,119	67
2014	4,218	78
2015	4,904	72

Source: Department of Customs, (2006-2015)

Turmeric is imported to Sri Lanka mainly from Asian countries. India was the largest turmeric importer of Sri Lanka during the last decade according to the Figure 17.4. Singapore and Myanmar were the second largest turmeric importers of Sri Lanka.



Source: Department of Customs, (2006-2013)

Figure 17.4: Quantity of Imports of Turmeric in Sri Lanka (2006-2013)

According to the data of quantity of exports of turmeric in Sri Lanka, Ukraine was the major exporter of Sri Lankan turmeric followed by the United Kingdom, France and Germany (Table 17.3). Maldives and South Korea were the Asian exporters of Sri Lankan turmeric in the given period.

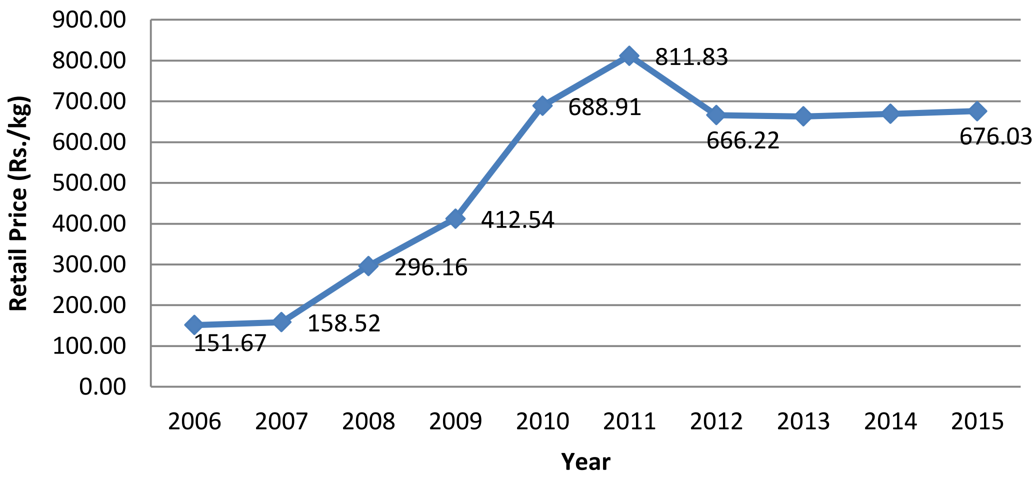
Table 17.3: Quantity of Exports of Turmeric in Sri Lanka (2006-2013)

Country	2006	2007	2008	2009	2010	2011	2012	2013
	Quantity (mt)	Quantity (mt)	Quantity (mt)	Quantity (mt)	Quantity (mt)	Quantity (mt)	Quantity (mt)	Quantity (mt)
Australia	1.52	1.20	3.24	1.16	0.92	1.15	1.71	4.43
Canada	0.57	3.66	0.11	1.70	1.11	1.76	2.69	2.33
France	0.05	1.26	1.64	1.02	0.12	0.22	4.55	12.57
Germany	0.60	0.12	0.17	0.12	0.02	0.72	0.94	10.85
Maldives	0.65	0.90	0.88	1.47	0.76	3.76	2.51	3.80
S. Korea	1.04	1.81	2.46	2.48	3.42	4.12	4.77	4.16
UK	6.51	6.97	1.50	5.60	5.12	8.79	0.58	2.53
USA	3.45	1.07	2.24	1.09	0.58	6.15	2.75	12.36
Ukraine	3.50	1.58	34.73	-	-	-	-	-
India	-	0.02	-	0.02	-	-	-	-
Other	6	25	8	4	1	4	9	14

Source: Department of Customs, (2006-2013).

17.1.4.2 Price Variations of Turmeric in Sri Lanka

According to Epasinghe, Kusum Kumara and Weerakkody, (2013) turmeric reaches to the market from November to March. Local production is not sufficient to cater to the domestic demand and imports balance the country's requirement. When compared with other crops, price fluctuation of turmeric is not to be reckoned with constant demand throughout the year.



*Price for the year 2014 is calculated using averages of 2013 and 2015
Source Hector Kobbekaduwa Agrarian Research and Training Institute, (2006-2015)

Figure 17.5: Retail Prices of Turmeric in Sri Lanka (Rs./kg)

Growers face a major marketing problem of turmeric since imports had resulted in local growers receiving a low price for their products. This price fluctuation is the result of arbitrary importation that caters to a more or less constant consumer demand for turmeric. Average retail price of turmeric per kilo was Rs. 519.50 for the given period.

According to the Figure 17.5 maximum retail price per kilo turmeric was observed in 2011.

17.2 Socio-economic Characteristics of the Sample Farmers

17.2.1 Demographic Characteristics of the Sample Farmers

Study areas Kurunegala and Gampaha districts belong to the intermediate zone and the wet zone respectively. Sixty-seven sample units were selected randomly from the study area which consisted of 29 from Kurunegala district and 38 from Gampaha district. The Table 17.4 presents the age distribution of turmeric farmers in the selected areas.

Table 17.4: Age Distribution of Turmeric Farmers

Age Category (Years)	District				Total	
	Kurunegala		Gampaha			
	No.	%	No.	%	No.	%
Age<30	0	0	1	3	1	1
30<=Age<40	1	4	1	3	2	3
40<=Age<50	5	17	10	26	15	22
50<=Age<60	9	31	7	18	16	24
Age>=60	14	48	19	50	33	50
Total	29	100	38	100	67	100

Source: HARTI Survey Data, (2016)

According to the data given in the Table 17.4, of the total respondents 50 percent were under the age of 60 years or above. Lack of youth participation in the turmeric cultivation is highly noticeable in this area. Of the total sample, the youth involvement of only one percent in turmeric growing is a glaring indication that the youth interest in this agricultural pursuit is not readily forthcoming. Involvement of youth in turmeric cultivation is even lesser than that of the middle aged people (age 30-50 years) in these areas.

Level of education of turmeric farmers is one of the highly influencing factors for the success of turmeric cultivation (Table 17.5). Reasons behind that are level of education can influence their productivity, use of new technologies, managing income expenditure for the cultivation and having more experiences. As per the Table 17.5, majority of the farmers had received education up to G.C.E (O/L) and only a small number of farmers had received primary education up to Grade Five.

Table 17.5: Level of Education of Turmeric Farmers

Level of Education	District				Total	
	Kurunegala		Gampaha			
	No.	%	No.	%	No.	%
Primary (1-5 Grades)	2	7	4	11	6	9
Secondary (6-11 Grades)	5	17	13	34	18	27
Passed G.C.E. (O/L)	12	42	15	39	27	40
Up to G.C.E. (A/L)	4	14	5	13	9	13
Passed G.C.E. (A/L)	5	17	1	3	6	9
Diploma	1	3	0	0	1	1
Total	29	100	38	100	67	100

Source: HARTI Survey Data, (2016)

According to the Table 17.6, majority of the respondent families belonged to the family category of 3-5 members. The farmers having more than 7 members in their family were very small in number.

Table 17.6: Number of Family Members of Turmeric Farmers

No. of Family Members	District				Total	
	Kurunegala		Gampaha			
	No.	%	No.	%	No.	%
Members<3	2	7	7	18	9	13
3<=Members<5	17	59	18	47	35	52
5<=Members<7	10	34	11	29	21	31
Members>=7	0	0	2	6	2	3
Total	29	100	38	100	67	100

Source: HARTI Survey Data, (2016)

17.2.2 Economic Characteristics of the Sample

The majority pursued farming/animal husbandry as their primary employment. Equal proportion (4%) each accounted for non-agricultural labour, self-employment and skilled labour as primary employments of the sample farmers. Following Table 17.7 shows the primary employment of the sample farmers.

Table 17.7: Primary Employment of Sample Farmers

Primary Employment	District				Total	
	Kurunegala		Gampaha			
	No.	%	No.	%	No.	%
Farming/Animal husbandry	10	43	27	85	37	66
Non-agricultural labour	2	9	0	0	2	4
Government job	5	22	2	6	7	13
Private sector job	3	13	1	3	4	7
Self-employment	0	0	2	6	2	4
Skilled labour	2	9	0	0	2	4
Other	1	4	0	0	1	2
Total	23	100	32	100	55	100

Source: HARTI Survey Data, (2016)

17.3 Agricultural Inputs

17.3.1 Land

17.3.1.1 Distribution of Land Holdings by Ownership

When considering land ownership of turmeric growing lands in Gampaha and Kurunegala, the majority of the farmers owned their own lands. In addition to single ownership, jointly owned, leased in, tenancy in, tenancy-out and permit holders' lands were also used for turmeric cultivation (Table 17.8).

Table 17.8: Distribution of Land Holdings in Sample

District	Ownership	No. of Farmers	No. of Holdings		Total Extent	
		No.	No.	%	No.	%
Kurunegala	Single owner	26	75	72	74.95	63
	Jointly owned	6	11	11	10.25	9
	Leased in	3	3	3	17.5	15
	Tenancy-in	1	1	1	2	2
	Tenancy-out	3	3	3	3.5	3
	Permit holder	3	3	3	6.75	7
	Other	5	7	7	4.5	4
	Total		103	100	119.45	100
Gampaha	Single owner	31	82	61	102	56
	Jointly owned	5	12	9	9.65	5
	Leased in	10	13	10	21.18	12
	Tenancy-out	4	4	3	3.58	2
	Permit holder	5	19	14	37.25	20
	Other	3	4	3	8.4	5
	Total		134	100	182.06	100

Source: HARTI Survey Data, (2016)

In Kurunegala district, the majority of turmeric farmers used single owned lands. In Gampaha district 61 percent of the farmers grew turmeric in their own lands and 14 percent were land permit holders.

17.3.1.2 Distribution of Operators by Size Class of Land

Majority of the farmers in both districts farmed between 2ac-5ac of lands. That proportion is 52 percent out of total sample. Comparatively a significant number of farmers had lands more than 5ac in extent (Table 17.9).

Table 17.9: Distribution of Operators by Size Class of Land in Turmeric Cultivation

District	Land Class (ac)	No. of Farmers	%
Kurunegala	0.5<=ext<1	1	3
	1<=ext<2	7	24
	2<=ext<5	14	49
	ext>=5	7	24
	Total	29	100
Gampaha	0.5<=ext<1	1	3
	1<=ext<2	6	16
	2<=ext<5	21	55
	ext>=5	10	26
	Total	38	100
Total	0.5<=ext<1	2	3
	1<=ext<2	13	19
	2<=ext<5	35	52
	ext>=5	17	25
	Total	67	100

Source: HARTI Survey Data, (2016)

According to the data given in the Figure 17.6, turmeric cultivation has become popular as a medium scale (cultivated land extent between 2ac-5ac) crop in both Kurunegala and Gampaha districts. Few limiting factors are identified for not shifting from small/medium scale to commercial scale in the turmeric cultivation (Epasinghe, Kusum Kumara and Weerakkody, 2013). Importation of turmeric to the country, lack of know-how to make value added products using turmeric and lack of understanding about the commercial value of turmeric as a spice are few among those limitations. It is important to allocate more lands for the growth of crop to fulfill the demand of both local and global buyers. Unless Sri Lanka has to strive to achieve the annual requirement of turmeric in Sri Lanka which is 7325 mt/year[2] (author's estimation) calculated by per capita consumption per year x mid-year population. This calculation only includes the domestic consumption.

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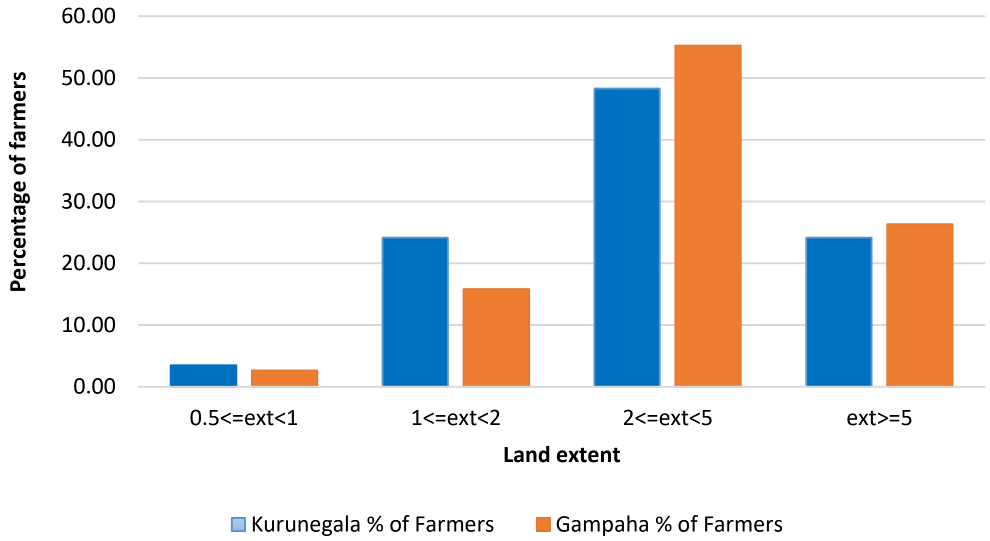
[2] Per Capita consumption of turmeric in 2016 is 28.79 g/month and mid-year population of Sri Lanka in 2016 is 21,203,000 (Department of Census and Statistics, 2016 and 2017).

A well planned course of action covering comprehensively the areas that need to be addressed in the furtherance of the turmeric farming, particularly the issues and the constraints spotlighted in this study and with sharp focus on allocating more land extents and luring young blood to their farm practice can have tangible results to achieve self-sufficiency in turmeric, thereby saving a sizeable amount of foreign exchange.



Source: HARTI Survey Data, (2016)

Figure 17.6: Distribution of Operators by Size Class of Land in Turmeric Cultivation

17.3.2 Irrigation

Gampaha and Kurunegala districts belong to the wet zone and the intermediate zone. Therefore, majority of the farmers grew turmeric under rain fed conditions in both districts. In addition to rain fed cultivation, the farmers cultivated under major, minor and supplementary irrigation as well. However, it was minimal (Table 17.10).

Table 17.10: Number of Land Holdings Based on Water Source in Turmeric Cultivation

District	Water Source	No. of Farmers	No. of Holdings		Total Extent	
			No.	%	No.	%
Kurunegala	Major irrigation	3	4	4	4.50	4
	Minor irrigation	8	10	10	6.25	5
	Rain fed	25	56	57	69.76	59
	Agro-well	10	11	11	22.60	18
	Reservoir/tank	2	3	3	2.00	2
	Domestic well	6	8	8	5.75	5
	Tap line	2	4	4	4.25	4
	Other	1	3	3	3.00	3
	Total	57	99	100	118.11	100
Gampaha	Minor irrigation	10	11	9	11.37	6
	Rain fed	34	81	63	123.23	69
	Agro-well	7	10	8	17.25	10
	Reservoir/tank	3	6	5	11.75	7
	Domestic well	12	18	13	13.41	7
	Tube well	1	2	2	2.50	1
	Total	67	128	100	179.51	100

Source: HARTI Survey Data, (2016)

17.3.3 Labour

Labour is a crucial component in turmeric cultivation. According to the crop budget of the Department of Export Agriculture, (2015), in turmeric cultivation, labour is used in secondary land preparation with bed preparation (40 man days/ac), planting seeds after seed treatment (26 man days/ac), mulching (6 man days/ac-2 times), chemical fertilizer application (6 man days/ac), weeding (16 man days/ac-2 times), earthning up (8 man days/ac-2 times), pesticide application (2 man days/ac), harvesting (80 man days/ac) and packing. A significant labour component was used for seed planting, weeding and harvesting activities. This is a vital factor to be reckoned with compared to other operations in turmeric cultivation that need man power.

17.3.4 Fertilizer and Pesticides

Both organic and chemical fertilizer had been used in turmeric cultivation. According to the Department of Export Agriculture, (2017), 130 kg of urea/ac, 200 kg of Miyuriate of Potash (MOP)/ac and 100 kg of Triple Super Phosphate (TSP)/ac are the fertilizer recommendations for turmeric and also well responsive crop for organic fertilizer and potassium.

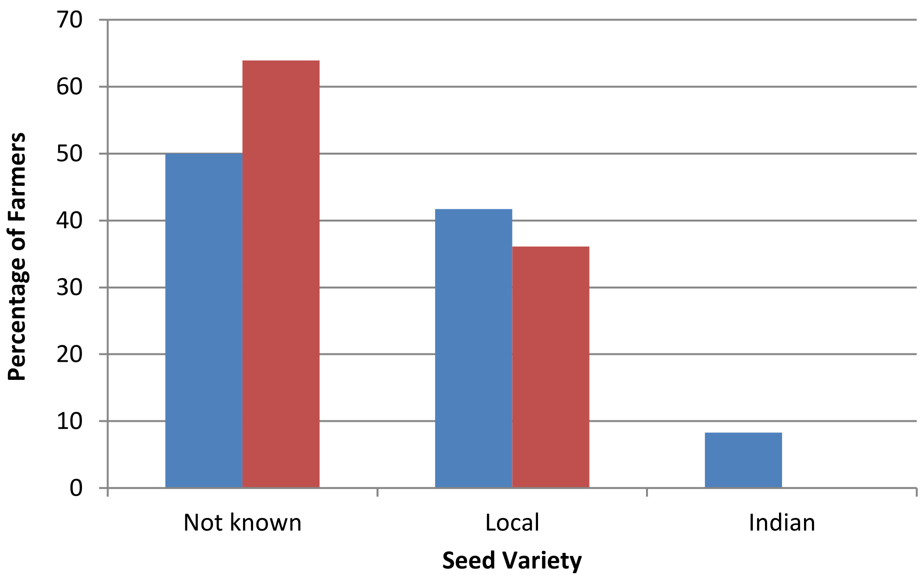
Lesser level of pests and diseases occurrences is found in turmeric. Leaf scorching can be found due to fungal attack. At the serious stage leaves look scorched. Better agronomic practices and cultural methods can be used to control this disease. Leaf blotch, leaf rot and rhizome rot are other diseases which can damage turmeric production. Stem borer is the major pest in turmeric growing. Dead heart symptom is the evidence to identify stem borer attack. Other minor pests of turmeric are leaf rolling caterpillars and scale insects.

17.3.5 Seeds/Planting Material

Seeds are one of the most important inputs for any crop cultivation as it enhances the quality of production. As per Epasinghe, Kusum Kumara and Weerakkody, (2013), mother rhizomes and finger rhizomes are used as planting materials for turmeric cultivation. When selecting planting materials in turmeric, 50 g weight of rhizome is selected to cultivate to get better yield. It is important to select mother rhizomes and finger rhizomes which are good in odour and acceptable in colour (orange or yellow colour). As a pretreatment, rhizomes are essential to be dipped in fungicide such as Captan or Thiram to prevent fungal attacks.

17.3.5.1 Seed Varieties Used in Turmeric Cultivation

Within the study area, turmeric farmers used local and Indian varieties. More than 50 percent of the farmers were unaware about the variety they had cultivated. According to the Figure 17.7, 42 percent of the farmers in Kurunegala and 36 percent in Gampaha district had used local varieties. However, around eight percent of farmers in Kurunegala district had used Indian varieties and prominently observed in Kurunegala district.



Source: HARTI Survey Data, (2016)

Figure 17.7: Seed Varieties Used in Turmeric Cultivation

17.3.5.2 Source of Seeds Used in Turmeric Cultivation

According to the Table 17.11, majority of the farmers used self-produced seeds for their cultivation in both districts. Around 12 percent of the farmers in Kurunegala district and three percent in Gampaha district had depended on seeds received from the Department of Agriculture. At the same time, farmers used seeds from neighbouring farmers also in both districts.

Table 17.11: Source of Seeds Used in Turmeric Cultivation

District	Source of Seeds	No. of Farmers	%
Kurunegala	Dept. of Agriculture	3	12
	Self-produced	16	62
	Neighbouring farmers	6	23
	Other	1	4
Gampaha	Dept. of Agriculture	1	3
	Self-produced	29	76
	Neighbouring farmers	8	21

Source: HARTI Survey Data, (2016)

17.3.6 Machinery

Before crop establishment, machinery is used in land preparation requiring not much of human labour. Four-wheel tractors and two-wheel tractors are used in ploughing and tillage operations in turmeric cultivation. This helps to have a flat land to maintain better drainage. A significant human labour component is used for seed bed preparation, planting, weeding, earthing up and harvesting activities.

17.3.7 Total Cost of Production

The Central Research Station, Department of Export Agriculture has introduced a recommended methodology for turmeric cultivation, but the farmers do not follow that practically. How far it was practicable was determined by calculating cost of production in turmeric (Epasinghe, Kusum Kumara and Weerakkody, 2013).

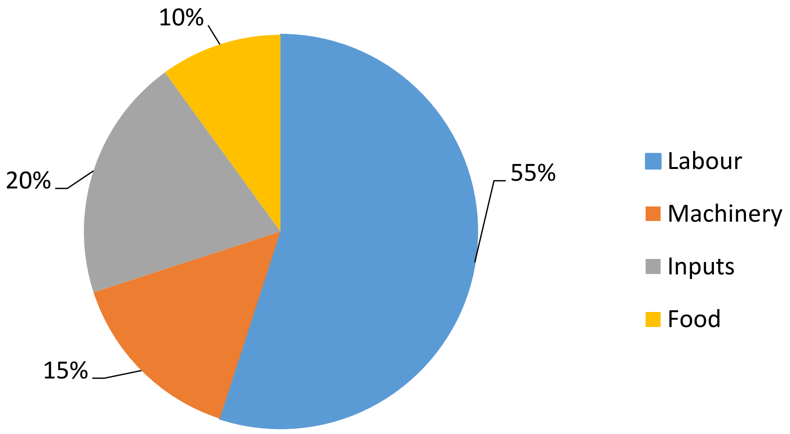
Labour cost, cost of machinery and cost of inputs were taken into account when estimating the cost of production for turmeric cultivation. The cost of production was calculated for one acre of land extent in both districts. It was noticed that, total cost of production ranges between Rs. 46000 - Rs. 54000 including family labour in both Gampaha and Kurunegala districts (Table 17.12).

Table 17.12: District wise Cost of Production in Turmeric Cultivation (Rs./ac)

Item	Cost/Rs.		Total Cost/Rs.
	Gampaha	Kurunegala	
Labour	32,175.00	21,785.00	26,980.00
Machinery	7,752.00	6,840.00	7,296.00
Inputs	10,157.00	9,806.00	9,982.00
Food	3,500.00	6,750.00	5,125.00
Total cost (with family labour)	53,584.00	45,181.00	49,382.00
Total cost (without family labour)	43,805.00	34,392.00	39,364.00
Average yield (kg)	2,455.00	1,684.00	2,070.00
Harvest ratio	1:06	1:04	1:05
Selling price (Rs.)	30-50	40-120	30-120
Total income	98,200.00	134,720.00	15,525.00
Cost of production per unit (with family labour)	Rs.22	Rs.27	Rs.24
Cost of production per unit (without family labour)	Rs.18	Rs.21	Rs.19

(Recommended harvest by Department of Export Agriculture, (2015) is 12,000kg/ac and recommended harvest ratio by Department of Export Agriculture, (2015) is 1:15)
Source: HARTI Survey Data, (2016)

According to the Table 17.12, it was calculated that the cost of production per 1kg of raw turmeric including family labour was Rs. 24/= for both districts. It was Rs. 19/= excluding family labour. It costs Rs. 22/= per 1kg of turmeric production including family labour in Gampaha while the corresponding figure for Kurunegala was Rs. 27/= per 1kg. Excluding family labour, cost of production per 1kg of turmeric in Gampaha was Rs. 18/= and it was Rs. 21/= for Kurunegala. As per the crop budget of the Department of Export Agriculture, (2015) cost of production of 1 kg of turmeric including family labour was Rs.23/= and it is mostly similar to the calculated cost in this study. When considering expenditure items in turmeric cultivation in both districts, as illustrated in the Figure 17.8, 55 percent of the cost share was incurred for the labour. Out of the total cost, 15 percent and 10 percent were incurred for machinery and food respectively. Nearly 20 percent was incurred for inputs including seeds, fertilizer, weedicides and pesticides.



Source: HARTI Survey Data, (2016)

Figure 17.8: Expenditure Items in Turmeric Cultivation

17.4 Potentials and Constraints of Turmeric Production

Turmeric cultivation has advanced to commercial scale from home gardening cultivation. At the same time, total cultivated land extent and yield per acre had increased during the last decade (2005-2010). To promote turmeric production several initiatives have been taken by the Department of Export Agriculture, especially introduction of subsidy programmes and incentives have tended to reduce the cost of production compared with other spices that are cultivated on the same line.

Major constraints hampering the turmeric cultivation are, not having a guaranteed price for turmeric and absence of a defined marketing channel. Continuation of the import of turmeric even during the harvesting period is resulted a lower price for the farmers, stressing on the need to suspend turmeric importation during peak local production periods to control the price fluctuations. Further, turmeric growers had experienced crop damages due to pest attacks and diseases that spread over the cultivations. At the same time, adverse weather conditions including water scarcities had unfavourably impacted on crop growth and rhizome formation process.

Farmers used to supply raw turmeric to the market without making value addition as some of they were unaware about the processing methods and new cultivation technologies in turmeric. High cost of inputs including coir used as mulch, difficulties to get coir and low use of fertilizer are disincentives for turmeric production. It is essential to identify the potentials and overcome the constraints related to turmeric cultivation.

17.5 Recommendations and Suggestions

1. Introduce and identify consumer preferred and high yielding turmeric varieties to promote and develop turmeric production.
2. Create awareness among the growers through research and extension regarding the value addition of turmeric production targeting to reach the share of international market.
3. Limit the low quality turmeric (less than 4% curcumin) importation and increase turmeric importation taxes to protect the local producers.

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Chapter Eighteen

Ginger

B.A.D.S.Bamunuarachchi

SUMMARY

Ginger is mostly cultivated in the wet zone home gardens as a mono crop or an inter-crop and used as a flavour in food industry, a raw material for the production of soft drinks and perfumes and as a medicine. Sri Lanka has a well-established export market for ginger particularly in China, India, Singapore, America and Britain due to its fragrance and high quality and exports ginger in several forms such as raw ginger, dried ginger and ginger oil. On the other hand, Sri Lanka imports ginger in the forms of fresh ginger, dried ginger and ginger oil from various countries worldwide. It is noticeable that the country has failed to meet the country's demand through local production hence have to spend huge sum of money each year to import dried ginger.

Gampaha and Kurunegala districts were selected as the study locations considering the extent under cultivation. The ginger can be considered as cash crop since it generated an additional income for the farmers as ginger was mostly grown as an intercrop and easy to maintain. Ginger was cultivated prominently on uplands and lesser extents in lowlands. The land extent under ginger cultivation in the sample varied from 20 perches to 10 acres. In general, ginger is cultivated under rainfed conditions. Family labour is used and the majority had used hired labour for weed controlling during the growing period. Applying organic manure was more popular among the small scale farmers. Local Sinhala variety, Rangoon and Chinese varieties were commonly used seed varieties.

The cost of production of ginger with imputed cost of labour ranged between Rs. 37-54/kg. Low price and fluctuation of price and low yield were major constraints in popularizing ginger cultivation. So that, it is of paramount importance to identify which factors contributed to reduce the price and yield in ginger cultivation. Hence having a fixed price and limit the dried ginger importation is vital along with expanding market for ginger in local as well as exports.

CHAPTER EIGHTEEN

Ginger

18.1 Overview of Ginger Crop

18.1.1 Introduction

Ginger (*Zingiber officinale*) which belongs to the family *Zingiberaceae* is originated in India and consequently spread throughout the Europe. It is an annual crop which can be grown as a spice and a medicinal plant. It is called “Inguru’ in Sinhala, ‘Maruppu’ in Tamil and ‘Mahoushadu’ in Sanskrit.

Ginger is mostly cultivated in the wet zone home gardens as a mono crop or an inter-crop and as being a shade loving plant it vigorously grows under coconut, banana and pepper. Ginger is used as a flavoring ingredient in food industry and as a raw material for the production of soft drinks (ginger beer) and perfumes. According to Professor Piyal Marasinghe[3] (personal communication) ginger is proven as a medicine for indigestion, diarrhea, dysentery, stomach aches and respiratory diseases of infants, gastritis, severe headache, allergies associated with fever, toothache, high blood pressure, constipation, vomiting, contusion, mouth ulcers, sore throat, earache, for venom and cold . Table 18.1 denotes characteristic features of different varieties of ginger.

Table 18.1: Varieties of Ginger

Ginger Variety	Colour	Pungency	Yielding	Average Yield (tons/ha)
Local	Ash-yellow colour fibrous rhizomes, small in size	High	After 8-9 months	12-14
Chinese	Less fibrous rhizomes with yellowish flesh	Low	After 7-8 months	18-20
Rangoon	Show intermediate features between local and Chinese varieties	Higher than Chinese variety	After 7-9 months	14-20

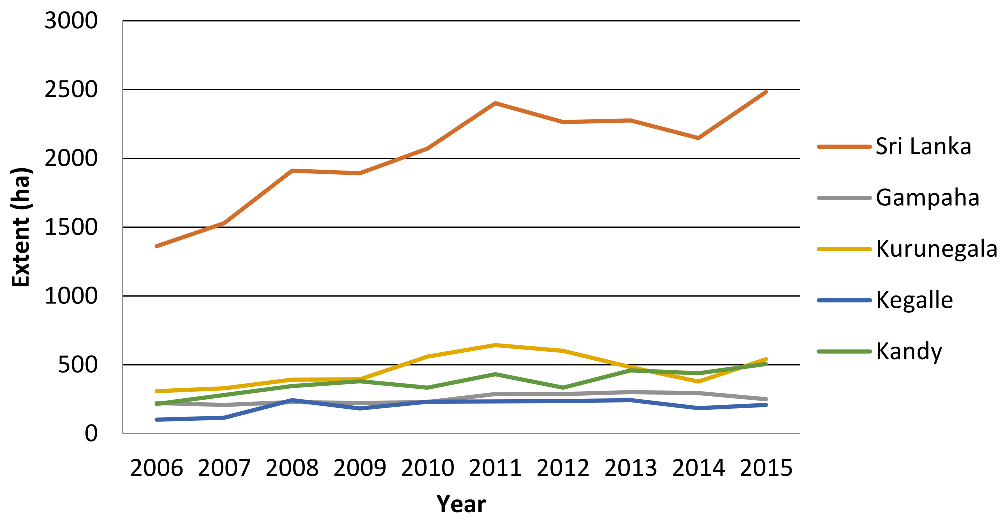
Source: Department of Export Agriculture

Prominent ginger varieties are Canton, Chinese, Malay and Jamaican. In fact, local varieties, Malay, Sinhala and Chinese are the common varieties grown in Sri Lanka. Rangoon is another ginger variety grown in Sri Lanka with intermediary features between local and Chinese.

[3] Scientist of the Aurvedic Department, Sri Lanka

18.1.2 Major Ginger Growing Areas and Extent under Cultivation

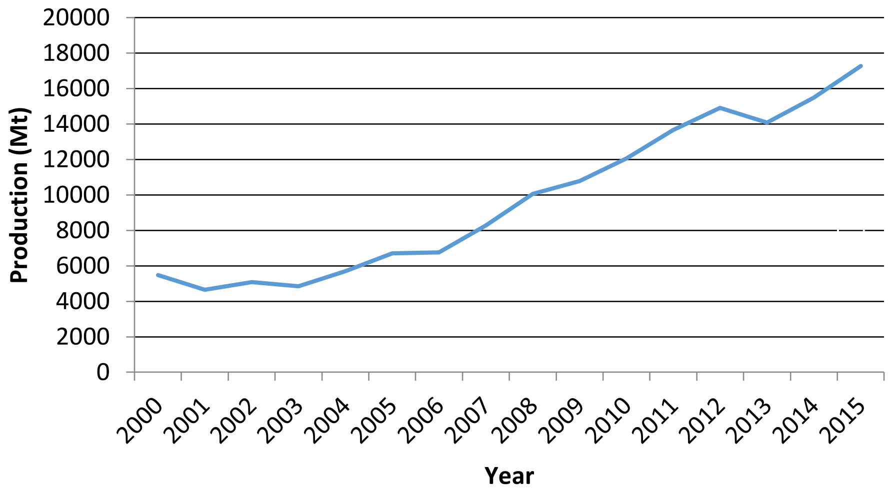
In fact, Ginger is considered as a low country wet zone crop, it is grown in the home gardens in Kegalle and Kandy districts as a mixed crop. Kurunegala, Gampaha, Kandy and Kegalle districts can be identified as major ginger cultivating districts. According to the Figure 18.1, there is a 28 percent increase in the national extent under ginger cultivation from 2006 (1362 ha) to 2015 (2483 ha). Kurunegala district can be considered as the major ginger cultivating district, whereas 541 ha were cultivated in 2015.



Source: Department of Census and Statistics, 2016

Figure 18.1: Extent under Ginger Cultivation in Sri Lanka by Districts

According to Figure 18.2, national production of ginger in Sri Lanka has shown a rapid increase of 15.6 percent from 5477 mt (2000) to 17272 mt (2015).



Source: Department of Census and Statistics, 2016

Figure 18.2: National Ginger Production in Sri Lanka

18.1.3 Climate and Soil

The Lands in the intermediate and the wet zones that receive a rainfall of over 1500 mm and well spread sunlight is conducive for ginger cultivation. The most suitable soil for ginger cultivation is well drained sandy loam soils, rich in organic matter within pH range from 5.5 to 6.5. Ginger cultivation can be carried out on lands up to 5600 feet above Mean Sea Level.

The ginger favours the optimum rainfall and tropical climatic conditions whereas well drained soil is a must. Moreover, ginger is best to be planted before onset of the South East monsoon from mid-March to early-April. Then the shoots come out in the early Yala season (March/April). By late Maha season (December/January) leaves gradually die with the maturity of the plant. It takes around 7-10 months to mature the rhizomes after planting and identifying the exact point of harvesting was a problem faced by farmers.

Table 18.2: Growth Schedule of the Ginger Vegetative Stage Seed Establishment

Production Stage	Period (month)	Growth Period
Seed establishment	Jan	Dormant
	Feb	
	March	Germination
	Apr	
Flowering/Growth	May	Primary growth stage (tillering)
	June	
	July	
	Aug	
	Sep	
Tuberization	Oct	-Tuber growth
	Nov	-Food storage
	Dec	Fiber storage
	Jan	Development of sheaths (external protecting tissues)

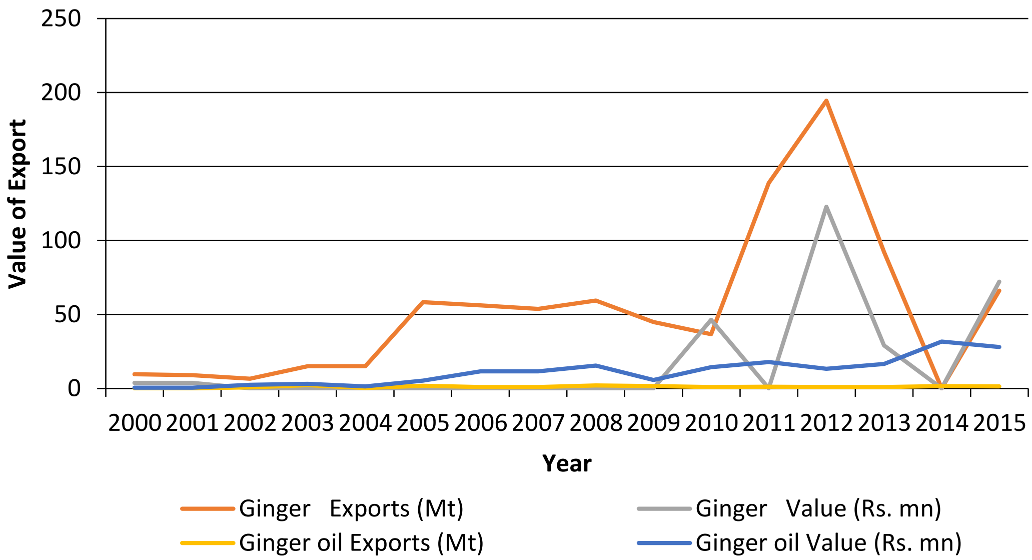
Source: Horticultural Crop Research and Development Institute, 2012

Early planting as well as late planting is not recommended since early planting results in weaker and irregular buds whereas late planting leads to a lower yield. When leaves in the well matured ginger plants turn yellow in colour and get dried and fall over the stem is the optimum time for harvesting ginger. It is essential to get the harvest from the matured plants, if is to be used as seeds, for instance, Chinese variety and local variety should be harvested when the plant is 7-8 months and 8-9 months after planting respectively. Department of Export Agriculture (DEA) recommends that the harvest should be taken after 5-6 months to be used as a raw material for value added products for which the Chinese variety is the best. Moreover, it can be introduced as a crop with high nutrient use efficiency that fertilization brings higher yields. Mulching with straw or paddy husk conserves soil moisture whilst suppressing weed growth.

Application of organic matter with a basal dressing of Nitrogen (N), Phosperous (P) and Potassium (K) leads to a proper crop plant growth. Weed control can be done easily by mulching leading to usage of herbicides at minimal level. The Horticultural Crop Research and Development Institute (HORDI) recommend that earthen up gives higher yield and a quality harvest. Correct application of cultural practices such as crop rotation, proper land preparation, selection of high quality seeds, seed treatment and water management is a prerequisite for proper control of diseases in ginger cultivation.

18.1.4 Importance of Ginger to the National Economy

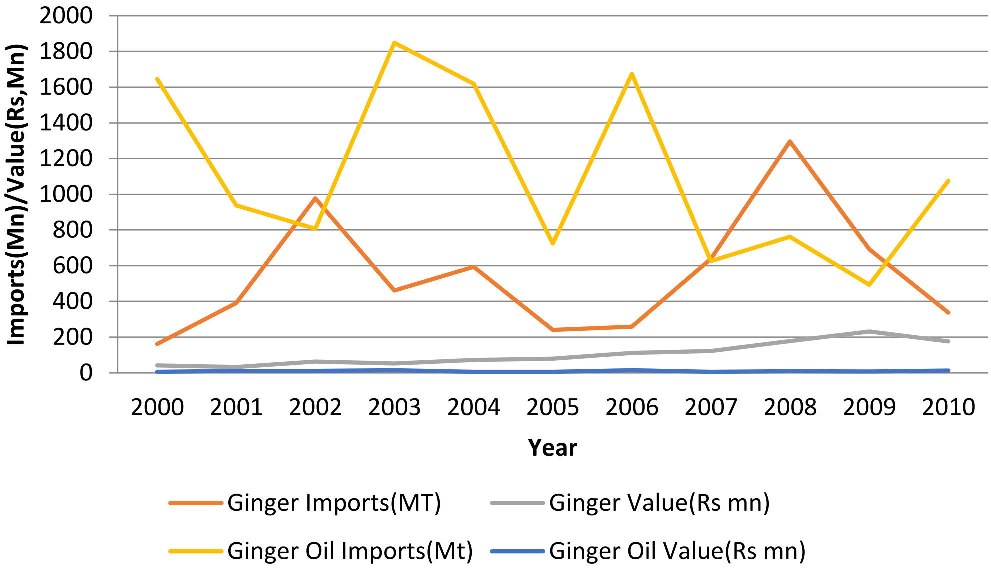
Sri Lanka exports ginger in several forms such as raw ginger, dried ginger and ginger oil. According to Figure 18.3, there is a gradual increase of ginger exports earnings of all the types from 2000 to 2008. In 2015, there was a drastic drop of export of ginger. Pale yellow ginger oil, a Sri Lankan exports item, is used as a fragrance and an essence for alcoholic and nonalcoholic beverages. Sri Lanka has a well-established export market for ginger particularly in China, India, Singapore, America and Britain due to its fragrance and high quality. The largest share in the world market for ginger is with India, Nigeria, China, Germany, Indonesia and Netherlands. Moreover, Sri Lanka also possesses a huge potential for the market expansion if necessary measures are taken. Added potential for the expansion of ginger production and productivity in Sri Lanka are; favourable climatic conditions, farmer preference for cultivating as an inter-crop and subsidies given by the government. Therefore, the expansion of market opportunities is a must for increasing incomes from ginger cultivation.



Source: Department of Customs, 2015

Figure 18.3: Value of Exports of Ginger and Ginger Oil in Sri Lanka (2000-2015)

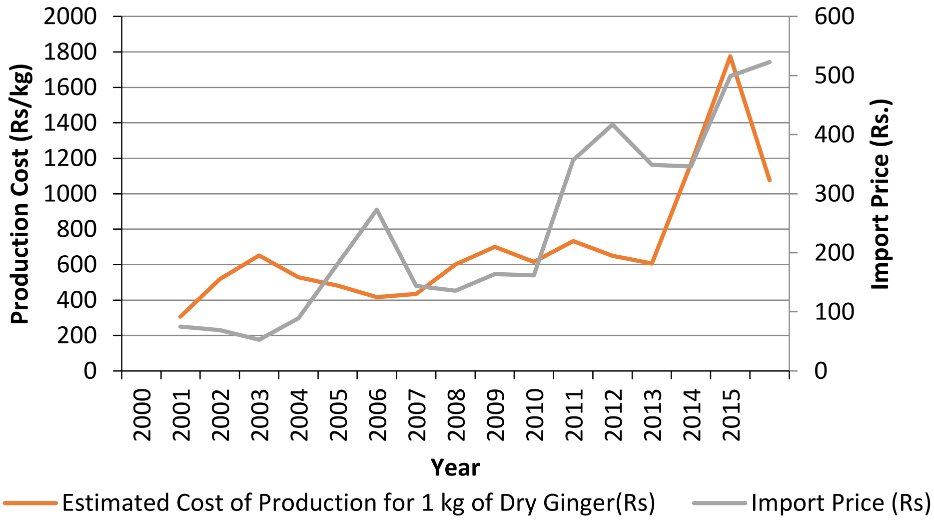
The Figure 18.4 depicts how ginger imports in Sri Lanka have been fluctuating over time and Sri Lanka imports ginger in the forms of fresh ginger, dried ginger and ginger oil for various countries worldwide.



Source: Department of Customs, 2015.

Figure 18.4: Import Data of Dried Ginger and Ginger Oil in Sri Lanka (2000-2015)

One kilogram of dried ginger is produced with 5.5 – 6 kg of fresh ginger. Accordingly, fresh/raw ginger worth Rs. 1076 was required to produce one kg of dried ginger in the year 2015 (during this period ginger price was high) excluding the cost of slicing, machine drying, and labour. The price of one kg of imported dry ginger was valued at Rs. 523/kg (Figure 18.5) and therefore there was a huge comparative advantage for the importation of dried ginger. Moreover, high quality and ready to use feature are the added advantages of imported dry ginger.

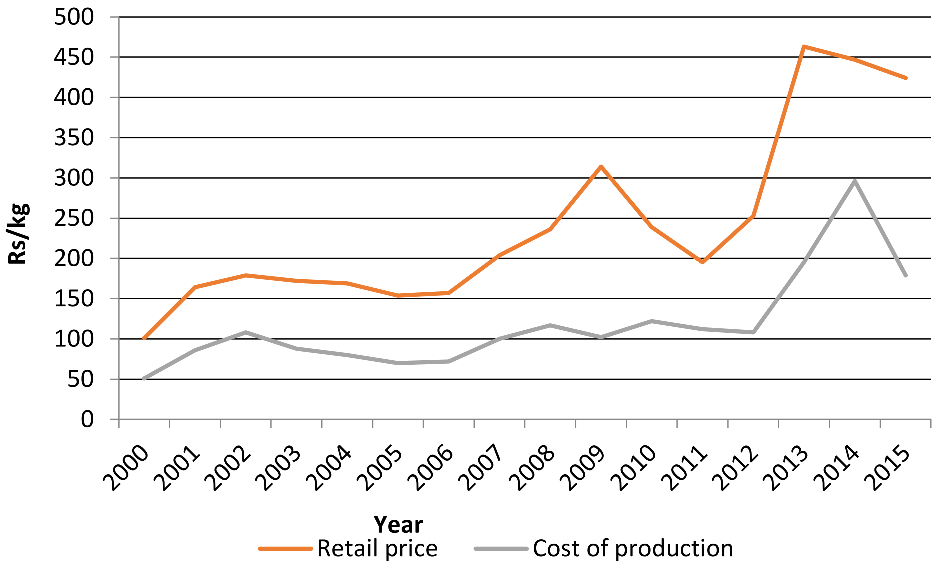


Source: Department of Customs, 2015.

Figure 18.5: Production and Export Statistics of Dried Ginger in Sri Lanka

In fact, locally produced fresh ginger fetched comparatively higher income in 2015 due to a significant increase of ginger price but there was a drastic drop of price in 2016. The Figure 18.6 shows the cost of production and retail price of fresh ginger from

2000-2015 in Sri Lanka. In 2005, the cost of production was Rs. 51/kg and the retail price was Rs. 101/kg whereas the corresponding figures in 2015 was Rs. 179/ kg and Rs. 424/ kg. It reveals that higher proportion is claimed by middlemen in the ginger marketing channel. Village collectors, collectors from the nearby town and distant places are among these intermediaries. According to facts revealed through the focus group discussions, the extent under cultivation could be increased if the farmer gets a higher profit margin.



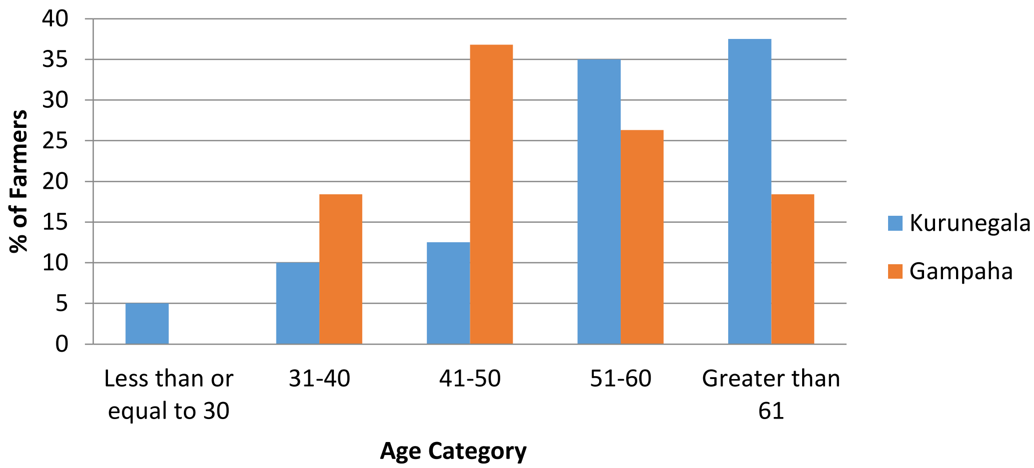
Source: Department of Census and Statistics, 2016

Figure 18.6: Cost of Production and Retail Price of Fresh Ginger in Sri Lanka

18.2 Socio Demographic Characteristics of the Sample

18.2.1 Demographic Characteristics of the Sample Farmers

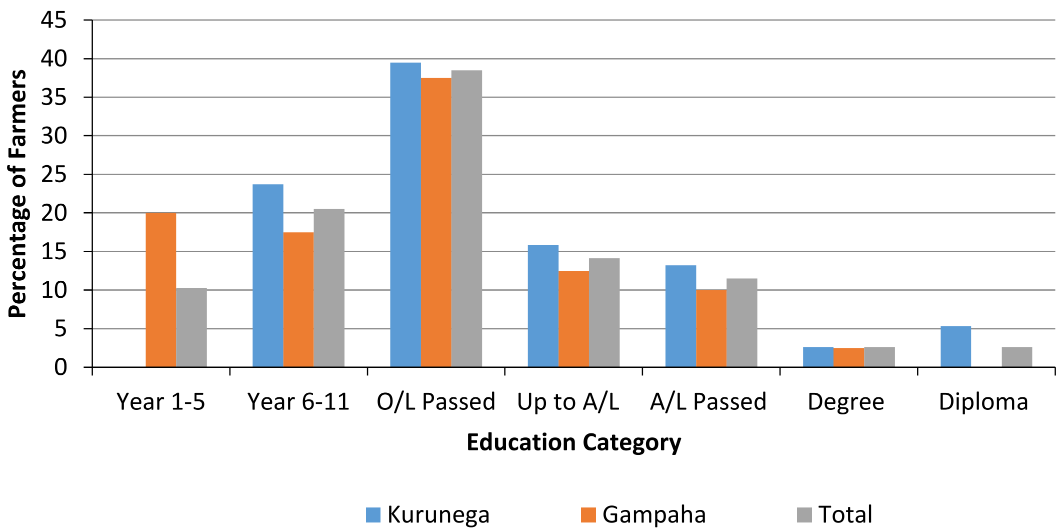
Gampaha and Kurunegala districts were selected as the study locations in terms of high extent under cultivation. Gampaha represents the wet zone whereas Kurunegala represents the intermediate zone. According to Figure 18.7, 59 percent of the total sample farmers belong to age group of older than 50 years whereas corresponding figures for Gampaha and Kurunegala are 72 percent and 45 percent respectively. The main reason behind the involvement of elder farmers in ginger cultivation is less time required for ginger cultivation and easy maintenance. The male female ratio of the householders is 4:1 and family size varies from 2 to 9 whereas the size of the majority of families lies within the category of 3 to 5.



Source: HARTI Survey Data, 2016.

Figure 18.7: Age Distribution of Household Heads

When considering the education level of the sample ginger farmers, majority of them (38%) have passed the GCE (O/L) examination irrespective of the district. As illustrated in the Figure 18.8 second highest group of farmers are in the education level up to grade 6-11.

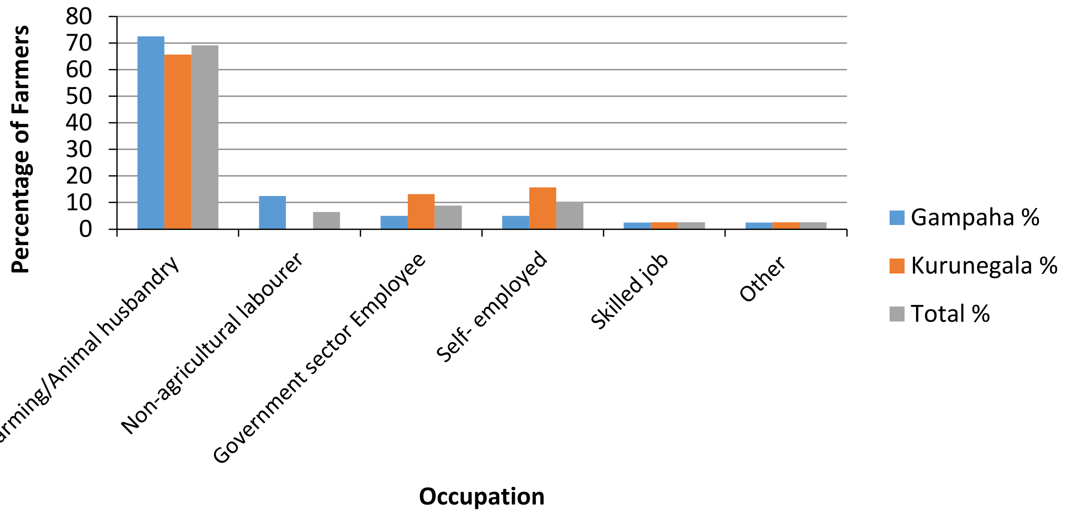


Source: HARTI Survey Data, 2016

Figure 18.8: Level of Education of Head of Households

18.2.2 Economic Characteristics of the Sample Population

Farmers viewed ginger as a cash crop since it generated an additional income for the farmers because in most cases ginger was grown as an intercrop (particularly under coconut). Further, easy to maintain (no extra irrigation required), can be cultivated as an intercrop under government subsidy scheme, less labour requirement for maintenance, no crop damages due pests and diseases and threats from animals were other favourable factors of ginger cultivation. According to findings, 59 percent in Gampaha district and 76 percent in Kurunegala district derived maximum benefits from cultivating ginger as an intercrop in coconut lands. Further, 52 percent of the farmers of the sample population had involved in ginger cultivation mainly due to the subsidy schemes implemented by the DEA.



Source: HARTI Survey Data, 2016

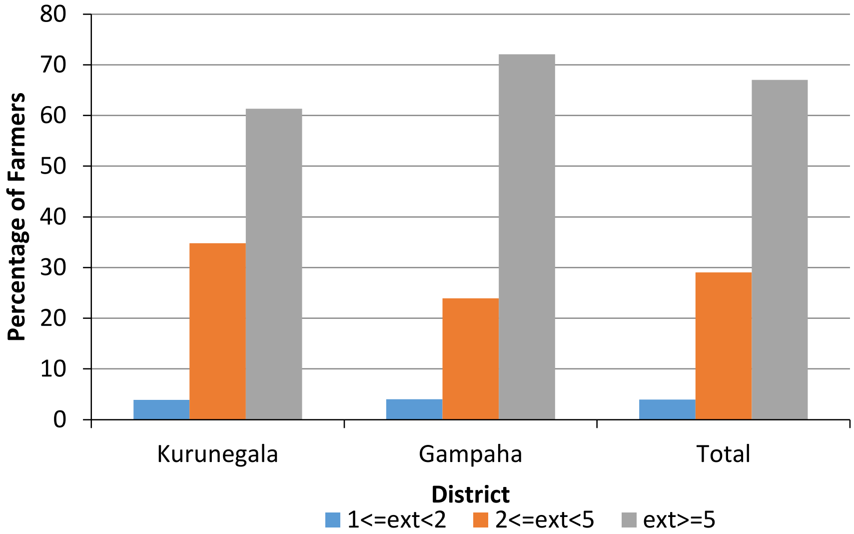
Figure 18.9: Main Occupation of the Household Heads

The main occupation of the 69 percent of the total sample was either farming or animal husbandry (Figure 18.9). Moreover, main crop grown was paddy and vegetables, betel and ginger were considered as an additional source of income.

18.3 Agricultural Inputs

18.3.1 Land

Ginger was cultivated prominently on uplands and lesser extents in lowlands. The extent under cultivation in the sample varied from 20 perches to 10 acres (Figure 18.10). The extent cultivated by the majority of the sample farmers (49%) accounted for 2ac to 5ac on their uplands. In Kurunegala district, the size of the ginger farm cultivated by 58 percent of the farmers belonged to 2ac to 5ac category whereas in Gampaha district 45 percent of the farmers had cultivated in larger plots over five acres since ginger is cultivated in coconut estates as an inter-crop.



Source: HARTI Survey Data, 2016.

Figure 18.10: Percentage Distribution of Land Area by Land Size

18.3.2 Irrigation

In general, ginger is not an irrigated crop and is cultivated under rainfed conditions. According to the farmers' view, (64%) comparatively water requirement of ginger is low.

18.3.3 Labour

Generally, family labour is used for many farm activities and the majority had used hired labour for weed controlling which is practiced three times during the growing period. Research findings show that earthen-up gives a high yield and also minimizes insects' damages. High wage rates and non-availability of labour were the issues faced by the majority of ginger farmers in both districts during the growing period. The Table 18.3 highlights the cost of labour in ginger cultivation.

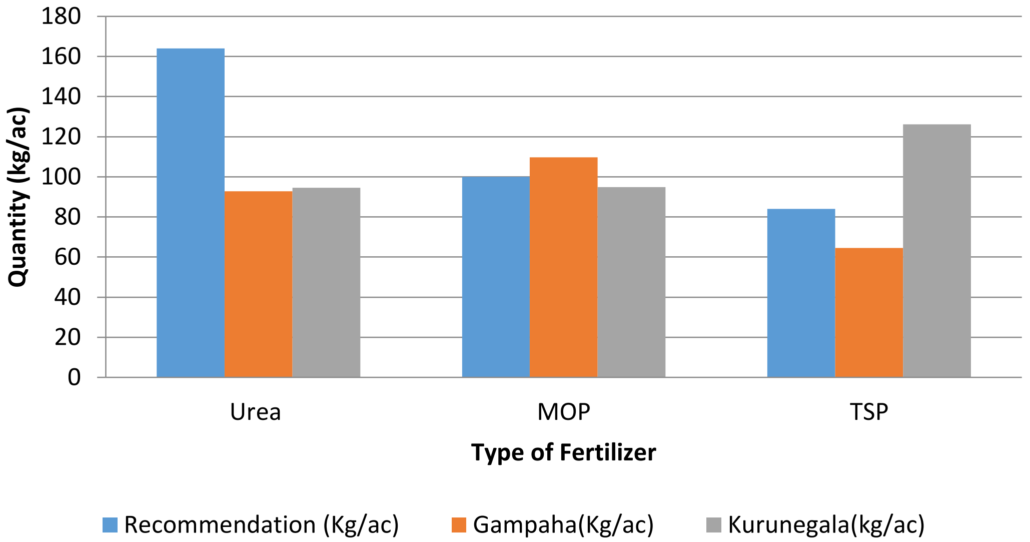
Table 18.3: Cost of Labour in Ginger Cultivation

District	Labour cost (Rs)	As a percentage of total cost	As a percentage of total cost(excluding family labour)
Gampaha	22147	27.1	30.3
Kurunegala	46591	41.9	45.1
Average total	34369	35.6	38.5

Source: HARTI Survey Data, 2016.

18.3.4 Fertilizer and Pesticides

The Figure 18.11 illustrates the usage pattern of inorganic fertilizer in both surveyed districts. Usage of urea in both districts was lesser than the recommended rates and according to farmers' discussions it had resulted in lower yields. Further, farmers in Gampaha district applied Muriate of Potash (MOP) above the recommended levels.



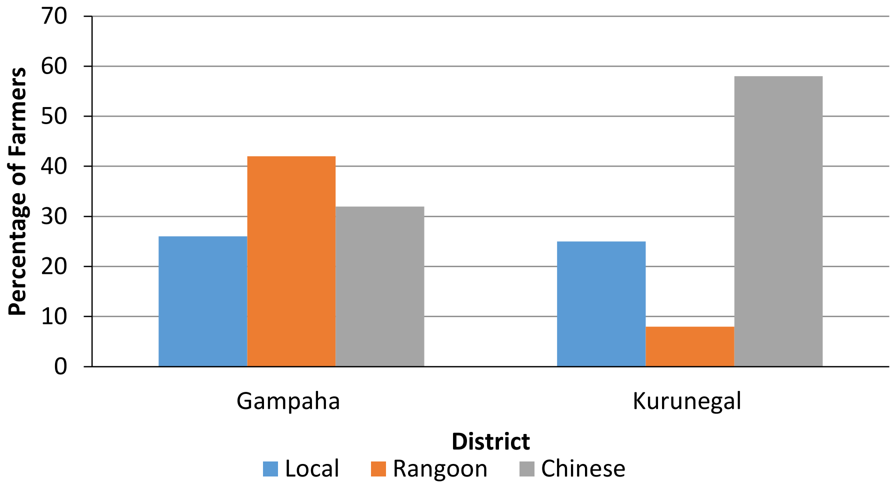
Source: HARTI Survey Data, 2016.

Figure 18.11: Use of Fertilizer in Each District

They had used paddy husk, fire wood ash, cow dung, poultry manure and coir dust as organic fertilizer. Applying organic manure was more popular among the small scale farmers whereas few large scale farmers having more than five acres had brought cow dung from other areas to apply for their fields. Nearly 20-30 percent of the farmers were aware of the importance of application of organic manure in soil fertility management. In fact, it was not much practiced due to unavailability of raw materials, they also have understood importance of the application of Gliricidia to control of diseases and improve soil fertility.

18.3.5 Seed

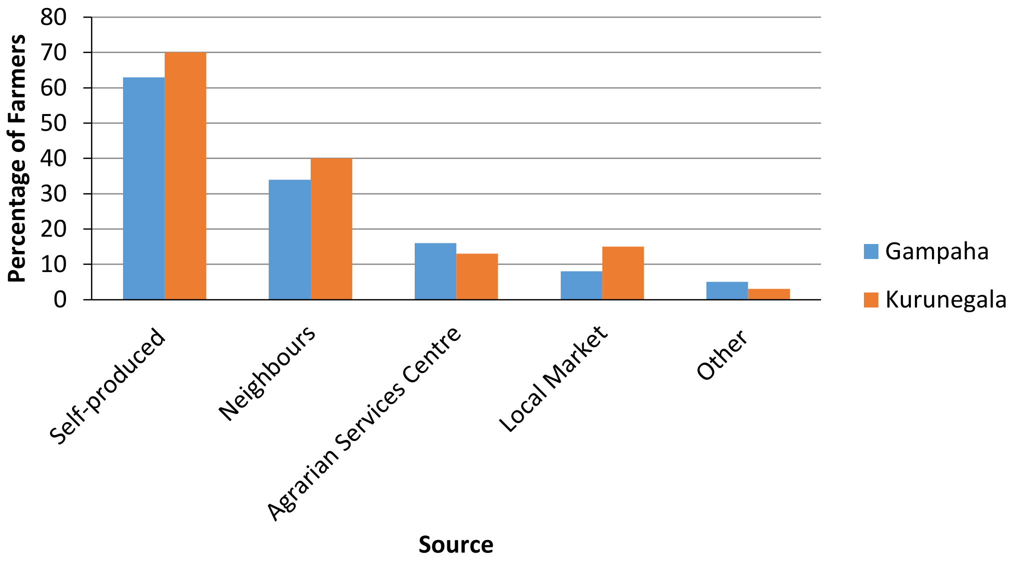
Local Sinhala variety, Rangoon and Chinese varieties were commonly used planting ginger varieties in Sri Lanka (Figure 18.12). The Chinese variety had used by 58 percent sample farmers in Kurunegala, whereas in Gampaha all the varieties were found to be used. Most prominent was the Chinese variety (used by 45% of the sample) due to its high yielding capacity (18-20 tones/ha) and high income gained.



Source: HARTI Survey Data, 2016.

Figure 18.12: Different Types of Ginger Seed Varieties

Usage of self-produced seeds predominated in the total sample irrespective of the district. However, majority of the farmers (78%) were not satisfied with the quality of self-produced seeds due to low yield (continuous use of self-produced seeds for generations has been practiced). Further, 22 percent of the farmers had received seeds from the extension officer of the DEA and others had obtained them at the local market irrespective of the scale of operation.



Source: HARTI Survey Data, 2016.

Figure 18.13: Sources of Ginger Seeds

DEA recommends 1500-2000 kg of planting materials for one hectare of land. However, 88 percent to the farmers in Gampaha district and 98 percent in Kurunegala district had used less than the recommended rate and it would be one of the reasons for low production, as revealed through the focus group discussions.

18.3.6 Machinery

Four wheel tractors were the mainly used type of machinery for land preparation. Further, in some instances excavating machines (JCB) were used for land preparation including soil beds. In most of the cases manual land preparation was being done. According to the farmers, usage of the excavating machines was easier and more profitable than using the four-wheel tractor. Finding the required machinery during the cultivation season was a common problem faced by the farmers in all districts. Moreover, the cost incurred in hiring the machines was reported as high.

18.3.7 Use of Improved Technologies

Soil sterilization is a must to be done for prospective ginger cultivation. Initially soil bed needs to be wet and covered with polythene for 15-20 days to avoid soil being exposed to sunlight. The process of sterilization had been practiced only by 24 percent of the farmers of the sample. Unawareness of the length of sterilization period (farmers had different opinions) indicated the need for the farmers to be nourished with the required knowledge.

Seed treatment is another technique in ginger cultivation and dipping cut rhizomes in a fungicide (Captan, Thiram etc) is done as a measure of controlling fungi. However, the majority of the farmers were not familiar with this process and some stated that it leads to dying of seeds. Hence, extension programmes should be conducted to make the farmers aware this essential process.

18.3.8 Cost of Ginger Production

The cost of cultivation of ginger in the two study districts were calculated under three cost items; labour, machinery, inputs and food (Table 18.4). Labour cost was calculated based on the activities such as land preparation, bed preparation and digging holes, seed treatment and planting, mulching, application of organic manure, chemical fertilization, weed control, earthen-up, pesticide application, harvesting, processing and transportation of the harvest.

Table 18.4: Cost of Production per acre of Ginger Cultivation -2014/2015 *Maha* Season

Category	Gampaha (Rs.)	Kurunegala (Rs.)	Total Average (Rs.)	As % of Total Cost
Labour cost	22147	46591	34369	35
Machinery cost	7325	10736	8851	9
Inputs	45454	51145	48300	50
Other cost	6750	2750	4750	6
Total cost (including family labour)	**81676**	**111222**	**96449**	**100**
Total cost(excluding family labour)	**73053**	**103386**	**89220**	

Source: HARTI Survey Data, 2016.

In Gampaha district input cost accounted for 56 percent of the production cost and in Kurunegala it was 46 percent. In general, 85 percent of the total cost of production represents labour and input cost. DEA data reveals that 6000 kg/ac yield can be harvested, if proper inputs and management practices are employed. However, the sample data records a range between 1500-3000kg of output per acre. Thus, the farmers actually obtained a ratio of 1:5 against the estimated ratio of 1:12 by the DEA.

The cost of production of ginger with imputed cost of labour ranged between Rs. 37-54/kg (Table 18.4). Low price and fluctuation of price and low yield were major constraints in popularizing ginger cultivation. So that, it is of paramount importance to identify which factors contributed to reduce the price and yield in ginger cultivation.

Table 18.5: Price of Ginger -2014/2015 *Maha* Season

Item	Gampaha (Rs.)	Kurunegala (Rs.)	Total Average(Rs.)
Average yield/ac	1512	2987	2250
Selling price/kg*	110-300	40-200	40-300
Total income/ac	229824	218051	223937
Unit price/kg (including family labour)	54	37	46
Unit price/kg excluding family labour)	48	35	42

* During the time of data collection there was very low price for ginger
Source: HARTI Survey Data, 2016.

18.3.9 Ginger Marketing Structure Prevailed in the Study Area

Ginger has been sold as fresh and dried ginger and organic ginger production was done by few farmers. Ginger is used for value added products such as biscuits, *dosi*[4], and cake. Price of ginger is determined mainly by the middleman. Producers had less or little knowledge on value addition and mostly fresh ginger is sold to the market.

Key Intermediaries in ginger marketing channels identified were;

- Village level collectors
- Traders coming from distant places
- Market nearby the village
- Collectors in the city
- Regional wholesale traders (Dambulla dedicated economic center/Manning market Colombo)
- Value adding private companies
- As seeds for farmers
- Organic ginger collector (Eg: PODI in Minuwangoda)

Many reasons influenced the farmers' choice of the marketing channel. High prices, close proximity, indebtedness to particular traders, need for obtaining credit facilities, being the only market available, collectors visiting home is convenient and no need

[4] This is local sweet item

for transport and being the conventional marketing channel were prominent reasons for this situation. Knowledge of the farmers about the market structure and marketing channels including export markets is limited due to the dominance of the conventional marketing channels.

18.4 Potentials and Constraints for Ginger Cultivation

Potentials

- DEA executes a subsidy programme for the promotion of ginger cultivation by providing planting materials at a rate of Rs. 60/kg up to 625 kg of seeds. The main drawback of the subsidy programme is reported as the delay in providing cash to purchase seeds for timely establishment of the crop. It was observed that some farmers had received the subsidy even after they obtained the harvest.
- Having traditional knowledge and experience would be much useful to improve both production and productivity of ginger.
- A huge potential rests with the production expansion due to favourable climatic conditions and presence of flat/slightly undulating lands in large coconut estates possible for inter-cropping.
- Involvement of the state sector extension personnel including Extension Officer of the DEA, Agriculture Instructor of the Department of Agriculture and Agricultural Research and Production Assistant (Krupanisa) at the grass roots level are among the institutional incentives for promoting ginger cultivation. This would help enhancing the application of proper management and cultural practices such as adhering to recommendations, use of high quality planting material and seed treatment methods, mulching and using organic manure by the farmers to tackle the production and productivity related issues.

Constraints

- Absence of a market information system is one of the major constraints. The number of value adders and exporters were very few among the growers and the middleman exploited the situation and went for a huge share.
- Large variation in price was another reason for restraining ginger cultivation. Further, during the time of data collection very low price for ginger prevailed and farmers were reluctant to harvest ginger since they wouldn’t be able to cover up even the cost of labour spent for harvesting (Prevailing price was Rs. 40/kg whereas at least Rs. 100 was required to bear up cost of production and gain a profit).
- High intensity of fungal attacks
- High proportion of the ginger demand was met by imports due to comparative advantage
- Lack of knowledge for producing dried ginger

18.5 Recommendations and Suggestions

To improve the production and the productivity

- Encouraging farmers to use organic fertilizers to minimize chemical fertilization to reduce the cost of production**.**
- Solve the problems relating to unavailability of high quality seeds and make farmers aware of fungal attack in ginger cultivation.
- Dissemination of available knowledge which did not reach farmers through proper management of the agricultural extension service.

To make the marketing structure more effective

- Have a fixed price and limit the dried ginger importation
- Design and implementation of a production and marketing strategy for ginger at Agrarian Service Centre (ASC) level to cater to the local and export demands.
- Identification of local entrepreneurs and encouraging them to produce for local and export markets through providing incentives, other concessions, and allowing fair grace periods in replaying loans etc.
- Encourage exporters of ginger and related products and provide them with certain tax concessions and training new comers to enter this business.

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Chapter Nineteen

Up Country Vegetables

P.A.J. Champika

SUMMARY

In this chapter major focus was given to six up country vegetables, which were selected for the baseline survey, carrot, leaks, cabbage, beetroot, capsicum and beans. Even though farming of upcountry vegetables is more popular in upcountry wet and intermediate zones, some varieties of certain types can be grown in mid country wet and intermediate zones as well as in low country dry zone.

Of the percentage share of Cost of Production (COP), labour cost is marked approximately one third, ranging from 33 percent to 44 percent. The highest share was reported for beetroot cultivation with the value of 44 percent while the lowest share was reported for capsicum with 33 percent. Family labour has been widely used by the farmers who cultivate less than one acre of land whereas large scale commercial farmers mainly depend on hired labour.

Inability of selling the produce at a reasonable farm-gate price, especially during the harvesting season was the main obstacle confronted by the farmers, followed by lack of marketing centers at rural level and exploitation by the middle - men.

One of the other major concerns of farmers was issues related to frequent changes in fertilizer policies. Changes of the fertilizer policies are creating irregularities to the market supply and those issues will be lead to make problems in the availability of fertilizer in rural markets. Low availability of domestic certified vegetable seeds, quality issues related to hybrid seeds, high pest and disease susceptibility of imported hybrid varieties were the main concerns of the farmers in selected area.

To minimize the intervention of middlemen there is a possibility of introducing good market linkages with the large scale buyers by establishing forward trade agreements or either buy-back system. Farmers have been widely fulfilled their water requirement using minor irrigation systems as their main source of water for agriculture. Regular maintenance of small scale irrigation systems within the villages to increase the water storage capacity and renovation of bunds and canals to maximize water distribution is also a pressing need.

CHAPTER NINETEEN

Up Country Vegetables

19.1 Overview of Up Country Vegetables

19.1.1 Introduction

Vegetables grown in Sri Lanka are broadly divided into two groups, such as upcountry vegetables and low country vegetables, based on the agro - ecological adaptability. The upcountry vegetables (the vegetables, which are mostly grown in agro - ecological zones[5] such as upcountry wet zone, upcountry intermediate zone, mid country wet and intermediate zones) constitute, beans (*Phaseolus vulgaris)*, carrot (*Daucus carota*), leeks (*Allium ampeloprasum var.porrum*), cabbage *(Brassica oleracea)*, beetroot (*Beta vulgaris*), raddish (*Raphanus sativusvar. longipinnatus*), capsicum (*Capsicum annum)* and knolkhol (*Brassica caulorapa*) (Department of Agriculture, 2017). In the central highlands, upcountry vegetables are grown with high cropping intensity all year-round, as upcountry wet and intermediate zones receive ample amount of rainfall from both North Eastern and South Western monsoons.

However, in this chapter, major focus is given to six vegetables, which were selected for the baseline survey, carrot, leaks, cabbage, beetroot, capsicum and beans. Even though farming of upcountry vegetables is more popular in upcountry wet and intermediate zones, some varieties of certain types can be grown in mid country wet and intermediate zones as well as in low country dry zone. Recommended varieties for each agro ecological zones are described in the Table 19.1

Table 19.1: Recommended Varieties of Selected Up Country Vegetables

Up Country Vegetable Type	Recommended Varieties	
	Upcountry	Mid and Low country
Carrot	Cape Market Top Weight	Cape Market, Nantes Half Long
Leeks	Large Long Summer	N.A
Cabbage	Green Coronet, Gloria F1, Hercules	Exotic F1
Beetroot	Crimson Globe	Detroit Dark Red
Capsicum	Hungarian Yellow Wax (HYW)	C.A. - 8
Beans	Bush beans –Wade, Top crop Pole beans- Kentucky Wonder Green, Kentucky Wonder Wax, Pees Butter, Katugastota, Lanka Nill	Bush beans –Wade, Top crop Pole beans- Kentucky Wonder Green, Kentucky Wonder Wax, Pees Butter, Katugastota, Lanka Nill

Source: Department of Agriculture, 2017

19.1.2 Major Growing Areas and Extent under Cultivation

[5] An Agro-ecological Zone is a land resource mapping unit, defined in terms of climate, landform and soils, and/or land cover, and having a specific range of potentials and constraints for land use. (FAO, 2017)

Similar to seasonal crops such as paddy, vegetable cultivation is also practiced in two seasons, the *Maha* and the *Yala.* However, demarcation of the seasons for vegetables is not as clear as for paddy or other field crops, as shorter crop durations allow cultivation of 1-4 rotations within the same field during one season, under favourable weather conditions. If the normal weather condition prevailed, *Maha* cultivation for both up and low country vegetables commences in early October to mid-November, with the North Eastern monsoonal rains. In upcountry and mid country areas, the *Maha* vegetable cultivation is mainly practiced on highlands hence, this season is known as *'kandukannaya'* (cultivated in highlands). As supply of irrigation is difficult in hilly areas, land preparation and establishment of seedlings are generally practiced after receiving monsoonal rains. Therefore, if the rain is delayed, commencement of the season is delayed accordingly, on highlands. Under normal circumstances, the supply of *Maha* production starts to reach the market from mid-January and continue still the last week of March. If inter-monsoonal rain continues in March and April, 3rd and 4th cycles of crops are practiced immediately by up-rooting the earlier establishments.

As described in Table 19.2, considering past five consecutive seasons, Nuwara Eliya, Badulla, Kandy and Matale districts accounted for 70 percent of the *Maha* seasons' upcountry vegetable cultivation and 74 percent of the *Yala* seasons' cultivation, on an average. Three mid country districts, namely Badulla, Kandy and Matale accounted for 40 percent of *Maha* season's cultivation and 38 percent of the *Yala* seasons' upcountry vegetable cultivation on average. (Department of Census and Statistics, 2010-2013)

Table 19.2: Major Districts for Up Country Vegetable Cultivation in Five (2010/11 *Maha* to 2012/2013 *Maha*) Consecutive Seasons.

Season	Total Extent (As at the end of the season) (ha)	Nuwara Eliya (%)	Badulla (%)	Kandy (%)	Matale (%)	Other Districts (%)
2010/11 - *Maha*	15,852	31.2	28.3	10.4	4.3	25.8
2011 - *Yala*	16,248	35.0	21.0	9.9	7.9	26.2
2011/12 - *Maha*	17,534	30.8	25.7	8.6	4.6	30.3
2012 – *Yala*	14,454	38.1	19.3	10.2	6.8	25.6
2012/2013 - *Maha*	16,942	28.0	23.0	11.2	4.0	33.8

Source: Champika, 2016

19.1.3 Climate and Soil

For selected upcountry vegetables, the most suitable climate and soil combinations for a flourishing crop are described in Table 19.3. Most of the upcountry vegetables can successfully be grown across all the agro climatic zones except leeks. Leeks recommended only for upcountry wet and intermediate zones, as it prefers cool climate.

Table 19.3: Suitable Climate and Soil

Up Country Vegetable Type	Recommended Varieties	
	Climate	Soil
Carrot	In all agro-ecological regions of the country	Well-drained soils with the pH range 6.0 - 6.8
Leeks	Up country wet and intermediate zones	Organic matter rich soils with the pH range 6.0 - 6.8
Cabbage	Between $15^{o}C$ - $20^{o}C$ temperature, above 800 m altitude	Well-drained soils with the pH range 6.0 - 7.0
Beetroot	In all agro-ecological regions of the country	Well-drained soils are suitable with the pH range 6.3 - 7.5
Capsicum	In all agro-ecological regions up to an elevation of 1500 m	Loamy well-drained soils with pH range of 5.5 - 6.8 are preferred.
Beans	Both bush beans and pole beans can be grown in all agro-ecological regions, except up-country wet zone.	Well-drained soils are suitable preferably with pH 6

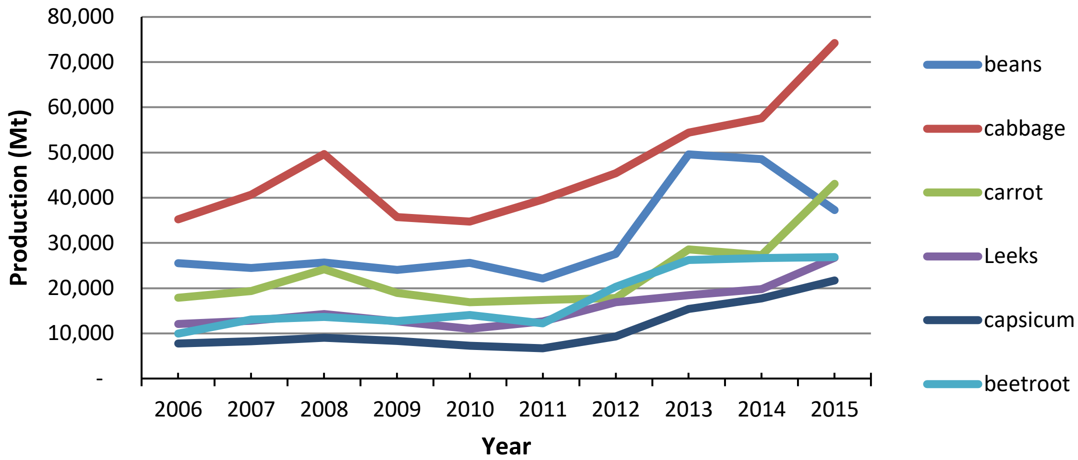
Source: Department of Agriculture, 2017

19.1.4 Importance of the Crop to the Economy

19.1.4.1 Production

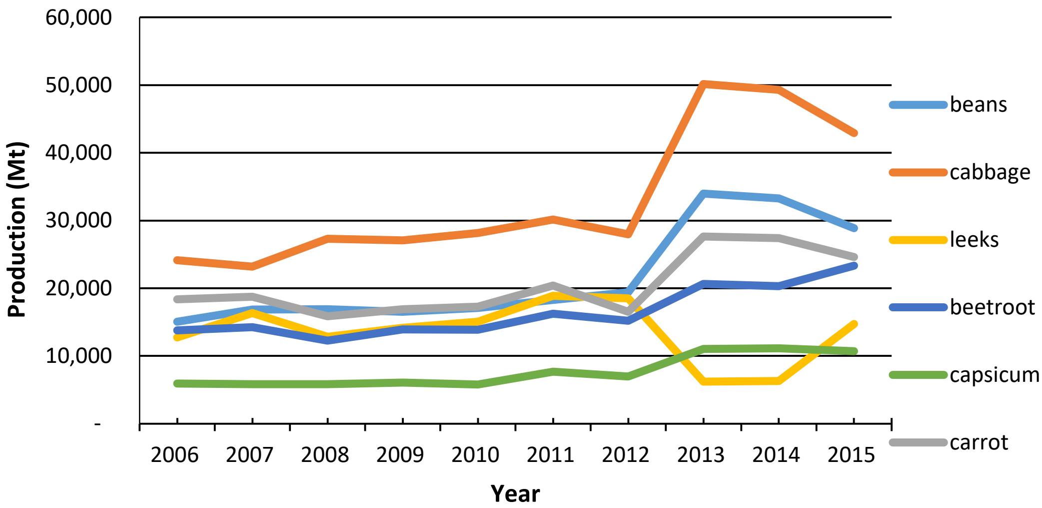
Variation in total production of upcountry vegetables during the period of 2006 - 2015 in the *Maha* (Figure 19.1) and the *Yala* (Figure 19.2) seasons are depicted below.

When comparing the trend in mean *Maha* seasons' cultivated extent with, mean *Yala* seasons cultivation extent of the upcountry vegetables over the last ten years, it was evident that the *Yala* seasons' extent had increased in high margin, compared with that of *Maha* season' due to popularization of hybrid seed varieties, which are relatively less susceptible to variations in the weather pattern common in the *Yala* season.



Source: Department of Census and Statistics (2006-2015)

Figure 19.1: Variation in Total Production - *Maha* Seasons



Source: Department of Census and Statistics (2006 - 2015)

Figure 19.2: Variation in Total Production - *Yala* Seasons

Accordingly, comparing the three year mean *Maha* seasons' production of upcountry vegetables (for the year 2006, 2007 and 2008, which were the early years of considered ten years period) with the three year mean value for latter three years of 2013, 2014 and 2015 period, a considerable increase in production (85,536 mt) was noted for all the upcountry vegetable types considered in the study. The same figure recorded a 55, 405 mt increase, with regard to the *Yala* seasons' production.

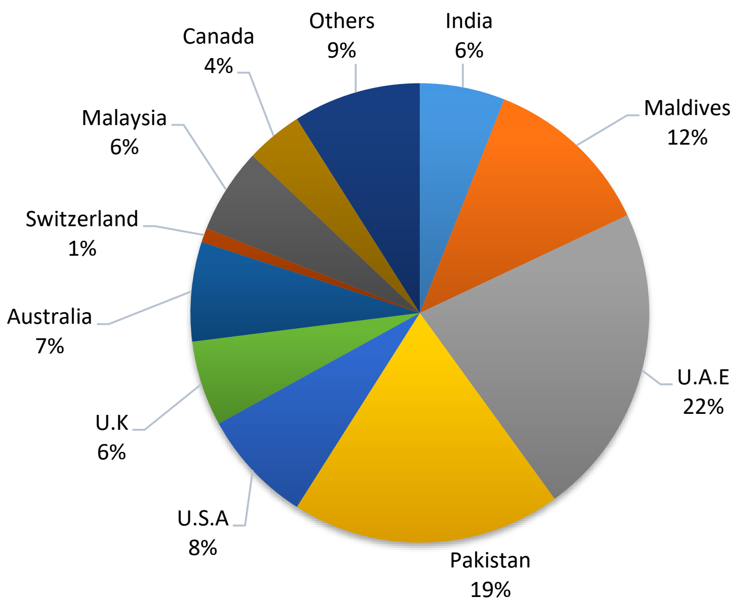
19.1.4.2 Exports

Contribution of agricultural exports to the total export earnings in 2013 and 2014 was 23 percent and 24 percent respectively (Export Development Board, 2013). However, contribution of vegetable export to the agricultural export earnings remained less than one percent, (Table 19.4). There was an increase in real value of vegetable export from Rs. 7 million to Rs. 15million (inflation adjusted) during 1990-2012 (Central Bank of Sri Lanka, 2013). However, export of processed vegetables decreased up to Rs. 5 million in 2012, from Rs. 13 million reported in 1990, mainly due to the collapse of the gherkin forward contract. As at 2014 major export destinations of Sri Lankan vegetables were U.A.E with 22 percent contribution followed by Maldives as 12 percent and Pakistan as 19 percent (Figure 19.3).

Table 19.4: Vegetable Export Data (Fresh and Chilled)

Year	Quantity Exported (mt)	Income (USD million)
2010	13,539	16
2011	13,062	19
2012	11,138	15
2013	15, 627	20
2014	20, 223	25

Source: Export Development Board, 2014



Source: Export Development Board, 2014

Figure 19.3: Major Export Destinations of Vegetables

19.1.4.3 Price Variation

During Maha season peak harvesting period (generally in February), daily supply of 2,500 mt – 3,500 Mt of vegetables of which 40 percent and 60 percent from upcountry and low country varieties are respectively, received to the Dambulla Dedicated Economic Centre (DEC). In the peak supply period, average wholesale prices of upcountry vegetables usually drop by 30-35 percent compared to the annual average price, while the observed price drops for low country varieties are generally in the range of 30-40 percent (HARTI data bank, 2012 - 2014). Vegetable supply gradually decreases to 1,000 mt – 1,200 mt at DEC, by at the end of April, and subsequently, prices mark an upward trend. Establishment of *Yala* crops begins with the South West monsoon rain in May, while wholesale prices of vegetables raise its peak in mid-June to mid-July, just before the *Yala* harvest reaches the market. As the lean season for vegetables reaches its peak, supply drops, hence average prices increase by around 35 percent and 25-35 percent for upcountry and low country vegetables respectively, compared to the annual average. The price increases observed in the lean period confined to 25-35 percent margin due to inter-seasonal cultivation in mid-March to mid-April period. If an extreme weather condition, such as drought or flood prevents the inter-seasonal cultivation of vegetables, average monthly prices would generally rise by more than 50 percent of the annual average (HARTI, 2012-2014).

With receiving of peak *Yala* supply to the market in August-September, prices drop by around 20-30 percent for both upcountry and low country varieties. Peak of the second lean season is observed in mid-November to mid-January in which the margin of price increases is determined by the intensity of the inter-seasonal cultivation, which is generally practiced during mid-September to mid-October.

Seasonal price variation can be determined by the price index, computing the monthly average wholesale prices into 3-year (2014-2016) average price as indicated Table 19.5. If the calculated seasonal index for a particular month records the value of hundred, it indicates that the monthly wholesale price recorded in that month is equal to the three-year annual average price of the considered period (Table 19.6). As the table shows, wholesale price indices for upcountry vegetables reached the lowest in February to April and August to October when peak *Maha* and *Yala* harvest respectively reached the market, whereas, the highest seasonal price indices were recorded from December to January and May to July on the off peak seasons for vegetables.

Table 19.5: Seasonal Price Indices of Selected Upcountry Vegetables (2014-2016) - Wholesale

Month	Beans	Carrot	Leeks	Beetroot	Cabbage	Capsicum
January	114.0	143.9	142.7	178.9	128.7	157.6
February	91.1	106.9	111.5	91.5	108.5	108.6
March	68.5	68.6	83.2	64.2	64.9	79.1
April	73.4	73.1	77.8	65.3	56.9	63.0
May	107.7	92.1	105.8	98.2	83.0	70.8
June	109.9	156.6	125.8	137.4	147.5	117.5
July	96.6	111.6	83.2	128.6	130.1	138.4
August	70.6	65.0	60.3	67.3	103.0	65.3
September	81.4	55.1	72.1	57.5	73.5	46.6
October	115.9	67.4	87.6	64.4	71.5	74.6
November	129.1	114.4	111.7	93.6	103.6	119.6
December	141.8	145.3	138.1	153.0	129.1	158.9
Three year average (Rs/Kg)	**123.7**	**105.3**	**81.3**	**76.8**	**53.3**	**155.3**

Source: HARTI, 2014 - 2016

Table 19.6: Three-year Average Prices (Rs/kg) (2014-2016) – Wholesale

Month	Beans	Carrot	Leeks	Beetroot	Cabbage	Capsicum
January	141	151.6	116	137.4	68.6	244.8
February	112.7	112.7	90.7	70.3	57.8	168.7
March	84.8	72.3	67.7	49.3	34.6	122.9
April	90.8	77	63.2	50.2	30.3	97.8
May	133.2	97	86	75.5	44.2	110
June	136	164.9	102.2	105.5	78.6	182.5
July	119.6	117.5	67.6	98.8	69.3	214.9
August	87.4	68.5	49	51.7	54.9	101.4
September	100.7	58	58.6	44.2	39.2	72.4
October	143.4	71	71.2	49.4	38.1	115.8
November	159.7	120.5	90.8	71.9	55.2	185.8
December	175.4	153	112.3	117.5	68.8	246.7

Source: HARTI, 2014 - 2016

19.1.4.4 Per Capita Consumption

As Household Income and Expenditure Survey 2012/13 indicate, (Table 19.7) average monthly per capita consumption of upcountry vegetables is recorded as 865.66 g while the average expenditure was Rs. 104.60. When it is converted to daily values, average daily consumption was only 29 grams, which is very much below than the recommended level. According to the USDA 2010, the recommended vegetable intake per person per day should be at least two times of 0.5 cups (200ml) per day (200g of fresh weight equivalent). As per the food based dietary guideline for Sri Lankans, at least 9 tablespoons of cooked vegetables or 3 cups of raw vegetable salads a day is required for a person. However, the per capita intake of vegetables (leafy vegetables + other types of vegetables) by a Sri Lankan was around 111.6/g per day, by 2012.

Table 19.7: Per Capita Consumption of Selected Up Country Vegetables

Up Country Vegetable	Consumption (g)/Month	Expenditure (Rs.)
Beans	325.63	40.77
Carrot	139.22	18.72
Beetroot	107.73	12.18
Cabbage	158.49	15.21
Capsicum	49.10	7.31
Leeks	85.49	10.41
Total	865.66	104.6

Source: Department of Census and Statistics, (2012/13)

19.1.4.5 Marketing

Marketing channel is the process of selling of different vegetables at different stages. Because of the very short shelf life and the perishable nature, these items require proper transportation, handling and storage facilities, so that they are available to the customer in a fresh state.

Before introducing the concept of the DECs, the main Wholesale Centre Colombo – Manning market managed the entire vegetable and fruit harvest distribution throughout the country. With the establishment of regional DECs, the importance of the Manning Market as the sole wholesale center shrunk considerably. At present, 12 dedicated economic centers scattered over the Sri Lanka act as main wholesale markets, namely; Thambuththegama, Nuwara Eliya, Keppetipola, Kurunduwaththa, Welisara, Veyangoda, Narahenpita, Embilipitiya, Meegoda, Piliyandala, Dambulla and Rathmalana. However, still the Manning market in Colombo acts as the wholesale market for vegetables to Colombo and suburbs.

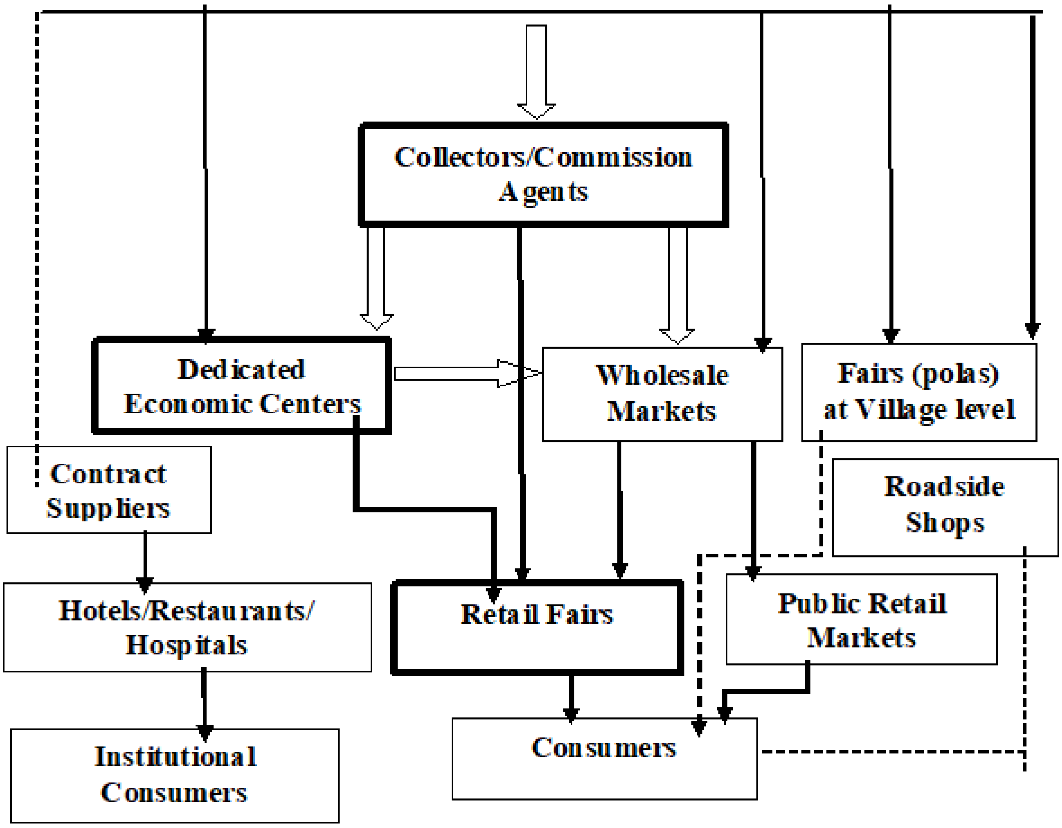
The Figure 19.4 illustrates the main conventional marketing channels, indicating how vegetables move from producer to end consumer. The bulk of the marketing is carried out by the commission agents (operate in both DECs and other Wholesale markets) and large traders of the private sector. The chain of intermediaries begins with the village level collecting agents and the most usual marketing channel is the farmer-assembler-wholesaler-retailer-consumer systems.

However, the flow follows different channels depending on the distance of the market to the producing area involving more intermediaries. Temperate vegetables, which are mainly grown in the mountain areas, are sent directly by the framers to the commission agents in the Manning market Colombo through organized transporters. Meanwhile, the collectors purchase tropical vegetables from the farmers at weekly fairs (*pola*) and send them to the same market. Wholesaling facilitates the economic function of buying and selling by allowing the forces of supply and demand to converge and establish a single price for a commodity. The people involved in wholesaling can be either merchants, buying and selling produce, be brokers dealing in orders rather than goods, be commission agents acting for the producers or be export/import agents, only dealing in foreign trade.

About 50 percent of the vegetables in the country are sold via DECs. Generally, the farmers sell their vegetables to the vegetable collectors or send supplies to the commission agents at the DECs through transporting agents. Most of the farmers in main producing areas bring their vegetables directly to the DECs. The commission agents tend to quote a price to the farmers which are lower than the price for which the vegetables were actually sold at the wholesale market. Thus, the commission agents are known to take undue advantage of the farmers.

The other emerging channel for vegetable supply is the supermarket supply chains. Even though it controls only about five percent of the total vegetable supply of the country at present, it differs substantially from the traditional marketing channels for vegetables, as it’s highly focus on the quality of the produce.

In the conventional vegetable supply chains there is no attention to the quality of the produce by any participants in the chain. In the traditional vegetable supply chains, quality signals are not being passed down to the farmers. The farmers are paid by the weight and they are not given a premium price for quality. Thus, their main focus is to increase the weight. This has in turn led to some farmers engaging in certain malpractices such as putting stones and inferior quality vegetables in the middle of the sacks of vegetables (Hettige and Senanayake, 1992; Rupasena *et al*., 2001; Perera *et al*., 2004).



Source: Priyadharshana *et al*, 2008

Figure 19.4: Conventional Marketing Channels of Vegetables

19.2 Socio-Economic Characteristics of the Sample Farmers

19.2.1 Demographic Information of the Farmer Households

19.2.1.1 Family Size

As it is shown in the Table 19.8, the farmers who grow beans and capsicum had much smaller families (highest proportion of respective samples had three members) compared to that of farmers who grow carrot and leeks, which reported five member families in 33 percent of each sample. On the other hand, highest proportion of the farmers who grow carrot and beetroot had four member families. According to the Department of Census and Statistics 2016, average family size of Sri Lanka is 3.8 Therefore, it seemed that carrot, leeks farmers had larger families compared to that of national average while the rest of the upcountry vegetable farmers had much smaller families compared to that of national average.

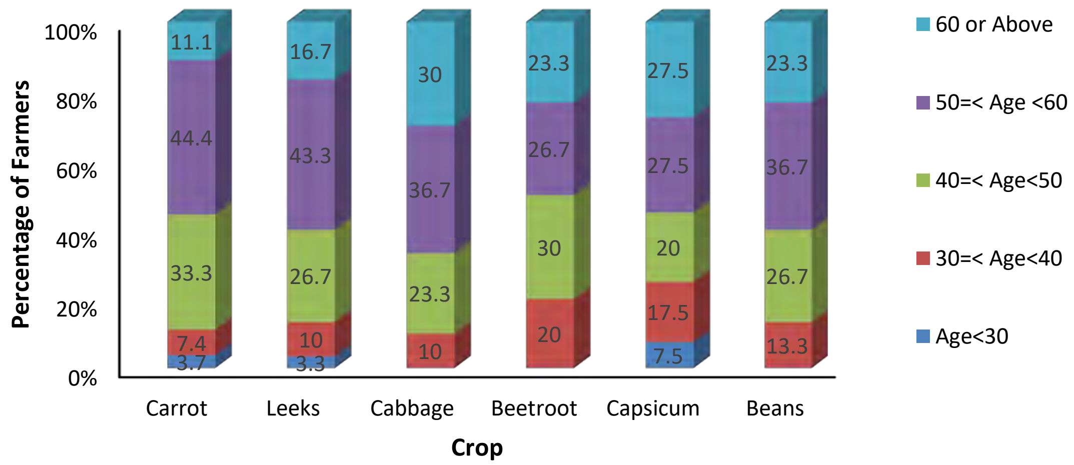
Table 19.8: Family Size of the Up Country Vegetable Growers

Number of Family Members	Up Country Vegetable Variety					
	Carrot (%)	Leeks (%)	Cabbage (%)	Beetroot (%)	Capsicum (%)	Beans (%)
1	0.0	0.0	0.0	0.0	0.0	3.3
2	11.1	6.7	16.7	16.7	5.0	16.7
3	7.4	16.7	6.7	6.7	30.0	30.0
4	29.6	26.7	36.7	36.7	22.5	23.3
5	33.3	33.3	16.7	16.7	25.0	23.3
6	11.1	10.0	16.7	16.7	12.5	3.3
7	3.7	6.7	3.3	3.3	5.0	0.0
8	3.7	0.0	0.0	3.3	0.0	0.0
9	0.0	0.0	3.3	0.0	0.0	0.0
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: HARTI Survey Data, 2016

19.2.1.2 Age Categories

As it is depicted in 19.5, the highest proportion of the farmers who cultivate carrot, leeks, cabbage, capsicum and beans belonged to 50 to 60 years' category. However, farmers who cultivate beetroot had much younger age structure as the highest proportion of them falls in to 40 to 50 years' age category.

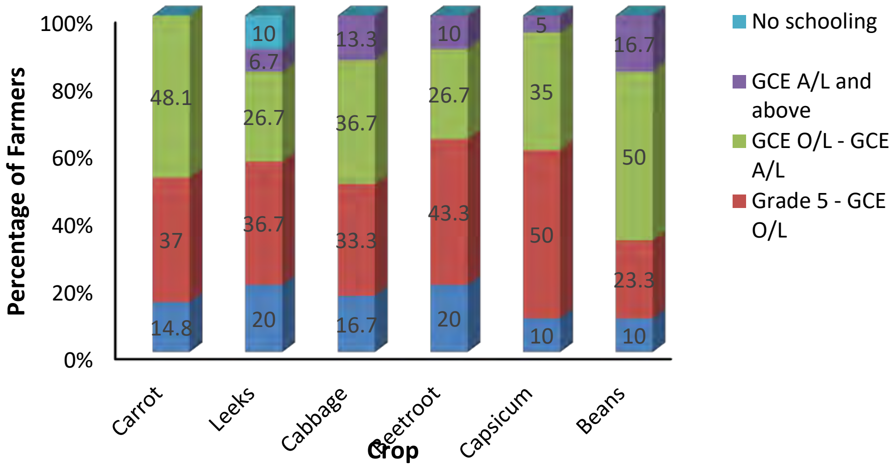


Source: HARTI Survey Data, 2016

Figure 19.5: Age Categories of the Up Country Vegetable Growers

19.2.1.3 Level of Education

Except in the case of the leeks farmers, almost all the other upcountry vegetable farmers had access to formal education (Figure 19.6). As leeks is confined to upper elevations of the Nuwara Eliya and Badulla districts, where estate population is predominant, their low access to formal education compared to other segments of the society is reflected in this sample. On the other hand, highest proportion of the farmers who grow carrot, beans and cabbage belonged to the category of above GCE O/L while the highest proportion of the farmers who grow leeks, beetroot and capsicum belonged to the category of above grade 5 level of education.



Source: HARTI Survey Data, 2016

Figure 19.6: Level of Education of the Up Country Vegetable Farmers

19.2.1.4 Primary and Secondary Sources of Income

Vast majority of the heads of the households in all the selected categories, were either farmers or engaged in animal husbandry by occupation and considered farming or animal husbandry as the main income source (Table 19.9). Other forms of main income sources of the upcountry vegetable farmers were government jobs, private sector jobs, self-employment and working as skilled labourers.

Table 19.9: Income Source of the Head of the Household

Income source of the head of the household	Up Country Vegetable Variety					
	Carrot (%)	Leeks (%)	Cabbage (%)	Beetroot (%)	Capsicum (%)	Beans (%)
Farming/animal husbandry	92.6	70.0	80.0	80.0	87.5	80.0
Government job	0.0	6.7	10.0	3.3	7.5	16.7
Private sector job	3.7	3.3	3.3	6.7	0.0	0.0

Self-employment	0.0	6.7	0.0	3.3	0.0	0.0
Skilled labour	0.0	3.3	3.3	0.0	0.0	0.0
Other	3.7	10.0	3.3	6.7	5.0	3.3
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: HARTI Survey Data, 2016

19.3 Agriculture Inputs

19.3.1 Land

Of the sample, holding size of carrot and leeks were smaller than that of cabbage, beetroot, capsicum and beans, where high proportion of the farmers who grow carrot and leeks belonged to the category of holding size 0.5 – 1 acres, while high proportion of the rest of the farmers belonged to the category of holding size of more than one acre (Table 19.10). Especially, cultural practices of leeks were regarded as labour intensive (COC per acre = Rs.235, 604.80 in Nuwara Eliya district), and therefore smaller land extents facilitated the efficient use of family labour. On the other hand, in Puttalam district, larger holding sizes (2- 5 acres) were observed as they have adopted mechanized farming, using sprinkler and drip irrigation.

As it is described in Table 19.11 and 19.12, of both upland and low land holdings, majority of farmers in each category had single owned lands with clear land titles.

Table 19.10: Land Extent of the Up Country Vegetable Cultivations

	Land Extent	Badulla (%)	Nuwara Eliya (%)	Matale (%)	Puttalam (%)
Carrot	ext<0.25	-	-	-	-
	0.25<=ext<0.5	6.7	8.3	-	-
	0.5<=ext<1	40.0	41.7	-	-
	1<=ext<2	46.7	16.7	-	-
	2<=ext<5	-	33.3	-	-
	ext>=5	6.7	-	-	-
Leeks	ext<0.25	6.7	-		-
	0.25<=ext<0.5	6.7	13.3	-	-
	0.5<=ext<1	53.3	33.3	-	-
	1<=ext<2	33.3	26.7	-	-
	2<=ext<5	-	13.3	-	-
	ext>=5	-	13.3	-	-

Cabbage	ext<0.25	-	13.3	-	-
	0.25<=ext<0.5	-	13.3	-	-
	0.5<=ext<1	26.7	46.7	-	-
	1<=ext<2	53.3	26.7	-	-
	2<=ext<5	20.0	-	-	-
	ext>=5	-	-	-	-
Beetroot	ext<0.25	13.3	13.3	-	-
	0.25<=ext<0.5	40.0	13.3	-	-
	0.5<=ext<1	40.0	40.0	-	-
	1<=ext<2	6.7	20.0	-	-
	2<=ext<5	-	13.3	-	-
	ext>=5	-	-	-	-
Capsicum	ext<0.25	-	-	-	-
	0.25<=ext<0.5	-	-	-	-
	0.5<=ext<1	-	-	35.0	-
	1<=ext<2	-	-	40.0	-
	2<=ext<5	-	-	15.0	60.0
	ext>=5	-	-	10.0	40.0
Beans	ext<0.25	-	-	-	-
	0.25<=ext<0.5	-	6.7	-	-
	0.5<=ext<1	13.3	6.7	-	-
	1<=ext<2	33.3	13.3	-	-
	2<=ext<5	53.3	66.7	-	-
	ext>=5	-	6.7	-	-

Source: HARTI Survey Data, 2016

Table 19.11: Distribution of Upland Holdings by Ownership

Ownership Status	Distribution of Upland Holdings by Ownership					
	Carrot (%)	Leeks (%)	Cabbage (%)	Beetroot (%)	Capsicum (%)	Beans (%)
Single owner	64.3	68.8	79.2	75.0	54.3	65.4
Jointly owned	10.7	12.5	0.0	3.6	5.7	15.4
Leased in	7.1	15.6	16.7	17.9	25.7	7.7
Tenancy-in	0.0	0.0	4.2	0.0	0.0	0.0
Tenancy-out	0.0	0.0	0.0	0.0	2.9	0.0
Permit holder	7.1	3.1	0.0	0.0	0.0	3.8
Encroached	0.0	0.0	0.0	0.0	2.9	0.0
Mortgaged	10.7	0.0	0.0	0.0	0.0	0.0
Other	0.0	0.0	0.0	3.6	8.6	7.7

Source: HARTI Survey Data, 2016

Table 19.12: Distribution of Lowland Holdings by Ownership

Ownership Status	Distribution of Low Land Holdings by Ownership			
	Carrot (%)	**Cabbage (%)**	**Capsicum (%)**	**Beans (%)**
Single owner	65.0	76.9	66.7	54.2
Jointly owned	10.0	0.0	4.2	16.7
Leased in	5.0	7.7	16.7	8.3
Tenancy-in	0.0	0.0	0.0	4.2
Tenancy-out	10.0	7.7	12.5	8.3
Permit Holder	0.0	7.7	0.0	0.0
Mortgaged	10.0	0.0	0.0	8.3
Total	**100**	**100**	**100**	**100**

Source: HARTI Survey Data, 2016

19.3.2 Irrigation

Sri Lanka receives rain under four major rainfall regimes namely (i) first inter-monsoon (FIM): March-April (268mm, 14%) (ii) Southwest monsoon (SWM): May-September (556mm, 30%) (iii) Second inter-monsoon (SIM): October-November (558mm, 30%) and (iv) Northeast monsoon (NEM): December-February (479mm, 26%) (Aheeyar, 2012). Variability of rainfall pattern is greatest in the Northeast monsoon which is essential for upcountry vegetable production. As described in Table 19.13, except in the case of leeks, highest proportion of farmers in all the other categories had worked under rain - fed conditions as the main source of water in both *Yala* and *Maha* seasons. Further, farmers who do cultivation under the rain-fed conditions and minor irrigation systems are regarded as the most vulnerable group to the climate change impacts that are caused by the variability of rainfall patterns.

Different irrigation methods are applied to irrigate upcountry vegetable lands (Table 19.14). Regarding carrot, cabbage and beetroot, the most popular irrigation method was sprinkler irrigation during the *Maha* season. However, regarding beans and capsicum, flood irrigation was the mostly applied method. This method has not changed significantly based on the season with respect to carrot, leeks, beetroot and beans. However, as most of the cabbages are cultivated in low lands in *Yala* season, the common irrigation method has changed to flood irrigation due to easiness of the application of that method in lowlands (19.15).

Table 19.13: Distribution of Land Holdings Based on Source of Irrigation

Source of Water (*Yala* *and Maha*)	Distribution of Land Holdings Based on Source of Irrigation					
	Carrot (%)	**Leeks (%)**	**Cabbage (%)**	**Beetroot (%)**	**Capsicum (%)**	**Beans (%)**
Major irrigation	33.3	36.7	3.3	3.3	2.5	16.7
Minor irrigation	48.2	26.7	40.0	23.3	17.5	60.0
Rain fed	63.0	6.7	56.7	33.3	65.0	60.0

Agro-well	7.4	10.0	10.0	3.3	7.5	0.0
Tank/Reservoir	0.0	0.0	16.7	10.0	10.0	3.3
Domestic well	0.0	0.0	13.3	10.0	2.5	
Pipe-borne water	11.1	0.0	6.7	20.0	2.5	20.0
Tube well	0.0	53.3	0.0	0.0	32.5	
Other	25.9	36.7	30.0	30.0	7.5	23.3

*Multiple choice questions. Sum of the percentage in each column may exceed 100.
Source: HARTI Survey Data, 2016

Table 19.14: Distribution of Land Holdings by Method of Irrigation – *Maha* Season

Method of Irrigation	Distribution of Land Holdings by Method of Irrigation – *Maha* Season					
	Carrot (%)	Leeks (%)	Cabbage (%)	Beetroot (%)	Capsicum (%)	Beans (%)
Sprinklers	63.3	25.0	75.0	100	44.4	44.9
Drip Irrigation	0.0	50.0	0.0	0.0	0.0	9.1
Flood Irrigation	36.3	25.0	22.0	0.0	56.5	44.9

Source: HARTI Survey Data, 2016

Table 19.15: Distribution of Land Holdings by Method of Irrigation – *Yala* Season

Method of Irrigation	Distribution of Land Holdings by Method of Irrigation – *Yala* Season					
	Carrot (%)	Leeks (%)	Cabbage (%)	Beetroot (%)	Capsicum (%)	Beans (%)
Sprinklers	66.7	25.0	14.3	100.0	54.5	50.0
Drip	0.0	50.0	0.0	0.0	0.0	10.0
Flood	33.3	25.0	85.7	0.0	45.5	40.0

Source: HARTI Survey Data, 2016

19.3.3 Labour

The cost of cultivation and the return on selected vegetables need to be studied so as to know the income earning capacity of the vegetable farmers. In certain studies, cost of cultivation is disaggregated into input cost, labour cost, land cost, machinery cost and livestock cost. However, the Department of Agriculture of Sri Lanka followed a slightly different procedure in calculating cost of cultivation. They have considered the total cost of cultivation as a combination of all inputs used in vegetable cultivation such as labour, power and machinery, seed, fertilizer and agro chemicals (pesticide, fungicides and weedicide) associated in different activities of vegetable farming. The labour input was calculated based on family and hired labour basis. Values of both own inputs (non-cash costs, except value of land rent) as well as purchased inputs (cash costs) were taken into consideration and the imputed values were calculated based on values of the purchased input.

Of the percentage share of cost of production (COP), labour cost was marked approximately one third, ranging from 33 percent to 44 percent (Table 19.16). The highest share was reported for beetroot cultivation with the value of 44 while the lowest share was reported for capsicum with 33 percent. Family labour have been widely used by the farmers who cultivate less than one-acre land whereas large scale commercial farmers mainly depend on hired labour

19.3.4 Seeds

19.3.4.1 Source of Seeds

Except in the case of farmers who grow capsicum, most of the other farmers have purchased both local and imported certified seeds from the local market (Table 19.16). As Department of Agriculture's sales outlets were rare in the villages, farmers had bought seeds produced by the Department, through the local market – mostly through private shops. Legally, only the certified seeds are allowed to be sold at the market. However, there were few instances where uncertified or seeds which had fraud certifications were being sold at the market.

Table 19.16: Source of Seed

Source of Seeds	Carrot	Leeks	Cabbage	Beetroot	Capsicum	Beans
Dept. of Agriculture	11	0	7	0	9	8
Self-Produced	4	0	0	0	57	20
Private Companies	14	31	15	36	17	4
Neighbouring Farmers	0	0	4	0	8	12
Local Market	71	69	74	64	9	56

Source: HARTI Survey Data, 2016

With regard to imported seeds, some agents of seed importing companies were blamed for mixing the imported seeds with low quality seeds. Private companies also played a major role in selling seeds. Since most of the Private companies do not have sales outlets at village level, they did the selling via agents who usually paid a visit to the farm fields with the onset of the season.

19.3.4.2 Types of Seeds

Of the surveyed sample, type of seeds used, had not varied much, depending on the season (Table 19.17). In other words, the farmers had used more or less the same seed type across all the growing seasons. Among all the categories of surveyed farmers, uncertified local seeds (which was either self-produced or bought from neighbour farmers) were the most popular type of seed with regard to bean as well as capsicum cultivation. Of the self-produced seed varieties, *Katugastota*, *Lanka Nill* and *Balangoda* were most common local seed types among bean growers, whilst among capsicum growers, *C.A.8* was the most popular. However, regarding cabbage, leeks and carrot, certified local seeds (produced by the Department of Agriculture and the private companies such as CIC) were the most commonly used seed type. Further, most of the certified imported seeds were of high yielding hybrids, from Malaysia, India and Japan.

Table 19.17: Types of Seeds

	Season	Certified seeds - Local	Uncertified seeds - Local	Certified seeds - Imported
Carrot	2015/16 *Maha*	67	11	22
	2015 *Yala*	77	0	24
Leeks	2015/16 *Maha*	55	23	23
	2015 *Yala*	56	22	22
Cabbage	2015/16 *Maha*	43	21	35
	2015 *Yala*	57	29	14
Beetroot	2015/16 *Maha*	35	25	40
	2015 *Yala*	42	42	17
Capsicum	2015/16 *Maha*	43	50	7
	2015 *Yala*	40	53	7
Beans	2015/16 *Maha*	29	53	18
	2015 *Yala*	39	50	11

Source: HARTI Survey Data, 2016

19.3.4.3 Seed Cost

Cost of seeds is primarily dependent on a combination of two variables, namely price of a unit weight of seeds and the seed requirement. As stated by the DOA, cost of cultivation report - 2014/15 *Maha*, for carrot, capsicum, beans and cabbage, the reported seed requirements for one acre of land were 1.8 kg, 0.638 g, 10.6 kg and 470 g, respectively. Their prices were Rs. 5,207/kg, Rs 12,800/kg, Rs 1,254/kg and Rs.58 /g respectively (Table 19.18). Even though the seed requirement is comparatively low in capsicum, its unit cost is comparatively high, whilst in beans, the reported seed cost is low but the requirement is the highest amongst the considered vegetables. As the survey results revealed, the highest value as well as the highest share of the total cost was recorded for leeks, while the lowest value as well as the lowest share was recorded for capsicum.

Table 19.18: Cost of Seed

Up Country Vegetable	Cost of Seed (Rs/Ac)	As a % of Total Cost (Including family labour)
Carrot	12,370.9	13
Leeks	35,919.5	17
Cabbage	25,433.6	16
Beetroot	21,282.1	6
Capsicum	9,553.7	9
Beans	17,546.1	16

Source: HARTI Survey Data, 2016

19.3.5 Fertilizer and Pesticides

Of the percentage share of COP, fertilizer and pesticide cost also marked approximately one third, ranging from 26 percent to 46 percent (Table 19.19). As imported hybrid seed varieties are more susceptible to pests and diseases under local condition, high frequency of the usage of insecticides and pesticide was reported in upcountry vegetables, which are highly depended on imported seeds. On the other hand, use of local seed varieties (*Lanka Nill* - pole bean variety and local bush bean varieties) are more in beans, compared to other upcountry vegetables, so that comparatively low share was invested on pesticides and insecticides on beans.

Further, application of organic fertilizer was commonly adopted across all the selected categories where a high cost was spent on organic than chemical fertilizer in cultivating beetroot and beans.

In general, intercropping is practiced with beans (e.g. bean potato intercropping) (Champika, 2016) hence, weed control has not become a difficult issue. Therefore, the cost of weedicide related to bean cultivation was reported as zero.

Table 19.19: Cost of Fertilizer and Pesticides

Crop	Chemical Fertilizer (Rs/ac)	Organic Fertilizer (Rs/ac)	Weedicide (Rs/ac)	Fungicide (Rs/ac)	Insecticide (Rs/ac)	Total Cost of Fertilizer and Pesticide (Rs/ac)	As a % of Total cost (including family labour)
Carrot	14,984.0	4,001.1	762.9	11,614.1	5,539.4	36,901.5	40
Leeks	37,366.8	18,395.1	1,733.6	10,464.5	5,265.6	73,225.6	34
Cabbage	23,518.3	8,950.9	558.5	7,440.0	8,159.2	48,626.9	30
Beetroot	32,169.1	70,168.6	600.0	11,623.1	13,689.8	128,250.5	37
Capsicum	22,443.7	8,767.5	180.6	7,795.2	9,031.3	48,218.2	46
Beans	9,984.9	6,861.9	0.0	3,794.2	6,956.9	27,597.9	26

Source: HARTI Survey Data, 2016

As indicated in Table 19.20, of weed control methods, hand weeding was the most popular as well as the commonly adopted practice by all the up country vegetable farmers. As vegetable plots were small in extent (except in the case of capsicum, majority of all the other farmers had less than one acre extent), hand weeding became easy and practical. However, majority of the farmers who grew carrot had applied weedicides but it was not a common practice among leeks, cabbage, beetroot, capsicum, and bean farmers. Further, very few farmers were seen letting the plots remain un-weeded. However, as upcountry vegetables are more susceptible to insect and pest attacks, keeping plots un-weeded can be problematic as weed plants act as breeding grounds for pests. Further, majority of the farmers in all the categories had used both organic and chemical fertilizers. As they were doing the cultivation generally in high cropping intensity, soil nutrient requirement couldn't be fulfilled by organic fertilizer alone. Further, almost all the farmers have applied chemical pesticides as imported seed types are highly susceptible to insect and pest attacks.

Table 19.20: Fertilizer and Pesticides Use

Fertilizer and Pesticides Use	Carrot	Leeks	Cabbage	Beetroot	Capsicum	Beans
1.Insecticide and pesticide use						
A. Insecticide use	96	100	100	100	100	100
B. Fungicide use	93	87	83	0	93	70
2. Type of Fertilizer use						
Chemical fertilizer only	22	0	10	3	18	20
Both organic and chemical	78	100	90	97	83	80
Other	63	37	57	70	13	87

Source: HARTI Survey Data, 2016

19.3.6 Machinery

Machinery cost as a percentage of total cost was low, as only a few farmers had used tractors for ploughing only at the initial stage. As use of tractors are somewhat difficult in rugged lands in hilly terrain farmer always preferred manual method of land preparation, using mamoties and hoes. The reported highest share of machinery cost was 12 percent for capsicum, whilst the lowest was 6 percent reported for beans (Table 19.21).

Table 19.21: Machinery Cost

Crop	Machinery Cost (Rs/Ac)	As a % of Total Cost (Including family labour)
Carrot	8,540.5	9
Leeks	15,392.8	7
Cabbage	11,821.2	7
Beetroot	35,216.1	10
Capsicum	12,218.3	12
Beans	6,569.3	6

Source: HARTI Survey Data, 2016

19.3.7 Total Cost of Production

As Table 19.23 indicates, COP is high in Nuwara Eliya district, compared to that of Badulla district for leeks, cabbage and beetroot. However, as shown in Table 19.22, a considerable yield gap is reported between the two districts for carrot, leeks and cabbage, where yield in Nuwara Eliya is always higher. Regarding beans, the situation is vice-versa, where the cost of production is slightly higher in Badulla but, is compromised with three times higher average yield reported in the district, compared to Nuwara Eliya due to prevalence of optimum growing condition. Therefore, one cannot conclude whether the cultivation is profitable or not by comparing only the COP values. Regarding capsicum, the COP values reported for Puttlam district was higher than those of Matale district, but average yield in Puttalam district was two times higher than that of the latter, due to large scale - mechanized cultural practices.

Table 19.22: Average Yield

Crop	Badulla (Kg/Ac)	Nuwara Eliya (Kg/Ac)	Matale (Kg/Ac)	Puttalam (Kg/Ac)	Average Yield for The Specific Crop (Kg/Ac)
Carrot	1,815.1	3,985.7	-	-	2,488.2
Leeks	3,935.7	36,864.1	-	-	22,585.8
Cabbage	3,338.8	9,028.2	-	-	5,863.4
Beetroot	8,630.6	8,972.9	-	-	8,812.0
Capsicum	-	-	3,322.0	6,184.6	5,519.6
Beans	3,417.8	999.0	-	-	2,251.7

Source: HARTI Survey Data, 2016

For leeks, optimum growing conditions prevailed in upper elevation regions of Nuwara Eliya district, so that a significant yield difference of 32,928.40 kg per acre was observed between the two considered districts (Table 19.23). On the other hand, large scale mechanized capsicum cultivation was practiced in Puttalam district compared to small scale manual cultivation in Matale district, hence a considerable yield difference of 2,862.60 kg per acre was noted between Puttalam and Matale, where yield in Puttalam was higher. Further, average yield of carrot and cabbage reported in Nuwara Eliya district was higher than that of Badulla district. However, for beans, the most suited agro-climatic condition is prevailed in Badulla district as its average yield remained 2,418.80 kg higher than that of Nuwara Eliya district.

Table 19.23: Total Cost of Production (Rs/Ac.)

	Category	Badulla	Nuwara Eliya	Matale	Puttalam	Total Cost of Production for the Specific Crop (Rs/Ac.)
Carrot	Including family labour (Rs/Ac)	95,365.7	89,755.0	-	-	92,872.1
	Excluding family labour (Rs/Ac)	59,221.1	71,673.3	-	-	82,533.6
Leeks	Including family labour (Rs/Ac)	192,503.6	235,604.8	-	-	216,640.3
	Excluding family labour (Rs/Ac)	182,985.4	208,252.1	-	-	197,134.7
Cabbage	Including family labour (Rs/Ac)	135,286.5	191,580.1	-	-	161,422.8

	Excluding family labour (Rs/Ac)	104,828.4	165,142.1	-	-	142,419.5
Beetroot	Including family labour (Rs/Ac)	344,408.5	349,463.6	-	-	347,216.9
	Excluding family labour (Rs/Ac)	294,671.8	328,376.9	-	-	313,396.8
Capsicum	Including family labour (Rs/Ac)	-	-	101,370.5	107,394.5	104,549.8
	Excluding family labour (Rs/Ac)	-	-	89,848.7	95,372.5	96,527.0
Beans	Including family labour (Rs/Ac)	126,460.4	89,599.6	-	-	108,030.0
	Excluding family labour (Rs/Ac)	117,394.2	71,617.7	-	-	94,506.0

Source: HARTI Survey Data, 2016

Except in the case of average selling price reported for carrot and beans in Badulla and Nuwara Eliya districts during 2015/16 *Maha* and 2015 *Yala* seasons, recorded average selling prices in 2015/16 *Maha* season was higher than that of 2015 *Yala* season in all the other instances (Table 19.24). As the *Maha* season possesses optimum conditions for vegetable cultivation, generally, quality of up country varieties remain higher in the *Maha* compared to *Yala.* Therefore, relatively higher prices are reported in the *Maha* season compared to that of the *Yala* season.

Table 19.24: Average Selling Price - Wholesale (Rs/Kg)

	Average Selling Price - Wholesale (Rs/Kg)				
	Season	**Badulla**	**Nuwara Eliya**	**Matale**	**Puttalam**
Carrot	2015/16 *Maha*	82.3	77.2	-	-
	2015 *Yala*	86.0	81.2	-	-
Leeks	2015/16 *Maha*	58.0	69.2	-	-
	2015 *Yala*	47.5	60.0	-	-
Cabbage	2015/16 *Maha*	63.2	49.3	-	-
	2015 *Yala*	43.3	59.0	-	-
beetroot	2015/16 *Maha*	69.6	75.0	-	-

	2015 *Yala*	43.3	59.0	-	-
Capsicum	2015/16 *Maha*	-	-	118.1	111.6
	2015 *Yala*	-	-	84.3	106.0
Beans	2015/16 *Maha*	74.3	55.0	-	-
	2015 *Yala*	100.7	67.8	-	-

Source: HARTI Survey Data, 2016

Of the considered marketing methods, selling to the private traders and selling at the respective DECs were most prominent (Table 19.25).

Table 19.25: Marketing Methods of Upcountry Vegetables

Marketing Methods	Carrot (%)	Leeks (%)	Cabbage (%)	Beetroot (%)	Capsicum (%)	Beans (%)
To the Government	6.3	1.9	4.0	0.8	2.1	6.5
Private traders	39.2	88.6	56.0	48.8	21.3	45.2
Own shop	0.0	1.9	0.0	0.0	0.0	0.0
Village fair	17.7	2.9	11.0	42.1	10.6	18.3
Shops in town	1.3	0.0	0.0	0.0	1.1	0.0
Economic center	35.4	3.8	28.0	8.3	61.7	30.1
Other	0.0	1.0	1.0	0.0	3.3	0.0

Source: HARTI Survey Data, 2016

Regarding the highest proportion of carrot, leeks, cabbage, beetroot and beans, the farmers, commonly relied on the private traders. On the other hand, regarding capsicum farmers, selling at economic centers was the widely practiced channel, as most of them were large scale (more than 2 acres of land) farmers who reaped bulky harvests. Survey results further revealed that, government purchasing mechanism of *Sathosa* had not been able to play an influential role in the purchase of upcountry vegetables.

As revealed in the survey (Table 19.26), of the marketing problems pointed out by the farmers, difficulty in selling the produce at a reasonable price turned out to be the most crucial issue for the upcountry vegetable growers, followed by high concern on quality by the traders and issues related to transportation.

As revealed in earlier studies, during the peak *Maha* harvesting period, the observed price drops for upcountry varieties were generally in the range of 30 – 35 percent compared to the annual average price. The same price drops observed in peak harvesting season of the *Yala* cultivation was 20 – 30 percent for upcountry varieties. When the lean season for vegetables reaches its peak, supply drops hence average prices are increased by around 35 percent for upcountry vegetables compared to annual average. The average price hike observed in the lean period is confined to 25

– 35 percent margin, mainly due to inter-seasonal cultivation in mid-March to mid-April period (HARTI, 2013-2014).

From the farmers' point of view, the major difficulty is to assume the selling prices at the time of planting. Inaccurate price predictions scan be potentially detrimental for the farmers' income. The result has created farmer indebtedness among small scale vegetable farmers. Then, farmers become unable to invest in their next season's production and further get trapped in the vicious cycle of indebtedness (Mitra and Boussard, 2011). Further, if farmers were provided with irrigation facilities and climate stress - tolerant seeds, market supply will smooth out and producers will be protected from glut season price drops.

Table 19.26: Marketing Problems

Marketing Problems	Carrot (%)	Leeks (%)	Cabbage (%)	Beetroot (%)	Capsicum (%)	Beans (%)
Not having reasonable price	53	36	46	36	59	44
Absence of marketing channel	6	5	9	3	3	7
High concern on quality	13	7	0	26	8	8
Transportation issues	15	13	9	12	4	13
Not buying the whole lot	3	1	0	0	6	6
Delay in payment	0	10	20	5	6	11
Other	2	2	1	0	4	1
No issues	8	27	15	17	11	11

Source: HARTI Survey Data, 2016

19.4 Constraints of Production

As Table 19.27 indicates, one of the main obstacles faced by all the farmers, regardless of the type of vegetable they cultivate, was several issues related to marketing of their agricultural products. Inability of selling the produce at a reasonable farm-gate price, especially during the harvesting season was the main obstacle confronted by the farmers, followed by a lack of marketing channels at rural level and exploitation by the middle - men.

One of the other major concerns of farmers was issues related to recent policy change in fertilizer subsidy scheme. In the budget 2016, the government decided to convert the fertilizer subsidy in to cash grant to the farmers who cultivate paddy lands below one hectare, from 2016 *Yala* season onwards. Therefore, 2015/2016 *Maha* season was the last instance when fertilizer was supplied directly to the farmers in physical form and there was a 1-3-week delay, compared with the usual time of delivery.

Table 19.27: Constraints of Production

Crop Specific Issues	Carrot (%)	Leeks (%)	Cabbage (%)	Beetroot (%)	Capsicum (%)	Beans (%)
Not having a defined price	15	70	46	10	30	17
Issues related to recent policy change in fertilizer subsidy scheme	11	20	7	10	32	24
Lack of quality seeds	44	27	25	24	3	-
Increasing seed prices	33	30	7	3	3	-
Increasing pesticide prices	19	10	4	7	16	10
High cost of labour	-	10	4	7	3	7
Quality issues in pesticides	-	-	36	-	3	-
Water scarcity (rain fed)	7	10	21	10	27	28
Weaknesses in the extension service	-	67	36	-	5	7
Fertilizer scarcity	4	3	11	3	5	-
Issues in infrastructure	-	7	-	10	-	3
Wild life damage	4	-	-	14	5	17
Pest & Disease issues	33	17	57	45	38	48
Not having a defined marketing channel	4	7	-	-	3	14
Others	11	3	25	31	27	21

*Multiple answers. Sum of the percentage in each column may exceed 100.

Source: HARTI Survey Data, 2016

Furthermore, respondents have stressed the importance of the provision of high quality inputs for the upcountry vegetable cultivation. Low availability of domestic certified vegetable seeds, quality issues related to hybrid seeds, high pest and disease susceptibility of imported hybrid varieties were the main concerns of the farmers in selected area.

Water scarcity was the other main issue faced by the farmers, the irrigation water management of Nuwara Eliya and Badulla districts are characterized with a well-functioning small scale anicut systems built across small streams flowing from the hilly watersheds and village level small tanks. Poor condition of the distributory and field canals of these simple and primary irrigation systems has been the major reason for low irrigation efficiency and water scarcity, mostly experienced in *Yala* season.

19.4.1 Findings

1. As it is revealed in the survey, most of the upcountry vegetable farmers have used rain water as the main source of water in both *Yala* and *Maha* seasons. Farmers who depend upon rain-fed conditions and minor irrigation systems for cultivation are regarded as the most vulnerable group to the climate change impacts, caused

by the variability of rainfall patterns. Therefore, vegetable farmers can be identified as one of the high risk groups to climate related uncertainties.

2. Of the percentage share of COP, labour cost marked approximately one third, ranging from 33 percent to 44 percent. The highest share was reported for beetroot cultivation with the value of 44 percent while the lowest share was reported for capsicum cultivation with the value of 33 percent. Family labour had been widely used by the farmers who cultivated less than one acre of land whereas large scale commercial farmers mainly depended on hired labour for cultural practices. Further, fertilizer and pesticide cost also marked approximately one third, ranging from 26 percent to 46 percent of the percentage share of COP. However, machinery cost as a percentage of total COP was lower than 10 percent in most instances, as only a few farmers used tractors for ploughing only at the initial stage.

3. Of the surveyed sample, type of seeds used, had not varied much, depending on the season. In other words, farmers had used more or less the same seed type across all the growing seasons. Among all the categories of surveyed farmers, uncertified local seeds (which were either self-produced or bought from neighbour farmers) were the most popular type of seed with regard to bean as well as capsicum cultivation. Legally, only the certified seeds are allowed to be sold at the market. However, there were a few instances where uncertified or seeds which had fraud certifications were being sold at the market. Respondents had highly stressed the importance of the provision of high quality inputs for the upland vegetable cultivation. Low availability of domestic certified vegetable seeds and quality issues related to hybrid seeds had become the major problems related to seeds.

4. Of the considered marketing methods, selling to private traders or respective economic centers were the methods in wider use. One of the main obstacles faced by all the farmers, regardless of the type of vegetable they cultivated was several issues related to marketing of their agricultural products. Inability of selling the produce at a reasonable farm-gate price, especially during the harvesting season was the main debacle confronted by the farmers, followed by a lack of marketing centers at rural level and exploitation by the middle - men.

19.4.2 Recommendations

As respondents have laid heavy stress on the importance of the provision of high quality inputs, especially seed, for the upland vegetable cultivation, controlling and regulation of importation and distribution of seeds is an urgent need. Furthermore, a separate breeding programme should be implemented targeting off-season cultivation, in order to breed varieties that produce high yields under climate stress.

When the farmers rely on mobile collectors who visit the village once or twice a week as the main buyers of their produce, exploitation by the middle men (mobile collectors) seems unavoidable. As a solution to marketing problem, development of continuous marketing linkages with large scale buyers and establishment of buy - back systems between the large scale buyers in the nearby cities such as Kandy, are steps towards the right direction.

As the farmers depend on minor irrigation channels, water streams and drain off water of major irrigation schemes as the main water source of agriculture, repair and rehabilitation of small scale tanks and reservoirs within the villages to increase the water storage capacity and renovation of bunds and canals to maximize the water distribution, is also a pressing need.

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Chapter Twenty

Low Country Vegetables

T. P. Munaweera

SUMMARY

Five main low country vegetables; bitter gourd, brinjal, capsicum, luffa and okra were selected for the survey conducted in Anuradhapura, Rathnapura, Matale and Puttalam districts with 164 respondents. The survey data reveal that the educational level of the respondent vegetable farmers is at a satisfactory level, suggesting the possibility to introducing the improved technologies and incentive farming systems. More than 50 percent of the vegetable plots are larger than two acres in extent. The owner himself grows vegetables in most cases and family labour is used extensively. However, the majority of farm families consist of three to five family members highlighting the necessity of hired in the production process. Farming is the principal source of income for many vegetable farmers.

Seeds, fertilizer, agrochemicals and labour are the major inputs used by the surveyed vegetable farmer. Input market is dominated by the private sector. Low country vegetable cultivation is mainly done under rainfed conditions in highlands in *Maha* season and also in *Yala* season under irrigated conditions. The majority of low country vegetable farmers use seeds purchased at the local market. Concerning the types of seeds used by the farmers in the study location, more than 40 percent use certified seeds produced locally. However, the survey reveals that farmers do not have proper understanding on the type of seeds they use.

The major problems faced by the farmers are pest and disease outbreaks, high input cost, water scarcity, poor quality seeds and poor extension service. Although they have many options in selling vegetables, private traders dominate at the farm level. The farmers' bargaining power is weak due to the absence of timely and reliable market information.

As a suggestion to develop the low country vegetable sector the need of a production plan in line with the market demand, improvement of research and extension, grouping farmers into organizations, development of infrastructure facilities and enhancement of market competition, can be highlighted.

CHAPTER TWENTY

Low Country Vegetables

20.1 Overview of the Low Country Vegetable Sector

20.1.1 Introduction

Besides rice, the vegetable sub sector plays an important role in the sphere of Sri Lankan agriculture not only because a large number of farmers are involved in it, but as a main source of dietary nutrition fulfillment. Low country vegetable farming system and up country vegetable farming system are the two main vegetable production systems in Sri Lanka. Under the upcountry category farmers cultivate vegetables that are resistant to a cool climate and most of the planting material and seeds are imported. This production system involves continuous and intensive cultivation practices on high sloppy lands in small plots with soil conservation methods. Low country vegetables are generally cultivated under rainfed conditions on small land plots or in home gardens using comparatively low amount of inputs by way of fertilizers and pesticides. Traditionally they are grown in lowlands in *Yala* season and shifting cultivation (*Chena*) lands in the dry zone and highlands in the wet and intermediate zones. Those grown in the paddy fields during *Yala* season are often under irrigated conditions.

Low country vegetables brinjal, bitter gourd, capsicum, luffa, okra, snake gourd, pumpkin, tomato, winged bean, wong bean, cucumber, etc. are suitable for the domestic climatic conditions. Based on the cultivation extent and production statistics five major low country vegetable crops, brinjal, bitter gourd, capsicum, luffa, and okra were selected for this baseline survey.

Table 20.1 illustrates the basic information on selected crops including the scientific names, recommended crop varieties, most suitable cultivation areas and preferable climatic conditions for optimum production. Brinjal covers the second largest extent under vegetable cultivation after curry banana (Table 20.2). Since brinjal is a ratoon crop, the plant can last more than one year. Due to hardy nature of the plant it can be successfully grown even in very dry areas under rainfed conditions. Bitter gourd is popular due to its medicinal properties and richness of different micronutrients. It can be successfully cultivated in low country and mid country in both seasons. Luffa is a cucurbit native to Asia and cultivated since ancient times. It is an annual, climbing herb and fruit is edible when young as mature fruits become very bitter due to the development of purgative chemicals. Luffa is well grown in the dry zone, the wet zone and the intermediate zone. Capsicum can be cultivated throughout the year on land an extent up to an elevation of 1500mm. Capsicum belongs to family *Solanaceae*. Water logged conditions leads to retarded growth in capsicum however supplementary irrigation is required during the season. Okra is another popular vegetable that can be cultivated in most of the regions in Sri Lanka.

Table 20.1: Overview of the Selected Low Country Vegetables

	Bitter gourd	Brinjal	Luffa	Capsicum	Okra
Scientific name	*Mormodica charantia L*	*Solanum melongina L*	*Luffa acutangula L*	*Capsicum annum L*	*Hibiscus esculentus L*
Recommended Varieties	Thinnavely white MC 43	Anjalee Amanda SM – 4 Thinnaveli purple Pagoda	LA 33 Asiri	Hungarian Yellow Wax (HYW) C.A. - 8	MI 5 MI 7 Haritha
Major growing areas	Kurunegala, Hambantota, Ratnapura, Kandy, Matale, Nuwara Eliya, Anuradhapura, Puttalam, Ampara	All agro-climatic regions except up country-wet zone	Low country dry zone, intermediate zone, wet zone	Badulla Nuwara eliya Puttalam	Hambantota, Matale Kurunagala, Ratnapura
Climatic requirements					
Elevation	Up to 1200m	Up to 1300m	Up to 500m	Up to 1500m	Up to 1300m
Rainfall	Adapted to wide range of rainfall, regular irrigation ensures high yield	Drought tolerant crop	Heavy rains not suitable	Excessive soil moisture detrimental to growth	Heavy rain & water logging adversely affect on plant growth
pH	6.0 – 6.7	5.5 – 5.8	6.5 – 7.5	5.5 - 6.8	Neutral pH
Soil	Well drained sandy loam soil	Well drain light soils	Deep well drained sandy loam soils	Well drained loamy soil	Well drained soils

Source: Department of Agriculture

Table 20.2 shows extent under cultivation for the selected low country vegetable in the last decade. According to statistics, much change cannot be observed in the area covered under each crop over the period.

Table 20.2 Extent (ha) under Low Country Vegetable Cultivation in Sri Lanka for the Period 2006 – 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Capsicum	10,169	10,158	11,442	10,824	11,011	11,308	11,760	12,296	11,635	10,831
Brinjal	3,943	4,072	4,534	4,170	4,474	4,523	4,689	4,928	5,038	4,259
Bitter gourd	1,323	1,606	4,317	4,428	4,708	4,873	4,701	4,990	4,816	4,464
Luffa	3,003	3,194	3,478	3,287	3,106	3,372	3,180	3,900	4,047	3,694
Okra	6,646	6,574	7,601	7,230	7,404	7,418	7,707	8,369	8,576	7,398

Source: Department of Census and Statistics, 2006-2015

20.1.2 Importance of the Low Country Vegetables to the Economy

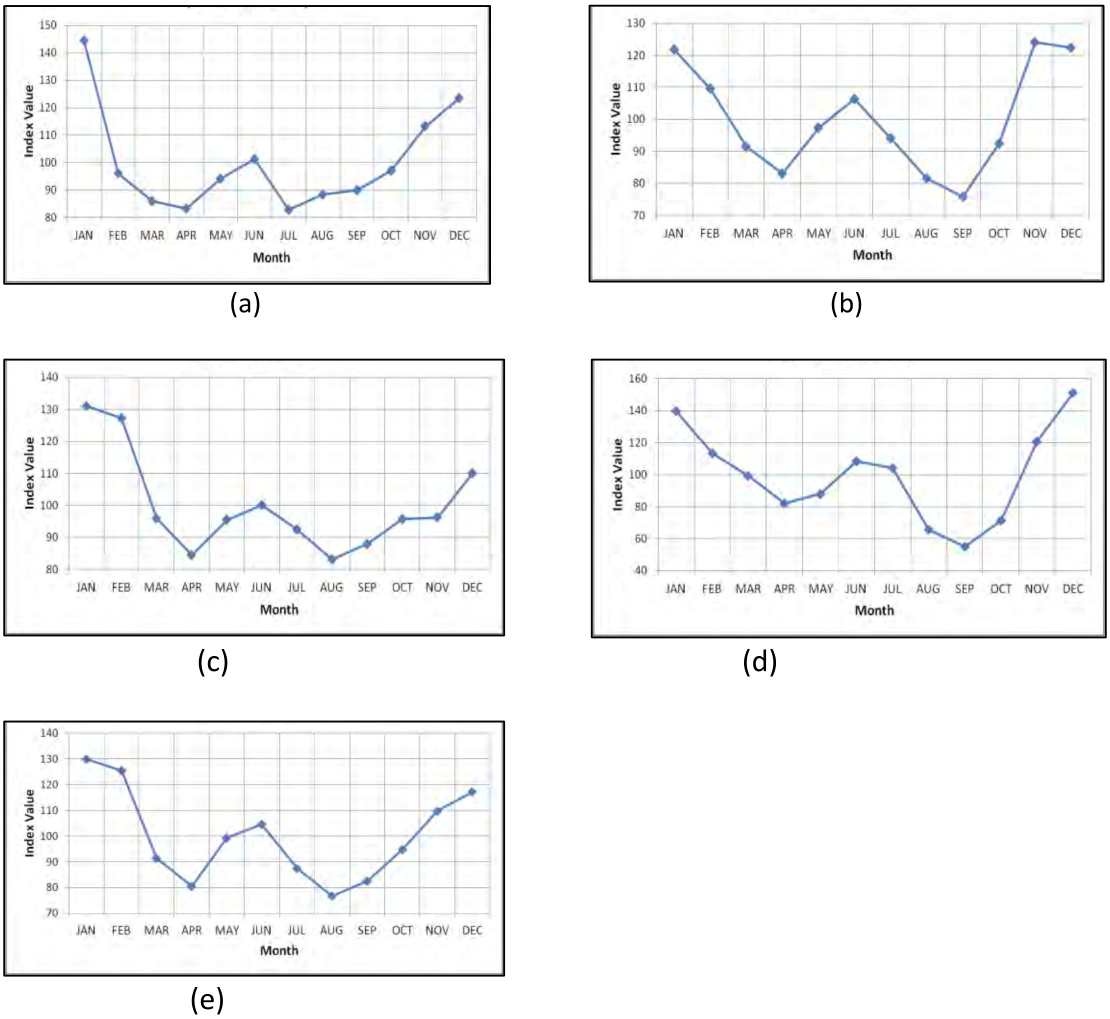
Low country vegetables are mainly grown by semi-commercialized small farmers whose individual extent of land does not exceed a hectare in most instances. Vegetables sector in Sri Lanka has good potential for further expansion due to the country's tropical climate and fertile soil. However, the potential remains largely untapped as most of the production is meant only for local consumption. Annual production of selected low country vegetables for last 10 years are illustrated in Table 20.3

Table 20.3: Low Country Vegetable Production (mt) in Sri Lanka for the Period 2006 -2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Capsicum	13,650	14,089	14,911	14,406	13,046	14,416	16,291	26,440	28,806	32,361
Brinjal	88,375	92,902	104,164	106,700	107,296	116,593	127,163	129,907	128,595	123,632
Bitter gourd	27,101	30,015	37,945	39,692	41,392	42,156	44,103	46,141	50,281	43,509
Luffa	13,381	14,038	33,835	39,577	45,125	43,217	42,786	46,399	45,789	46,681
Okra	40,634	42,935	52,128	56,549	57,788	58,683	65,451	69,615	67,456	66,120

Source: Department of Census and Statistics, 2006-2015

Figure 20.1 illustrates the seasonal price index for the five selected low country vegetables brinjal, bitter gourd, capsicum, luffa and okra. As a result of the seasonality of harvesting price fluctuations can be observed in seasonal and off seasonal periods. Highest price is observed in the months of January, June and December while a slight reduction in prices can be perceived in March – April and August – September.



Source: Department of Census and Statistics

Figure 20.1: Seasonal Price Index of Selected Vegetables (a-Brinjal, b-Bitter Gourd, c-Luffa, d-Capsicum, e-Okra)

According to the information available in the three recent Household Income and Expenditure Surveys conducted by the Department of Census and Statistics per capita consumption of five selected vegetables has increased slightly.

Table 20.4: Per Capita Consumption of Selected Vegetables over the Years

Item	Unit	2006/07	2009/10	2012/13
Brinjal	grams	234.68	266.05	263.59
Okra	grams	103.25	106.84	117.86
Bitter gourd	grams	67.92	64.01	73.34
Luffa	grams	84.77	77.48	81.14
Capsicum	grams	48.45	51.33	49.1

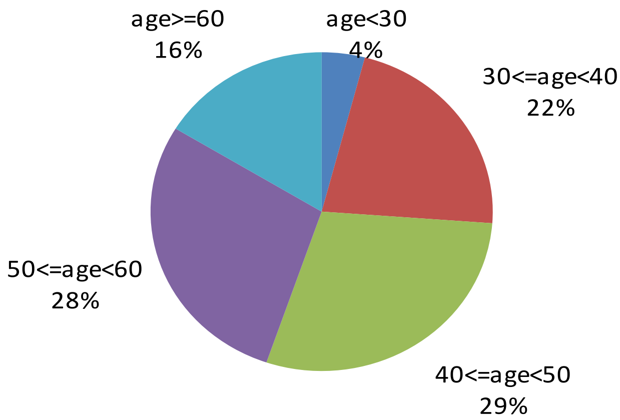
Source: Household Income & Expenditure Survey - Dept. of Census & Statistics

20.2 Socio-Economic Characteristics of the Sample Red Onion Farmers

This section of the chapter commences with a review of socio-economic conditions of the low country vegetables farmers in selected study locations.

20.2.1 Age Distribution

Figure 20.2 illustrates the age distribution of the selected low country vegetable farmers. There is no marked variation in age distribution among the farmers in the districts and different crops concerned. Highest percentage of the farmers are reported to be in the age category of 40 – 60 years while only a smaller number of farmers reported in age under 30 years.

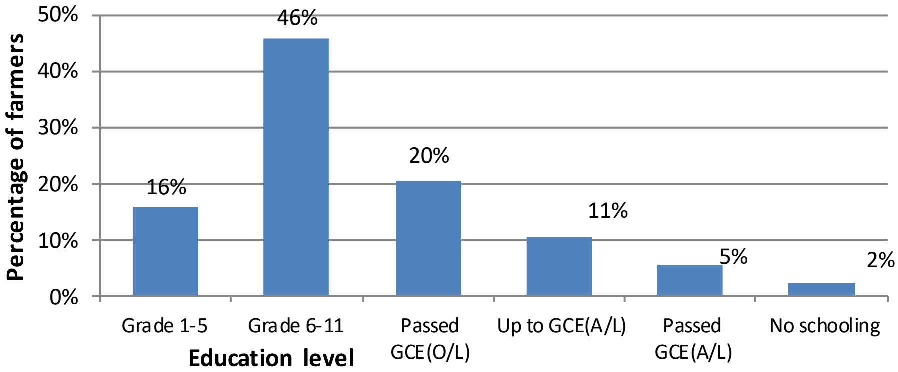


Source: HARTI Survey Data, 2016

Figure 20.2: Age Distribution of Sample Low Country Vegetable Farmers

20.2.2 Education

Figure 20.3 shows the educational level of the sample farmers. A noteworthy feature is that the literacy rate of those in the sample was 98 percent, which is above the national level. There was no marked difference in the literacy level between districts and crops. Some 46 percent of the sample had secondary education, while nearly 20 percent had been successful at the G.C.E Ordinary Level. Highest educational attainment recorded was G.C.E Advanced Level and it was five percent of the sample. This favorable knowledge should be explored in an extension exercise to enhance the farmer knowledge about their livelihood by introducing new technologies to improve their farm products and lure farmers towards the growing of low country vegetables where the investment in least ensuring a fairly remunerative return.

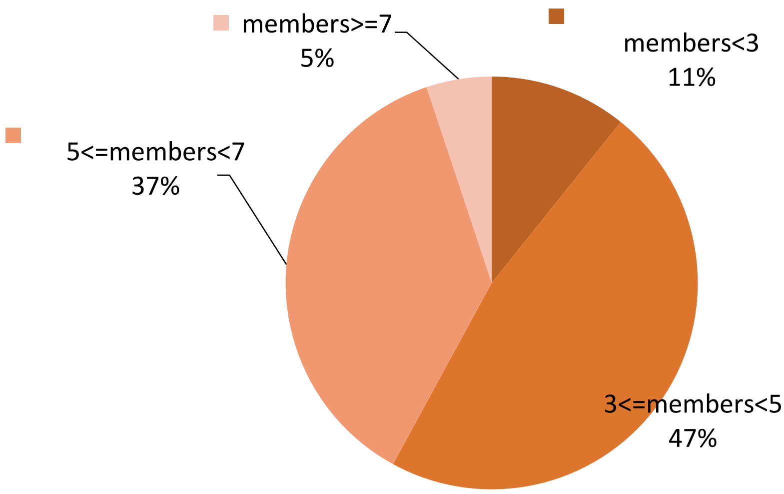


Source: HARTI Survey Data, 2016

Figure 20.3: Level of Education among Sample Low Country Vegetable Farmers

20.2.3 Family Size

Family size of the sample population is shown in Figure 20.4. Nearly 47 percent of the sample households have 3-5 family members. Approximately 37 percent of households have members ranging from 5-7 and that is higher than the national average of 3.9 (Central Bank of Sri Lanka 2016). Out of the total selected low country vegetable farming households around 11 percent have three or less than three members in their family.



Source: HARTI Survey Data, 2016

Figure 20.4: Household Size Distribution among Sample Low Country Vegetable Farming Households

20.2.4 Primary Income

Primary income source of the sample low country vegetable farmers in the four studied districts namely Anuradhapura, Rathnapura, Matale and Puttalam are presented in Table 20.5. Out of the 164 respondents in the sample, 94 percent reported farming and animal husbandry as their principal means of livelihood. Government sector employees among the employed population were only three percent. The labourers who reported wage as the main income source both in agriculture and in other areas and self-employed in the work force were insignificant. This means that members of vegetable farm families might not have time to involve in such activities having spent considerable time in their own farm.

Table 20.5: Primary Employment of Sample Low Country Vegetable Farming Households in Selected Districts

Income Source	Anuradhapura		Rathnapura		Matale		Puttalam		Total	
	N	%	N	%	N	%	N	%	N	%
Farming/Animal husbandry	45	98	41	95	32	89	36	92	154	94
Private sector employment	1	2		-	-	-	1	3	2	1
Self-employment	-	-	1	2	-	-	1	3	2	1
Skilled labour	-	-		-	-	-	1	2	1	1
Government employment	-	-	1	3	4	11	-	-	5	3
Total	46	100	43	100	36	100	39	100	164	100

Source: HARTI Survey Data, 2016

20.3 Agricultural Inputs

This section of the chapter analyses the use of different agricultural inputs in low country vegetable production.

20.3.1 Land

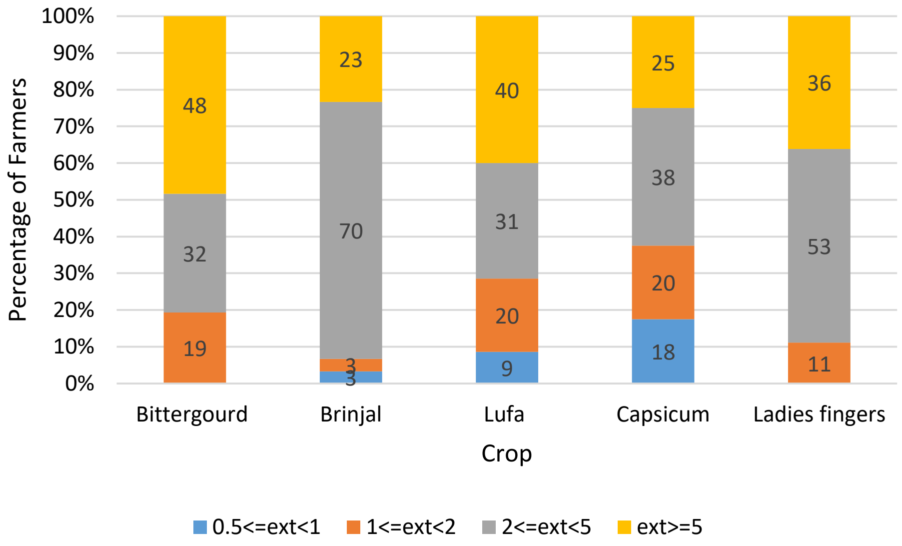
Table 20.6 provides the information on seasona and type of lands used to cultivate the five selected low country vegetables. As indicated in the tables, all five crops are cultivated in both *Yala* and *Maha* seasons in the lowlands and the highlands. However, some differences can be observed when comparing the cultivation patterns in different selected districts. In Puttalam district only capsicum are cultivated on highlands, on the other hand due to limitations in water supply in Matale district capsicum is not cultivated on highlands during *Yala* season. Highest production of low country vegetables is reported on highlands in *Maha* season.

Table 20.6: Extent under Low Country Vegetable Cultivation in Lowlands and Highlands in Different Seasons in Sample Area

Crop	Highland				Lowland			
	Yala		*Maha*		*Yala*		*Maha*	
	N	ac	N	ac	N	ac	N	ac
Brinjal	5	2.5	9	5.25	7	4.5	11	10.5
Capsicum	9	15.75	23	27.75	9	4.65	10	7.02
Okra	9	1.93	18	7.81	9	9	13	12.83
Luffa	5	5.95	10	8.25	18	8.74	14	6.74
Bitter gourd	6	6.93	8	4.04	10	8	5	3.75

Source: HARTI Survey Data, 2016

Analysis of the average plot size in low country vegetable cultivation brings out that more common plot size is 2 – 5 acre category followed by equal or greater than 5 acre category (Figure 20.5). District wise discrepancy can be found in land fragmentation patterns. Smaller land plots are found in Matale district compared with those of Anuradhapura, Ratnapura and Puttalam.



Source: HARTI Survey Data, 2016

Figure 20.5: Distribution of Operators by Size of Land Class in Sample Low Country Vegetable Farming

The Table 20.7 shows the ownership of low country vegetable plots in the sample. Most of the vegetable plots were self-owned. The 63 percent of capsicum land extents are owned by farmers themselves.

Table 20.7: Distribution of Land by Ownership among Low Country Vegetable Farmers in Sample Area

Crop	Bitter gourd		Brinjal		Luffa		Capsicum		Okra	
	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%
Single owner	86.24	58	35.11	25	55.93	29	87.99	63	67.26	39
Jointly owned	1.5	1	11.88	9	4.33	2	4.12	3	11.06	6
Leased in	14.25	10	34	25	4.25	2	37.97	27	37.97	22
Tenancy-in	1	1		-	5.5	3	-	-	2.5	1
Tenancy-out	12	8	6.5	5	17.75	9	4	3	28.5	17
Permit Holder	3	2	6.75	5	4.25	2	-	-	10.25	6
Encroached	26.68	18	37.5	27	98.75	52	4.5	3	14.5	8
Mortgaged	4	3	6	4	0.25	-	-	-	-	-

Source: HARTI Survey Data, 2016

The corresponding figures for other crops are, 58 percent for bitter ground 39 percent for okra, 29 percent for lufa and 25 percent for brinjal. It was found that 52 percent of luffa land extent, 27 percent of brinjal and 18 percent of bitter gourd extents were land encroachments. Samples for these three crops were drawn from Anuradhapura district hence it revealed that a considerable proportion of low country vegetable production in Anuradhapura district was on encroached lands. In Matale and Ratnapura district farmers leased lands to cultivate vegetables.

20.3.2 Irrigation

Low country vegetable cultivation is practiced utilizing different water sources (Table 20.8) and extent of dependency on each water source varies among the districts (Figure 20.6). Vegetable cultivation is mainly done under rainfed conditions during *Maha* season on highlands. The study found that 33 percent of the total land extents under low country vegetable cultivation were farmed under rainfed conditions. Other 24 percent of vegetable growing lands had irrigation water from the major irrigation schemes. In Anuradhapura district 40 percent of the lands had access to water from major irrigation schemes. Land extent under major irrigation is considerably high because the sample was drawn from Rajanganaya Irrigation Scheme, one of the major irrigation schemes in Anuradhapura district with abundant water throughout the year.

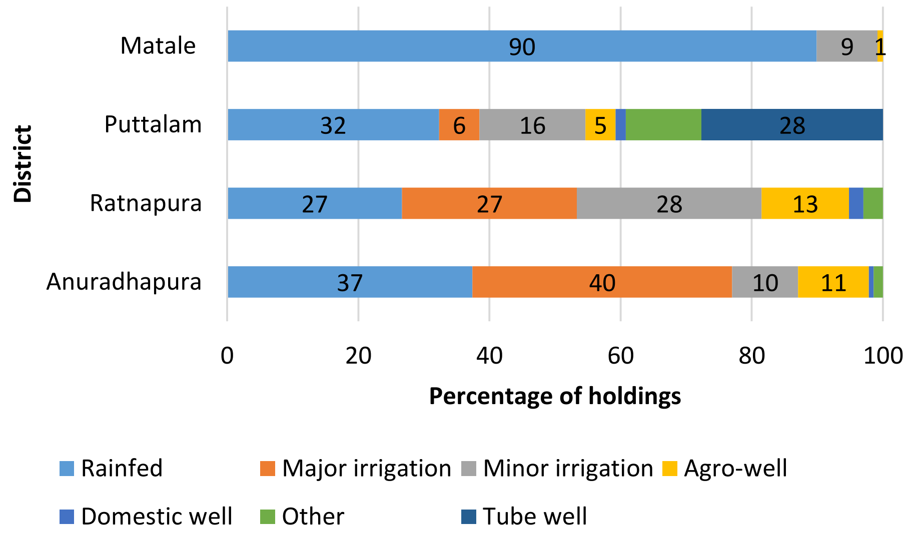
In Matale district almost all the luffa farmers had done their cultivation under rainfed conditions. As followed by 69 percent for capsicum. In Ratnapura district 28 percent of land holdings had water from minor irrigation systems including anicut systems for vegetable cultivation.

Table 20.8: Land Extent under Different Water Sources among Sample Low Country Vegetable Farmers

Water Source	Bitter gourd		Brinjal		Luffa		Capsicum		Ladies fingers	
	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%	Ext (ac)	%
Rainfed	31.00	21	35.36	26	126.66	67	45.19	32	26.36	15
Agro-well	31.50	21	18.50	14	13.85	7	6.75	5	5.75	3
Tube well	0	0	0	0	0	0	65.10	45	5.00	3
Major irrigation	56.75	38	38.00	28	20.25	11	0.25	0	72.08	42
Minor irrigation	21.55	14	42.63	31	28.00	15	10.12	7	35.25	21
Domestic well	0.87	1	0.25	0	0	0	2.00	1	0	0
Other	8.00	5	1.5	1	0	0	14.05	10	27.34	16
Total	149.67	100	136.24	100	188.76	100	143.46	100	171.78	100

Source: HARTI Survey Data, 2016

In Puttalam district the use of tube wells for vegetable cultivation is significant. The survey found that 28 percent of vegetable cultivation plots get water from tube-wells and the source of water for approximately 68 percent of total capsicum cultivation lands was tube-wells. In Anuradhapura and Ratnapura districts considerable number of rainfed farmers use agro-wells as a supplementary water source.



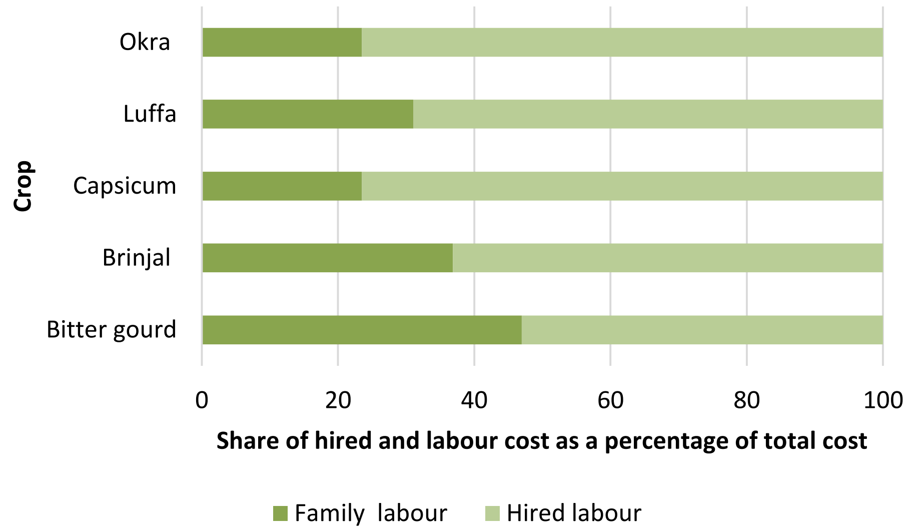
Source: HARTI Survey Data, 2016

Figure 20.6: Percentage of Low Country Vegetable Land Holdings under Different Water Sources in Selected Districts

However more than 50 percent of the farmers in Puttalam district use sprinkler irrigation method both in *Maha* & *Yala* seasons in capsicum cultivation.

20.3.3 Labour

Since vegetable is a labour intensive cultivation, labour cost comprises as major component in the total cost of cultivation. The Figure 20.7 illustrates the share of hired labour and family labour as a percentage of the total labour requirement. In most cases cultivators have to get the service of hired labour at various stages of the production cycle. Okra and capsicum cultivators fulfilled more than 75 percent of the labour requirement from hired labour.



Source: HARTI Survey Data, 2016

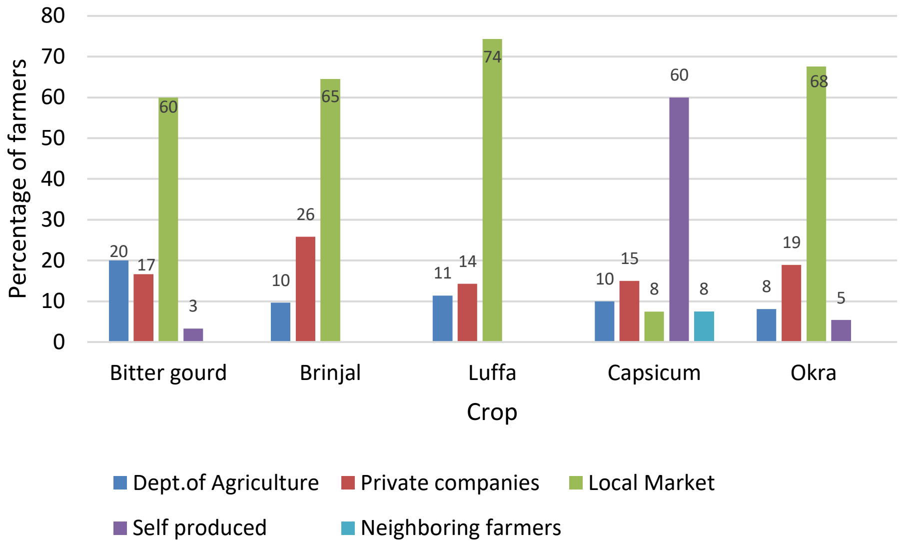
Figure 20.7: Share of Hired and Family Labour Costs as a Percentage of Total Labour Requirements

20.3.4 Seeds

Seed is a crucial factor for a better harvest at the end of the season. An attempt was made to ascertain the information on source of seeds, type and varieties used by low country vegetable farmers.

20.3.4.1 Sources of Seeds

Unlike the up-country vegetable seeds, most of the low country vegetable seeds can be produced within the country. A larger proportion of the low country vegetable seed requirement is met with local seed production by the Department of Agriculture (DOA), provincial councils, cooperatives, farmer organizations, farmers themselves and the private companies along with imported hybrid seeds (Bamunuarachci, 2013). Except for capsicum, majority of the other selected four types of low country vegetable farmers use seeds purchased at the local market (Figure 20.8). However, 60 percent of the sample capsicum farmers used self-produced seeds. A few numbers of farmers buy seeds from the Department of Agriculture including Agrarian Services Centre outlets because of the non-availability of DOA produced seeds adequately in the Department outlets on time.

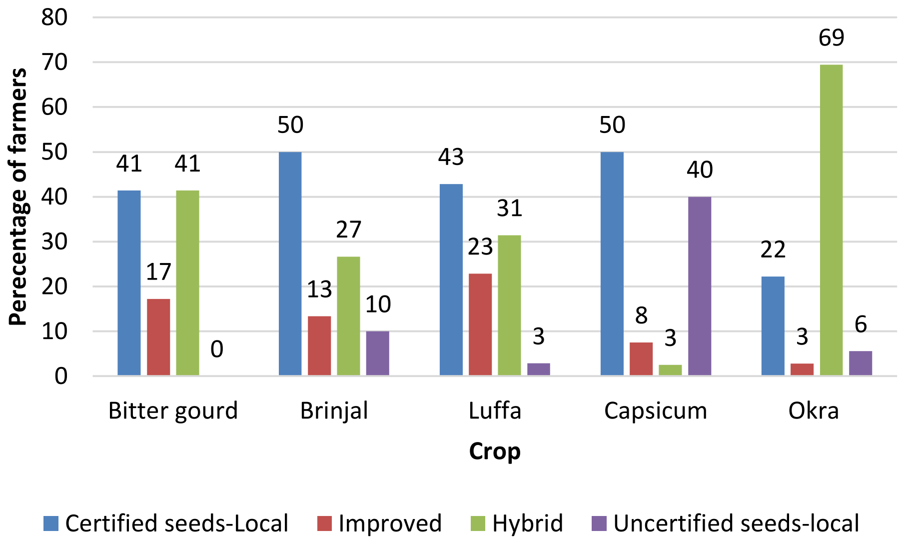


Source: HARTI Survey Data, 2016

Figure 20.8: Source of Seeds for Sample Low Country Vegetable Farmers

20.3.4.2 Types of Seeds

Concerning the types of seeds used by the low country vegetable farmers, a considerable proportion in the sample (more than 40 percent) used certified seeds produced locally. On the other hand, as illustrated in the figure 20.9, 69 percent of okra, 41 percent of bitter gourd, 31 percent of luffa and 27 percent of brinjal farmers used hybrid seeds for their cultivations. The number of farmers in the category of those using uncertified locally produced seeds is high because they had used self-produced seeds.



Source: author’s survey data, 2016

Figure 20.9: Type of Seeds Used by Sample Low Country Vegetable Farmers

20.3.4.3 Seed Varieties

For each crop the DOA has issued the list of recommended varieties that are most suitable for different agro-ecological conditions. Most commonly, cultivated bitter gourd variety mentioned by the sample farmers is *Black bitter gourd*, which is a similar genotype of variety MC 43 which is recommended by the DOA. Most popular types of brinjal varieties among the farmers are *Lenaeri* and *Raveena*. *Lenaeri* is a variety developed by the Horticultural Crop Research & Development Institute (HORDI) and other than that, farmers also cultivated local varieties, which are originated from *Lenaeri*. This variety has good resistance to bacterial wilt and very good yield potential over a long period. Raveena is an imported hybrid brinjal variety more popular among farmers in Ratnapura district. More than 91 percent of the selected luffa cultivating farmers in both Matale and Anuradhapura districts use the variety *Naga*. Naga is a F1 hybrid variety comprising a number of desirable traits other than higher yield such as strong and vigorous plants, fruits with long deep ridges, attractive green colour fruits, better fruit weight, length and early maturity compared to the local Luffa cultivars (Dissamayake *et al*, 2015). Commonly used okra variety is Haritha followed by different imported hybrid varieties referred to by company names. Since most of the capsicum farmers in the sample, cultivated self-produced seeds, they were not aware on the seed variety. However according to field experience the farmers have adopted different imported hybrid varieties based on their previous experience.

20.3.5 Fertilizer

Depending on the crop and soil requirement farmers apply chemical and organic fertilizers in vegetable farming. Contrary to up country vegetable farming most of the low country vegetable farmers mainly depend on chemical fertilizers to fulfill crop nutrient requirement. As presented in Table 20.9 level of organic fertilizer application is minimal among the low country vegetable farmers.

Table 20.9: Mean Chemical and Organic Fertilizer Costs in Selected Low Country Vegetable Production

Crop	Mean chemical Rs/ac	Mean organic Rs/ac
Bitter gourd	22,346	-
Brinjal	22,025	615
Luffa	14,674	5,087
Capsicum	22,444	8,767
Okra	9,087	987

Source: HARTI Survey Data, 2016

20.3.6 Machinery

The Table 20.10 depicts the average machinery cost of selected low country vegetable production. In the farming of these selected five vegetables machinery is mainly used for land preparation. This average cost component slightly varied among district due to variation in land types.

Table 20.10: Mean Machinery Cost in Selected Low Country Vegetable Production

Crop	Mean cost Rs/ac
Bitter gourd	7,345
Brinjal	8,920
Luffa	6,973
Capsicum	12,218
Okra	11,739

Source: HARTI Survey Data, 2016

20.3.7 Pesticides

Vegetables are quite different from most perennials because they produce high quantity of biomass within a short period of about 2 – 3 months. Therefore, with the intention of getting the maximum harvest within limited period farmers try their maximum to overcome pest and disease problems, which reduce the quality of harvest by all means. The use of agrochemicals including pesticides has been found to be the immediate and cheaper way to produce unblemished vegetables and increased farm productivity. The Table 20.11 shows the average weedicide, insecticide and fungicide cost of selected vegetables.

Table 20.11: Mean Pesticide Cost in Selected Low Country Vegetable Production

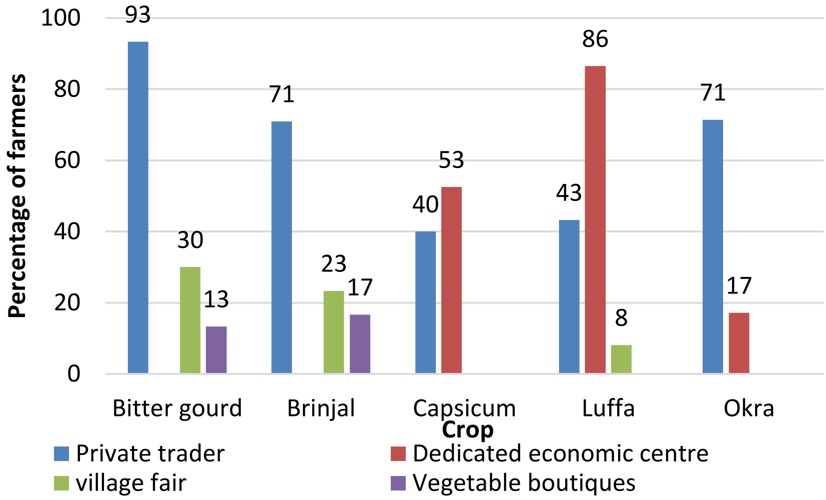
Crop	Mean cost Rs/ac		
	Weedicide	Insecticides	Fungicides
Bitter gourd	2,321	23,245	13,662
Brinjal	3,408	27,193	14,412
Luffa	502	10,105	7,677
Capsicum	180	9,031	7,795
Okra	-	6,250	-

Source: HARTI Survey Data, 2016

Most commonly used type of pesticide by the low country vegetable farmers is insecticides followed by fungicides. Weedicide usage is low among those farmers and the reason for that is after establishing the crop in field they practice manual weeding.

20.3.8 Marketing

There are various options available for vegetable farmers to sell their products. The Figure 20.10 illustrates the popular marketing channels identified in selected sample areas in the baseline survey.



Source: HARTI Survey Data, 2016

Figure 20.10: Different Methods in Low Country Vegetable Marketing

Most number of farmers gives first preference to sell the product to the private trader. The category of private traders includes the collectors who came to the farm to purchase the product (collectors) and traders in the outlets in town or village. First priority goes to this private trader because it is convenient to sell the product to a buyer who came to their doorstep or vegetable outlet closer to the farmland. The fair is also important mean of selling in Ratnapura and Anradhapura districts. Vegetable farmers in Puttalam and Matale districts largely sell their products to the Dedicated Economic Centers located in those areas. Farmers prefer to sell their product to these centers because of the higher price they can fetch. Farmers select marketing channel mainly based on the price, instead of that farmers in the study sample choose marketing channels based on availability of transport facilities and the quality parameters. If the buyer is not concerned about the quality of the harvest and not practicing the grading, the farmers prefer to sell the product to that buyer even at lower prices.

20.3.9 Total Cost of Production

Average production costs per acre of land calculated for selected crops using sample survey data is shown in Table 20.12.

Table 20.12: Average Cost of Production in Values for Selected Low Country Vegetables (Rs/ac)

Crop	COP (including family labour) (Rs/ac)	COP (excluding family labour) (Rs/ac)
Bitter gourd	127365.70	121326.20
Brinjal	100802.30	98882.74
Capsicum	104549.80	92531.72
Luffa	102688.90	94200.75
Okra	74311.51	65777.55

Source: HARTI Survey Data, 2016

20.4 Potentials and Constraints of Production

The Table 20.13 indicates the few main impediments that low country vegetable farmers confront when they grow low country vegetables. Pest and disease outbreaks were highlighted as the main threat to vegetable production by 49 percent of respondent farmers in all selected areas irrespective of the crop. More than 45 percent of the bitter gourd farmers pointed out pest attacks as the main constraint that decay the production. Many farmers faced another set of issues at the time the production. Most of the issues related to marketing arose due to non-availability of proper marketing channel. The farmers argued that the price they received was not adequate to cover the input cost and cost of living especially during the harvesting time. Vegetables have high risk of price fluctuations even within a day due to its nature of perishability.

Table 20.13: Major Issues in Low Country Vegetable Production

	Bitter gourd		Brinjal		Luffa		Capsicum		Okra		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Pest and disease attacks	21	45	18	30	14	29	14	19	16	25	83	49
Marketing issues	3	6	17	28	6	13	12	17	18	29	56	33
High input cost (pesticide, labour, seeds)	5	11	5	8	12	25	10	14	9	14	41	24
Lack of quality seeds	1	2	1	2	6	13	1	1	8	13	17	10
Issues in quality and availability of inputs	8	17	4	7	4	8	7	10	3	5	26	15
Escalating fertilizer prices	3	6	6	10	2	4	12	17	4	6	27	16
Water issues	3	6	4	7	4	8	10	14	1	2	22	13
Damages from natural disasters	1	2	3	5		0	4	6	2	3	10	6
Poor in extension service	2	4	2	3		0	2	3	2	3	8	5

Source: HARTI survey data, 2016

The other main constraint faced by the farmers is non-availability of quality inputs on time. This is a huge problem with planting materials. Approximately 10 percent of the sample farmers responded that they find it hard to set good quality seeds at the required time. Even though the use of organic fertilizer in low country vegetable cultivation is comparatively low, the farmers pointed out that despite their willingness to apply organic fertilizer there is an issue in availability. Other than that 16 percent of the sample farmers pointed out increasing fertilizer price as an obstacle to their cultivations. About 13 percent of the selected farmers reported water related issues during the cultivation period. Major issue related to water is water scarcity during certain periods especially in rainfed cultivation.

20.5 Recommendation and Suggestions

Vegetable sector in Sri Lanka has huge potential for expansion because of the continuous demand for vegetables within the country and it could be further developed as an export product. The government interventions to develop this sector should be designed in a way to address the key issues faced by the vegetables farmers. Based on the farmers' views some recommendations are made to be considered in government policy formulation.

Main issues faced by most of the vegetable farmers are related to marketing, such as price volatility, not having a reasonable farm gate price etc. Absence of production planning in line with market demand is one of the main reasons for production and marketing related problems (Rupasena, 1999). A sound production plan for the vegetable sector should be developed by analyzing the year around domestic and international demand on a monthly basis. Since this planning should be an all island plan with participation of stakeholders from all relevant government, provincial, regional and farmer organization level.

It is important to highlight the necessity of addressing the issues related to input market allied with vegetable production. Provision of quality seeds at the correct time is needs due attention. The key players in the local vegetable seed industry in Sri Lanka are DOA, private companies and small scale contract farmers. However, private companies being profit oriented cannot expect to sell their product at lower prices, Therefore, the DOA as the main stakeholder of local vegetable seed production has to be involved more efficiently to enhance the local seed production through contract farming. Extension services have to be revitalized as most of the farmers stress the need of an effective extension system.

Since vegetable farmers are smallholders, by grouping farmers into organizations can minimize production cost and increase returns. The establishment of farmer companies, which is an elevated type of farmer organizations, can provide agricultural inputs such as fertilizers and pesticides at a price below the market price through bulk purchasing. Acting as a group enhances the bargaining power of the farmers more than that of individuals hence can go for a maximum possible price.

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Chapter Twenty-One

Fruits

R.M.M.H.K. Rambodagedara
J.A.U.P. Jayasinghe

SUMMARY

This chapter discusses baseline information on pineapple, mango, papaya, banana and watermelon which are among the most prominent fruit crops in Sri Lanka.

The average extents of cultivation and production have fluctuated significantly in the reference period particularity for banana, papaya and mango. Further production of these fruits has increased over the period except pineapple which shows a slight production drop. Further, both in terms of quantity and value, exports of all the fruits (in fresh and value-added forms) except preserved mango recorded a remarkable increase.

Despite the nutritious value and good taste, per capita consumption of fruits is much lower than the requirement however, banana consumption is somewhat higher than the other types of fruits which are discussed in this chapter. Prices of all types of fruits have fluctuated over the period. It can be observed a notable gap between the producer and retail prices of fruits; particularly this price gap is much higher in pineapple providing fewer benefits to the producer and to the consumer.

There is very less representation of young farmers in fruit cultivation as the majority of farmers belong to higher age categories. Primary income of the great majority of the surveyed farmers is agricultural-based and fruits are mainly grown under rain-fed condition except for banana. Farmers are used different sources for obtaining seeds and seedlings as they cultivated diverse varieties of fruits. Cost of production is considerably high in each type of fruit and major cost component is varying to the type. Crop damages due to pest and disease is the most common and critical issue pertains in fruit cultivation indicating a need for the proper remedial measure. Absence of proper marketing channels, water scarcity, lack of quality seeds and high input cost are other major issues encountered with the fruit cultivation.

CHAPTER TWENTY ONE

Fruits

21.1 Overview of the Crops

Five fruit crops namely, pineapple, mango, papaya, banana and watermelon were selected for the baseline survey considering the national production targets of fruits in 2016.

21.1.1 Background of the Selected Fruit Crops

Pineapple

The pineapple (*Ananas comosus*) is a tropical plant which is indigenous to South America. Temperature is the most important climatic factor affecting productivity where the optimum temperature ranges between 24-27°C. It is important to have a well distributed rainfall throughout the year with the mean annual rainfall of 1000 mm. The best soils for pineapple production are well drained, deep and gravel soils. In Sri Lanka, low country wet and intermediate zones are more suitable for pineapple cultivation and it can be grown in the dry zone with the supplementary irrigation. Kurunegala, Gampaha, Badulla, Puttalam, Monaragala, Colombo and Galle are the major pineapple growing areas. Main recommended varieties in Sri Lanka are Kew and Mauritius (Department of Agriculture, 2015).

Mango

Mango (*Mangifera indica*), belongs to *Anacardeaceae* family of trees and native to tropical Asia and Indo-Malaya. The mango is one of the most popular fruits world-wide, and is today cultivated in every continent except Europe (Bose & Mitra,1990). Seventy species of mango are presently recognized. In Sri Lanka, mangoes grow in almost every part of the country up to 600 m altitude. Predominantly, it is grown in Kurunegala, Anuradhapura, Hambantota, Puttalam, Monaragala, Jaffna districts and Mahaweli Systems H & C. Optimum temperature for cultivation ranges from 27°C to 30°C and areas which are having a well distributed rainfall varied from 500mm to 2500 mm per year is quite suitable for its cultivation. The crop is grown on a variety of soils where well-drained, deep and light soil is the best soil for its cultivation.

There is a wide range of mango cultivars presently grown in Sri Lanka. Out of these, a number of best cultivars have been identified for cultivation under various agro-ecological regions of the country. In the dry zone major cultivars are *Karthakolomban, Willard, Vellaicolomban, Ambalavi, Chembatan* and *Malwana.* For the intermediate zone it is *Karthakolomban*, *Vellaicolomban, Willard, Bettiamba* and *Malwana*. In wet zone *Vellaicolomban, Gira amba, Peterprasand* and *Dampara* are the prominent cultivars (Department of Agriculture, 2015).

Banana

Banana (*Musa cuminata Colla*) is very popular fruit all over the world and it originated in the Asian region. Banana is grown in more than 150 countries in the world and it is believed that there are more than 1000 banana varieties in the world.

Banana is a very popular fruit which is grown on large, medium, small scales and in the home gardens. Banana is a good source of energy. It is highly digestible, good for gastro intestinal disorders, constipation, arthritis, anemia and allergies. Particularly unripe fruit is good for urinary tract disorders, obesity and disorders of menstruation. According to Department of Agriculture, recommended varieties are Embul, Kolikuttu, Anamalu, Seeni kesel, Rathambala and Embon. However, Embul, Kolikuttu, and Seeni are the popular banana varieties cultivated in Sri Lanka in large extent. In addition to fresh banana production various value added products such as salads, chips, flour and juice could be produced through fresh Banana (Department of Agriculture, 2015).

Papaya

Papaya, botanically known as *Carica papaya* is native to the tropical region of America and now cultivated in most tropical countries. In Sri Lanka papaya is cultivated primarily as a home garden crop and mainly grown in the dry and intermediate zones of the country. The major papaya producing district in the country is Kurunegala followed by Kalutara, Rathnapura, Gampaha, Galle, Anuradhapura, Puttalam, Hambantota and Badulla districts. The main recommended varieties of papaya are *Rathna* and *Red lady.* Although the crop can be grown in areas where the large temperature gap exists, most suitable temperature range for the crop is 28°C - 35°C. It is important to have a well-drained deep soil which is rich in organic matters for the papaya cultivation (Department of Agriculture, 2015).

Watermelon

Watermelon is tropical or subtropical plant and botanically known as *Citrullus lanatus,* originated in Southern Africa. Watermelon belongs to the family *Curcurbitaceae*. Watermelon contains about 92 percent water and six percent sugar. It has zero fat or cholesterol. It is also a nutritious fruit that rich in vitamins and antioxidants.

Today more than 1,200 varieties of watermelon are grown around the world in different shapes, colours and tastes. Watermelon plants love hot climates and need temperature higher than about 25°C. Crop grows best in fertile, well-drained sandy loam soils.

21.1.2 Major Producing Areas

Pineapple

Gampaha and Kurunegala are the major producing areas of pineapple both by extent and production as shown in the Table 21.1 and 21.2. Accordingly, 68 percent of the total pineapple cultivation area belonged to these two districts in the reference period. In 2011, the extent of pineapple production increased by 26 percent compared to 2010, however in 2012 the cultivation extent dropped by 17 percent.

Table 21.1: Major Pineapple Producing Areas in Sri Lanka (2006 to 2015) by Extent

Year	Major Gowing Areas by Extent (ha)						
	Gampaha		Kurunegala		Other		Sri Lanka
	Extent (ha)	%	Extent (ha)	%	Extent (ha)	%	Extent (ha)
2006	2076	42	1730	35	1157	23	4963
2007	1841	39	1664	35	1273	27	4778
2008	1780	36	1636	33	1546	31	4962
2009	1739	36	1627	34	1416	30	4782
2010	1756	35	1578	32	1622	33	4956
2011	1764	28	1616	26	2885	46	6265
2012	1968	38	1648	32	1595	31	5211
2013	2040	37	1739	31	1754	32	5533
2014	2020	37	1609	30	1781	33	5410
2015	1572	30	1507	29	2082	40	5161

Source: Department of Census and Statistics, 2007/2016

Kurunegala and Gampaha districts contributed up to 75 percent of the pineapple production of the country during the period from 2006 to 2015 as illustrated in Table 21.2. Other than these two districts, Colombo, Kalutara, Puttalam, Badulla, Moneragala and Hambantota districts also made a substantial contribution to the pineapple production of the country.

Table 21.2: Major Pineapple Producing Areas in Sri Lanka (2006 to 2015) by Production

Year	Major Producing Areas by Production (No. of Fruits)						
	Kurunegala		Gampaha		Other		Sri Lanka
	'000	%	'000	%	'000	%	'000
2006	20,160	42	19,440	41	8,040	17	47,640
2007	19,224	43	17,058	38	8,139	18	44,421
2008	17,325	40	15,142	35	11,013	25	43,480
2009	17,277	42	14,920	36	9,092	22	41,289
2010	17,294	39	15,121	34	11,773	27	44,188
2011	16,863	38	16,143	36	11,423	26	44,429
2012	16,425	35	19,353	42	10,836	23	46,614
2013	17,188	44	10,216	26	11,659	30	39,063
2014	16,775	43	10,054	26	11,753	30	38,582
2015	13,113	30	16,417	37	14,379	33	43,909

Source: Department of Census and Statistics

Mango

Mango has diverse geographical distribution however, as highlighted in Figure 21.3 and Figure 21.4 Kurunegala district is the leading mango producing district in Sri Lanka in terms of both extent and production. Nearly 20 percent of mango had been cultivated in Kurunegala district and around 20 percent of total production came from the same district in the reference period.

Table 21.3: Major Mango Producing Areas in Sri Lanka (2006 to 2015) by Extent

Year	Major Producing Districts by Extent (ha)												
	Kurunegala		Gampaha		Kandy		Anuradhapura		Hambantota		Other		Sri Lanka
	Extent (ha)	%	Extent (ha)	%	Extent (ha)	%	Extent (ha)	%	Extent (ha)	%	Extent (ha)	%	Extent (ha)
2006	4768	19	2049	8	1813	7	1565	6	1166	5	12412	49	25315
2007	4634	18	1959	8	1758	7	1770	7	1181	5	12596	50	25271
2008	4620	18	1835	7	1862	7	1748	7	1255	5	13044	51	25747
2009	4361	17	1909	7	1888	7	1741	7	1187	5	13687	52	26120
2010	4533	17	1710	6	1854	7	1735	6	1590	6	14123	52	27179
2011	4514	16	1507	5	2003	7	2121	8	1682	6	14692	53	27686
2012	4331	15	1777	6	1972	7	2237	8	1584	6	15032	53	28126
2013	4349	16	2055	7	1911	7	2147	8	1446	5	14442	52	27670
2014	4583	15	2101	7	1954	7	2199	7	1747	6	15840	53	29744
2015	5119	18	1687	6	2006	7	1571	6	1552	6	14508	52	27786

Source: Department of Census and Statistics

Table 21.4: Major Mango Producing Areas in Sri Lanka (2006 to 2015) by Production

Year	District (No. of Fruits)												
	Kurunegala		Anuradhapura		Ratnapura		Hambantota		Gampaha		Other		Sri Lanka
	('000)	%	('000)	%	('000)	%	('000)	%	('000)	%	('000)	%	('000)
2006	89206	21	29267	7	22951	5	25572	6	36157	8	223624	52	426777
2007	88313	21	34486	8	23601	6	26900	6	34538	8	216863	51	424701
2008	75855	19	28694	7	25363	6	21281	5	14534	4	228871	58	394598
2009	70039	17	22090	5	23470	6	23699	6	31430	8	241035	59	411763
2010	69385	16	22317	5	24424	6	31371	7	28194	7	257212	59	432903
2011	68222	16	29129	7	22843	5	31943	8	24233	6	243133	58	419503
2012	65392	17	27274	7	20833	5	25473	6	17366	4	238286	60	394624
2013	65546	17	26066	7	23849	6	38523	10	19248	5	221341	56	394573
2014	69589	18	26536	7	23849	6	20656	5	19567	5	222468	58	382665
2015	66018	16	26838	6	42422	10	21969	5	18604	4	248212	59	424063

Source: Department of Census and Statistics

Banana

Leading districts contributing to banana production in Sri Lanka both in terms of extent and production were the Kurunegala, Rathnapura and Monaragala districts in the reference period. (Table 21.5 and 21.6)

Table 21.5: Major Banana Producing Areas in Sri Lanka (2006 to 2015) by Extent

Year	Major Banana Producing Districts								
	Kurunegala		Ratnapura		Monaragala		Other		Sri Lanka
	Extent (ha)	%	Extent (ha)	%	Extent (ha)	%	Extent (ha)	%	Extent (ha)
2006	8311	17	5570	11	4482	9	30493	62	48856
2007	8369	17	5717	12	4502	9	30833	62	49421
2008	8362	18	5705	12	4927	10	28688	60	47682
2009	8289	17	5878	12	4603	10	29277	61	48044
2010	7874	15	6202	12	5545	11	32756	63	52378
2011	7308	14	6514	12	5545	10	33991	64	53359
2012	5631	11	7002	13	6305	12	33882	64	52819
2013	5235	10	7609	14	7581	14	32520	61	52941
2014	4965	9	7609	14	7581	13	36062	64	56216
2015	6981	13	7471	14	6962	13	31832	60	53246

Source: Department of Census and Statistics

From the total production nearly 40 percent of banana was cultivated and produced in these districts. In addition, Hambantota, Kandy, Kegalle, Matara and Gampaha districts also provided a considerable contribution for banana production in Sri Lanka.

However, when the overall banana production trend in major producing areas is taken into consideration, the extent of banana cultivation and yield show declining trend in Kuruneagla district while the extent and yield have increased in the Rathnapura and Monaragala districts in the reference period.

Table 21.6: Major Banana Producing Areas in Sri Lanka (2006 to 2015) by Production

Year	Major Banana Producing Districts (No. of Bunches)								
	Kurunegala		Ratnapura		Monaragala		Other		Sri Lanka
	('000)	%	('000)	%	('000)	%	('000)	%	
2006	6,209	20	4,154	13	2,261	7	18,904	60	31,528
2007	6,330	20	4,463	14	2,956	9	18,670	58	32,419
2008	6,414	19	5,199	16	4,327	13	17,181	52	33,121
2009	6,434	20	4,835	15	3,811	12	16,902	53	31,982
2010	6,256	17	5,655	16	4,903	14	18,962	53	35,776
2011	5,886	16	6,330	17	4,903	13	20,542	55	37,661
2012	4,294	11	6,860	17	4,969	12	23,649	59	39,772
2013	3,933	10	7,462	19	6,344	16	22,358	56	40,097
2014	3,669	8	7,462	17	6,344	14	26,702	60	44,177
2015	4,487	8	8,965	16	8,705	15	34,841	61	56,998

Source: Department of Census and Statistics

Papaya

Major Papaya producing district was Hambantota in terms of both extent and yield in the period from 2006 to 2015, as illustrated in Table 21.7 and 21.8. Around 50 percent of papaya production is spread over five districts in Sri Lanka including Hambantota. Other major papaya producing districts were Kalutara, Kurunegala, Puttalam and Anuradhapura.

Table 21.7: Major Papaya Producing Areas in Sri Lanka (2006 to 2015) by Extent

Year	Major Producing Districts by Extent (ha)														
	Gampaha		Kandy		Anuradhapura		Hambantota		Kurunegala		Galle		Other		Sri Lanka
	Extent	%	Extent	%	Extent	%	Extent	%	Extent	%	Extent	%	Extent	%	
2006	414	8	394	8	405	8	469	9	263	5	240	5	2,894	57	5,079
2007	550	10	337	6	541	10	479	9	341	6	250	4	3,083	55	5,581
2008	525	8	427	7	513	8	496	8	429	7	412	7	3,472	55	6,276
2009	331	5	438	7	528	9	551	9	471	8	386	6	3,416	56	6,120
2010	358	5	468	6	602	8	1,674	22	577	7	429	6	3,609	47	7,716
2011	358	4	495	6	534	7	2,079	26	642	8	426	5	3,548	44	8,081
2012	396	5	437	6	512	6	1,701	21	717	9	507	6	3,660	46	7,933
2013	390	6	410	6	492	7	851	12	676	10	482	7	3,759	53	7,061
2014	364	5	402	6	316	5	877	13	659	9	482	7	3,844	55	6,943
2015	336	5	419	6	194	3	820	12	752	11	519	8	3,626	54	6,666

Source: Department of Census and Statistics

As shown in the Table 21.8, in 2015 Kalutara district was the highest payaya producer in Sri Lanka recording a 55 percent of production increase when compared with the production in 2014. In contrast there was a significant drop by 50 percent in papaya yield in Hambatota district in 2015 when compared with the production in the previous year, 2014.

Table 21.8: Major Papaya Producing Areas in Sri Lanka (2006 to 2015) by Production

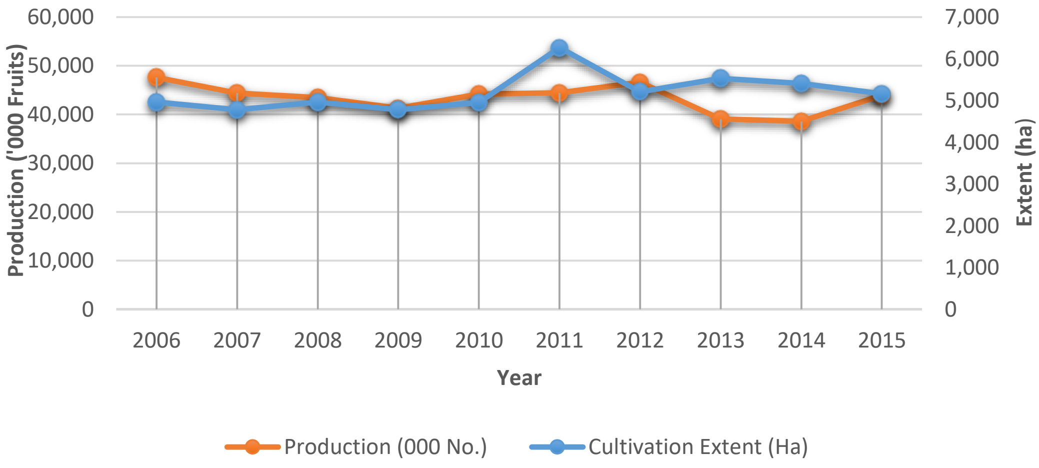
Year	Major Producing Districts by Production (No. of Fruits)												
	Hambantota		Kalutara		Puttalam		Kurunegala		Anuradha pura		Other		Sri Lanka
	(‘000)	%	(‘000)	%	(‘000)	%	(‘000)	%	(‘000)	%	(‘000)	%	
2006	3,273	10	3,590	11	2,359	7	2,374	7	2,770	9	18,154	56	32,520
2007	3,476	10	2,821	8	2,645	8	2,342	7	2,357	7	19,914	59	33,555
2008	4,433	12	2,076	5	2,471	6	2,996	8	1,376	4	25,009	65	38,361
2009	4,637	12	2,819	8	970	3	3,278	9	2,476	7	23,140	62	37,320
2010	13,463	27	3,305	7	1,362	3	3,477	7	3,693	7	24,300	49	49,600
2011	16,095	31	2,828	5	3,356	6	4,004	8	3,780	7	22,280	43	52,343
2012	19,805	32	3,408	6	5,145	8	4,446	7	3,756	6	24,924	41	61,484
2013	11,708	21	3,348	6	4,174	8	4,080	7	4,049	7	27,712	50	55,071
2014	19,591	31	4,586	7	4,174	7	4,098	7	2,454	4	27,545	44	62,448
2015	9,135	15	10,242	17	3,469	6	6,941	11	1,543	3	30,015	49	61,345

Source: Department of Census and Statistics

21.1.3 Extent under Cultivation and Production

Extent under Cultivation and Production of Pineapple

As Figure 21.1 reflects pineapple cultivation extent varied between 4778 ha to 6265 ha in the reference period. The highest extent of cultivation of pineapple was reported in 2011 and it was 21 percent increase of the cultivation extent when compared with the extent in 2010.



Source: Department of Census and Statistics

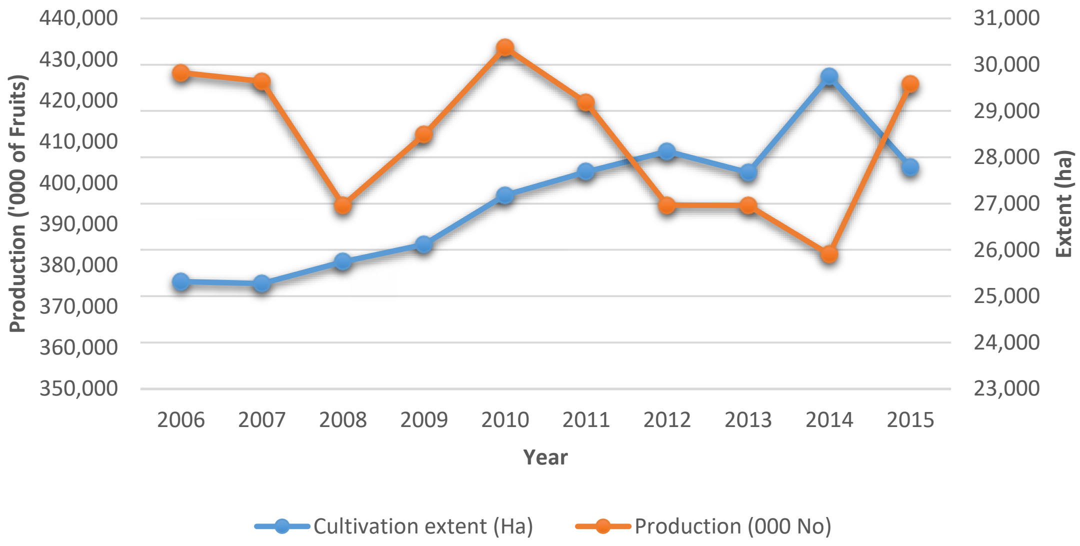
Figure 21.1: Average Production and Average Extent of Pineapple (2006 to 2015)

The production of pineapple fluctuated over the period 2006 – 2015. The highest pineapple production was recorded in 2006. In 2013 there was a plunge in the production and the yield decreased by 16 percent compared with the year 2012. However, in 2015 pineapple production again increased by 14 percent.

Mango: Extent under Cultivation and Production

Mango cultivating extent increased slightly during the reference period until 2015 as illustrated in Figure 21.2. In 2015, extent under total Mango cultivation decreased by six point five percent. However, during the period from 2006 to 2015 it increased by around Nine percent (2471 ha).

Mango Production fluctuated significantly over time varying from 382,665,000 fruits to 432,903,000 fruits during the period 2006 to 2015. In 2015, production increased by around 10 percent compared with the production in 2014 recording the highest mango yield in Sri Lanka in the reference period.

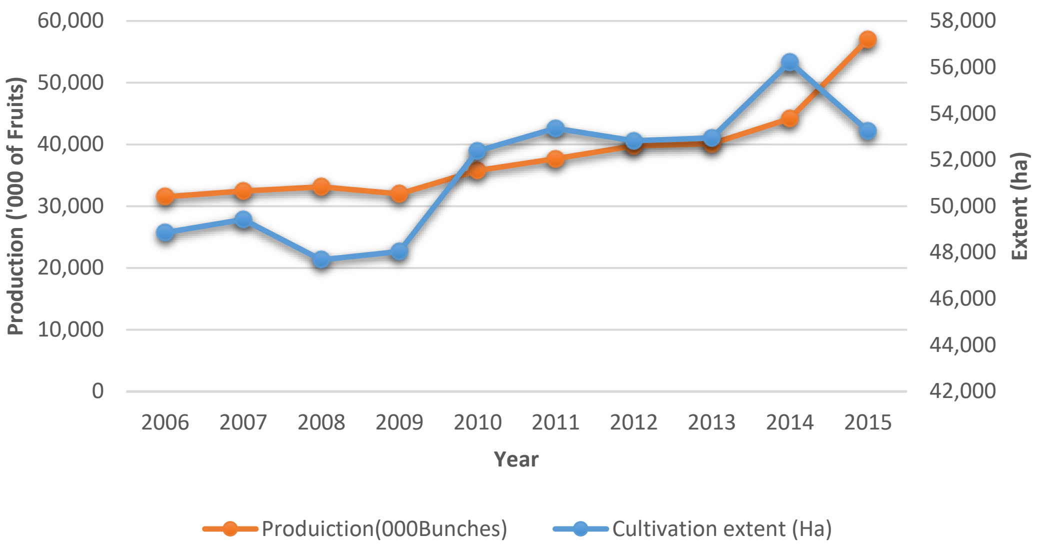


Source: Department of Census and Statistics

Figure 21.2: Average Production and Average Extent of Mango (2006 to 2015)

Banana: Extent under Cultivation and Production

Banana cultivation extent varied between 47,682 ha to 56, 216 ha during the period from 2006 to 2015. As shown in the Figure 21.3, from 2006 to 2007 cultivation extent of banana slightly changed and in 2010 there was a sudden upsurge of the cultivation extent of banana by eight percent.



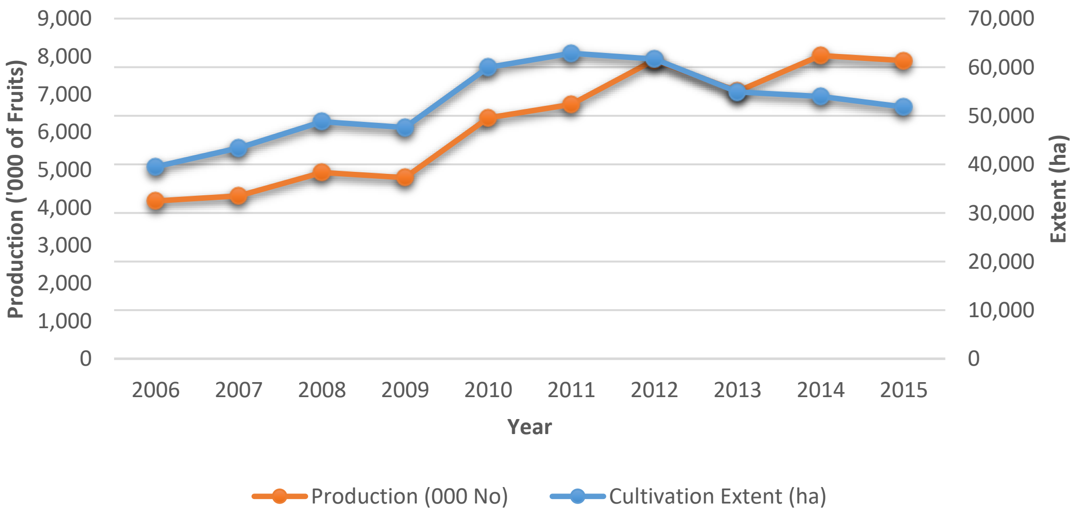
Source: Department of Census and Statistics

Figure 21.3: Average Production and Average Extent of Banana (2006 to 2015)

Banana production varied between 31,528,000 and 56,998,000 (Bunches) in the reference period of 2006 to 2015. After 2009, an upward trend in banana cultivation was observed as shown in Figure 21.3. In 2015, banana production was 56,998,000 bunches recording the highest production during the period and it was a 22 percent of increase when compared with the figures for 2014.

Papaya: Extent under Cultivation and Production

As illustrated in Figure 21.4, papaya cultivation extent had slightly changed in the reference period. The highest cultivation extent recorded in 2011 and was 8,081 ha. From 2006 to 2015 total papaya production had increased by 31 percent.



Source: Department of Census and Statistics

Figure 21.4: Average Production and Average Extent of Papaya (2006 to 2015)

Overall, the papaya production depicted an upward trend over the period from 2006 to 2015 with the slight decreases in the production in the years of 2009, 2013 and 2015. The highest Papaya production was recorded in 2012, followed by a steep decline in 2013.

21.1.4 Importance of the Crop to the Economy

This section discusses the export value and quantity of export of pineapple, mango, banana and papaya, as major fruit crops that contribute to the export earnings of the country. However, relevant data and information for watermelon are not available for the reference period.

Export Value of Pineapple

Pineapple is among the main fruit crops used in the fruit processing industry, hence a leading contributor to value added fruit exports in Sri Lanka. As shown in Table 21.9, export earning of dried pineapple was higher than that of other value added products of pineapple in the reference period. In 2015 export earning value of the dried pineapple increased by 50 percent.

In 2013, the export of the quantity of pineapple fresh fruit more than trebled and the export value increased over fourfold within the year after a sharp drop of quantity and value of fresh pineapples in 2012.

Table 21.9: Fresh and Value Added Fruit Exports of Pineapple: 2006 to 2015

Year	Pineapple							
	Fresh		Juice		Dried		Preserved	
	Qty (mt)	Value (Rs’000)	Qty (mt)	Value (Rs’000)	Qty (mt)	Value (Rs’000)	Qty (mt)	Value (Rs’000)
2006	1,752	148,284	4	615	251	104,823	159	36,797
2007	1,513	190,298	108	23,131	217	114,448	134	40,430
2008	1,488	188,909	12	1,857	334	220,485	463	111,995
2009	1,254	139,149	31	7,089	84	55,072	394	97,181
2010	798	116,991	75	6,326	102	95,805	295	69,362
2011	704	99,328	270	36,844	93	96,276	529	129,014
2012	346	48,589	234	89,260	130	144,493	283	71,931
2013	1,270	208,440	232	57,001	144	173,943	341	90,435
2014	1,982	357,024	104	37,725	218	287,293	508	147,048
2015	1,454	285,082	73	30,180	267	404,703	314	113,330

Source: Department of Census and Statistics

Export Value of Mango

The export value of both fresh and preserved mango had fluctuated throught out the reference period as shown in Table 21.10.

Table 21.10: Fresh and Value Added Fruit Exports of Mango: 2006 to 2015

Year	Mango			
	Fresh		Preserved	
	Quantity (mt)	Value ('000 Rs.)	Quantity (mt)	Value ('000 Rs.)
2006	40	16,776	28	6,671
2007	90	60,980	26	9,972
2008	43	27,238	19	6,042
2009	62	25,085	28	6,027
2010	103	27,935	2	1,034
2011	79	28,739	16	3,633
2012	25	13,469	9	3,185
2013	34	20,127	8	3,364
2014	134	28,627	11	3,733
2015	67	39,051	3	1,326

Source: Department of Census and Statistics

In 2007, value for fresh and preserved mango was recorded exceptional growth. In 2014, both export quantity and value of fresh Mango has increased. However, in 2015 preserved mango in terms of both quantity and value has decreased considerably by 73 percent and by 64 percent respectively.

Export Value of Banana and Papaya

In terms of both quantity and value banana is a dominant fruit crop in the fresh fruit export market. This is mainly due to the commercial level Cavendish cultivation in Sri Lanka. Export of other banana varieties such as Ambul, Suger Plantain, Kolikuttu, Rathabala and Ambun is very limited as these varieties are mainly consumed by the local consumers (Perera *et al*, 2015).

Table 21.11: Export of Banana and Papaya by Quantity and Value (2006 of 2015)

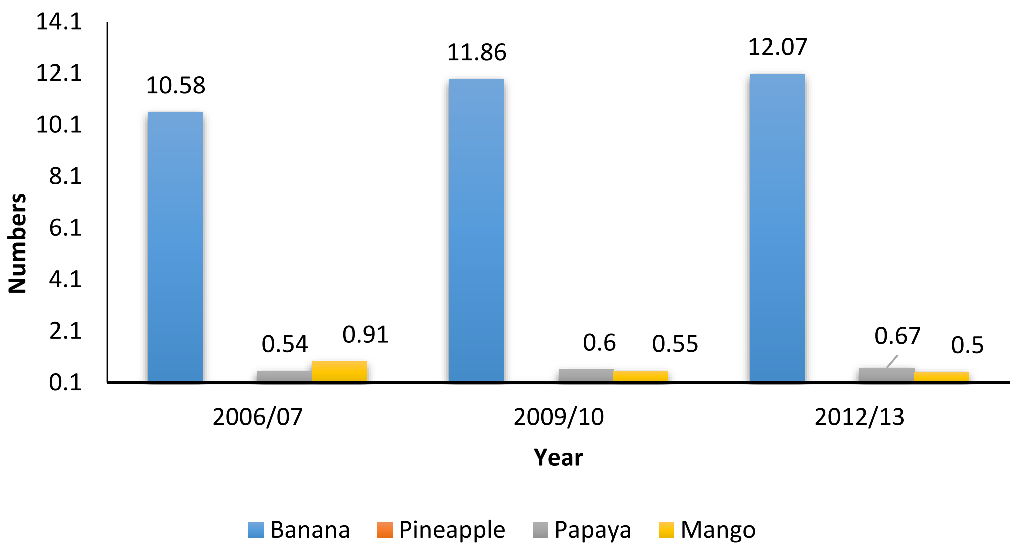
Year	Banana		Papaya	
	Fresh		Fresh	
	Quantity (mt)	Value ('000 Rs.)	Quantity (mt)	Value ('000 Rs.)
2006	58	11,227	113	23,711
2007	855	51,568	197	35,369
2008	1,751	87,558	800	97,580
2009	2,657	114,792	454	53,601
2010	5,048	212,545	783	82,831
2011	10,116	416,508	668	80,254
2012	16,218	775,618	1,188	98,928
2013	19,358	1,063,213	1,644	150,403
2014	19,166	2,010,806	3,229	241,727
2015	19,025	2,159,259	2,767	259,679

Source: Department of Census and Statistics

As shown in Table 21.11, banana exports have doubled in 2011 in both quantity and value terms. In 2012, Papaya export quantity increased considerably by 43 percent (520 mt). Most prominent variety of papaya export is Cavendish and Red Papaya. Rise of export in these varieties has caused to increase the export earning of fresh fruits during the period.

21.1.5 Per Capita Consumption of Fruits

Monthly per capita consumption of all fruit varieties was much lower than the required levels. As shown in Figure 21.5, per capita consumption banana by numbers was much higher than other three types of fruits since year round availability as a fruit, reasonability of price and smaller size of the fruit compared to other types of fruits considered here.



Source: Department of Census and Statistics

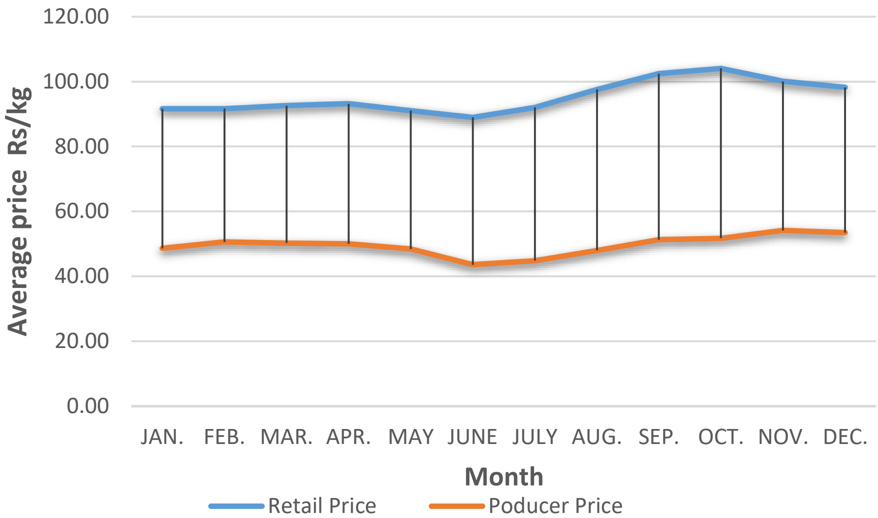
Figure 21.5: Per Capita Consumption of Banana, Pineapple, Papaya and Mango per Month (By numbers)

Pineapple is the least consumed fruit by the Sri Lankans when compared with other three types of fruits considered in this study. However, the per capita consumption of pineapple had remained relatively stable in the period. Per capita consumption of papaya per month had been more constant over the years as well. Although papaya is one of the healthiest fruits available throughout the year per capita consumption was much lower. In case of mango also the situation was the same in the reference period.

21.1.6 Prices of Fruits

Retail and Producer Price of Pineapple

It can be observed a considerable price difference between produce and retail prices which record approximately Rs.50 price difference (Figure 21.6). Both retail and producer prices of the pineapple have fluctuated over time. In the months of June and July both retail and producer prices of pineapple dropped, since this period is the main and natural harvesting season. In contrast, pineapple prices were at peak in the months from October to December due to low supply.



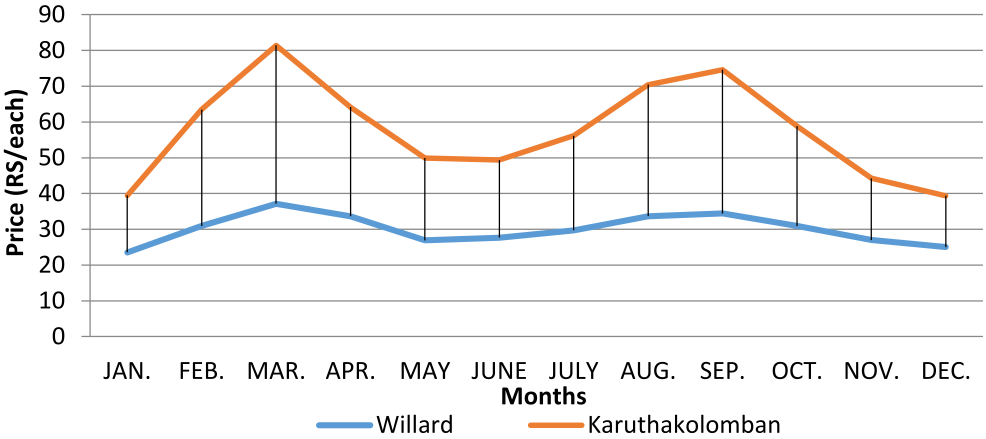
Source: Department of Census and Statistics, HARTI

Figure 21.6: Retail and Producer Prices of Pineapple for the Period of 2006 to 2015

Retail Price of Mango

Average retail price of karuthakolomban and Willard fluctuated significantly over the period. Price variation of mango is largely determined by the seasonality of the fruit. As illustrated in Figure 21.7, off season prices were significantly high. In each variety average retail prices were at peak in month of March recording Rs 37.13 average price for Willard and Rs 81.44 average price for Karuthakolomban. In the months from November to January retail prices of two mango varieties were significantly dropped. The average retail price of Willard was dropped to Rs 23.53 in Januaray and average retail price of Karthakolomban was dropped to Rs 39.39 in December recording lowest prices.

(*Since producer price details were not continuously collected over the period it was unable to capture for this report)



Source: Marketing Food Policy and Agribusiness Division, HARTI

Figure 21.7: Retail Prices of Mango (Karuthakolomban and Willard) for the Period of 2011 to 2015

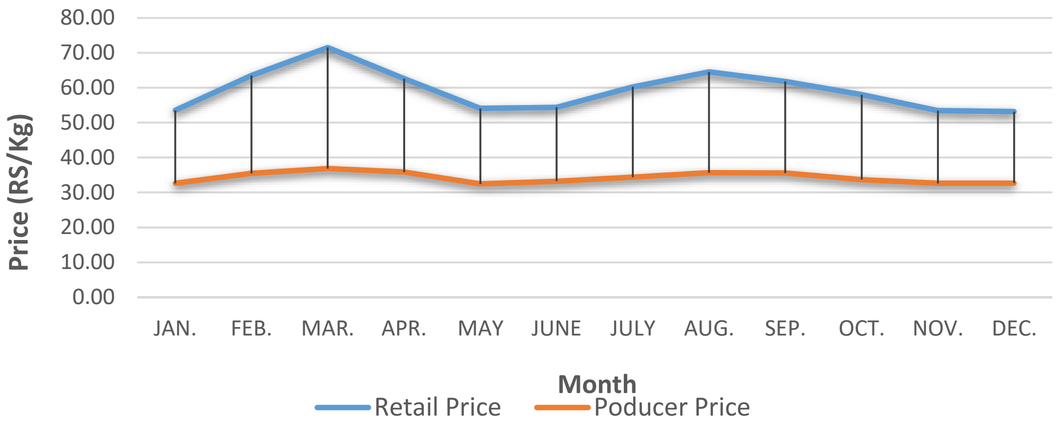
Producer and Retail Prices of Banana

Producer and retail prices of Anamalu and Ambul which are among two main banana varieties in Sri Lanka are discussed in this section. Prices of Anamalu were relatively stable with little fluctuations while other variety (Ambul) showed moderate level of fluctuations (Figure 21.8 and 21.9). Accordingly, average producer price of Anamalu varied from Rs. 8.20 to Rs. 6.62 while average retail price varied from Rs 11.63 to 10.61 showing the little variation of the prices. Price behavior pattern of Banana for two varieties discussed here was quite dissimilar. In the months of Januaray, April, September and October both producer and retail prices of Ambul were higher. In the month of October producer price of Anamalu was at peak, however retail price was recorded highest in the month of September.

Producer and Retail Prices of Papaya

The Figure 21.8, shows the seasonal price variation of papaya. Producer prices of papaya were almost remained constant with little fluctuations. In contrast, the retail prices of papaya fluctuated widely over the period and varied from Rs.58.14 to Rs. 71.52. In February and March papaya retail prices were quite higher, where it was reverse in May, October, November and December.

In generally the gap between the producer price and retail prices were high. Particularly in March the difference between producer price and retail price was almost doubled providing fewer benefits to both producer and consumer.



Source: Department of Census and Statistics

Figure 21.8: Producer and Retail Prices of Papaya

21.2 Socio-Economic Characteristics of the Sample Farmers

For the baseline survey, 135 fruit growers were selected for the sample considering the major growing areas of each crop. Accordingly, 15 farmers for pineapple and 30 farmers for each other fruits represented the sample.

21.2.1 Age Distribution of Farmers

As shown in the Table 21.12, great majority of the fruit farmers were in the higher age categories. There was very less representation of young farmers below age of 40 in fruit cultivation. Engagement of youth who were below the age of 40 was relatively high in the banana and watermelon cultivation when compared with other fruit crops. The high profitability might be the reason for this. This favourable situation demonstrates a potential to be exploited to motivate younger farmers to fruit cultivation by creating awareness among them about the future prospects in this sphere. A comprehensive extension programme should be in place targeting further development of the cultivation for enhancing the quality and quantity of the product bearing in mind the export potential.

Table 21.12: Age Distribution of Pineapple, Mango, Banana, Watermelon and Papaya Farmers

Age Category	Pineapple (%)	Mango (%)	Banana (%)	Watermelon (%)	Papaya (%)
Age<30	Not reported	3.3	0.0	3.3	3.3
30<=age<40	6.7	13.3	23.3	23.3	3.3
40<=age<50	26.7	3.3	10.0	40.0	36.7
50<=age<60	33.3	43.3	40.0	20.0	30.0
Age>=60	33.3	36.7	26.7	13.3	26.7

Source: HARTI Survey Data, 2016

21.2.2 Level of Education of Farmers

As shown in the Table 21.13, majority of the farmers had obtained formal education only up to the secondary level indicating the lower level of education. However, education level was much higher among pineapple farmers compared with other fruit growers.

Table 21.13: Level of Education of Pineapple, Mango, Banana, Watermelon and Papaya Farmers

Level of Education	Pineapple %	Mango %	Banana %	Watermelon %	Papaya %
Primary (1-5 Grades)	6.7	26.7	26.7	30.0	20.0
Secondary (6-11 Grades)	33.3	46.7	36.7	46.7	60.0
Passed G.C.E. (O/L)	20.0	0.0	23.3	16.7	10.0
Up to G.C.E. (A/L)	26.7	10.0	6.7	3.3	6.7
Passed G.C.E. (A/L)	13.3	6.7	6.7	3.3	3.3
Diploma Holder	0.0	3.3	0	0.0	0.0
Not attended school	0.0	6.7	0.0	0.0	0.0

Source: HARTI Survey Data, 2016

21.2.3 Family Size

Family labour plays an important role in agrarian economies however, in the study location an impediment prevails since over 50 percent of fruit growers had fewer than five members in their households as shown in the Figure 21.14. Households of surveyed farmers with more than seven family members were quite a few.

Table 21.14: Number of Household Members

No. of Family Members	Pineapple (%)	Mango (%)	Banana (%)	Watermelon (%)	Papaya (%)
Members <3	6.7	16.7	23.3	3.3	13.3
3<=members<5	60.0	46.7	40.0	56.7	43.3
5<=members<7	33.3	30.0	30.0	33.3	36.7
Members >=7	0.0	6.7	6.7	6.7	6.7

Source: HARTI Survey Data, 2016

21.2.4 Economic Characteristics of the Sample Population

As illustrated in the Table 21.15, primary income of the great majority (88 percent) of the surveyed farmers was agricultural based. Only a few farmers engaged in other types of economic activities to earn their primary income. Remarkably, all the pineapple growers received their primary income through agricultural activities as pineapple is one of the commercially viable and increasingly demanding fruit crops grown in Sri Lanka.

Table: 21.15: Primary Income of the Farmers

Primary Employment	Pineapple %	Mango %	Banana %	Watermelon %	Papaya %	Total %
Farming/Animal husbandry	100	73	86	90	96	88
Government job	0	8	7	3	0	4
Private sector job	0	8	0	0	0	2
Self-employment	0	12	7	3	4	6
Skilled labourer	0	0	0	3	0	1

Source: HARTI Survey Data, 2016

21.3 Agricultural Inputs

21.3.1 Land

Distribution of Land Holdings by Ownership

As shown in Table 21.16, majority of the pineapple farmers had single ownership for their lands. Number of land holdings used by them was 45 out of the total extent of 103.62 acres. Other ownership category mentioned in the table includes leased in and tenancy out. The results indicate that average farmer had around eight acres of land for pineapple cultivation.

Table 21.16: Distribution of Land Holdings by Ownership - Pineapple Cultivation

Ownership	No. of Farmers	No. of Holdings	Total Extent (Ac)
Single owner	15	45	103.62
Other	3	5	16.00
Total	18	50	119.62

Source: HARTI Survey Data, 2016

Mango Cultivation: Distribution of Land Holdings by Ownership

Great majority of mango growers had single ownership for their lands as illustrated in Table 21.17. Average size of the land belonging to mango farmers was nearly four acres indicating the commercial orientation of the mango cultivation. According to the finding of the survey, in Kurunegala district average land extent of mango growers doubled that of the mango growers in Hambantota district.

Table 21.17: Distribution of Land Holdings by Ownership - Mango

Ownership	No. of farmers	No. of holdings	Total Extent
Single owned	29	66	102.5
Jointly owned	4	4	4
Encroached	4	7	6.5
Tenancy-in	3	3	5
Other	5	5	6
Total	45	85	124

Source: HARTI Survey Data, 2016

Banana Cultivation: Distribution of Land Holdings by Ownership

Ownership type of the majority of banana land holdings (69) was the single ownership and the total extent of single owned land holdings was 71.62 acres (Figure 21.18). Further, 11 land holdings were leased in lands distributed among nine farmers. Average land size of the banana farmers was 4.2 acres as banana is also a commercially viable crop, farmers have opted to grow.

Table 21.18: Distribution of Land Holdings by Ownership – Mango Cultivation

Ownership	No. of Farmers	No. of Holdings	Total Extent
Single owned	29	69	71.62
Jointly owned	4	7	14.75
Tenancy-out	4	4	5.50
Leased in	9	11	17.00
Other	5	10	16.75
Total	51	101	125.62

Source: HARTI Survey Data, 2016

Watermelon Cultivation: Distribution of Land Holdings by Ownership

Single ownership was the most common land ownership type of watermelon farmers as shown in the Figure 21.19.

Table 21.19: Distribution of Land Holdings by Ownership – Watermelon Cultivation

Ownership	No. of Farmers	No. of Holdings	Total Extent
Single owner	28	61	71.25
Jointly owned	4	4	2.75
Leased in	12	16	51.00
Other	6	6	7.75
Total	50	87	132.75

Source: HARTI Survey Data, 2016

Number of land holdings with single ownership was 61 covering a total extent of 71.25 acres. Sixteen land holdings were leased in lands worked by among 12 farmers. Average land size of watermelon was 4.4 acres.

Papaya Cultivation: Distribution of Land Holdings by Ownership

According to the survey findings 73 land holdings with an extent of 83.73 acres were single owned lands (Figure 21.20). Another 25 land holdings covering 49.33 acres of land were leased in lands. Average land size of the surveyed farmers was around six acres.

Table 21.20: Distribution of Land Holdings by Ownership – Papaya Cultivation

Ownership	No. of Holdings	Total Extent
Single owner	73	83.73
Leased in	25	49.33
Jointly owned	5	7.00
Encroached	10	31.00
Other	11	16.00
Total	124	187.06

Source: HARTI Survey Data, 2016

21.3.2 Number of Holdings Based on Water Sources

Pineapple Cultivation: Number of Holdings Based on Water Sources

According to Table 21.21, the pineapple cultivation was pursued mainly under rain fed conditions as there was little irrigation for even in the main producing areas. Accordingly, 82 percent of pineapple land extent was farmed under rain fed conditions while 15 percent of land out of total extent had minor irrigation facilities for cultivation.

Table 21:21: Number of Land Holdings based on Water Source – Pineapple Cultivation

Water Source	No. of Holdings	% of Holdings	Total Extent	% of Total Extent
Minor irrigation	7	14	18	15
Rain-fed	41	82	97.62	82
Other	2	4	4	3
Total	50	100	119.62	100

Source: HARTI Survey Data, 2016

Mango Cultivation: Number of Holdings Based in Water Sources

As shown in Table 21.22, similar to pineapple cultivation, mango too was farmed mainly under rain fed conditions. Accordingly, 69 percent of land holdings that covered 55 of land extent depended on this source of water.

Table 21.22: Number of Land Holdings based on Water Source – Mango Cultivation

Water Source	No. of Holdings	% of the Holdings	Total Extent	% of Total Extent
Major irrigation	6	8	8.50	7
Minor irrigation	14	18	25.00	20
Rain-fed	55	69	67.25	55
Other	5	6	22	18
Total	80	100	122.75	100

Source: HARTI Survey Data, 2016

Banana Cultivation: Number of Holdings based on Water Sources

As shown in Table 21.23, around 50 percent of banana cultivation extent was under major irrigation. Other major sources of water for banana were minor irrigation and rain fed conditions. A few decades back cultivation of banana in paddy lands had been a common practice in irrigated areas such as Sooriyawewa due to less water requirement for banana cultivation.

Table 21.23: Number of Land Holdings based on Water Source –Banana Cultivation

Water Source	No. of holdings	% of the holdings	Total Extent	% of Total Extent
Major irrigation	38	39	61.25	49
Minor irrigation	26	27	29.62	24
Rain-fed	26	27	20.75	17
Other	8	8	12.5	10
Total	98	100	124.12	100

Source: HARTI Survey Data, 2016

Watermelon Cultivation: Number of Holdings based on Water Sources

Watermelon too was grown mainly under rain fed conditions followed by major and minor irrigation as indicated in Table 21.24. Other source consisted of agro wells. Although the percentage of landholdings irrigated with water from agro-wells was eight, 27 percent of the total land extent received water mainly from this source.

Table 21.24: Number of Land Holdings based on Water Source – Watermelon Cultivation

Water Source	No. of Holdings	% of the Holdings	Total Extent	% of Total Extent
Major irrigation	20	23	26.75	20
Minor irrigation	14	16	20.00	15
Rain-fed	45	52	49.50	37
Other	7	8	36.25	27
Total	86.00	100.00	132.50	100.00

Source: HARTI Survey Data, 2016

Papaya Cultivation: Number of Holdings based in Water Sources

Major source of water for papaya cultivation was natural precipitation (34 percent of land holdings) followed by major irrigation (31 percent land holdings) and minor irrigation (21 percent land holdings). There was no remarkable difference in the usage of these main water sources for papaya cultivation (Table 21.25).

Table 21.25: Number of Land Holdings based on Water Source – Papaya Cultivation

Water Source	No. of Holdings	% of the Holdings	Total Extent	% of Total Extent
Major irrigation	39	31	56.58	30
Minor irrigation	26	21	49.12	26
Rain-fed	42	34	59.50	32
Other	17	14	21.86	12
Total	124	100	187.06	100

Source: HARTI Survey Data, 2016

21.3.3 Varieties, Sources and Types of Seed/ Seedling

Pineapple Cultivation:

The prominent variety used by the pineapple farmers was Mauritius. The farmers depended on three main types of sources for obtaining pineapple seeds, the Department of Agriculture, neighbouring farmers or self-produced seedlings. Majority of the farmers used improved varieties for the pineapple cultivation as revealed in the survey.

Mango Cultivation:

Karthakolomban and TJC were the prominent mango varieties grown by the farmers. The main source of seedlings for the mango cultivation was the Department of Agriculture. Only a few farmers obtained mango seedlings from other sources such as private companies and local markets. Locally certified seedlings and improved varieties were popular among the mango growers.

Banana Cultivation:

Pualu, Ambul and *Seeni* were the widespread banana varieties grown by the farmers. As for the seedlings, most of the farmers used self-produced banana seedlings or seedlings obtained from their neighbouring farmers. Only a few farmers obtained banana seedlings from other sources such as the Department of Agriculture and private vendors.

Papaya Cultivation:

According to the survey findings the local market was the main source for papaya seeds. Improved and hybrid seeds were the most prominent among the farmers. Red Lady was one of the popular papaya varieties used by the majority of Sri Lankans farmers in both Hambantota and Ratnapura districts. In addition, considerable number of farmers used other varieties including Sintha and MS 100.

Watermelon Cultivation:

Improved varieties purchased mainly at the local market were mostly popular among the farmers. Considerable number of farmers purchased seeds from the Department of Agriculture and private companies while some farmers used self-produced seeds.

When compared with other fruits the use of watermelon varieties marked a notable variation. Accordingly, Rocky variety was the most prominently used by the farmers and other varieties such as Kinira, Hyrock and Rambo were also popular.

21.3.4 Production and Average Yield of Fruits

Pineapple Cultivation:

Larger the land extent of used, higher was the productivity in case of pineapple growers. Average yield of pineapple was 4321.89 kg/ac as derived from the survey findings (Table 21.26).

Table 21.26: Total Production and Average Yield of Pineapple

Extent Group	Total Ext.	Total Production	Yield(kg/ac)
0.5<=ext<1	1	4300	4300.00
1<=ext<2	2	6000	3000.00
2<=ext<5	17.5	26000	1485.71
ext>=5	21.75	146300	6726.44
Total	42.25	182600	4321.89

Source: HARTI Survey Data, 2016

Land extent used higher under pineapple and to average yield is taken into account, the highest average yield was harvested from the lands in extent group, ext>=5 recording a yield of 6726.44 (kg/ac).

Mango Cultivation:

The average yield of mango reported by surveyed farmers was 9175.88kg/ac (Table 21.27). Lands which in the extent group 0.5<=ext< 1 produced the highest average yield of 21635.64 kg/ac.

Table 21.27: Total Production and Average Yield of Mango

Ext. Group	Total Ext.	Total Production	Yield(kg/ac)
0.25<=ext<0.5	0.5	4000	8000.00
0.5<=ext<1	2.75	59498	21635.64
1<=ext<2	5.25	45700	8704.76
2<=ext<5	4	5500	1375.00
Total	12.5	114698	9175.84

Source: HARTI Survey Data, 2016

Banana Cultivation:

The average yield for banana across the study area was 20035.74 kg/ac (Table 21.28). The highest average yield was 44800 kg/ac, harvested from the lands which belonged to the extent group of larger than 5 acres. Lowest average yield which was 7772 kg/ac was from the lands under extent category 0.25<=ext<0.5 acres.

Table 21.28: Total Production and Average Yield of Banana

Ext. Group	No. of Farmers	Total Ext.	Total Production	Yield(kg/ac)
0.25<=ext<0.5	2	0.5	3886	7772.00
0.5<=ext<1	7	3.5	31055	8872.86
1<=ext<2	11	13	136745	10518.85
2<=ext<5	7	15.5	330890	21347.74
ext>=5	1	6	268800	44800.00
Total	28	38.5	771376	20035.74

Source: HARTI Survey Data, 2016

Watermelon Cultivation:

According to the survey findings the average yield of watermelon was 7464.48 kg/ac (Table 21.29). As in the case of many other fruit crops the highest extent group (ext>=5) produced the highest average yield which was 10625 kg/ac. Lowest land extent group produced the lowest average yield of 4000 kg/ac.

Table 21.29: Total Production and Average Yield of Watermelon

Ext. Group	No. of Farmers	Total Ext.	Total Production	Yield(kg/ac)
0.5<=ext<1	5	3	12000	4000.00
1<=ext<2	16	17.75	120600	6794.37
2<=ext<5	7	17	123900	7288.24
ext>=5	1	8	85000	10625.00
Total	29	45.75	341500	7464.48

Source: HARTI Survey Data, 2016

Papaya Cultivation:

Results of the survey indicate total production of papaya in the study area was 579000 kg and the average yield was 21783.30 kg/ac (Table 21.30). Highest average Papaya yield was harvested from the lands belonging to the extent group 0.25<=ext<0.5 and the lowest average yield from the lands falling under extent group 2<=ext<5.

Table 21.30: Total Production and Average Yield of Papaya

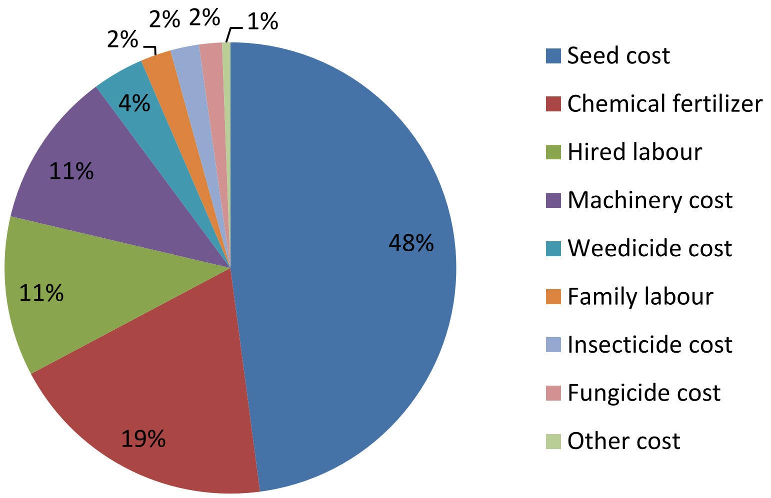
Ext. Group	Total Ext.	Total Production	Yield(kg/ac)
0.25<=ext<0.5	0.58	15500	26724.14
0.5<=ext<1	5	129600	25920.00
1<=ext<2	12.5	313150	25052.00
2<=ext<5	8.5	120750	14205.88
Total	26.58	579000	21783.30

Source: HARTI Survey Data, 2016

21.3.5 Cost of Production

Pineapple

According to the cost of production calculations based on the survey data, total cost of production of pineapple was Rs. 95430/ac including family labour. As shown in Figure 21.9 seedlings cost accounted for 48 percent of the total cost of production of pineapple. Chemical fertilizer cost (19 percent) was also considerably high since pineapple demands higher doses of fertilizer. In addition, labour cost too was of a higher proportion when compared with other cost components in Pineapple cultivation due to the increase of wage rates in the recent past. In addition, machinery cost (11 percent) was among the costly components of pineapple cultivation.

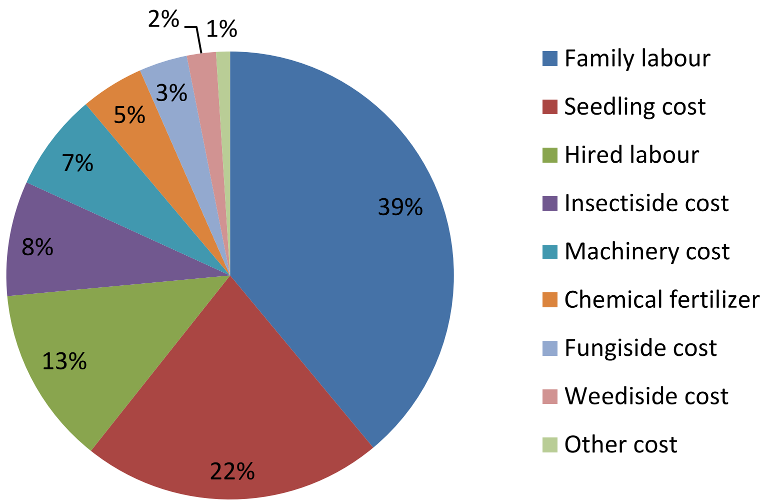


Source: HARTI Survey Data, 2016

Figure 21.9: Cost of Production of Pineapple

Mango

The cost of production of mango including family labour was Rs 21, 697/ac while It was Rs 13276.73/ac excluding family labour. The major component of the cost was labour which accounted 52 percent of the total cost including both family labour (39 percent) and hired labour (13 percent) as shown in Figure 21.10. Seed cost was the second largest contributing factor for the cost of production that accounted for 22 percent of the total cost followed by Insecticide and machinery cost.

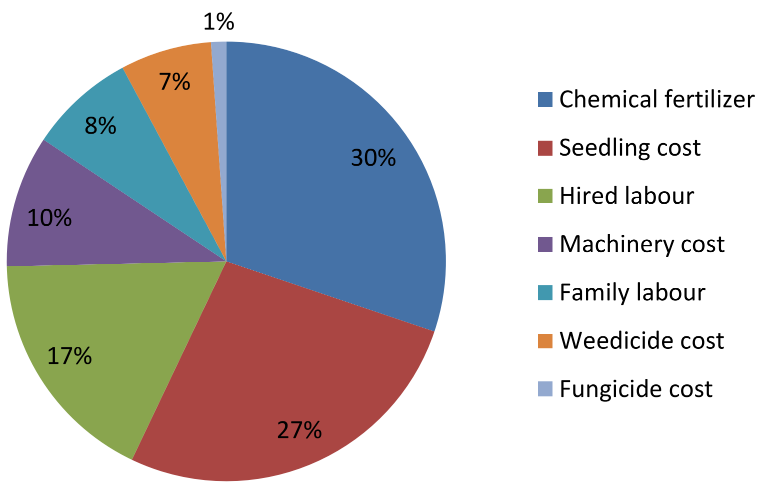


Source: HARTI Survey Data, 2016

Figure 21:10: Cost of Production of Mango

Banana

Cost of production of banana including family labour was Rs. 74530.38 /ac while it was Rs. 68703.21/ac excluding family labour. As illustrated in Figure 21.11, two major components in production cost were chemical fertilizer (30 percent) followed by seedling (27 percent). These two costs accounted for 57 percent of the total cost of cultivation. In addition, hired labour as a major input, accounted for 17 percent of the total cost of banana cultivation.

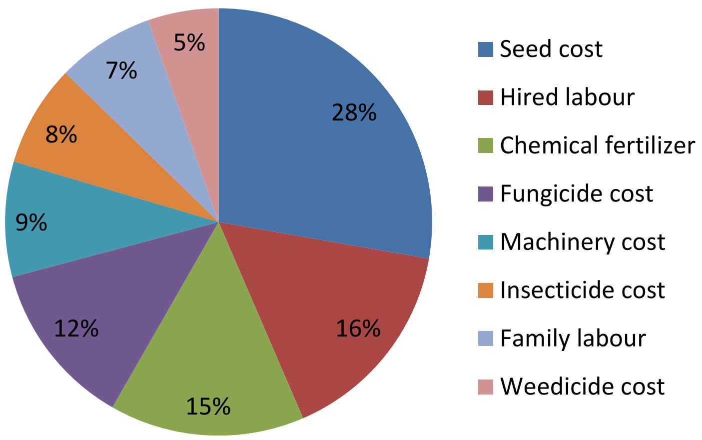


Source: HARTI Survey Data, 2016

Figure 21.11: Cost of Production of Banana

Watermelon

Cost of production of watermelon including family labour was Rs. 60,956.56/ac whist excluding family labour the cost was Rs. 56466.40/ac. The major share of the cost component was seed cost representing 28 percent of the total cost. Hired labour (16 percent), chemical fertilizer (15 percent) and fungicide (12 percent) were other major cost components in the watermelon cultivation (Figure 21.12).



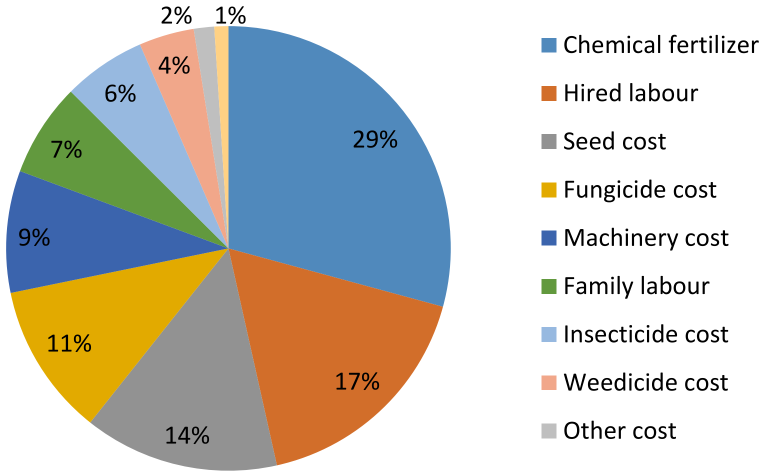
Source: HARTI Survey Data, 2016

Figure 21.12: Cost of Production of Watermelon

Papaya

Cost of production of Papaya including family labour was Rs. 134393.60/ac and excluding family labour it was Rs. 125248.40/ac according to the cost of production calculations. Chemical fertilizer was the costliest input in the papaya cultivation.

As illustrated in the Figure 21.13, chemical fertilizer accounted for 29 percent of the total cost. As a major input, labour cost was also considerably high in papaya cultivation, with the cost of hired labour accounting for 17 percent of the total cost. This is mainly become of the fact that in papaya cultivation land preparation, crop management practices and harvesting are more labour intensive. Seed cost (14 percent), fungicide cost (11 percent) and machinery cost (9 percent) were the other major cost components.



Source: HARTI Survey Data, 2016

Figure 21.13: Cost of Production of Papaya

21.4 Crop Specific Issues

Pineapple

The major issue faced by the pineapple growers was crop damages due to pest and disease attacks. Absence of proper marketing channels for their harvest as well as not having defined prices at the market, were the other burning problems that farmers had to confront. Operations of the middleman had resulted in a drop in the profit the farmers accrued. Increasing pesticide costs, labour related issues, quality issues of the agro-chemicals, scarcity of lands and high cost of coir were the other impediments that pineapple growers have to struggle with.

Mango

The survey findings brought to light that the crop damages due to pest and diseases were the major constraints with regard to mango cultivation too. Pest and diseases attacks were on the rise spreading across the mango cultivation causing heavy damages at different stages. In the crop necessitations the immediate intervention of the extension staff to educate the farmers about ways and means, so that their attacks could be brought under control minimizing to damages. In addition, wild animal attacks had brought the situation worse. Water scarcity unfavourably affected significant number of mango cultivators especially when the plants were young. Issues related to the infrastructure in farmlands, absence of proper marketing channels, lack of knowledge on updated technology and methods, land related issues and effects of adverse climatic conditions were the other issues that emerged as stated by the surveyed mango farmers.

Banana

The common issue of pest and diseases afflicted the banana growers too. In addition, escalation of fertilizer prices, absence of stable prices of the markets and increasing of pesticide prices were among the noticeable issues prevalent in the banana cultivation. Banana is a high water demanding crop and that would not have been fulfilled by direct rain. So, alternative water supply is compulsory to meet this demand. Hence water scarcity in rain fed areas was a challenge for the banana farmers.

Watermelon

Here again the critical problem was pest and diseases. In addition, increasing of fertilizer prices, not having proper market prices, water scarcity and lack of quality seeds were among the other key issues that the farmers had to deal with.

Papaya

Crop damage caused by pest and diseases was the major issue constraining the papaya farmers as revealed in the survey. Crop damages due to leaf curl complex and anthracnose were very common in papaya farming. Lack of quality seeds, escalation of prices of fertilizer and unavailability of stable price for the product were among the other major issues in papaya cultivation.

21.5 Recommendation and Suggestions

1. Fruits are highly susceptible to pest and other diseases. Therefore, remedial measures need to be put in motion to overcome this commonest impediment which deprives the farmers of a sizable share of their profits.

2. The extension services leave much to be desired as complained by fruit growers to who better and comprehensive extension activities would be an incentive particularly in the context of promising prospects for fruit growers with the escalating demand for fruits.

3. Proper marketing channels for all fruit crops are indispensable as farmers face many difficulties in the absence of proper marketing channels to sell their products and to get reasonable prices.

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Annexes

Annex Table 4.1: Extent, Production and Average Yield of Paddy

Year	Gross extent cultivated (Ha)			Production (mt)			Average yield (Kg/Ha)		
	Maha	***Yala***	**Total**	**Maha**	***Yala***	**Total**	**Maha**	***Yala***	**Total**
2000	549,246	328,748	877,994	1,781,219	1,078,672	2,859,891	3,798	3,958	3,856
2001	478,986	319,273	798,259	1,612,981	1,082,094	2,695,075	3,860	4,102	3,954
2002	510,403	342,126	852,529	1,773,671	1,085,804	2,859,475	3,990	3,742	3,893
2003	601,584	381,033	982,617	1,894,694	1,176,511	3,071,205	3,794	3,709	3,762
2004	520,662	257,887	778,549	1,669,663	958,174	2,627,837	4,002	4,228	4,080
2005	580,562	356,613	937,175	2,012,706	1,233,484	3,246,190	3,955	3,976	3,963
2006	591,297	319,196	910,493	2,135,605	1,206,317	3,341,922	4,070	4,263	4,137
2007	525,340	291,376	816,716	1,972,931	1,158,150	3,131,081	4,299	4,543	4,386
2008	581,597	471,393	1,052,990	2,125,219	1,750,030	3,875,249	4,175	4,195	4,187
2009	632,130	345,015	977,145	2,383,989	1,267,692	3,651,681	4,421	4,187	4,337
2010	646,037	419,244	1,065,281	2,629,566	1,671,054	4,300,620	4,583	4,444	4,528
2011	730,136	493,005	1,223,393	1,997,319	1,898,040	3,895,359	3,668	4,347	3,970
2012	702,075	364,542	1,066,617	2,716,961	1,128,984	3,845,945	4,444	4,145	4,353
2013	779,635	447,613	1,227,248	2,846,276	1,774,452	4,620,728	4,281	4,408	4,329
2014	651,289	312,979	964,268	2,235,851	1,144,929	3,380,780	4,222	4,204	4,264
2015	772,626	480,662	1,253,288	2,876,987	1,942,408	4,819,395	4,364	4,527	4,428

Source: Department of Census and Statistics, Data bank of HARTI

Annex Table 4.2: Cultivated Extent of Paddy by Major Growing Districts (Hectares)

Area	Period	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average (11-15)	*%*
Ampara	Maha	62,715	51,803	64,490	69,979	69,861	70,819	71,877	82,921	81,940	83,133	78,138	
	Yala	55,036	53,787	60,168	46,227	59,255	61,904	60,864	64,403	44,377	65,973	59,504	
	Total	117,751	105,590	124,658	116,206	129,116	132,723	132,741	147,324	126,317	149,106	137,642	*12.0*
Kurunegala	Maha	73,331	71,731	75,351	77,291	68,758	79,071	62,621	81,580	61,138	79,375	72,757	
	Yala	35,093	28,729	68,912	48,916	56,682	68,619	41,517	52,461	59,599	62,649	56,969	
	Total	108,424	100,460	144,263	126,207	125,440	149,882	104,138	142,506	120,737	142,024	129,726	*11.3*
Anuradhapura	Maha	61,782	57,562	72,717	80,724	81,463	89,772	89,253	100,598	52,789	99,814	86,445	
	Yala	21,201	14,635	49,133	18,164	22,887	54,471	26,568	46,888	17,542	50,398	39,173	
	Total	82,983	72,197	121,850	98,888	104,350	167,584	115,821	147,486	70,331	150,212	125,619	*11.0*
Polonnaruwa	Maha	53,176	50,565	55,529	57,298	60,312	65,396	64,512	66,372	62,200	74,766	66,649	
	Yala	48,501	49,558	54,481	36,862	58,301	61,666	53,452	62,503	34,553	62,135	54,862	
	Total	101,677	100,123	110,010	94,160	118,613	127,062	117,964	128,875	96,753	136,901	121,511	*10.6*
Batticaloa	Maha	46,772	18,469	19,134	45,905	54,855	59,520	59,470	66,276	62,204	61,014	61,697	
	Yala	15,498	2,705	17,728	17,073	20,901	21,699	23,887	27,556	20,282	27,011	24,087	
	Total	62,270	21,174	36,862	62,978	75,756	81,219	83,357	93,832	82,486	88,025	85,784	*7.5*
Hambantota	Maha	19,881	22,320	24,234	25,575	26,098	26,733	26,759	28,946	26,882	27,175	27,299	
	Yala	16,448	20,923	24,500	21,553	24,255	25,339	21,403	25,896	21,524	26,302	24,093	
	Total	36,329	43,243	48,734	47,128	50,353	61,423	48,162	54,842	48,406	53,477	51,392	*4.5*
Trincomalee	Maha	23,743	16,287	18,987	23,014	26,535	30,331	30,161	35,011	26,133	34,470	31,221	
	Yala	11,027	10,368	15,296	13,950	13,116	18,514	16,107	23,012	7,394	22,294	17,464	
	Total	34,770	26,655	34,283	36,964	39,651	48,810	46,268	58,023	33,527	56,764	48,685	*4.2*
Monaragala	Maha	16,746	23,544	25,827	26,529	27,360	28,761	31,985	36,762	34,814	36,038	33,672	
	Yala	6,579	8,926	13,716	8,341	14,016	15,764	13,468	15,346	8,814	15,415	13,761	
	Total	23,325	32,470	39,543	34,870	41,376	46,351	45,453	52,108	43,628	51,453	47,433	*4.1*

Source: Department of Census and Statistics, Data bank of HARTI

Area	Period	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average (11-15)	%
Badulla	Maha	22,162	22,266	25,331	27,225	27,023	27,819	27,552	29,262	27,637	27,057	27,865	
	Yala	11,337	10,705	12,746	8,168	12,665	13,179	11,676	-	12,843	13,074	10,154	
	Total	33,499	32,971	38,077	35,393	39,688	41,025	39,228	29,262	40,480	40,131	38,020	***3.3***
Mahaweli-H	Maha	25,106	24,183	24,178	24,849	25,012	25,533	24,215	23,930	22,641	23,851	24,034	
	Yala	13,451	11,440	17,758	6,481	15,824	17,558	12,533	14,134	4,727	18,064	13,403	
	Total	38,557	35,623	41,936	31,330	40,836	17,558	36,748	38,064	27,368	41,915	37,437	***3.3***
Puttalam	Maha	11,360	12,579	12,284	19,680	14,415	20,253	13,181	20,354	13,944	20,116	17,570	
	Yala	6,781	5,320	14,484	15,258	10,576	17,521	6,341	11,533	10,741	15,327	12,293	
	Total	18,141	17,899	26,768	34,938	24,991	37,774	19,522	31,887	24,685	35,443	29,862	***2.6***
Other	Maha	174,523	154,031	163,535	154,061	164,343	206,128	200,489	207,623	178,967	205,817	199,805	
	Yala	78,244	74,280	122,471	104,022	110,766	116,771	76,726	81,931	70,583	102,020	89,606	
	Total	252,767	228,311	286,006	258,083	275,109	311,982	277,215	289,554	249,550	307,837	289,411	***25.2***
Sri lanka	Maha	591,297	525,340	581,597	632,130	646,037	730,136	702,075	779,635	651,289	772,626	727,152	
	%	***64.9***	***64.3***	***55.2***	***64.7***	***60.6***	***59.7***	***65.8***	***63.5***	***67.5***	***61.7***	***63.6***	
	Yala	319,196	291,376	471,393	345,015	419,244	493,005	364,542	447,613	312,979	480,662	419,760	
	%	***35.1***	***35.7***	***44.8***	***35.3***	***39.4***	***40.3***	***34.2***	***36.5***	***32.5***	***38.4***	***36.4***	
	Total	910,493	816,716	1,052,990	977,145	1,065,281	1,223,393	1,066,617	1,227,248	964,268	1,253,288	1,146,912	***100.0***
	%	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	***100.0***	

Annex Table 9.1: Cultivated Extent of Big Onion in Major Producing Areas during Last 10-Year Period (2006-2015)

Area	Period	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Avg. (06-15)	*%*
Matale	Maha	93	113	37	43	6	12	24	21	20	-	37	
	Yala	3195	3283	1790	2838	1890	1611	2801	1863	2392	2400	2406	
	Total	3288	3396	1827	2881	1896	1623	2825	1884	2412	2400	2443	*46*
Anuradhapura	Maha	74	45	17	18	122	13	10	20	17	16	35	
	Yala	981	1119	1101	1284	1197	916	1294	1094	1921	1213	1212	
	Total	1055	1164	1118	1302	1319	929	1304	1114	1938	1229	1247	*24*
Mahaweli-H	Maha	-	-	-	-	-	10	16	75	6	3	11	
	Yala	1957	1887	605	492	582	443	669	567	1706	1246	1015	
	Total	1957	1887	605	492	582	453	685	642	1712	1249	1026	*19*
Other areas	Maha	146	92	166	121	115	173	142	145	298	593	199	
	Yala	368	449	375	285	246	305	430	438	467	404	377	
	Total	514	541	541	406	361	478	572	583	765	997	577	*11*
National Total	Maha	313	250	220	182	243	207	191	260	342	612	282	
	Yala	6501	6738	3871	4899	3915	3276	5195	3963	6485	5263	5011	
	Total	6814	6988	4091	5081	4158	3483	5386	4223	6827	5875	5293	100

Source: Department of Census and Statistics
Data Bank of HARTI

Annex Table 9.2: Production of Big Onion in Major Producing Areas during Last 10-Year Period (2006-2015)

Area	Period	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Avg. (06-15)	%
Matale	Maha	419	1419	573	297	62	125	253	210	202	-	356	
	Yala	36370	44877	31629	51788	26930	34573	42068	38867	49796	40800	39770	
	Total	36789	46296	32202	52085	26992	34698	42321	39077	49998	40800	40126	*52*
Anuradhapura	Maha	699	337	133	235	1243	163	91	182	253	151	349	
	Yala	10301	11731	13539	18404	19151	12268	24325	18078	24947	18802	17155	
	Total	11000	12068	13672	18639	20394	12431	24416	18260	25200	18953	17503	*23*
Mahaweli-H	Maha	-	-	-	-	-	60	163	750	58	16	105	
	Yala	21918	30184	7400	8004	8908	9596	10511	5608	16861	19313	13830	
	Total	21918	30184	7400	8004	8908	9656	10674	6358	16919	19329	13935	*18*
Other areas	Maha	1205	726	1168	815	669	1346	1932	1297	4173	4418	1775	
	Yala	2704	2892	2929	2164	1967	2906	4218	4643	4876	6267	3557	
	Total	3909	3618	4097	2979	2636	4252	6150	5940	9049	10685	5332	*7*
National Total	Maha	2323	2482	1874	1347	1974	1694	1833	2439	4686	4585	2524	
	Yala	71293	89684	55497	80360	56956	59343	81728	67196	96480	85182	74372	
	Total	73616	92166	57371	81707	58930	61037	83561	69635	101166	89767	76896	100

Source: Department of Census and Statistics
Data Bank of HARTI

Annex Table 12.1: Cultivated Extent of Potato in Major Producing Areas during Last 10-Year Period (2006-2015)

Area	Period	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Avg. (11-15)	%
Badulla	*Maha*	2,045	1,993	1,014	1,518	1,499	1,444	1,756	1,713	1,884	1,637	1,687	
	Yala	1,715	2,259	2,481	1,827	1,634	2,341	1,863	2,120	2,120	1,765	2,042	
	Total	3,760	4,252	3,495	3,345	3,133	3,785	3,619	3,833	4,004	3,402	3,729	*74.7*
Nuwara Eliya	*Maha*	341	205	575	335	353	309	521	738	775	1,059	680	
	Yala	1,117	860	768	390	315	355	478	503	503	636	495	
	Total	1,458	1,065	1,343	725	668	664	999	1,241	1,278	1,695	1,175	*23.5*
Other	*Maha*	71	13	27	33	39	27	21	39	80	238	81	
	Yala	5	4	1	35	2	4	9	23	3	7	9	
	Total	76	17	28	68	41	31	30	62	83	245	90	*1.8*
Sri Lanka	*Maha*	2,457	2,212	1,618	1,886	1,893	1,780	2,298	2,491	2,739	2,934	2,448	
	%	*46.4*	*41.5*	*33.2*	*45.6*	*49.3*	*39.7*	*49.4*	*48.5*	*51.1*	*54.9*	*48.7*	
	Yala	2,837	3,124	3,251	2,253	1,951	2,700	2,350	2,647	2,626	2,408	2,546	
	%	*53.6*	*58.6*	*66.8*	*54.4*	*50.8*	*60.3*	*50.6*	*51.5*	*49.0*	*45.1*	*51.3*	
	Total	5,294	5,336	4,869	4,139	3,844	4,480	4,648	5,138	5,365	5,342	4,995	*100.0*
	%	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	

Source: Department of Census and Statistics
Data Bank of HARTI

Annex Table 12.2: Production of Potato in Major Producing Areas during Last 10-Year Period (2006-2015)

Area	Period	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Avg. (11-15)	%
Badulla	*Maha*	28,152	27,962	14,011	21,480	19,898	17,579	22,821	23,374	25,711	31,618	24,221	
	Yala	25,448	33,188	38,689	27,502	20,459	31,517	32,500	31,227	31,227	28,025	30,899	
	Total	53,600	61,150	52,700	48,982	40,357	49,096	55,321	54,601	56,938	59,643	55,120	*71.1*
Nuwaraeliya	*Maha*	5,741	3,397	9,194	5,700	5,887	4,482	9,229	14,843	15,585	21,597	13,147	
	Yala	18,450	12,671	12,683	6,512	5,346	5,534	7,422	8,702	8,702	12,518	8,576	
	Total	24,191	16,068	21,877	12,212	11,233	10,016	16,651	23,545	24,287	34,115	21,723	*28.0*
Other	*Maha*	653	113	204	263	320	222	179	450	1,124	1,097	614	
	Yala	40	38	11	239	14	31	35	155	23	41	57	
	Total	693	151	215	502	334	253	214	605	1,147	1,138	671	*0.9*
Sri lanka	*Maha*	34,546	31,481	23,425	27,452	26,114	22,283	32,229	38,667	42,420	54,311	37,982	
	%	*44.0*	*40.7*	*31.3*	*44.5*	*50.3*	*37.5*	*44.7*	*49.1*	*51.5*	*57.2*	*48.0*	
	Yala	43,938	45,905	51,389	34,253	25,819	37,082	39,957	40,084	39,952	40,584	39,532	
	%	*56.0*	*59.3*	*68.7*	*55.5*	*49.7*	*62.5*	*55.4*	*50.9*	*48.5*	*42.8*	*52.0*	
	Total	78,484	77,386	74,814	61,705	51,933	59,365	72,186	78,751	82,372	94,895	77,514	*100.0*
	%	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	

Source: Department of Census and Statistics
Data Bank of HARTI