Economic and Social Commission for Asia and the Pacific

CGPRT Centre WORKING PAPER No. 67

Prospects of Feed Crops in Sri Lanka: the Role of CGPRT Crops

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United Nations

The CGPRT Centre

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In co-operation with ESCAP member countries, the Centre will initiate and promote research, training and dissemination of information on socio-economic and related aspects of CGPRT crops in Asia and the Pacific. In its activities, the Centre aims to serve the needs of institutions concerned with planning, research, extension and development in relation to CGPRT crop production, marketing and use.

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Prospects of Feed Crops in Sri Lanka: the Role of CGPRT Crops

"CGPRT Centre Works Towards Reducing Poverty Through Enhancing Sustainable Agriculture in Asia and the Pacific Region"

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Foreword

Coarse grains, pulses, root and tuber (CGPRT) crops are a very important component of the farming system in Asia and the Pacific region, particularly in marginal areas where economically, ecologically and socially less favorable conditions prevail, and many farmers' activities and lives rely on CGPRT crops. Therefore, it is crucial to promote the sustainable production of CGPRT crops and to expand the income generation opportunities through expanding market opportunities of CGPRT crops.

CGPRT crops are versatile crops and they can provide an extraordinary range of end uses, not only as foods for direct human consumption but also as materials for a diverse range of end products, including industrial uses. Feed is one of the alternative end products of CGPRT crops.

In developing countries, there has been a dramatic rise in the consumption of animal origin food products. It was a result of demand changes caused by changes in the diets of billions of people in the region, through population growth, urbanization, and income growth in these countries.

As animal-product demand increases, feed grain utilization also increases. Animal feeds are dominated by coarse grains, pulses, root and tuber crops or the products of these CGPRT crops. Therefore, this provides an expansion of market opportunity for CGPRT crops.

The development of animal husbandry and demands for feed vary greatly from country to country. Therefore, we need to analyze them comparing among countries within the region. Responding to this need, the CGPRT Centre has implemented a research project, "Prospects of Feed Crops in South Asia", in collaboration with partners from four countries: India, Nepal, Pakistan and Sri Lanka.

It is my pleasure to publish **Prospects of Feed Crops in Sri Lanka: the Role of CGPRT Crops** as one of the results of the project. This volume covers topics such as historical overviews of the animal industry, agricultural policies, trading policies and prospects of feed demand and supply in Sri Lanka.

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Nobuyoshi Maeno
Director
CGPRT Centre

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Kulugammana Ellapitagedara Karunatilake

Executive Summary

Due to the rapid expansion of the poultry industry not only in Sri Lanka but also in other countries, the demand for feed crops has increased substantially. The CGPRT Centre initiated a study to analyze the situation in South Asia under a project called “Prospects of Feed Crops in South Asia (FEED)”.

The study was initiated to understand the demand/supply gap, weaknesses, opportunities, constraints and policy options to bridge the gap of feed crops in Sri Lanka.

For this study, the data was collected from the Department of Animal Production and Health (AP & H), the Department of Census & Statistics and the Central Bank of Sri Lanka. Additional data was collected from other sources such as the Department of National Planning, Sri Lanka Customs and the Institute of Policy Studies to investigate the behaviour mainly on imports and policies related to the development of food and feed crops in Sri Lanka. Most of the relevant data was collected from the Ministry of Agriculture and Livestock and the Department of Agriculture.

The collected data was processed and a model was used to determine future demand and supply of maize as the main feed crop in Sri Lanka. The models were not used for soybean, root and tuber crops or other pulses due to the non-availability of sufficient data at present. A workshop, with the participation of senior scientists, policy makers and private sector representatives, was conducted to identify the strengths, weaknesses, opportunities and threats of expanding feed crops and some policy recommendations for the further development of these crops.

It was found that the increase in income and the exposure to foreign influences in recent years has led to changes in lifestyle and to changes in dietary habits, particularly among the urbanized. Annual meat consumption, which was around 0.8 kg per capita in the late eighties, had increased to 4.45 kg by 1999, after just a decade. This phenomenal increase can be contributed largely to increases in the consumption of chicken meat. The annual per capita consumption of broiler meat increased from 0.6 kg to 2.5 kg during the ten years from 1987 to 1997 and currently stands at 3.2 kg. As a result, the poultry industry has grown at around 10 per cent each year during the last five years and is expected to grow at the same rate over the next decade.

The switch over to large-scale intensive broiler farming, the development of integrated private companies which undertook all related activities such as the breeding, feeding, raising, processing and marketing as well as changes in government policies were the main reasons for this rapid development in the poultry sector.

However, demand for other meat (mainly for beef) is almost static due to a combination of health and religious concerns. Mutton and beef originates from goats and cattle reared under extensive grazing and browsing systems in rural areas and “wet pork” from pigs fattened on small holdings on swill.

It is further found that inland and aquaculture fish production provides only about 10-12 per cent of the total production although total fish production has increased to 0.304 mt (2000) from 0.183 mt (1990). The aquaculture practices are not well developed in the country yet except shrimp aquaculture. Shrimp farming for export is a lucrative enterprise in coastal areas of the country.

Ninety per cent of the total compound feed production in the country is for the poultry industry while 5 per cent is for dairy. The balance of five per cent is for all others in the sector. No increase has been reported in the feed industry for sub sectors other than poultry.

About 65-70 per cent of the raw materials required for compound feed (mainly for poultry feed) production are imported. The main raw materials (feed crop materials) which are imported are maize (80 per cent) and soybean meat (100 per cent). At present, usage of locally produced maize in poultry feed is only 20 per cent. Rice by-products like rice bran/polish and coconut cakes/poonac are the other local raw materials available.

The compound feed milling industry, which was started in the early 1960's as a government owned business, was handed over to the private sector with the introduction of open economic policies to the country in the mid 1980's. With all these changes, a six fold increase in feed production has been reported during the last three decades since 1970.

Total compound feed production in 2000 was 455,000 mt, out of which 375,000 mt were produced by the 17 registered council oriented feed millers. The balance was produced by the unregistered small scale self mixtures or cottage level entrepreneurs.

Maize is the most important grain available in Sri Lanka. Therefore, the demand for maize is high and can be expected to increase in the future. Tubers (especially manioc) and yams have a potential to at least partly replace maize as an energy source but the high cost of production and other technical reasons do not permit its inclusion in animal feed. The estimated maize requirement in the year 2010 will be about 513,200 mt, out of which 32.7 per cent will be for the human food industry (including green cob consumption). Even with a well organized integrated production programme Sri Lanka will not be in a position to produce the entire requirement of maize within the country.

However, it is reported that the productivity of maize, although it is not reported accurately, has increased with the positive efforts made by the state as well as the private sector towards research and development activities. This situation should be further improved in order to narrow the large gap between demand and supply of maize in the country.

In light of what has been stated, the major recommendations to increase local maize production are presented below.

i. Although maize is grown mainly in maha (wet) as a rainfed crop, the efforts which have already been taken to cultivate during yala (dry) in paddy fields with an assured water supply should be further strengthened to achieve commercial level cultivation. Underutilized, well drained paddy land in major irrigation schemes can also be used to produce maize, even in the maha (wet) season.
ii. A well planned collaborative Research and Development programme must be implemented with the private sector, financing agencies, marketing agencies and farmer companies to generate technologies, provide inputs and other facilities whenever possible.

Low quality is the biggest constraint to the utilization of locally produced maize both in the feed and food industry. This is mainly because of the involvement of a large number of small-scale resource poor farmers who do not have the basic facilities for processing maize in the country. At least one third of the total requirement can be produced locally if sufficient emphasis is given to research and development activities both in the production and processing of maize. The balance must be imported.

Soybean is the main protein supplement used in animal feed and it is used in soybean meal form. At present, 100 per cent of the soybean meal requirement is imported as no processing facilities for soybean seed processing for animal feed are available in the country. The small quantity produced in Sri Lanka is used in the human food industry. Therefore, it can be concluded that importation of soybean meal for the feed industry must be allowed to continue until seed processing facilities are established in the country.

It has been found that most other feed crop cereals (kurakkan), pulses and roots and tubers are facing decline in their cultivated extent. It appears that all other crops, other than maize, can not be utilized in the feed industry because of insufficient quantities available even

for food. Although cassava would be a good source of energy for animal feed in Sri Lanka, it is not used due to a very high demand as human food and comparatively high costs.

It is noted that although alternative energy sources such as jack seed, rubber seed etc. are available, their potential utilization has not been exposed yet.

Finally, it is concluded that depending on demand, productivity and the production scenario it is not possible to meet the deficit between demand and supply even of maize with only local production. However, there is a very big potential to increase production by increasing extent as well as productivity.

1. Introduction

1.1 Background and justification

Although Sri Lanka is considered an agricultural country, the contribution to GDP from agriculture, forestry and fisheries has declined in recent years to 20.5 per cent in 2000. At the same time, other sectors such as services, mining and quarrying, manufacturing and construction have increased their share and in 2000, contributed 53.4 per cent, 1.7 per cent, 17.4 per cent and 7 per cent respectively.

Within the agricultural sector, ignoring plantation crops, the main contributors are paddy, vegetables and subsidiary food crops, which in 2000, had shares of 3.2 per cent, 4.3 per cent and 1.9 per cent of the GDP respectively. Of the CGPRT crops, roots and tuber crops are categorized as "subsidiary food crops" or other field crops and the rest classified as vegetables. The contribution of animal husbandry to the GDP was marginally less than 2 per cent with forestry and fisheries together amounting to 4.6 per cent of the GDP in 2000. Animal production in the country is dominated by the poultry industry (44 per cent broiler meat, 26 per cent eggs). Other meats contribute 19 per cent (mutton 3 per cent, pork 1 per cent and beef 15 per cent) and milk production around 11 per cent.

The total human population of Sri Lanka, according to the latest Census, is 19.04 million, of which 38.2 per cent were engaged in agriculture, including animal husbandry in 1998/1999. The proportion employed on the land decreased by 14.8 per cent over the four decades from 1960 to 2000, showing a tendency for people to seek employment in sectors other than agriculture. At the same time, per capita income has increased from US$ 709 in 1995 to US$ 856 in 2000 due not only to productivity increases in the agricultural sector but also to increasing employment in other activities that have a greater capacity to generate foreign exchange.

The increase in income and the exposure to foreign influences in recent years has led to changes in lifestyle and to changes in dietary habits, particularly among the urbanized population. As proposed by Bennett's Law, the population (still the majority) whose income is comparatively low consume relatively higher amounts of grains, whereas semi-urban and urban populations whose income is higher consume more foods of animal origin (meat, milk and fish). Annual meat consumption, which was around 0.8 kg per capita in the late eighties, increased to 4.54 kg by 1999, after just a decade. This phenomenal increase can be attributed largely to increases in the consumption of chicken meat. The annual per capita consumption of broiler meat increased from 0.6 kg to 2.5 kg during the ten years from 1987 to 1997 and currently stands at 3.2 kg. Due to a huge increase in demand, the price of chicken meat has increased by 69 per cent during the last five (1995-1999) years despite the increased availability. The increase in demand for chicken is attributable to a lowered demand for beef (due to a combination health and religious concerns), and the lowered availability and high prices of fish (due to ongoing conflicts) as well as the general increase in demand for animal products accompanying the increase in income of the population.

As a result, the poultry industry has grown at around 10 per cent each year during the last five years and is expected to grow at the same rate over the next decade. The estimated poultry population in 1999 was 992 million birds of all kinds. Most of the eggs and chicken meat are produced by the private sector in capital intensive, agri-businesses located around urban centres.

The price of eggs, beef, mutton and pork have increased by 43, 50, 44 and 75 per cent respectively during the five years from 1995 to 1999. The urban demand for beef and mutton is met by the slaughter of local cattle and goats reared under extensive conditions in the rural areas and depends, therefore, on the availability of free land for grazing. The consumption of beef

increased with the population growth from 16 to 24 million kg between 1994 and 1998 but has decreased since then due to publicity relating to diseases and religious factors.

The rapid growth in the broiler industry was accompanied by and made possible by a series of developments in the animal sector, especially in the poultry industry, in the recent past. These changes include the switch over to large-scale intensive broiler farming, the development of integrated private companies which undertook all related activities such as the breeding, feeding, raising, processing and marketing as well as changes in government policies which facilitated these developments.

It must be noted, however, that although the broiler industry grew at around 10 per cent per annum, layer production grew at only about 1 per cent during the same period. It is estimated that about two thirds of the annual egg production (900 million eggs) is produced by intensively fed layers using compound feed and that the balance is produced by village chicken farmers who rear hens under extensive or scavenging systems. Nearly all the broiler farmers, in contrast, rear birds in intensive rearing systems that use only compounded feed.

Alternate poultry species such as duck, turkey, guinea fowl and quail are found in relatively small numbers and usually raised by smallholder farmers under scavenging conditions. Mutton and beef originate from goat and cattle raised under extensive grazing and browsing systems in rural areas and "wet pork" from pigs fattened on smallholdings on swill. Accordingly, (*see* Ranawana 1999) the feeding of concentrates is largely restricted to chickens, milking cows and breeding pigs.

Government involvement in the rapidly expanding poultry sector is restricted to monitoring and regulation. It implements a range of statutes that govern the quarantine of chick imports, control of disease outbreaks, registration of hatcheries, preparation and sale of feeds and import and manufacture of drugs. All production activities, including the importation of feed ingredients and the manufacture of feeds, production of day-old chicks, provision of drugs and vaccines and commercial poultry production are in the hands of the private sector. Moreover, many of these activities are now confined to a few fully-integrated companies which use small farmers as "outgrowers" for the commercial production of broilers and eggs.

At present, both imported and locally produced raw materials are used in the compound feed industry, which caters primarily (90 per cent) to the poultry industry. Large amounts of a few ingredients, primarily maize and soybean, are imported for this purpose, whilst the local ingredients used include maize, rice bran/rice polish, coconut poonac and others, such as gingerly (sesame) poonac. The entire requirement of rice bran and polish and around 20 per cent of maize are sourced locally. Other CGPRT crops, such as roots and tubers, are not used to any appreciable extent in animal feeding in Sri Lanka at present.

Maize and soybean are the two main ingredients used in large amounts in the animal feed industry which can be successfully grown in Sri Lanka. Apart from these two crops, all CGPRT crops such as pulses, roots and tubers as well as other coarse grains can also be grown in Sri Lanka. At present, however, other than maize, the pulses, tubers and root crops produced in the country are consumed as human food and unavailable to the feed industry. A proportion of locally produced maize is also eaten and only the balance is used in the animal feed industry.

It has been estimated that 17 per cent of the total animal protein in the diet of the Sri Lankan people comes from fish. According to the available data, there has been a gradual increase in fish production in Sri Lanka which reached 237,500 mt in 1995 and increased further to 242,000, 269,850 and 279,900 mt in 1997, 1998 and 1999 respectively. The highest production was reported in 2000, which was 304,380 mt. The contribution of the inland fisheries and aquaculture sector to overall fish production was only 11 per cent in 1988 and 12.1 per cent in 2000 and fish feed production is at present, negligible. Aquaculture and inland fish production is viewed as a sector with great potential in the future and the demand for fish feed and the ingredients for such feeds can be expected to increase rapidly.

The Medical Research Institute of Sri Lanka (MRI) has recommended an intake of 21 kg of fish per person per annum; the per capita availability per person in 1998 was 16.9 kg. Since

then, despite being a steady increase in fish production, it is not sufficient to meet the demand. Local fish production currently provides only 78 per cent of the supply, while the balance is imported. Shrimp farming for export is a lucrative enterprise in coastal areas of the country. Breeding of ornamental fish, again for export, is also a high value industry. Most of the compound fish feed required by these producers is imported. A small quantity of feed produced locally is also used by these two industries. It is expected, however, that with the current promotion of inland fish production for local consumption, that there will be a large increase in the demand for fish feeds and ingredients in the future.

1.2 Objectives of the study

From the discussion above, it can be seen that there is a rapidly increasing demand for animal feed ingredients for animal and fish feeds arising from the changing food habits of the population and that these trends are likely to continue in the next few decades. It can also be seen that Sri Lanka is currently unable to even produce the present requirement of feed crops, such as maize and soybean. The major objectives of this study, therefore, are as follows:

i. Analyze historical dynamics, the current situation and future trends of demand and supply for feed crop products.
ii. Evaluate potentials, weaknesses, opportunities and constraints for expanding feed crop farming in Sri Lanka to meet future demands.
iii. Formulate policy options to promote the sustainable development of feed crop farming with equity for small farmers in Sri Lanka.
iv. Examine and propose possible schemes of co-operation in trade and development of feed crops and products among South Asian countries.

1.3 Commodity coverage

Of the CGPRT crops, maize and soybean meal are the main ingredients which are used in the animal feed industry and the demand for which is likely to increase sharply in the future. Other coarse grains, pulses, roots and tubers, although grown in Sri Lanka, are consumed as food items and are not likely to play a significant role in animal feeds in the near future. Accordingly, this report will focus primarily on the two feed crops, maize and soybean but will refer to other CGPRT crops where appropriate.

1.4 Organization of the report

This report is presented in 7 main chapters with references, a summary and the appendices forming Chapters 8 to 10. The contents of each of the Chapters 1 to 7 are briefly described below.

1. **Introduction**: Background, justification and objectives of the study.

2. **Methodological Approach**: Describes the methods used in the collection and analysis of information and includes the Conceptual Framework, Model Formulation and Sources of Data.

3. **Review of Current Status**: Provides an overview of the current situation with respect to the livestock and animal feed industries, their historical development as well as the agricultural and general trade policies that have influenced these sectors.

4. **Demand for Feed Crops**: Presents an analysis of the current demand for feeds and feed crops, the determinants of this demand and projections for the next decade.

5. **Supply of Feed Crops**: This chapter analyzes the factors that determine the supply of feeds and feed crops and includes a projection for the next decade.

6. **Measures for Closing the Supply and Demand Gap**: This chapter identifies and describes some of the measures that need to be taken to ensure that supplies of feed crops are adequate to meet the demand. It includes state and private sector initiatives and the important issue of farmer participation in this process to ensure equity.

7. **Conclusions and Recommendations**: This chapter is a summary of the findings of the study as well as of the suggestions to the government based on Chapter 6.

2. Methodological Approach

When using a model to explain an actual situation, it is necessary to take both theoretical and empirical implications into account. This Chapter provides the foundation for the analytical procedures used in the current study. The first section describes the basic concepts with definitions and an analytical framework. This is followed by model formulation based on theoretical considerations and an empirical understanding of the animal feed industry. The model is used to make projections and in the final section, the management tool, namely SWOT analysis, is discussed.

2.1 Conceptual framework

The primary interest of the present analysis is to develop a model to forecast prospects for the feed crop industry. This section aims to develop a framework considering both economic theory and empirical findings regarding the Sri Lankan feed industry. The first section deals with definitions relevant to the feed industry, whilst the second presents the analytical framework.

2.1.1 Definition

In order to develop the conceptual framework, the following definitions related to the feed industry are used:

Feed

Feed refers to various combinations of food substances suitable for animal consumption. The term, feeding stuffs, refers to the range of individual materials available to be fed to farm animals. Such feedstuffs include materials such as fresh forages, conserved forages (e.g. hay, silage), concentrates and succulent feeds.

Feed can also be divided into conventional feed and non-conventional categories. Feeds that have been traditionally used over long periods of time are categorized as conventional feedstuffs. This category consists of crops such as maize, rice, sorghum, wheat, barley, cassava, fish meal and copra meal. Non-conventional feedstuffs are the by-products of industries which, although possessing a potential for feeding, have neither been used traditionally for animal feeding nor been included in commercial livestock rations.

Concentrates

These can be single ingredients or mixtures of ingredients characterized by being highly concentrated in energy or protein with a low fiber content. Concentrates are factory made products and have relatively high feed quality compared to their volume.

Feed crops

Crops that are used in fresh or processed form as animal feed are considered as feed crops. It usually refers to crops whose main product or by-product is used in concentrate feeds.

2.1.2 Analytical framework

In seeking to understand the prospects for the Sri Lankan feed crop sector, it is important to consider inter-related influences that exist in the market. Since this is mainly concerned with the demand and supply sides of the feed crop sector, the analytical framework is developed based on the economic theory of demand and supply. Demand for feed crops can be divided into three groups, demand for food, demand for feed and demand for other uses. From a country point of view, due to the relatively low value additions in the agricultural sector, demand for "other uses" has little relevance to the feed crop sector. Therefore, demand for this purpose is not considered in the analysis. Supply is the total available feed for the country's feed industry. Total supply of a particular commodity is basically the sum of domestic production, imports and stock from the previous year. The available stock, however, cannot be considered in the analysis due to the unreliability of the data available in Sri Lanka. Given the theoretical relationship that demand and supply should be equal at equilibrium, empirically derived demand and supply functions were used to project the future requirement, actual production and deficit/surplus figures for the country. Findings of this exercise were used for decision making through SWOT analysis.

2.2 Model formulation

The theoretical relationship specified in the previous section represents a system of simultaneous equations. However, this simultaneity could not be taken into account in econometric modeling because time-series data was not available for a sufficient number of years. Single equation models were therefore developed assuming the non-existence of simultaneous causality among variables. From the Sri Lankan point of view, maize is the major crop related to the animal feed industry. In addition, since only chicken meat and egg production industries are operating at a commercial level, the ground situation was approximated with supply and demand aspects of maize in these industries.

Turning to the supply side, total production can be derived by yield and area estimates. Given the country specific performances in the feed crop sector, a single equation for the area function was formulated as follows:

$$\ln AM_t = A_0 + \beta_1 \ln MP_{t-1} + \beta_2 \ln SP_{t-1} + \beta_3 \ln AM_{t-1} \qquad (1)$$

Where AM_t, AM_{t-1}, MP_{t-1}, and SP_{t-1} are area cultivated to maize, area cultivated to maize in the previous year, lagged price of maize and lagged price of soybean respectively. β represents the estimated coefficient of each variable.

The price of maize is expected to have a positive relationship with area. Soya is a feed crop and its price is expected to have a negative impact on area cultivated to maize. According to Nerlove, the relationship of the lag value of area cultivated to maize and its present value is positive (Koutsoyiannis, 1977). Therefore, the expected signs of the variables of the above area function are as follows:

Expected signs:	$\ln MP_{t-1}$	(+)
	$\ln SP_{t-1}$	(-)
	$\ln AM_{t-1}$	(+)

Yield does not only depend on the farmer's choice of inputs but also on his price expectations. The anticipated relationship between yield and other variables can be expressed as the following functional form:

$$\ln YM_t = B_o + \alpha_1 \ln MP_{t-1} + \alpha_2 \ln SP_{t-1} + \alpha_3 \ln FP_{t-1} + \alpha_4 \ln YM_{t-1} \quad (2)$$

Where YM_t *and* YM_{t-1} are respectively the current yield and lagged yield of maize. Urea price in the previous year is represented by FP_{t-1}. Coefficient estimates are denoted by α.

Since the estimated coefficients for variables considered in present values were not significant, the above yield function was estimated using lagged values. It seems that farmers respond to market prices of the previous year in the decision making process of cultivation practices.

Relationships similar to the area function, lagged price of maize, soybean, fertilizer and lagged yield of maize can be expected. The expected signs are:

$\ln MP_{t-1}$	(+)
$\ln SP_{t-1}$	(-)
$\ln FP_{t-1}$	(-)
$\ln YM_{t-1}$	(+)

Domestic production of maize can then be estimated by:

$$QHM_t = AM_t \times YM_t \quad (3)$$

Total demand

As discussed in the previous section, for the Sri Lankan case, total demand can best be described by dividing demand into two blocks, the food demand block and the feed demand block. i.e.

$$QM_t = QFM_t + QLM_t \quad (4)$$

Where QM_t, QFM_t and QLM_t are the total demand, the food demand and the feed demand respectively.

Food demand

Sri Lankan farmers use a portion of maize production for their own domestic consumption. Since rice is the staple food, its availability should have an impact on maize consumption. In addition, income will have a considerable affect on its consumption. To illustrate these relationships, a function was developed as follows.

$$\ln QFM_t = C_0 + \gamma_1 \ln RP_t + \gamma_2 \ln MP_t + \gamma_3 \ln INC_t \quad (5)$$

Where RP_t and INC_t are price of rice and per capita income respectively. γ denotes the coefficient estimates for respective variables.

Assuming maize and rice as close substitutes, the anticipated relationship between demand for maize and rice price is positive. In addition, there may be a negative relationship

between direct consumption of maize and per capita income. This is because rice is the staple food of Sri Lanka.

Expected signs of the above relationship can be given as:

ln*RP*t	(+)
ln*MP*$_t$	(-)
ln INC$_t$	(+)

Feed demand

Demand for maize for feed in Sri Lanka can be expressed as a function of its own price and soybean price. In addition, prices of poultry and eggs are also determinants of the quantity demanded of maize. Empirically however, there was hardly a significant impact of price of maize and price of soybean on the demand for maize. It seems that prices of maize and soybean can not influence the feed industry due to its level of production (subsistence level). Only egg production and poultry production were, therefore, treated as determinants of feed demand. This relationship can be illustrated as:

$$\ln QLM_t = D_0 + \eta_1 \ln PP_t + \eta_2 \ln EP_t \qquad (6)$$

Where current year poultry production and egg production are denoted by PP_t and EP_t respectively.

Expected signs:	InlnPP$_t$	(+)
	InlnEP$_t$	(+)

Trade equation

Sri Lanka is basically an importing country due to its excess demand. Consideration of only the import side is, therefore, sufficient to explain the trade position of the feed industry in Sri Lanka.

Various models were tried in empirical estimation that included exchange rate and price ratio of domestic and world market prices. Nevertheless, it was found that only the level of poultry production was a significant determinant of the country's maize imports. Therefore, as a functional form, the relationship can be expressed as:

$$\ln IMM_t = \varphi \ln PP_t \qquad (7)$$

Where IMM_t is the amount of maize imports. The expected sign for the coefficient estimate of the variable, poultry production, is positive.

2.3 Equilibrium

If the market is in balance, the equilibrium properties of the feed market can be analyzed in terms of equilibrium in the demand and supply of the feed industry. At equilibrium:

Total supply - total demand = 0

$$QHM_t + IMM_t = QM_t \qquad (8)$$

2.4 Projections of production and consumption

The parameter estimates based on the above models in log form provide the elasticities for respective variables. These estimates can be employed to predict the future values relating to the feed industry in Sri Lanka. Simply, future trends can be forecast using the average growth rates and the elasticities of respective variables. This can be illustrated as:

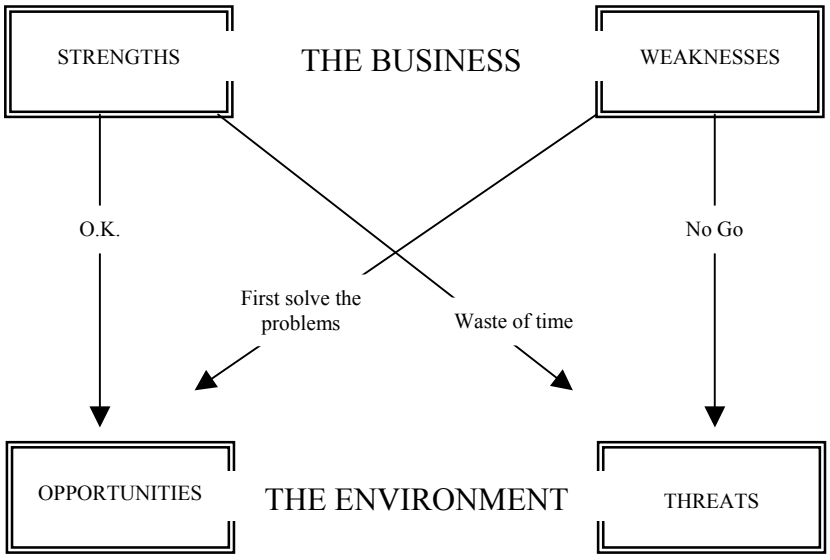
$$dY = \varepsilon_1 dX_1 + \varepsilon_2 dX_2 + \varepsilon_3 dX_3 + ... + \varepsilon_n dX_n \quad (9)$$

Where ε_i represents the elasticity of explanatory variables. dX and dY are respectively the growth rates of explanatory variables and the dependent variable of each equation.

2.5 SWOT analysis

SWOT analysis is used as a management tool to understand the strengths and weaknesses in the industry and to develop policy guidelines. The framework of SWOT is illustrated in Figure 2.1. Its purpose is to further evaluate the results from the supply and demand analysis and to see whether or not the country is ready to expand production domestically to substitute imports.

Figure 2.1 Decision-making through SWOT analysis



2.6 Limitations of the study

The short length of the time series data limited the analytical procedures of the current study. Econometrically, less than 20 years of data is not sufficient to provide enough coverage to carry out such an analysis to forecast for a ten year period (Appendix Table 1). In addition, projections made for a ten year period are at a risk of inclusion of a higher error component because error components in estimates increase with the time period concerned. It is inappropriate to estimate demand and supply models in separate single equations without considering simultaneous equations.

3. Review of Current Status

3.1 Livestock status

The livestock sector in Sri Lanka contributes around 2 per cent to the total GDP of the country. This contribution comes largely from the poultry sub-sector, with broiler meat and eggs contributing around 44 per cent and 26 per cent respectively. The other meats, mutton, pork and beef share the balance of 19 per cent. Poultry farming, especially broiler meat production, is a well established agri-business, largely seen around the cities. Broilers are reared under an intensive deep litter system using commercial compound feeds. In the case of layers however, although there is an increasing trend towards intensification, it is estimated that from 15 to 30 per cent of eggs still originate from extensively managed village flocks. Goat meat and beef are produced largely from animals raised by farmers on extensive grazing and browsing systems and milk mainly from mixed, crop-livestock smallholdings. Swine meat production has shown little growth and remains a small sub-sector with pigs still raised under a scavenging system in many areas. The economic contribution of pig meat is small and among the reasons for this poor performance are that pig meat is not a popular commodity among most sections of the population, that commercial pig production is uneconomic at the prevailing price of feeds, and also due to problems of environmental pollution. There is a potential, however, for increasing swine meat production in smallholder semi-intensive production systems that use feed resources readily available locally.

Even though livestock can play an important and multi-faceted role in the development of the economy and contribute to food security in the country, their potential has not been fully exploited in the recent past. The growth rate and trends in livestock populations during the past two decades, as indicated in Table 3.1, were nearly static in the case of cattle, goat, sheep and pigs, with declining trends for draught buffalo. The cattle population is largely represented by local or indigenous animals, reared under extensive conditions in rural areas. They provide beef for the urban market and draught power for paddy cultivation. The consumption of beef has increased from 16 to 24 million kg between 1994 and 1998. Although the slaughter of buffalo is officially banned, the declining use for paddy field work have made them uneconomical to raise and the illegal slaughter, leading to a reduction in numbers, no doubt takes place. Buffaloes are, however, also milked in some areas for the preparation of a curd which is very popular in Sri Lanka. For this reason, the use of dairy-type (river breeds) buffalo cows is increasing on many parts of the island, particularly in the peri-urban, wet zone areas, in which a ready and lucrative market for the buffalo curd is available. There is little doubt that there are good prospects for dairy buffalo production in the future. For this purpose, the relatively small numbers of exotic river-type buffalo, mainly confined to state breeding farms at present, need to be used to improve the indigenous swamp animals, whose milk production is low.

It is estimated that the production of milk increased from 0.225 million tons in 1988 to 0.341 million tons in 1998 but that during this same period, the import of milk powder increased from 40.1 million to 53.6 million kg. This clearly shows that local production cannot match the increasing demand, even though the consumption is still below international standards. This shortfall can be expected to become further aggravated unless the major issues, such as a lack of suitable land to grow good quality forages, a shortage of economical feed supplements and inefficiencies in the marketing system are addressed and resolved.

The per capita availability of eggs in Sri Lanka increased from 50 in 1987 to 54 in 1997 and to 60 in 2000, but still remains low when compared to consumption levels in developed countries or even to some of the developing countries in the region. Although egg consumption has shown marginal increases over the years, the growth rate in the layer sector was not

significant in most years compared to the massive growth seen in broiler meat production. Table 3.1 shows the total poultry population without meat type or a breakdown of which, for the year 2000, is given in Table 3.2. The number of broiler birds reared for meat is not included in the above census. Therefore, the broiler population is estimated using the day old broiler chicks production. However, egg protein still remains the cheapest animal protein source when calculated as Rupees per unit of protein.

The production of chicken meat has recorded a phenomenal increase from 15 million to 40.8 million birds, a growth of 170 per cent during the period 1987 to 1997. Production passed the 50 million mark in 2001.The annual per capita consumption jumped from 600 g to 2,540 g during the ten year period from 1987 to 1997 and currently stands at just over 3 kg. Further increases in production are expected in the future and the industry appears able to respond to additional demand for chicken meat.

The pig population in the country always remained less than 100,000, hence its contribution to per capita consumption is negligible. A breakdown of the pig population for 2000 is given in Table 3.3. Present estimates do not suggest any appreciable increase in the pig population during the next few years.

Fish protein in the form of fresh and dried fish is an important animal protein source in the Sri Lankan diet. There was a gradual increase in fish production during the last few years averaging 260,000 mt in 1998. The revitalization of the inland fisheries and aquaculture sector, part of which requires compounded feed, contributed 11 per cent to total fish production in the country. However, this production met only 78 per cent of the demand and the balance came from imports. Price increases have been the major constraint in popularizing fish consumption.

Most of the 450,000 mt of feed produced by the expanding animal feed industry is for the poultry sector. It is estimated that over 70 per cent of the feed produced consists of imported materials, particularly maize, and the industry is therefore vulnerable to changes in the availability and cost of these materials in international markets.

Table 3.1 Livestock populations

Category	1980**	2000*
Cattle	1,644,000	1,616,700
Buffalo	843,000	727,700
Goat	493,000	514,400
Sheep	28,000	12,100
Pigs	71,000	73,600
Poultry	6,341,000	9,922,700

Source: * Livestock data, Year 2000, Department of Animal Production and Health.
** Department of Census and Statistics.

Table 3.2 Poultry population in 2000

Laying hens	4,283,100
Other hens *	1,633,800
Chicks	3,066,200
Cock birds	1,639,300
Broilers **	9,341,666
Ducks	9,900

* Village chickens.
** Estimated from day old chick production, 59.7 million/year. Assumed 5 per cent mortality and 6 cycles pr/yr.

Table 3.3 Pig population in 2000*

Sows	12,984
Boars	2,576
Breeder grower	6,180
Fattener	38,200
Piglets	13,660
Total	**73,600**

* Adapted from Wickramaratne *et al*. (2001), swine farming systems in coastal regions of Sri Lanka. Report submitted to the Council of Agricultural Research Policy (CARP), Sri Lanka.

Table 3.4 Per capita availability of animal products (kg/year), 2000

Source	Amount kg/yr
Meat	4.54
Eggs	2.63
Fish	11.73
Milk	15.34
Milk products	16.40

Source: Department of Census and Statistics (1999).

3.1.1 Aquaculture industry in Sri Lanka

Aquaculture resources, on the basis of water type, can be reviewed in three ways.

- Fresh water — 261,941 ha on the island and seasonal tanks contribute a major part (100,000 ha).
- Brackish water — The island has 120,000 ha, of which two thirds is contributed by deep lagoons and estuaries.
- Marine water — The island owns 437,000 km^2 of sea water as an exclusive economic zone, which is 7 times larger than the area of the island.

As is indicated in Table 3.5 total fish production has increased from 183,990 mt to 304,380 mt in the last decade. The same table shows inland and aquaculture fish production has fluctuations and provides only about 10-12 per cent of the total production.

Table 3.5 Fish production by fishing zones (1990-2000)/mt

Year	Total fish production	Inland and aquaculture fish production	Percentage of inland and aqua
1990	183,990	38,190	20.8
1991	198,060	23,830	12.0
1992	206,170	21,000	10.2
1993	220,900	18,000	8.1
1994	224,000	12,000	5.4
1995	237,500	18,250	7.7
1996	228,550	22,250	9.7
1997	242,000	27,250	11.3
1998	269,850	29,900	11.4
1999	279,900	31,450	11.2
2000	304,380	36,700	12.1

Source: Statistics Unit of the Ministry of Fisheries and Aquatic Resources Development.

Inland and aquaculture fish production comes mainly from the seasonal water bodies and reservoirs/tanks. However, aquaculture practices are not well developed in the country with the exception of shrimp aquaculture.

As indicated in Table 3.5, total inland and aquaculture production in 2000 was 36,700 tons, which is about a 17 per cent increase over the 1999 level. More than 67 per cent of this production comes from five districts.

Most aquaculture, mainly shrimp production, was reported in the Puttlam district (a coastal district).

Shrimp culture

Shrimp production in 2000, was the highest reported during the last decade.

Table 3.6 Shrimp production (mt) 1990 to 2000

Year	Aquaculture	Wild Capture	Total
1990	500	4,469	4,969
1991	1,100	5,176	6,276
1992	1,630	6,470	8,100
1993	1,910	6,737	8,647
1994	3,100	3,900	7,000
1995	3,600	4,400	8,000
1996	4,160	4,240	8,400
1997	3,640	4,110	7,750
1998	6,520	5,480	12,000
1999	3,820	5,160	8,980
2000	6,970	6,480	13,450

Source: Statistical Unit of the Planning and Monitoring Division.

Table 3.6 shows that production in 1999 went down drastically, this was mainly because of deadly disease. However, shrimp (prone) farming is a very popular activity in the northwestern coastal area of the country and the produce is mainly exported to developed countries.

As there are no substantial commercial agricultural practices developed in the country, the food fish culture is also not yet much developed. However, several attempts were made to develop both inland and sea fish farming.

The National Aquaculture Development Authority (NAQDA), which has the mandate to develop inland aquaculture in the country, has a few breeding stations.

Under the breeding programme, NAQDA produces food fish seeds and later produces post larvae of carp, mainly to be given to fish farmers. Stocking of seed or post larvae (try or finger lings) in reservoirs/tanks or seasonal water bodies free of charge was the main development activity of NAQDA in the early days. Later, a decision was taken to sell seeds and/or larvae to farmers. However, shrimp and ornamental fish production is undertaken intensively in Sri Lanka.

Ordinance, acts and regulations pertaining to the fishery sector in Sri Lanka were around, even before independence (1948). However, more comprehensive legislation appeared in the form of the Fisheries and Aquatic Resources Act, 1996. This act reviewed and brought much of the old legislation together. It also included culture fishing, including rapidly expanding shrimp farming. With the introduction of this act, the collection of cess for imported fish products also began.

3.2 Feed resource availability

3.2.1 Feed resource availability for ruminants

Natural forages are found extensively in the dry and intermediate zones as scrub jungles, savannas, villus and in the hills and mid country as patana grasslands. Paddy lands, railway embankments, riverbanks, tank grounds, road sides and uncultivated terrains are the other rich sources for natural pasture. These forages are estimated to contribute more than 90 per cent to total pasture production in the country.

Farm grown pasture and fodder is estimated to be less than 10 per cent of the total herbage production in the country. Most of the farmers are reluctant to grow improved pasture and fodder grass due to the low farm-gate price for milk.

Tree fodders like *Gliricidia sepium*, *Erythrina variegata* and *Lencaena leucocephala* and agro-industrial by-products, mainly the by-products from rice and coconut industries, play an important role in ruminant feeding.

Although the Government of Sri Lanka has given high priority to milk production during the last 2-3 decades, the compound feed produced for dairy animals remained static. With the existing milk prices, feeding concentrates becomes uneconomical and hence, most of the farmers resort to feeding coconut poonac, rice bran or a mixture of the two with some mineral mixture. Therefore, there are no prospects for significant increases in compound feed demand for dairy cattle for the next few years. Further, a typical compound feed mixture for dairy cattle feed in Sri Lanka is based on coconut poonac and rice by-products but may include some maize.

3.2.2 Feed resources for poultry, swine and fish production

In Sri Lanka, chickens are the main poultry species reared for meat and eggs. About 50 million broiler birds were produced last year using compound feeds. Broiler production has shown 5-10 per cent annual growth during the last decade. However, layer production has remained static. Annual egg production is about 900 million eggs and it is estimated that about two thirds of these are produced by intensively fed layers, using compound feeds and one third by village chickens reared under extensive or scavenging systems. Other poultry species like duck, turkey, guinea fowl and quail are found in very small numbers and their feed requirement and usage is negligible.

The total compound feed produced for poultry in 2000 was about 350,000 mt. About 65-70 per cent of the raw materials required for compound poultry feed production are imported. Rice by-products, like rice bran/polish and coconut cakes/ poonac, arising from the extraction of oil from coconut, are the main local raw materials available. Annual coconut poonac production is about 32,000 mt and used completely for animal feeding, mainly for mixing in cattle and pig feeds. Total rice bran/polish usage for compound feed is about 100,000 mt, which is less than 50 per cent of the estimated production. The under utilization of rice bran/polish in poultry feeds is primarily due to the poor quality of the product, arising from rice milling using traditional huller type mills. The utilization of industrial by-products and other non-conventional feed resources for compound feed production or poultry feeding is minimal. Centralized, large-scale feed mills operating near the capital city, demand a regular supply of quality raw materials in large volumes. Therefore, the government is encouraging the establishment of small-scale feed mills in remote areas to utilize these materials.

The small population of pigs, just under 100,000 pigs at present, are mainly fed with swill or by-products mixed with swill, except in a few breeder operations, where compound feed is used. Total compound feed produced for swine is less than 15,000 mt.

Fish production systems in the country are based on the exploitation of natural food present in the water bodies. Therefore, the carrying capacity of these water bodies is directly proportional to the natural food availability in the system. However, only a small quantity of fish and shrimp feed is produced in the country and the main requirement is imported. Most of the feed mills lack the facilities and technology required for the production of fish feeds. This situation is not expected to change in the immediate future. The amount of shrimp feed and ornamental fish feeds used in 1999 was around 9,500 and 2,000 mt respectively.

3.3 Animal feed (compound feed) industry

3.3.1 Historical background

Compound feed production in Sri Lanka began with the establishment of a government owned feed mill under the Ceylon Oils and Fats Corporation (OFC) at Seeduwa in the early 1960's. The main purpose of establishing this feed mill was to cater for the poultry sector, which gradually turned from a free-range back yard system to intensive deep litter production. From this time, the feed industry underwent several changes, but poultry feed production remained as the main business. Although there were a few small feed mills operating during the early days with the OFC, such as the British Ceylon Corporation and Moosajees Ltd. their volume was small and produced mainly customer-mixed feed for selected farms. OFC was producing primarily layer feeds, using local raw materials. Only feed additives were imported during these early days. However, with further expansion in the layer industry, the volume of feed produced also increased and local raw material supply became insufficient to meet the demand. Therefore, some raw materials like fish meal and soybean meal were imported in addition to additives. With the changing of government policies from time to time, certain restrictions were introduced to control the import of raw materials, in the form of taxes and permits. However, up to the early 1980's, the amount of raw materials imported remained below 35 per cent of the total used in feed manufacturing.

The move to large-scale imports of raw materials began with the rapid expansion of broiler production in the mid 1980's, which coincided with the privatization of the government-owned feed mills, including OFC. In the next decade, three modern feed mills were established. The past growth in broiler production, which was well above 10 per cent during this period, was the main factor for the establishment of the new feed mills. With these developments, total feed production increased and as local raw material supply was hardly sufficient to meet the demand, large-scale imports of raw materials rose to around 80 per cent of the total used. This situation remains unchanged at present.

Table 3.7 Compound feed production ('000 mt) from 1970 to 2001

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
60	60	65	70	75	80	110	125	110	105	100

1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
105	110	115	120	125	130	140	200	175	200	205

1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
240	260	265	340	300	320	330	345	385	415

Source: Dept. of Animal Production and Health.

Figure 3.1 Compound feed production from 1970 to 2001

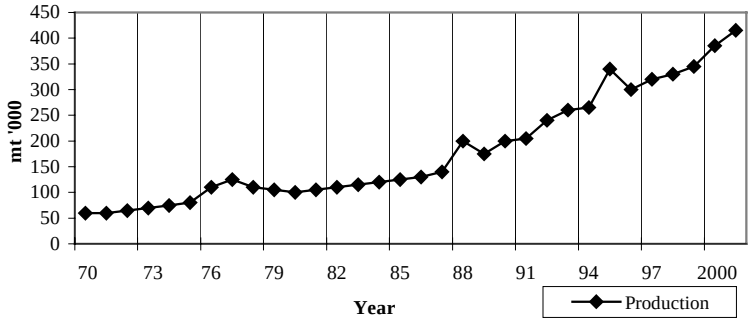


Table 3.7 shows the amount of feed produced during the last three decades in the country. A sharp increase has been reported since open economic policies were implemented. However, a six-fold increase is reported during the last three decades in feed production.

3.3.2 Present status

Total compound feed production in Sri Lanka, with a breakdown of different feeds produced in 2000, is given in Tables 3.8 and 3.9, and further illustrated in Figure 3.1.

Table 3.8 Animal feed production (mt) in Sri Lanka in 2000

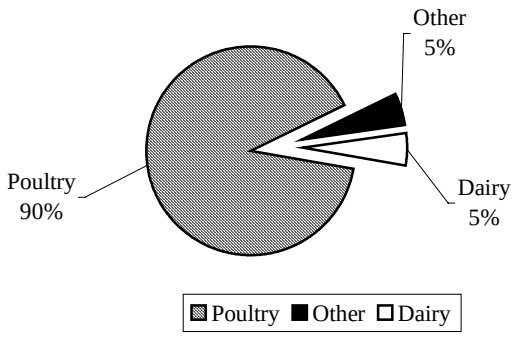
Poultry	350,000
Dairy	12,000
Pig	8,000
Other	5,000
Self mixing (Poultry)	80,000
Total	**455,000**

Source: Department of Animal Production and Health.

Table 3.9 Poultry feed production (mt) in 2000

Broiler feed	175,000
Layer feed	136,875
Breeder feed	118,125
Total	430,000

Figure 3.2 Compound feed production in 2000



Poultry feed remained to be the main compound feed produced, and the amount has increased over the years. However, there was no significant increase in the production of dairy, pig and other feeds. Other feeds include fish and horse feeds. Although the volume of fish feeds produced locally did not increase, the amount of imported feed has shown an increasing trend. The volume under self-mixing was the feed produced at farm level, which comprised 100 per cent of poultry feeds both for commercial layers and for breeders.

Table 3.10 Projected feed production

Year	Amount (mt) '000
2001	415
2002	450
2003	484
2004	525
2005	570

Source: Dept. of Animal Production and Health.

The amount of compound feed produced has shown a continuous increase during this period, except in some years due to specific reasons such as diseases (1996), the privatization of the government feed mill resulting in large-scale self–mixing (1989) and restrictions on imports of raw materials (during 1978 to 1981). This increasing trend is expected to continue according to the projections. Actual compound feed production by registered feed manufacturers up to 2000, is included in Table 3.7. These manufacturers are required to submit their production levels to the Department of Animal Production and Health, under the Animal Feed Act of Sri Lanka. However, total production should be higher than what is given in this table. For example, total feed production in 2000, as shown in Table 3.5, is 455,000 mt when the volume produced by self-mixing is also included, however, registered manufacturers produced only 375,000 mt. This point should be considered when estimating the requirement of raw materials for compound feed production.

3.4 Raw materials for animal feed production

Compound animal feed is a mixture of raw materials, mixed according to a balanced formula, to provide all the required nutrients for the animal. As the nutritional requirements vary according to species, type and class of animal, the formula or raw material proportions in the compound mixture also change. In this context, intensively reared, high producing poultry will require high nutrient density (high energy, high protein and low fibre) feeds compared to dairy cattle. Poultry feed formulations, therefore, require a higher density of raw materials like maize.

Although local raw materials are used, the majority of the raw materials required for compound animal feed production are imported. A list of imported and local raw materials is given in Table 3.11. The table also gives the total quantity available and usage, with respect to major raw materials.

Poultry and swine feeds in most of the Asian countries are corn soybean based and Sri Lanka is no exception. A typical feed formulation will have the following materials.

Cereals
Cereal by-products
Fats and oils
Animal/plant protein sources
Vitamins/minerals/additives

Table 3.11 Local and imported raw materials used for animal feed production (1999)

Raw materials	Usage (mt)	Imports (mt)
Maize	175,000	125,00
Soybean meal	75,000	75,000
Rice/broken rice	nil	nil
Rice polishing/rice bran	100,000	nil
Coconut poonac	15,000	nil
Fish meal	nil	nil
Gingerly meal	nil	nil
Wheat	nil	nil
Wheat bran/pollard	nil	nil
Sorghum	nil	nil
Rape seed	nil	nil
Groundnut poonac	nil	nil
DCP	nil	nil
Shell grit	nil	nil
Salt	nil	nil
Meat meal/ meat and bone meal	nil	nil
Vitamins	nil	nil
Minerals	nil	nil
Additives	nil	nil

Source: Animal Production and Health, Feed Millers.

Usage limits of the aforementioned raw materials in different feed formulations will depend on several factors including, cost, nutritional quality of the materials and the nutritional requirement of the particular animal species or class concerned. Some of the important raw materials and their usage limits in different feed formulations are given in Table 3.12. The usage limits are determined by availability, cost and nutritional constraints. Factors limiting the inclusion level of each raw material are as follows:

1. There is no nutritional constraint to use levels higher than what is given in the table but cost factors limit the maximum inclusion level.
2. Seasonal availability, quality and cost limit inclusion levels.
3. Nutritional limits due to high fibre and low energy. Traditional milling contributes largely to the high fibre. Introducing modern milling can help increase utilization as this is the cheapest local raw material.
4. Only used in high energy feeds; tallow and palm oil are the main sources. Tallow and palm oil are both imported at present. Oils or fats become important in high-energy feeds, especially when maize inclusion is low.
5. All imported; cost determines the maximum inclusion level.
6. Large requirement. 100 per cent imported.
7. Availability depends on oil prices. Majority fed directly to dairy cattle.
8. Major quantity imported. The volume is small when compared to other raw materials.

Table 3.12 Important raw materials and their usage levels

Raw material	Animals species	Animal class	Usage limit (per cent in feed)
Cereals	Poultry	Broiler	40-60
Maize (1)		Layer	30-50
	Pig	Fattener /breeder	20-30
	Dairy	Dairy cow/calf meal	15-25
Cereal by-products	Poultry	Broiler	5-10
Broken rice (2)		Layer	10-20
Rice bran/polish (3)	Pig	All	20-30
	Dairy	All	20-30
	Poultry	Broiler	10-20
		Layer	20-40
	Pig	Fattener/breeder	30-50
	Dairy	Dairy meal	40-60
Fats and oils (4)	Poultry	Broiler	2-5
Animal/plant protein sources			
Fish meal/ meat meal (5)			
Soybean meal (6)	Poultry/pig	All	2-8
	Poultry	Broiler	20-30
		Layer	15-20
Coconut poonac (7)	Pig	All	15-20
	Poultry	Broiler	1-5
		Layer	10-20
	Pig	All	20-50
	Dairy	All	30-60
Vits/minerals/additives (8)	All	All	1-3

Source: Dept. of Animal Production and Health and Faculty of Veterinary.

It is important to note that the total requirement of soybean meal for animal feed is imported because there is no soybean processing facility available in Sri Lanka to process soybean for animal feeds. Similarly, although the quantity is smaller, DCP, vitamins and

additives are also imported. The countries from where these raw materials are imported are given in Table 3.13.

Table 3.13 Imports of raw materials for animal feed production

Raw material	Country
Maize	China, India, USA, Indonesia, Burma, Argentina
Soybean meal	India, China, Brazil
Fish meal	New Zealand, Denmark, Chili, Maldives, Malaysia
Meat and bone meal	Australia, New Zealand
Oils and fats	Australia, Malaysia
Feed additives	Holland, UK, USA, Belgium, Singapore
Minerals	Holland, UK, USA, Belgium, Singapore
Oil and fats	Australia, Malaysia
Feed additives	Holland, UK, USA, Belgium, Singapore
Minerals	Holland, UK, USA, Belgium, Singapore

Source: Sri Lanka Customs.

Maize

Maize remains the most important of the cereal grains available for animal feeding in Asia as well as much of the world. Although Asia produces large amounts of rice as well as some wheat, these grains cannot compete with maize in terms of nutritive quality and cost for animal feeding. At the same time, production of other cereal grains, such as sorghum and millet have not shown a significant increase. For these reasons, the demand for maize is high and can be expected to increase in the future. Tubers and yams have a potential to at least partly replace maize as an energy source but the cost of production under Sri Lankan conditions is high and does not permit its inclusion in animal feeds.

In formulae for broiler diets, energy levels were gradually increased during the last few years in response to market demand for a high energy feed to produce a bird within a short period of time. Energy levels used in most of the broiler feeds in the 1980's were around 2,800 to 2,900 kcal of ME per kg but today have reached over 3,000 kcal. The marketing age has proportionately reduced from 7 to 8 weeks to 5 to 6 weeks during the corresponding period. This has resulted in being able to produce a 2 kg bird in less than 42 days.

Local production of maize is gradually decreasing although an increasing trend has been seen since 1999. This has resulted in consistent increases in imports. It should be also noted that a reasonable amount of maize is harvested as green cobs for human consumption. This quantity is estimated at around 25-50 per cent of total production, bringing the availability of local maize for animal feed production down further.

Soybean

Soybean is the main protein supplement used in animal feed and it is used in soybean meal form. One hundred per cent of the soybean meal requirement is imported because no processing facility is available for soybean seed processing for animal feeds. Therefore, the small quantity produced is used for human food.

Cassava

Cassava is a good source of energy for animal feeds, especially for pig feeds in some countries. It also serves as a binder in feed pelleting. However, in Sri Lanka, all of the cassava produced is used for human consumption and market prices do not permit its inclusion in animal feeds. On the basis of present market prices, it will be about 4 to 5 times more costly to include cassava as an energy source in poultry and pig feeds compared to maize. Hence the potential of cassava as an animal feed in Sri Lanka will not become a reality.

3.5 Agricultural policies

The Government of Sri Lanka has implemented some policy options to develop the food crop sector in the country. Most of these policy options were taken in favour of selected crops, taking into consideration their social and political importance. These major crops include rice, maize, soybean, potato and some other non-CGPRT crops like chili and onions.

3.5.1 Production policies

A favourable set of policy decisions have been taken by the government to boost the production of food crops by increasing the cultivated extent as well as productivity. The possibilities of increasing the cultivated extent are limited in the maha (wet) season due to the non-availability of land with basic resources, such as water.

Therefore, a decision was taken in the early seventies to diversify well drained paddy land during the yala (dry) season due to insufficient water availability for paddy and a high demand for other food items, such as condiments and pulses. More emphasis was given to crop diversification programmes with the development of new lands for cultivation, under the biggest river basin development project, known as the "Mahaweli Development Project" in the early eighties.

Another policy decision was taken in the early nineties to introduce maize in paddy fields under major and minor irrigation schemes during the yala season to fulfil at least part of the maize requirement for the feed industry.

In order to increase the productivity of food crops including rice, coarse grains, pulses, condiments, potato and selected vegetables, the government provided about Rupees 100 million as a development fund to carry out rapid development programmes for 3 years starting from 1999. Productivity increases were reported for rice, maize and condiments like onions.

The average paddy yield increased from 3.51 mt/ha (1996) to 3.85 mt/ha (2000) within four years. Similarly, big onion yields increased up to 13.6 mt/ha (1999) from 9.8 mt/ha (1997).

Fertilizer subsidy - only for nitrogen fertilizer (urea) - was re-imposed in the nineties. The National Fertilizer Secretariat and the Treasury jointly decide the subsidy rate, which is given to the importers to maintain Rs 350 (US$ 3.7) per 50 kg bag of urea. Normally the amount of subsidy given to importers is around US$ 135 per ton.

The private sector is encouraged to enter into forward sales contract agreements with the farming community to purchase the raw production. The individuals and organizations are provided with basic facilities, including soft loans, through the state or commercial banks.

The Central Bank of Sri Lanka initiated the forward sales agreement programme a few years back, mainly to protect farmers who are involved in food crop production. Forward sales contracts are legally binding agreements between a buyer and a seller. Actually, in this exercise the farmer is the producer. He enters into a contract with a buyer before cultivation begins, to sell his product at a profit and the buyer is assured of good quality supplies at a fixed price. Soft loans for farmers, as well as purchasers, are provided after an agreement is signed by both parties with the involvement of a third party as a facilitator. The agreement contains the major points, such as purchasing price, quality etc. The maximum amount given as a loan to a purchaser (individual or organization) is Rs 25 million. However, purchasers must fulfil the requirements imposed by the bank.

The producer (farmer) can also obtain a short-term cultivation loan from the bank. The interest rate for both parties under this special scheme is about 12.5 per cent. The Central Bank of Sri Lanka provides the balance, 10 per cent, as a subsidy to the particular bank to bear the other costs.

At present, this scheme is mainly implemented for rice, maize and onions. According to the Central Bank of Sri Lanka, in total, 12,957 contracts have been signed by farmers, within six

months, from April to September 2002 through commercial banks. Out of which 2,092, 820 and 711 were for maize, soybean and finger millet respectively.

Seed production and importation of all food and feed crops is given to private sector organizations, while the Department of Agriculture is engaged in the entire basic seed and a little certified seed production in a competitive manner. This situation was created by the formulation of a Seed Act and a Seed Law by the government in the mid-nineties. The private sector is allowed to import and introduce hybrid varieties of maize, chillie, vegetables and some fruits. Most of these policy decisions were taken during the last decade to increase productivity as well as the quality of the products of agricultural crops.

3.5.2 Agro-processing policies

The Government is encouraging private sector organizations to engage in processing of agro-products as food and feed, for local as well as export markets.

Commercial level feed production, which was started in the early fifties, was dominated by the two state owned provender mills. At that time, the private sector millers played a secondary role. In the late seventies, the government took a decision to privatize the feed milling industry and the private sector was given opportunities to engage in feed milling under the open economy policy. Today, the entire feed milling industry is in the hands of the private sector.

An Animal Feed Law was enacted in 1986 by the government aiming to protect farmers as well as genuine producers. It provides for the appointment of a registrar of animal feeds, annual licensing of manufactured feeds and imports, and bans the sale of unlicensed feed in the market. It also allows farmers to appeal against poor quality feed and provides for sampling and analysis of such feeds. The government is now not involved in food processing that utilizes any type of agricultural raw material. This is all being undertaken by the private sector.

With the prevailing open economy, foreign firms as well as local investors are allowed to invest freely. It is also not necessary for foreign investors to join hands with any local partner and there is no restriction on exports. The government gives a range of incentives to investors through the Bureau of Investment, such as priority in allocating lands on industrial estates, duty free imports on machinery and project related items, tax free status for five years and no taxes on exports.

Government assistance, such as finance through soft loans, importation of duty free machinery and related items, and a grace period for loan repayment are given to small and medium-scale entrepreneurs who also want to engage in agro-processing.

3.5.3 Pricing policies

Various pricing policies have been implemented by the government in order to protect local producers of some of the major crops by creating a favourable environment that ensures adequate income for them.

Almost all of the policies related to price were imposed for CGPRT crops, which are considered as other field crops due to their importance from an economic and social point of view. These policies, which were imposed after the introduction of open economic policies were changed on a few occasions due to various reasons.

However, the government was compelled to change some of the pricing policies to safeguard the industries which utilize some of these crops as raw materials. Examples are maize and soybean.

Occasionally, some policies were changed to protect consumers who could not afford high commodity prices. An example being potato.

Some of the policies with reference to CGPRT crops, are given in Tables 3.14, 3.15 and 3.16.

Table 3.14 Maize pricing policies implemented during the last decade

Year	Policy (Rs/kg)
1990	Floor price 4.25 (increased by Rs 1).
1991	Floor price 5.25.
1993	Floor price 6.00 (increased by 0.75 cents).
1997	Producer price scheme was introduced Rs 10-12/kg.
2000	10 per cent duty on CIF against free imports.
2000 March	Licence requirement for imports was also removed in March.
2001 May	Another 40 per cent surcharge for 10 per cent duty was introduced.
2002 March	All taxes were removed.
2002 August	20 per cent value added tax (VAT) was imposed.

Source: Central Bank of Sri Lanka.

Before 1990, the government was directly involved in maize marketing. In 1989 the Paddy Marketing Board (PMB), which was a government organization established for grain marketing, purchased about 46,208 mt of maize within three months. The government's direct involvement in marketing was gradually withdrawn with the introduction of open economic policies to the country. However, the government tried to help maize farmers by introducing a floor price, producer price and tax schemes. After the closing down of the PMB, a producer price scheme was introduced, under which the government encouraged the private sector to purchase at a predetermined price. In order to achieve this, free imports were not allowed and importers were required to obtain a licence from the Ministry of Agriculture for imports.

However, in 2000, the licence requirement was removed and an import tax of 10 per cent on CIF was introduced for further liberalization. In May 2001, another 40 per cent surcharge on import duty (10 per cent) was introduced for all imports including maize.

Today, the government is not involved in maize marketing or importation, except for imposing taxes as policy measures. All import taxes for maize imports were removed in March 2002 in order to assist feed millers. However, the government took a decision to change the tax structure in August 2002. At present, a value added tax system is in operation for all kinds of business in the country, under which 20 per cent is charged for imported maize as value added tax. A fluctuation in farm gate prices of maize can be seen, mainly due to these price packages.

Importation of maize, only as a feed ingredient, waa permitted duty free until 2000 with non-tariff measures. After 2002, duty free imports were not allowed and a 10 per cent duty on imported maize for animal feeds was imposed and in May 2001 another 40 per cent above the 10 per cent was added. However, in the middle of 2002, free imports were permitted again. At present (since August 2002), with the introduction of a new tax structure called value added tax (VAT), 20 per cent is charged on imported maize for feed.

Table 3.15 Soybean pricing policies implemented during the last decade

Year	Policy (Rs/kg)
1990	Floor price 7.30.
1993	Floor price was increased by 85 cents (8.15).
1994	Another increase of Rs 5.85 (14.00).
1996	Government liberalized the imports but under a licence issued by the Ministry of Agriculture.

Source: Central Bank of Sri Lanka.

Table 3.16 Potato pricing policies implemented during the last decade

Year	Policy (Rs/kg)
1992	Seed and other potatoes were brought under licence control – effective from June 1992 with a tax scheme.
1995	Liberalized imports: Turnover tax was removed. Import duty reduced from 35 per cent to 20 per cent.
1998	35 per cent tariff protection was imposed to protect local production..
1999	Eliminate the import licence requirement.
2000 (early)	Tariff – 35 per cent surcharge was imposed on top of the existing 35 per cent duty until 7th December 2001.
2001 (late)	Specific duty of Rs 20/kg was imposed on 8th December mainly to protect local production.

Source: Central Bank of Sri Lanka.

The extent cultivated with potato in the country was drastically reduced and some social unrest was created in producing areas due to free imports in 1999. Therefore, the government was compelled to take some policy measures to protect local producers.

A similar pricing scheme was implemented for green gram, black gram and groundnut. A floor price of Rs 12.00 per kg of green gram which was imposed in 1990, was continued until 1993. It was increased by another Rs 8.00 per kg (Rs 20.00) in 1993. In 1997, a producer price scheme (Rs 30-40 per kg) was introduced instead of a floor price. Government organizations were ordered to purchase at the producer price but the open market price of green gram was higher than the offered price under the producer price scheme.

A similar scheme which was implemented for green gram was implemented for black gram and groundnut also. However, the open market prices prevailing each year were higher than the offered prices. There were, therefore, no marketing problems as the production levels were less than the demand.

3.6 Marketing and trade policies

Before the introduction of an open economic policy to the country, agricultural marketing, mainly grain marketing, was governed by the state sector. Private sector organizations were also involved in agricultural marketing but not in a competitive manner.

3.6.1 State trading enterprises

An organization known as the Paddy Marketing Board (PMB), as a state organization, was formed in the early sixties mainly to purchase and process paddy grown by local farmers. The PMB handled only 10 per cent of the production but controlled the whole grain market. This organization was actively involved in maize marketing in the seventies and eighties on behalf of the state owned animal feed milling industry. The state-owned Oils and Fats Corporation purchased soybean seed for oil extraction and used the by-product cake for the animal feed industry. The Paddy Marketing Board and Oils and Fat Corporation were the main state owned organizations which were actively involved in grain and other feed crop marketing in the country during the seventies and eighties. Similarly, those were the organizations which implemented government pricing policies in the agricultural sector.

However, the activities of these organizations were gradually withdrawn with the implementation of open economic policies in the late eighties. As a result, the PMB was closed down to create a competitive environment in grain marketing and the Oils and Fat Corporation was privatized to create a favourable environment for the development of the poultry sector in the country.

The government has been taking steps to protect local producers as well as consumers since the open economic policies were introduced in the late eighties. The government is also involved directly in agricultural marketing in a competitive manner and uses semi governmental organizations like the Cooperative Wholesale Establishment (CWE) for this purpose.

The Central Bank of Sri Lanka introduced a Forward Sales Contract System in the late nineties to promote trade in agricultural products at a predetermined price and of assured quality. Feed and food producers who use locally grown raw materials such as paddy, maize and essential commodities, purchase their part of the requirement under this system. The financial assistance is provided by the Central Bank through commercial banks as short-term, soft loans. This forward sales contract system helps to stabilize the producer price scheme as well as maintain the quality of the products specified by the industrialists.

3.7 Policy reform initiatives

The following policy changes were made during last decade:

i. Liberalization of the production, imports and distribution of seeds. Under the new policy initiative, the government took a decision to produce only basic and registered seeds and certified seed production was handed over to the private sector. In order to strengthen this, the few state owned farms were given to the private sector, mainly on long-term leases.

ii. Four special task forces were appointed for paddy, other field crops, vegetables and fruits separately, in order to strengthen the national level, crop development programme.

The programmes for feed crops were handled by the task force for other field crops. The main objectives of these task forces were to develop organized production, processing, marketing and distribution in a more effective manner and make these crops available to the consumer or end user at an affordable price.

Most of the development programmes, with the participation of the private sector and state sector agencies for maize development in the country, were initiated by the task force for other field crops. Productivity increases, quality improvements, group farming use of quality seeds for planting and the introduction of hybrid seeds are some of the impacts of the maize production programmes implemented under the leadership of the task force for other field crops during a three year period from 1995.

iii. Liberalization of the fertilizer trade in order to encourage farmers to apply the recommended doses of fertilizer to their crops, mainly food and feed crops. A fertilizer subsidy scheme was introduced in early October 1994. This subsidy was paid through importers of fertilizer and has generally resulted in the price of fertilizer being reduced by about one-third of its selling price.

The ultimate objective of this scheme was to increase the productivity of food and feed crops cultivated by local farmers.

iv. In December 1996, the Ministry of Agriculture, Lands and Forestry launched a country-wide food production drive with the following objectives:

- To commercialize subsistence farming.
- To adopt integrated farming techniques for year round cultivation.
- To enable farmers to increase their bargaining power.

v. The Ministry of Agriculture, Lands and Forestry began to design policies related to the domestic agricultural sector in 1995. Under these policy options, the Ministry arranged:

- The supply of high quality, locally produced or imported (Hybrid) seeds for planting by the private sector.
- Involving both the private sector and non-governmental organizations in the development of the non-plantation, agricultural sector.
- Establishing farmer companies to market, transport and distribute farm products.

3.8 Consequences of trade liberalization of CGPRT crops

With the introduction of open economic policies in the late eighties, the trade of many food crops was liberalized. Potato and non CGPRT crops, such as chili and onions, were the main crops imported and affected due to open economic policies.

Maize and soybean are also imported in bulk for the animal feed industry. Rice imports were allowed when local production was low, in order to fulfil the demand. Although open economic policies have been implemented, the government has taken some steps to protect local

producers by introducing tariff and/or non-tariff barriers. As is indicated in Table 3.16 tariff policies have been implemented in an ad-hoc way during last decade. A similar situation can be seen in non-CGPRT crop imports also.

Following are some of the consequences of ad-hoc policy implementation in local production of main and other field crops. (Epaarachchi *et al*., 2002).

i. Local producers of potato, chili and onions have faced difficulty competing with cheaper imports of these commodities as a result of the relaxation of import restrictions.
ii. This situation has encouraged a large number of producers to shift away from the cultivation of these crops. This resulted in fluctuations (mainly reductions) in cultivated extent of these crops during the last decade.

The lowest potato production of 25,899 mt was reported in 1998. Very high production levels were maintained until 1996. However, since the imports were liberalized in 1996, local potato production faced stiff competition from cheap imports, resulting in a sharp decline in domestic production until 1998. However, after imposing a 35 per cent protection tariff in 1998, the cultivated extent has increased.

Trade liberalization has negatively affected local production of non CGPRT crops also. Chili and big onions are the most affected cash crops grown in Sri Lanka.

Local chili production decreased between 1990 and 2000 from 39,000 mt in 1990 to 14,000 mt in 2000, while chili imports increased from 8,000 mt in 1990 to 23,000 mt in 2000. The cost of production of chili in India is comparatively lower than it is in Sri Lanka due to low cost materials, low wage rates and the use of high yielding varieties.

As is in the case of chili, domestic big onion production showed a declining trend between 1994-1998. The lowest production was reported in 1998 due to the removal of import liberalization in 1996.

In the case of maize, which is imported mainly for feed, a declining trend in extent can be seen between 1998 and 2000. This may not be due to trade liberalization and due to climatic conditions. The imported price (with taxes) was similar to the local price of maize.

With trade liberalization, new technology, such as new seed varieties, including hybrids of maize etc. were brought to the country. Not only seeds but also equipment such as seed cleaning, sorting and grading, packing and seed testing equipment and micro irrigation equipment were allowed duty free imports in 1999. By implementing these trade liberalization policies, the government expects to increase local production of selected crops.

Trade liberalization has assured the sustainability of agro-based industries, such as the feed industry, by the continuous supply of raw materials at affordable prices. The total soybean requirement in meal form and 80 per cent of the maize requirement are imported.

4. Demand for Feed Crops

As is indicated in previous chapters, none of the CGPRT crops which are cultivated in Sri Lanka, are used in the animal feed industry. Although there is potential to be used in the animal feed industry, most of the CGPRT crops grown in Sri Lanka are not used because of high demand as human food. Almost all of the pulses (soybean, green gram, cowpea, black gram), root and tuber crops (potato, sweet potato and other tubers) and course grains (kurakkan etc.) are consumed by human beings in processed or raw form. According to Ranawana (1999) most of the feed ingredients are imported from other countries. Poultry feed, which is the main compound feed (90 per cent of the total), is produced mainly from imported ingredients. The local ingredients used include maize, rice bran/polish, broken rice, coconut poonac and minor ingredients, such as gingerly poonac.

Table 4.1 Percentage of use of locally available ingredients and importation

Ingredient	Imports as a percentage of total
Maize	80
Soybean	100
Rice bran/polish	00
Coconut poonac	00

Source: Ranawana (1999).

Coconut poonac is used mainly in feeds for the dairy industry. Table 4.1 indicates that at present, only 20 per cent of locally produced maize is used in the animal feed industry.

Per capita consumption of livestock products is expected to increase along with the increase in income and related factors. FAO has predicted that meat and milk consumption will grow at 2.8 and 5.3 per cent respectively in countries like Sri Lanka.

As is indicated in Chapter 3, the main meat source in Sri Lanka is chicken. Therefore, at present, the main compound feed consumer is the poultry industry.

According to the Department of Animal Production and Health, per capita availability of broiler meat and eggs in 2000 and the predicted availability in 2010 are as follows:

	2000	2010
Broiler meal (kg)	3.2	6.28
Eggs (No)	62.1	73.3

This means a 10 per cent and 1 per cent growth rate in broiler and egg production is expected in the next decade.

The demand for feed in Sri Lanka is a drived demand and depends mainly on the number of poultry and other animal populations.

4.1 Maize

4.1.1 Consumption behaviour and product development

Table 4.2 Supply and demand projection for 2001-2010

Year	Estimated production ('000 mt)	Estimated feed consumption ('000 mt)	Estimated food consumption ('000 mt)	Estimated demand ('000 mt)
2001	31.27	114.82	68.10	182.92
2002	31.61	129.75	75.30	205.05
2003	31.95	146.61	83.27	229.88
2004	32.30	165.67	92.07	257.74
2005	32.65	187.21	101.81	289.02
2006	33	211.55	112.57	324.12
2007	33.36	239.05	124.47	363.52
2008	33.72	270.12	137.64	407.76
2009	34.09	305.24	152.19	457.43
2010	34.45	344.92	168.28	513.20

Table 4.2 shows the estimated requirement of maize up to 2010. The data in Table 4.2 has been calculated by a methodological approach taking both theoretical and empirical implications into account. However, economic explanation clearly reveals that it is very difficult to obtain a precise picture regarding the future trends of commodity requirement due to the following reasons:

i. The period of data availability is very short.
ii. The prevailing trend, even during recent years is not clearly indicated by the data set.
iii. The demand and supply trend have changed year by year due to the changes in political, social and economic policies.

However, the following factors were also considered in this exercise:

i. The growth rates of the broiler and layer industry are 10 per cent and 1 per cent respectively.
ii. According to the relevant authorities, no expansion will take place in the "Thriphosa" industry but growth rates of other commercial food industries will be about 1 per cent - 2 per cent per year.

The state controlled Thriphosa (high nutrient food) Project, which produces high nutrient foods for pregnant women, mothers and children, will not be expanded in the near future. Therefore, the amount of maize needed for Thriposa (8,000 mt/year) remains unchanged. Another two private sector medium-scale organizations, namely Plenty Food (Pvt.) Ltd and Cereal Product (Pvt) Ltd are also engaged in the production of human food using maize as its main ingredient. There are some other cottage industries which produce flour and other various mixtures for human consumption. Large-scale biscuit manufacturers use maize in cookie production. All these organizations utilize aflatoxine free quality maize. It is estimated that the present maize requirement of these human food industries, except Thriphosa, is about 5,000 mt per annum. According to these organizations, the industry is growing at a rate of 1-2 per cent annually.

Maize is mainly grown in a few major districts in the dry zone of the country (Chapter 5). Most of the maize growers are resource poor, small-scale, rainfed farmers and their main crop is maize. They consume maize as their staple food item.

Green cob consumption (boiled immature cobs) as a snack, is very popular among all sectors of the society. Although it has not been properly surveyed yet, it can be assumed about 30-40 per cent and 50 per cent of the total production is used for green cob consumption in maha (wet season) and yala (dry season) respectively.

Table 4.2 shows the estimated maize requirement up to 2010. A large amount is used in the animal feed industry. According to the Department of Animal Production and Health, 90 per cent of the total compound feed production is for poultry, while 5 per cent is for dairy and the balance of 5 per cent is for other animals. Maize usage in poultry feed varies according to its use. In Sri Lanka, provision is there to use 30-60 per cent maize in broiler feed and 30-50 per cent in layer feed.

In 2000, compound feed production for dairy and piggery was 12,000 mt. and 8,000 mt respectively. Only about 20 per cent maize is used in these rations. Therefore, the total maize requirement for compound feed for dairy and piggery was only 4,000 mt. Due to slow growth in both industries, maize requirement in the future may not be much higher than the present requirement.

At present, almost all of the feed manufacturers use 40 per cent and 33 per cent maize in their broiler and layer rations respectively, mainly due to the high cost of other energy substitutes. This feed information was used in the process of estimating the requirement in the future.

The demand for maize is rising with the rapid growth of the poultry industry in the country. Similarly, maize consumption as a human food in various forms is also increasing.

4.1.2 Consumption structure

As indicated in 4.1.1, maize is consumed as the staple food by resource poor rural small-scale farmers in major producing areas. They consume maize in various forms, on some occasions maize alone or with other ingredients such as rice. However, when maize is consumed as the staple food, farmers tend to add other food items such as protein, vitamins, minerals etc. by incorporating available food resources. Green cob consumption can be seen all over the country by all sectors of the society. However, suitable varieties such as sweet corn, are not grown in Sri Lanka at present. Some varieties which are suitable for the animal feed industry are grown for green cobs also. Road side selling is a very popular enterprise all over the country.

At present, the animal feed industry is completely managed by the private sector. The industries total installed capacity is about 455,000 tons per annum, of which 80 per cent is utilized. Table 3.7 in Chapter 3 shows the breakdown of actual animal feed production in 2000. Ownership of the industry is completely in the hands of the private sector, apart from a few cooperative societies which carry out some feed mixing, mostly for their own farmers. A few large companies dominate the industry and three of them alone produce 70 per cent of the annual production. This means that more than 65 per cent of the maize requirement is consumed by these three producers. The balance of 35 per cent of the maize requirement is consumed by the medium (2), and small-scale (12) manufacturers and self-mixing poultry feed producers.

Almost all of these facilities are located in three districts, namely Colombo, Gampaha and Kurunegala, where the poultry industry dominates.

Table 4.3 Number of registered poultry feed millers and their capacities (2001)

	2001	Estimated usage per cent		
		Maize	Soya	Rice bran
Total number registered	17	100*	100*	100*
Large-scale >40,000 mt year	03	65	67	
Medium-scale 10,000-40,000 mt/year	02			
Small-scale < 10,000 mt/year	12	35	33	100*

Source: Dept. of Animal Production and Health.

* Not including the amount used by the self-mixing industry.

In addition to these registered feed millers, it is reported that a few thousand people are engaged in poultry feed production in terms of self-mixing. No official data is available about their capacities, etc.

In 2000, it was estimated that these people produced about 80,000 mt of poultry feed for their own use and for selling.

4.1.3 Consumer price behaviour

Farm gate and imported prices are given in Table 4.4. The farm gate price of maize has risen 178 per cent in the last decade. Despite the dramatic rise in the price of maize, the demand for maize has also risen drastically with the rapid expansion of the poultry sector in the country.

This is mainly because of fluctuations in import prices and the difficulties in importing due to government policies, not only in Sri Lanka but also in other countries.

Although the rupee value has decreased against the US dollar, the CIF price has not changed accordingly. Table 4.4 clearly shows this situation. This may not be reported correctly or some price manipulation may have occurred.

It can be observed that major feed millers tend to reduce maize usage in the poultry feed manufacturing process when world market prices are higher or local production is less. Similarly, when the prices of other energy sources are higher than the normal price, millers tend to use more maize (sometimes up to 60 per cent) as an energy source. This is happening today. Therefore, the demand for maize in the animal feed industry may be higher than the estimated requirement.

Table 4.4 Imported and farm gate prices of maize during the last decade (Rs/kg)

Year	Farm-gate	Imported (CIF)	Value US$ (Rs)
1990	5.81	6.45	40.06
1991	5.60	9.09	41.37
1992	7.20	10.92	43.13
1993	7.13	6.63	48.25
1994	7.28	6.99	49.41
1995	9.31	7.93	51.25
1996	10.52	11.91	55.27
1997	13.74	9.83	58.99
1998	14.09	8.82	64.59
1999	na	8.88	70.39
2000	16.34	9.45	75.77

Source: Dept. of Agri/ Central Bank of Sri Lanka/ Sri Lanka Custom.

4.1.4 Consumption response to market forces

Consumption response of maize to market forces is analyzed by two separate demand blocks; demand for food and demand for feed. The estimated values are presented in the following functional forms.

Demand for feed

$$\ln QLM_t = 0.52 \ln PP_t + 0.35 \ln EP_t - 1.18 \text{ DI}$$
$$\quad\quad\quad\quad (0.06) \quad (0.13) \quad\quad (0.18)$$

DW = 1.86 $R^2 = 0.92$

Sample period = 1985-1999

Note: Figures in parenthesis are standard errors.

(A dummy variable (DI) is used for the period 1988-90, to represent the sharp decline in maize consumption in livestock production. Civil unrest prevailed in the country during this period affecting the marketing channels of maize production)

Demand for food

$$\ln QFM_t = -8.31 - 0.19 \ln MP_{(t-1)} - 1.2 \ln RP_{(t)} + 1.6 \ln INC_{(t)}$$
$$(7.14) \quad (0.16) \quad (0.93) \quad (1.02)$$

$DW = 3.18$ $R^2 = 0.25$

Sample period 1981 – 1999

Note: Figures in parenthesis are standard errors.

According to the estimates, demand for maize for livestock production is mainly attributable to the production levels of poultry and egg production. The coefficient estimate for poultry production of the feed equation implies that a one per cent increase in poultry production would increase maize demand by 0.5 per cent. In addition, 0.35 per cent demand would be due to a one per cent increase in egg production.

Although the estimates of the demand function of food are not statistically impressive, the results are used and presented here due to the difficulties encountered in fitting a better model for food demand. Results give evidence to the fact that rice and maize prices affect the maize demand negatively while income is positively related to human maize consumption. The observed relationships do not give a clear picture of maize consumption patterns but a rather complicated pattern. Maize is sometimes a staple food for rural people when rice is in short supply. In addition, eating maize as a snack is becoming popular in the urban sector. Thus the observed weak relationships are not surprising.

The above estimates were used to forecast future demand and are presented in section 4.1.5 and Table 4.2.

4.1.5 Consumption projections

The consumption levels are forecast using the two estimated demand functions for the period 2001-2010. This is presented in Table 4.2. The basic assumption behind the forecasting procedure is that the trends of the relevant variables do not change during this period. As appears in Table 4.2, maize demand for the livestock industry will increase from 114,820 mt to 344,920 mt during the decade. This is nearly a three fold increase over the demand in 2000. Accordingly, the demand for human consumption is projected to increase from 68,100 mt to 168,260 mt. Compared to human consumption, the growth rate of demand for maize for livestock production is relatively high. If this trend continues, there should be a sharp expansion in the poultry production sector. On the whole, these results indicate that there may be noticeable demand increases in both human consumption and in the livestock feed industry.

4.2 Soybean

Soybean is a relatively recently introduced crop to Sri Lanka. It was once a popular rainfed highland crop where it was good for stabilizing the slash/burn system of agriculture, dependent on natural vegetation to rejuvenate the soil. Soybean is known as the poor man's meat due to its high protein contain. It has a good potential for value addition, both as a cottage industry and a medium-scale industry for preparation as human food and livestock feed.

The Oils and Fats Corporation, which was a government owned organization, was the major buyer of soybean in the early seventies. However, after privatization of the Oils and Fats Corporation, there was no reputed well established organizations to purchase the local soybean production for oil extraction.

4.2.1 Consumption behaviour and product development

Soybean is consumed as human food in various forms and as a protein ingredient in animal feed.

At present, almost all of the local production of soybean is used in the human food industry. Various food products are produced by cottage level and medium-scale entrepreneurs.

These are:

i. Triphosa – High nutrient food for pregnant women/mothers and children.
ii. Samaphosa, Ranphosa – High nutrient cereal products, similar to Thriphosa.
iii. Tempe, toffu, soy meat for curry preparation.
iv. Soy snacks.
v. Soy ice cream and milk.

Total production in the country is not sufficient even to fulfil the requirement of the above local industries. Therefore, the Triphosa Project, which is a government controlled organization, imports part of its annual requirement. The total requirement is about 3,600 mt per annum. The whole seed is used to produce the above products.

Apart from the use of the whole seed, some of the by-products are also used in the food as well as the feed industry. Textured vegetable protein (TVP) is imported to use directly or as a raw material in the human food industry. There are a few (3-4) major industries which consume total imported TVP to produce soy meat for human consumption.

The animal feed industry is the major soybean consumer in the country today but it consumes only defatted soybean meal. The total requirement of soybean meal is imported due to two reasons. They are, the non-availability of locally produced defatted soybean meal due to the non-availability of infrastructural facilities for oil extraction and insufficient local production, even for human food production.

4.2.2 Consumption structure

The involvement of a few NGO's and medium-scale private sector organizations in human food production has revitalized the soya industry and is showing some prospects for possible demand for the crop.

The Triphosa Project, managed by a Ceylon Tobacco Company Ltd. but controlled by the Ministry of Health, consumes 3,600 mt tons of soybean seed annually. Thriphosa (name of the product) is a high nutrient food given free of charge to pregnant women, mothers and children.

According to the Ministry of Health, there is no possibility of increasing production capacity in the near future. Therefore, the requirement remains unchanged.

There are two other medium-scale human food producers in the country, both of which are private sector organizations. One Plenty Food (Pvt.) Ltd., produces various cereal food items under their tradename Samaphosa. Soybean is also one of the main ingredients in their range of products. The other organization, called Cereal Product (Pvt.) Ltd. produces another set of snacks under their tradename Ranphosa, using soybean and other ingredients. Both of these organizations consume about 1,200 mt of soybean (seeds) per annum. Apart from soybean, maize is also used as a main ingredient. These two organizations have arranged contract growing programmes with selected farmer groups in selected areas to fulfil their soybean and maize requirements.

Apart from these organizations there are a large number of cottage level entrepreneurs who produce various products as indicated above. The amount which is being consumed by these cottage level entrepreneurs has not been estimated yet due to difficulties in obtaining accurate information.

The amount of textured vegetable protein (TVP) imported, only for further value addition as a human food (soy meat), was not clearly indicated in the available data. The total amount of TVP imports are consumed by a very few (3-4) local companies. This is a popular food item (curry) in the poor man's daily diet. The demand for this item (soy meat) may rise with price increases of other animal proteins such as chicken, beef, mutton, etc.

According to the compound feed producers, only soy meal is used as the protein source in their rations. The entire requirement for the feed industry is imported from other countries. Presently, soy meal usage is 20-30 per cent in broiler feed and 15-20 per cent in layer feed. Ranawana (1999) indicated that the large feed producers dominate the industry with three of them being responsible for 70 per cent of the feed produced. The balance is produced by medium (2) and small-scale (12) feed producers and a few thousand self-mixing poultry feed manufacturers. Most of the time, small-scale and self-mixing producers have to depend on others to fulfil their soya requirement because they do not have access to the importation process. These self-mixing producers are resource poor, small-scale rural individuals. In 1999, eighteen registered importers were engaged in importing energy and protein feed ingredients and a number of feed additives to the country.

4.2.3 Consumer price behaviour

The farm gate price or wholesale price prevailing in the country may not have any positive affect on soybean meal usage or consumption in animal feed manufacturing. However, the international market price or CIF price may have a positive affect on it.

The recommended amount of soybean meal in any ration can not be substituted by any other ingredient, mainly due to the need for protein in a feed. When the CIF value is higher than the normal price, feed producers tend to use the minimum requirement of soy meal in a feed.

Large amounts of oil cake and solid residues have been imported into the country since 1995. Although it is not properly named, it can be determined that all these stocks are soybean meal or other by-products for the animal feed industry.

4.3 Estimated requirement

In normal circumstances, soybean meal usage in broiler and layer feeds is 22 per cent and 15 per cent respectively. The requirement of soybean meal is indicated in Table 4.5.

Table 4.5 Soybean meal requirement for animal feed

Year	Requirement (mt)
2002	88,510
2003	94,140
2004	100,174
2005	106,651
2006	113,597
2007	121,051
2008	129,051
2009	137,643
2010	146,869

Source: Department of Animal Production and Health.

As feed production for dairy and other animals is comparatively low, the major share of the requirement is for poultry feed manufacturing. Since the three major producers are responsible for 70 per cent of the total feed production, about 70 per cent of the soybean meal is also consumed by these producers. The following assumptions were made in the process of estimating the future requirement of soy meal:

i. Average usage in broiler and layer feeds is 20 per cent and 15 per cent respectively.
ii. Requirement in broiler and layer feeds increases at a rate of 10 per cent and 1 per cent respectively.

4.4 Demand of other CGPRT crops

No other CGPRT crops, other than maize and soybean, which are grown in Sri Lanka, are used in the feed industry. The entire production of these crops is consumed as food in raw or processed form.

The other major CGPRT crops which are grown in Sri Lanka are as follows:

Coarse grain	-	Kurakkan	(*Eleucine coracana*)
Pulses	-	Cowpea	(*Vigna unguiculata*)
		Green gram	(*Vigna radiata*)
		Black gram	(*Vigna mungo*)
Root and Tubers	-	Manioc	(*Manihot escutenta cranz*)
		Potato	(*Solanum tuberosum*)
		Sweet potato	(*Ipomea botatas L*)
		Kiriala	(*Xanthosoma sagittifolium*)
		Innala	(*Solenostemon rotundifolius*)

4.4.1 Other coarse grains

Kurakkan (Eleucine coracana)

Since this commodity is not consumed as a staple food item, demand changes year by year depending on the supply situation.

Kurakkan, which was a resource poor, small farmers' stable food, has become a part of the urban diet. Kurakkan is a popular food item, especially among elderly people due to it's health value.

The future requirement can not be estimated accurately. The frequent fluctuations in demand, limitation in industrial expansion, comparatively low demand as human food and lack of information on consumption in the food industry are some of the reasons for difficulties in demand estimation. However, the task force appointed for other field crop development has estimated the annual requirement of kurakkan as about 11,000 mt for all purposes.

Sorghum

Sorghum was a major crop in the early seventies because at that time the government banned imports of food items into the country. However, with trade liberalization, popularity as well as the importance of this crop decreased and today, it is grown only on about 150 ha of land.

The reasons for the declining production are the non-availability of suitable varieties, no demand from the food industry, high bird damage and lack of priority.

However, up to a certain level, imported sorghum was used in the feed industry between 1993-1997 as a substitute for energy sources. The imported amounts were 27,805, 18,305 and 10,094 mt in 1993, 1995 and 1996 respectively. The figure for 1997 was 622 mt. Sorghum has not been imported in any form since 1997.

It is reported that feed millers tend to replace maize with sorghum when the comparative price advantage is realized. At present, sorghum is not used in any feed industry in the country.

However, selected varieties of sorghum may be introduced to grow as direct feeding fodder for the dairy industry. It again depends on policies, which are geared to increase food production for food security in the country.

4.4.2 Other pulses

Pulses other than soybean, which are grown in Sri Lanka, are cowpea (*Vigna unguiculata*), green gram (*Vigna radiata*) and black gram (*Vigna mungo*). In the past, several attempts were made to popularize pigeonpea in the dry and intermediate zones of Sri Lanka but failed.

The entire production of these pulses is consumed directly by humans or used in the food industry. However, usage in the food industry is comparatively low. The food industries using these pulses are not properly organized in the country. However, recently established food industries which consume maize and soybean, also consume green gram in their food items. It can be forecast that there will be an increasing trend in green gram requirement with the expansion of these processed food industries.

So far, no one has been able to accurately estimate the requirement of these pulses due to the non-availability of sufficient data. Non of these pulses are used in the feed industry in Sri Lanka. No attempts have been made to utilize these products in animal feed formulas due to the high cost of production, availability of cheap alternatives, and a high demand as food. However, the task force for other field crop development estimated the annual requirement of cowpea, green gram and black gram as 21,000, 40,000 and 17,000 mt respectively.

Although not grown in Sri Lanka, the lentil has acquired an unforgettable position in the diet of the Sri Lankan population, irrespective of their social status. The total lentil requirement is imported. The high level of lentil consumption is a real threat for the expansion of other pulses within the country due to it's comparative price advantage, consumer acceptance and ease of preparation. This prevailing situation in the country creates more difficulties for demand estimation of other pulses such as green gram and cowpea.

Black gram is mainly consumed by one ethnic group (Tamils), and is mainly grown in the northern part and north central part of the country. A series of food items are prepared using black gram but the demand fluctuates due to the civil unrest in the country.

However, it is reported that husks, which come as a by-product of the processing industry of other pulses (mainly black gram and lentil) are used in the animal feed industry. In some instances, husk is used to prepare a mixture with coconut poonac as a dairy feed.

4.4.3 Root and tubers

The main root and tuber crops which are commonly grown are potato, sweet potato, kiriala (*Xanthosoma sagittifolium*) and innala (*Solenostemon rotundifolius*).

Potato is a recently introduced but commercial crop, grown mainly in the higher elevations of the country. Due to the high cost of cultivation, it is not grown by the resource poor farmers. Potato can be considered as a political crop because of its importance in the social life of the population. Sweet potato is considered as a crop of exotic origin, but people regard it as indigenous because it has been in cultivation in Sri Lanka as an important traditional food crop from very ancient times. Sweet potato can be grown successfully throughout the year in all agro-ecological zones.

Kiriala (*Xanthosoma sagittifolium)* is now on its way to being a market and export oriented crop. At present, it is grown under large-scale, open land cultivation on marginal rice lands in the dry and intermediate zones and irregular sloppy lands in the wet zones.

Innala (*Solenostemon rotundifolius*) is another tuber crop grown in Sri Lanka but not on a commercial scale. However, it has an export potential. The entire production of these root and tuber crops is consumed as food or sometimes in industry. At present, products or by-products are not used in the animal feed industry.

No relevant data is available to estimate the future requirement, as all of them are consumed as subtraction. However, the task force appointed by the then Ministry of Agriculture, Land and Forestry, had projected production levels for human consumption and other purposes up to year 2005. Those production levels are presented in Table 4.6.

Table 4.6 Projected production of root and tuber crops up to 2005 (mt)

Crop	2002	2003	2004	2005
Potato	139,076	142,176	144,130	148,686
Sweet potato	118,526	121,638	124,872	128,063
Kiriala	28,630	31,928	36,750	42,750
Innala	8,522	9,843	11,368	13,123

Source: Task Force (Vegetables), Ministry of Agriculture Land and Forestry.

Manioc (Cassava)

Manioc (*Cassava*) is the major root crop which stands out in the country as the most important source of energy for the calorie deficient, low income population strata. Almost the entire production is consumed as a human food and in some of the manufacturing industries. A series of cottage level, food preparation industries have been established recently with the introduction of processing technologies.

However, due to technical and economical reasons, cassava is not used in the feed industry. Some of the reasons for not using cassava in the feed industry are as follows:

i. Lack of processing technologies which remove toxic substances from the fresh product.
ii. Availability of energy sources other than (*cassava*) manioc.
iii. High demand as human food, especially in the low-income population.
iv. Seasonal availability and the long age status of the crop.
v. High cost of production.

5. Supply of Feed Crops

As indicated in previous chapters, not all of the CGPRT crops are used in animal feed formulations. Currently, mainly maize and soybean are used. The total requirement of soybean is imported. Although there is a potential to be used in the animal feed industry, most of the CGPRT crops grown in Sri Lanka are not used because of a high demand as human food. Almost all of the pulses (soybean, green gram, cowpea and black gram), root crops (Potato, sweet potato and tubers) and course grains (kurakkan) grown in Sri Lanka are consumed by human beings as food. According to the available information, only locally grown maize, rice bran/polish are used as ingredients in raw or by-product form. The demand for maize is fulfilled by local production with the balance coming from imports.

However, the supply situation of other CGPRT crops, other than maize, is also examined in this chapter. Almost all of the CGPRT crops are grown successfully, both in the maha (rainfed) and yala season (irrigated) in the country.

5.1 Maize

5.1.1 Production structure

Maize is the second most common food crop grown in Sri Lanka. A decade ago, it was grown only in the highlands during the (wet) maha season as a rainfed crop. With the expansion and rapid development of the animal feed industry (mainly poultry feed), a large demand was created for maize in the late eighties.

In the meantime, maize became a popular food item among consumers in green cob form. Immature pods are boiled and eaten. This consumption pattern is very popular among all sectors of the society.

Due to the high demand, the Department of Agriculture in 1992, introduced maize to the lowland paddy fields in the dry and intermediate zones during the dry (yala) season as an irrigated crop. The lowlands (well drained paddy lands) in major and minor irrigation schemes, where paddy can not be grown during the yala (dry) season, were selected for this purpose. This type of land are available mainly in the dry and intermediate zones of Sri Lanka.

Maize is mainly grown in Anuradhapura, Monaragala, Badulla and Ampara districts and that part of the country is known as the maize belt (Appendix Figure 1)

Maize was introduced to the low country wet zones (Appendix Figure 2), in the1995/96 maha season, due to a very high demand for green cob consumption in urban areas with two objectives:

i. To produce a maximum number of cobs to fulfil the green cob demand in urban areas.
ii. To minimize the movement of green cobs from dry zones in order to produce grain for animal feed and other industries in the dry zones.

At present, maize is grown on suitable lands all over the country, without the restriction of normal seasons (yala and maha), mainly to be sold as green cobs but not on a commercial scale.

However, maize is mainly grown in maha (September - March) as a rainfed crop in the highlands and in yala (April - August) in lowlands with supplementary irrigation.

Almost all of the maize growers who cultivate during maha, are small-scale farmers. It is estimated that about 250,000 farmer families are directly engaged in other field crop production and a similar number indirectly benefits from the involvement of other activities related to other field crops. Most of the other field crops (course grains, pulses, oil crops and condiments) are

CGPRT crops. Although a survey has not been undertaken yet, it can be estimated that about 60,000-75,000 farm families are engaged in rainfed maize cultivation during maha because almost all of the maize farms are about one to one and half acres in extent.

The size of the land lot given to a family in major irrigation schemes is one hectare, while that in a minor irrigation schemes (an area of less than 80 ha) is less than one hectare.

The entire area in major or minor irrigation schemes can not be used to grow maize due to the suitability only for paddy. Therefore, the extent grown with maize per person in yala is also less than one hectare. However, a non-significant number of farmers are engaged in large-scale (10-50 ac) maize growing during maha in the highlands. These large-scale farmers have their own infrastructure facilities for commercial cultivation.

5.1.2 Private sector involvement

Due to trade liberalization and investment promotion, a few private sector organizations and individuals are engaged in maize development programmes in the country.

A major company is engaged in maize cultivation in a former sugar cane area (state land) which is given on lease. Already, they have started maize farming on about 175 ha (maha 2000/01), the largest extent is about a few thousand hectares. Some more organizations have shown their willingness to engage in maize farming.

Most of the private sector companies and investors are engaged mainly in maize purchasing, with or without forward sales agreements and in input supply, such as seeds. Ceylon Agro Industries (CAI) Ltd., a subsidiary of Prima Group, started a programme to popularize hybrid maize seed among growers. This was started by the company after a programme jointly implemented with the Department of Agriculture, Ceylon Grain Elevators (Pvt) Ltd and US Aid funded Agro Enterprises Development Project (AgENT) in 1995/96.

A production package, including hybrid seeds was introduced under the above joint programme and farmers who were involved realized the importance of hybrid seeds. As a result, CAI (Ltd.) periodically engaged in hybrid seed distribution as indicated in Table 5.1.

Table 5.1 Hybrid seed importation by Ceylon Agro Industries (Ltd.)

Year	Amount distributed kg
1995/96	20,000
1996/97	-
1997/98	20,000
1998/99	-
1999/00	20,000
2000/01	20,000

Source: Ceylon Agro Industries (Pvt.) Ltd.

Chemical Industries Colombo Ltd (CIC) is engaged in quality seed (open pollinated) production in the country. Two large-scale, state farms have been given to CIC Ltd under the investment promotion programme for seed production.

At present, all feed manufacturing is undertaken by the private sector with the large and medium-scale feed producers importing a major portion of their requirement. The balance is purchased locally. Ceylon Grain Elevators Ltd. (the largest feed producer), Gold Coin (Pvt.) Ltd, and Nutrina (Pvt.) Ltd. are the main maize buyers. All these major buyers have been arranging forward sales contracts with farmers at a predetermined price with the assistance of the Department of Agriculture, Cooperatives and the Central Bank of Sri Lanka since 1999/00. The Central Bank of Sri Lanka announced that 2,092, 820 and 711 contracts were signed by farmers for maize, soybean and finger millet respectively, from April to September 2002.

Other than these feed manufacturers, there are a few major human food producers who also purchase quality maize at a higher price. The state controlled Thriphosa Project, which produces high nutrient food (Thriphosa) for pregnant women, mothers and children consumes 8,000 mt of afalatoxine free maize annually. Plenty Foods (Pvt.) Ltd. and Cereal Products (Pvt.)

Ltd are also engaged in human food production using afalatoxine free maize. All of these organizations utilize maize, soybean (locally produced), green gram and other pulses in their food formulations. They do not engage in maize cultivation but provide some assistance, such as credit and inputs for their contract growers.

One major investor, namely KST Evergreen (Pvt.) Ltd., has started a maize development programme under the investment promotional package. This company, which is situated in the Anuradhapura district, where maize is grown as the main crop, is engaged in maize collection and processing. This is the only organization which purchases maize in cob form and supplies it to animal feed industries after drying. This company is seeking assistance from the government to import a dryer in order to help the industry. The capacity of the threshing machine (seed removing) is 4 tons/per hour. Apart from collection and processing activities, this organization arranges contract growing programmes by providing quality seeds for planting and creating publicity, mainly in the Anuradhapura district.

5.1.3 Production behaviour

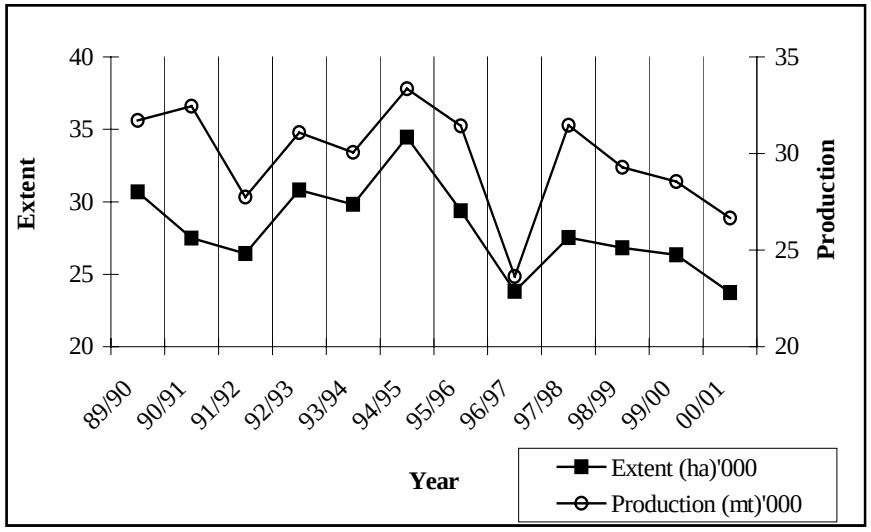
As indicated above, maize is mainly grown in the two major seasons. The production figures for both seasons are given in Tables 5.2 and 5.3.

Table 5.2 Maize cultivation and production in maha (September-March)

Season	Extent (ha)	Production (mt)	Av. yield mt/ha
1989/90	30,673	31,703	1.03
1990/91	27,499	32,456	1.08
1991/92	26,419	27,743	1.05
1992/93	30,802	31,073	1.01
1993/94	29,826	30,056	1.01
1994/95	34,455	33,340	0.97
1995/96	29,391	31,430	1.07
1996/97	23,824	23,630	0.99
1997/98	27,531	31,451	1.14
1998/99	26,822	29,284	1.09
1999/00	26,344	28,540	1.08
2000/01	23,734	26,661	1.12

Source: Department of Census and Statistics.

Figure 5.1 Maize extent and production, maha



Source: Department of Census and Statistics.

The total production in maha depends on climatic conditions, mainly rainfall. Rainfall is the main source of water for maize cultivation in the highlands. Average rainfall during maha is about 1000 mm, which falls from October to mid January. However, this rainfall does not fall in an uniform manner and there are long droughts and heavy rain spells. During dry spells, crops suffer due to water stress. If drought occurs at the beginning of the season, planting may not be done in time. During high intensity rain, crops are damaged due to poor drainage. The fluctuations in extent cultivated and production achieved were mainly due to the variations in rainfall received in the respective years. The fluctuations can be seen in Table 5.2 and Figure 5.1.

The Department of Census and Statistics carries out crop cutting surveys, only for paddy, to determined average yield in both seasons. The average yields of other crops, including maize, are estimates in both seasons. According to the information available at various sources the productivity is higher than the estimates.

Maize was introduced to paddy lands in major and minor irrigation schemes during the yala season due to the following reasons:

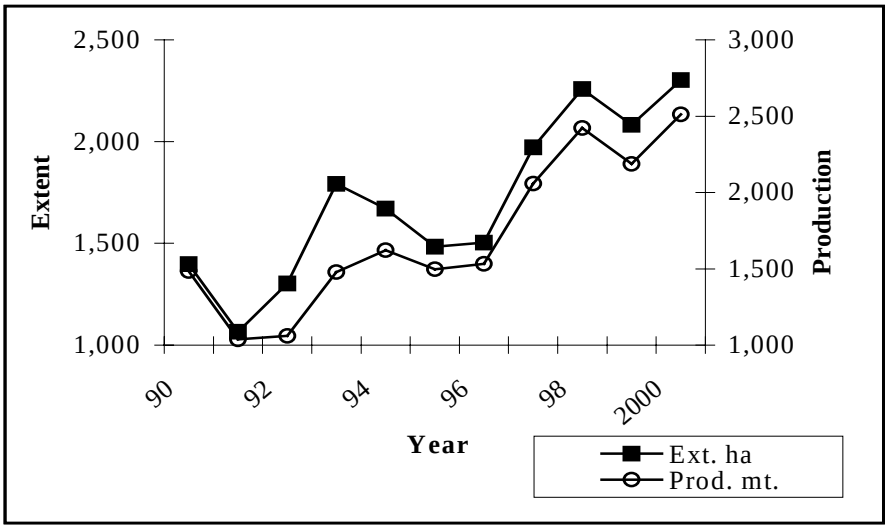
i. Insufficient irrigation water available for rice growing.
ii. Increase local production to meet at least a portion of the national demand.
iii. Increase farmers' income by introducing an economically viable crop.

Table 5.3 Maize cultivation and production in yala (April-August)

Year	Ext. ha	Prod. mt.	Average yield
1990	1,397	1,485	1.06
1991	1,066	1,037	0.97
1992	1,302	1,060	0.81
1993	1,792	1,478	0.82
1994	1,671	1,622	0.97
1995	1,483	1,496	0.01
1996	1,504	1,533	1.02
1997	1,972	2,059	1.04
1998	2,259	2,423	1.07
1999	2,082	2,187	1.05
2000	2,302	2,512	1.09

Source: Department of Census and Statistics.

Figure 5.2 Maize extent and production, yala



Source: Dept. of Census and Statistics.

Table 5.3 and figure 5.2 show that there is an increasing trend in cultivated extent as well as production. Although a proper study has not been carried out as yet, it can be reported that 40-50 per cent of the maize production in yala is consumed as green cobs by humans. A similar situation can be seen in maha but at a lower (30-40 per cent) percentage.

Actually, there is a very high potential to grow maize during yala in paddy fields because more than 50 per cent of the available lands in major and minor irrigation schemes are left fallow due to insufficient irrigation water for paddy cultivation.

5.1.4 Imports of maize

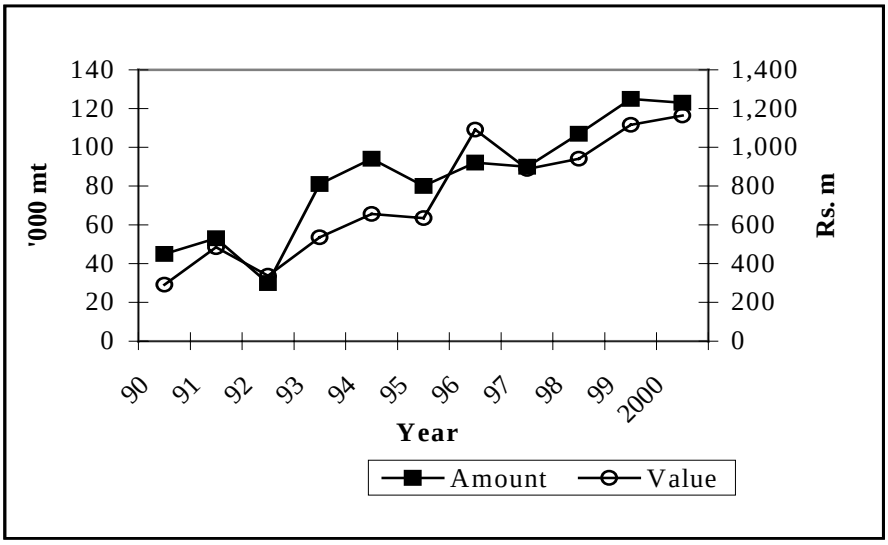
Large amounts of maize are imported each year to meet the local demand, mainly in the animal feed industry. Table 5.4 shows the amount imported and value since 1990.

Table 5.4 Imports of maize during the last decade

Year	Imports		CIF value	Exchange rate
	mt	Rs.m	Rs/kg	Rs/US$
1990	45,051	290.668	6.45	40.06
1991	53,331	484.950	9.09	41.37
1992	30,842	336.775	10.2	43.13
1993	80,762	535.122	6.63	48.25
1994	93,833	656.342	6.99	49.41
1995	80,058	634.735	7.93	51.25
1996	91,578	1,090.987	11.91	55.27
1997	90,241	887.475	9.83	58.99
1998	106,537	939.702	8.82	64.59
1999	125,625	1,115.252	8.88	70.39
2000	123,112	1,163.255	9.45	75.77

Source: Sri Lanka Customs and Central Bank of Sri Lanka.

Figure 5.3 Imports of maize during the last decade



Due to the rapid expansion of the animal feed industry, the amount imported increased year by year.

Maize is only imported by private sector organizations. Nine importers were registered to import maize in 2001. Out of them, three are the main importers and also the main animal feed (mainly poultry feed) producers in the country. Sixty five per cent of total imports are imported by Ceylon Grain Elevators Ltd.

Non-significant amounts have been exported to other countries but not in grain form. Exports have a decreasing trend.

The Government of Sri Lanka (Department of Agriculture) only undertakes quarantine regulations and permit issuing for importation. Most of the imports are from China, USA, Indonesia and Argentina. Imports from Argentina were banned very recently due to the threat of disease infestation.

High quality maize seeds are also imported for the human food industry. The Thriphosa Project, which consumes about 8000 mt/year, imports more than 90 per cent of the yearly requirement. This project is managed by the Ministry of Health and run by a private organization. Under the guidance of the Government of Sri Lanka, high quality grains are purchased locally and the maximum amount purchased so far is 1,591 mt (during the first six months of 2002).

5.1.5 Producer price behaviour

The price offered to the producer is another factor which contributes greatly to producer decision making. Due to high demand and the importance in the economy, the Sri Lankan Government has introduced various price structures to protect maize farmers in the past.

Table 5.5 Changes in farm gate prices of maize in the past

Year	Farm gate price Rs/kg	US$ value (cents)
1990	5.81	40.06
1991	5.60	41.37
1992	7.30	43.85
1993	7.13	48.25
1994	7.28	49.41
1995	9.31	51.25
1996	10.52	55.27
1997	13.74	58.99
1998	14.09	64.59
1999	*24.20	70.39
2000	16.34	75.77

* Off season price.
Source: Central Bank of Sri Lanka.

According to the data given in Table 5.5 and 4.4 in Chapter 4, the farm gate price was lower than the CIF price during the early nineties. However, farm gate prices have risen in an increasing trend. On the other hand, although the rupee value against the US dollar has decreased since 1990, the CIF price of maize has not gone up but has fluctuated. The maximum average CIF price was reported in 1996. At present, according to the available information, the CIF price of maize is about Rs 11.50.

The average farm gate price is higher, mainly due to the high prices offered for quality grains used in the food industry. It may be concluded that the importation of maize is better to reduce costs of production of feed in the country. However, it may create unfavourable conditions for local maize production programmes.

5.1.6 Production changes due to market forces and production response to market forces

Results of both yield and area response functions are as follows:

Yield Function

$$\ln YM_t = 0.19 + 0.19 \ln MP_{(t-1)} - 0.35 \ln SP_{(t-1)} - 0.052 \ln FP_{(t-1)}$$
$$(0.07) \quad (0.09) \quad (0.10) \quad (0.02)$$

$DW = 2.15 \quad R^2 = 0.48$

Area Function

$$\ln AM_t = 9.86 + 0.24 \ln MP_{(t-1)} - 0.27 \ln SP_{(t-1)} + 0.072 \ln AM_{(t-1)}$$
$$(0.10) \quad (0.12) \quad (0.13) \quad (0.02)$$

$DW = 1.9 \quad R^2 = 0.59$

AM_t - Area cultivated of maize.
$AM_{(t-1)}$ - Area cultivated of previous year.
MP - Lagged price of maize.
SP - Lagged price of soybean.
FP - Urea price.
YM_t - Current yield of maize.

Note: Figures in parenthesis are standard errors

The models developed for yield and area response were estimated using data for the period 1980-2000. Deflated prices did not show significant relationships in any of the estimated response functions. This suggests that farmers respond to the nominal prices rather than the real ones. Both models with lagged values of nominal price showed quite satisfactory results in terms of signs and significance levels of estimated coefficients.

According to the estimated results, a one per cent increase in the price of maize would lead to a 0.19 per cent rise in its yield. In addition, it was found that a one per cent increase in the price of soybean and the price of urea would reduce yield by 0.35 per cent and 0.5 per cent respectively. A one per cent rise in the maize price would increase the area by 0.24 per cent. Soya price is, as expected, negatively related to the area cultivated of maize. Cultivated area of maize in the previous year contributed positively to the current cultivated area. Supply from local production can be projected based on the above estimates.

As discussed in Chapter 2, imports are also important to estimate the total supply. It is observed that the level of imports depends mainly on poultry production. The estimated model for the period 1982-2000 is presented below.

$$\ln IMM_t = 1.23 \ln PP_t$$
$$(0.06)$$

$DW = 1.9 \quad R^2 = 0.79$

The results indicate that a one per cent increase in poultry production would increase the quantity of imports of maize by 1.23 per cent. Based on the above estimates, projected total supply is presented in Table 4.2.

Apart from the use in the animal feed industry, maize is consumed as a human food in various forms. Immature cob consumption is popular in all sectors of society today. This situation creates employment opportunities for unemployed men and women in cultivation, transportation and selling cobs in boiled form. Due to this high demand for green (immature) cobs, farmers tend to cultivate maize during the off season in non traditional areas, like the low country wet zones of Sri Lanka. Although no systematic study has been carried out, it can be estimated that 50 per cent of the production in yala and about 30-40 per cent in maha is consumed as green cobs. Green cobs produced in dry and intermediate zones are transported to urban areas due to the high demand in those places. Changes in the purchasing price of cobs also has a positive effect on maize production.

Table 5.6 Changes in purchasing price of green cobs

Year	Rs./Cobs
1988	0.52
1999	2.00-2.50
2000	3.00-5.00

Source: Dept. of Agriculture.

Cottage level industries, such as popcorn production, developed recently with the introduction of popcorn varieties from other countries. Sri Lanka does not produce any popcorn variety. All stocks are imported. However, a popcorn variety is being tested at the Field Crop Research and Development Institute, Mahailluppallama to be released in the future.

A high demand from the human food industry is another market force which creates a favourable environment to change the production situation in the country.

Table 5.7 Estimated requirements of maize in various organized food industries

Products	Annual req. (mt)	Remarks
Thriphosa	8,000	A meal for children and pregnant mothers
Others	2,000	"Ranphosa" and "Samaposa" are major products similar to Thriphosa produced by the private sector

Source: Ministry of Health, Plenty Foods and Cereal products (Pvt.) Ltd.

Table 5.7 indicates the requirement for good quality maize grains for major food production. Until 1995/96, the entire requirement for Thriphosa production was imported due to various reasons. However, a decision was taken to utilize quality maize for this programme from local production in 1995/96. As a historical event, one farmer organization in the Ampara district (a major maize growing district) supplied 2.5 mt of very high quality (aflatoxine free) maize for Thriphosa production in the maha season (wet season), 1995/96.

The amount of locally produced maize used for Thriphosa gradually increased and the Huruluwewa farmers' company, which is in the Anuradhapura district, supplied 700 mt of very high quality maize in the 1997 yala (dry) season.

Samaphosa high nutrient food, similar to Thriphosa, is produced by Plenty Foods Private Ltd. which is a medium-scale, privately owned subsidiary company. It's requirement per annum is about 1,800 mt. Similarly, another medium-scale organization which produces Ranphosa utilizes 200 mt of maize per annum. All of these organizations are supporting local farmers by providing inputs and other materials, such as small-scale machinery for processing. It is reported that this industry grows at 1-2 per cent annually and monthly turnover is about Rs 45 million. This market force creates a large demand for quality maize and is also a considerable threat to the usage of maize in the animal feed industry.

Another significant change due to market forces is the production of maize in dried cob form instead of grains. A private organization has developed infrastructure facilities for seed removal and drying of maize after buying cobs in bulk. This has a positive affect on reducing the cost of production for farmers and to maintain the quality of seed because most of the

growers do not have sufficient storage facilities on their farms. This also has a positive affect on expansion of the cultivated extent.

5.1.7 Development of production technologies

The Field Crop Research and Development Institute (FCRDI) of the Department of Agriculture, which is situated in the North Central Province (dry zone), has the mandate of production research on most of the CGPRT crops, except roots and tubers. The Horticulture Research and Development Institute of the same department is responsible for root and tuber research in the country and is situated in the Central Province.

5.1.7.1 Variety development

So far, FCRDI has released the following open pollinated varieties (OPV) for cultivation:

Table 5.8 Varieties developed by the Department of Agriculture

Variety	Age in days	Seed colour	Potential yield mt/ha	Remarks
Badra	110-115	Orange	4.5	
Ruwan	110-115	Yellow to Orange	4	Most common variety
Aruna	90-100	Yellow	4	More suitable for yala (dry season)
Muthu	110-115	White	5	Suitable for flour production

Source: Field Crop Research and Development Institute/DOA.

Apart from these OPV's, a few hybrid lines were tested by the FCRDI during the past three years. The Government of Sri Lanka provided special allocation for this purpose considering the importance of maize in agricultural development. Of these lines, one has been selected to be released as a recommended hybrid variety in the near future. That will be the first hybrid maize variety developed in the country.

5.1.7.2 New fertilizer recommendation

The inorganic fertilizer recommendations for both rainfed and irrigated farming were similar in the past. New fertilizer recommendations were developed for rainfed and irrigated maize cultivation separately in the early nineties in order to realize the potential yield under both situations.

5.1.7.3 Mechanization

The Farm Machinery Research Centre (FMRC) of the Department of Agriculture has developed a medium-scale power thresher to remove seeds from cobs. It can be operated by a two wheel or four wheel tractor and has a capacity of one ton per hour (Appendix Figure 3).

This technology has been given to two medium-scale machinery manufacturers and they, at present, are in the process of manufacturing the threshers for sale. A number of machines are being used by grain producers, especially for the human food industry. A series of demonstrations are being carried out to popularize these threshers among maize producers for the animal feed industry too.

Apart from this power thresher, a simple seed remover has been developed and manufactured by the Rice Processing Research and Development Centre (RPRDC), presently known as the Post harvest Technology Centre of the Ministry of Agriculture. The capacity of this hand operated tool is 3 cobs per minute. This is being used by some small-scale maize farmers.

Recently, FMRC has developed a seeder and an inter cultivator in order to reduce labour usage in seeding and weeding. A hand operated, pushing type small-scale seeder has the capacity of 0.8 ha per day. One person can operate the seeder. (Appendix Figure 4)

The planting space has to be adjusted to use the inter-cultivator at the early stage of crop growth. Two weedings, which are essential during the first month of growth, can be performed by a tractor operator. (Appendix Figure 5)

These two machines have been developed due to an increasing demand for mechanization with the increasing trends of maize growing in the country. However, these machines are not yet produced for sale.

5.1.7.4 Introduction of production packages

A production package was introduced by the Department of Agriculture to increase productivity. The package comprises of a few major components, which are:

i. Use of quality seed.
ii. Use of balanced fertilizer.
iii. Maintenance of plant population.
iv. Proper land preparation for irrigated farming and drainage improvement.
v. Weed control.

The task force established under the Ministry of Agriculture, Land and Forestry for the development of other field crops (OFC) initiated a production/demonstration kit programme during the maha 1995/96 in collaboration with Agro Enterprises Development Project of USAID, Ceylon Grain Elevators Ltd. and Ceylon Agro Industries Ltd. About 400 trial kits were distributed in major maize growing districts with the following objectives:

i. To provide an opportunity for farmers and their associates to see the performance of yielding maize varieties under good management.
ii. To encourage other farmers to observe and adopt the new technology for maize production.
iii. To demonstrate that maize production is a profitable venture.
iv. For research and extension to receive feedback on the performance of open pollinated and hybrid varieties under farmers' field conditions.

This was the very first occasion in which a hybrid maize variety was used for normal cultivation in farmers' field. A similar programme was implemented in paddy fields in yala 1996, also in 250 locations. Results indicated that the average yields for both varieties were between 4-5 mt/ha. A hybrid variety imported from Thailand gave 20-25 per cent higher yields than open pollinated varieties.

Based on this result, Ceylon Agro Industries (Pvt.) Ltd. (CAI), which was a partner of the programme, is now importing hybrid variety Pacific 11 for general planting in the country. It is reported that there is an increasing demand for hybrid seeds in both seasons. CAI distributed about 28,000 kg of Pacific 11 among farmers in major maize growing districts in maha 2001/02.

5.1.7.5 Identification of production systems

As the crop has assumed importance as the principal constitution in animal feed and to the same extent in human food in various forms, authorities have tried to boost local production by introducing various technologies as well as production systems.

In 1992, maize was introduced to lowland paddy fields during yala as a commercial cultivation. It was observed that high quality grains, without aflatoxine, could be produced during yala (dry season) due to favourable whether conditions during the season, mainly low rainfall at the harvesting period. Now, maize has become an economical crop during yala in major and minor irrigation schemes. There is a very sharp increasing trend in extent cultivated in yala. The trend can be seen in Figure 5.2.

Subsequently, maize was introduced to low country wet zone areas in maha 1995/96, where maize was not grown in the past.

Production yayas (Blocks)

In order to increase productivity and maintain expected quality levels, a concept called production yayas (Blocks) was introduced with the financial assistance of the National Agricultural Production Programme (NAPP) funded by the Sri Lankan Government in 1999.

Each year, one hundred (100) yayas are established with the participation of 10-20 farmers in each. Seeds and fertilizer are given to them and at the end of the season the value, in rupees, of these inputs is collected and a revolving fund is established by the farmer group for future use. The main objectives of this programme are to organize farmers to adopt the technology package as a group and to organize other activities, such as marketing, collectively. Today, this production yaya programme is considered a very successful programme because farmers themselves have realized the importance of group farming. Yields obtained in the yayas, established in major producing districts during the last few seasons, are given in Table 5.9.

Table 5.9 Average yield obtained in yayas in major maize producing districts during maha and yala

District	Maha kg/ha		Yala kg/ha		
	1999/00	2000/01	1999	2000	2001
Anuradhapura	2,093	3,186	3,787	4,286	3,155
Badulla	2,717	-	3,596	4,368	-
Monaragala	5,917	3,302	3,562	5,382	-

Source: Department of Agriculture.

Based on the results obtained in yaya production programmes, an NGO (World Vision) and a private sector organization (Ceylon Agro Industries Ltd.) were involved with the Department of Agriculture to establish large-scale production yayas (about 200 ha each) in the Anuradhapura district in maha 2001/02. This will be expanded to other major growing areas very soon with the help of NGO's and private sector organizations.

Year round cultivation

Due to the increasing demand for green cob (immature cobs) consumption, farmers tend to cultivate maize in other months than normal yala (April-August) and maha (September-March). Cultivating maize for green cobs is a high income generating venture within the shortest possible period (75-80 days) in Sri Lanka today.

5.1.8 Production projections

Production responses to price levels and to other determinants were presented in section 5.1.6. Using these estimates, anticipated local production for the period 2001-2010 is presented in Table 4.2. Projections are made assuming that trends of respective variables do not change during this decade. Projections show that, on average, there will be a mild improvement in the maize production sector during this period. By 2010, anticipated total production will be around 34,450 mt. Compared to the anticipated situation of demand, if the present production situation does not change in the future, maize imports will increase.

The future situation may change due to development programmes, which are just starting in the maize growing sector.

Table 5.10 Total extent cultivated with other field crops (OFC) and the percentage of maize during maha (rainfed)

Year	Extent (ha)		
	OFC	Maize	Maize per cent
1990	121,998	30,673	25.1
1991	109,334	27,499	25.1
1992	107,575	26,419	24.5
1993	118,829	30,802	25.9
1994	116,975	29,826	25.4
1995	111,331	34,455	30.9
1996	98,449	29,391	29.9
1997	89,734	23,824	26.5
1998	94,269	27,531	29.2
1999	90,130	26,822	29.7
2000	85,947	26,344	30.6

Source: Dept. Census and Statistics/Dept. of Agriculture.
(OFC- maize, chili, all pulses, onions (red, big) and oil crops).

Table 5.10 shows that average extent cultivated with maize during maha as a rainfed crop is about 28,500 ha and it is only 27.5 per cent of total extent. The same table shows that about 86,000 to 122,000 ha have been cultivated with other field crops (OFC) during the last decade as rainfed crops in the country. However, according to the Department of Census and Statistics, extent in sparsely-used-but-available-for-cultivation land (Appendix Table 2) is about 1.2 million ha in the country. Although there is plenty of land for rainfed cultivation, only about 10 per cent is used to cultivate other field crops including maize and other CGPRT crops. This is mainly because of social and technical reasons. This situation clearly shows that there is a limitation to increase the maize extent during maha. However, with the involvement of all the relevant agencies, such as the government and the private sector, NGO's and farmers, maize cultivation can be developed and extent can be increased up to a certain extent during maha in the highlands.

Table 5.11 Total extent cultivated with other field crops and the percentage of maize during yala in paddy fields under irrigation

Year	Ext. ha		Percentage of maize
	OFC	Maize	
1990	50,089	1,397	2.7
1991	47,035	1,066	2.2
1992	45,053	1,302	2.8
1993	47,405	1,792	3.7
1994	46,565	1,671	3.5
1995	42,024	1,483	3.5
1996	38,205	1,504	3.9
1997	30,416	1,972	6.5
1998	33,974	2,259	6.6
1999	34,853	2,082	5.9
2000	29,741	2,302	7.7

Source: Dept. of Census and Statistics, Dept. of Agriculture.

Although other field crop cultivation during yala has been decreasing since 1990, maize extent is increasing. As indicated in Table 5.11, after 1995, the annual growth of maize extent is about 5 per cent.

No rainfed farming is practiced in the highlands or lowlands during yala due to insufficient rainfall for farming. This is common practice in dry and intermediate zones of Sri Lanka. All the feed crops are grown in lowland paddy fields in major irrigation and selected minor irrigation schemes with supplementary irrigation in yala.

The total extent in these schemes is cultivated with rice during the maha (wet) season but most of the land is left fallow due to insufficient water availability for paddy cultivation during the yala (dry) season.

5.2 Other ingredients in animal feeds

According to the Department of Animal Production and Health, 90 per cent of the total compound feed production is for poultry and only 5 per cent each for dairy and others. Ranawana (1999) indicated that poultry feed is largely produced from imported ingredients. The local ingredients used include maize, rice bran/rice polish, broken rice, coconut poonac and minor ingredients such as gingerly poonac.

He further pointed out that all of the other ingredients such as soybean meal, fish meal, meat and born meal and feed additives are imported from other countries.

5.2.1 Soybean

Soybean is another crop which is grown both in maha and yala in the country but not on a large-scale. In the early seventies, the government owned Oil and Fat Corporation utilized local soybean for oil extraction and produced soymeal for the animal feed industry. In the late seventies, however, as per the government's privatization policy, this state owned corporation was handed over to the private sector for poultry development but not for feed production.

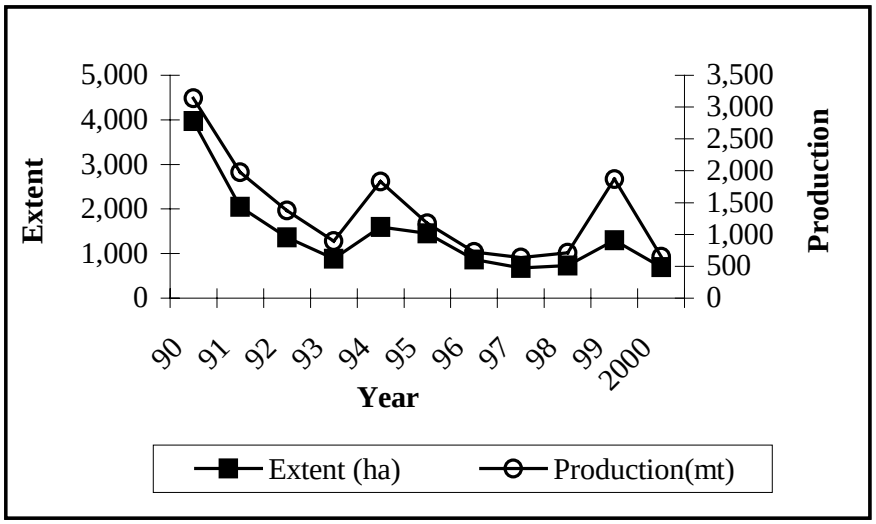
In the eighties, another factory was opened as a semi governmental organization to produce human food using soybean in the dry zones of Sri Lanka, where soybean is mainly grown. However, due to economic and other reasons it was closed down in the late eighties. Due to these two reasons, soybean marketing within the country became a serious problem in the late eighties. Therefore, extent and production are decreasing, both in maha and yala, as indicated in Table 5.12.

Table 5.12 Soybean cultivation and production in Sri Lanka (both maha and yala)

Year	Extent (ha)	Production (mt)
1990	3,973	3,143
1991	2,053	1,979
1992	1,364	1,376
1993	884	896
1994	1,596	1,832
1995	1,454	1,178
1996	864	729
1997	678	635
1998	731	713
1999	1,303	1,869
2000	694	648

Source: Dept. of Census and Statistics.

Figure 5.4 Soybean extent and production



Source: Dept. of Census and Statistics.

No oil extraction industry has been developed in the country as yet. Therefore, locally produced soybean meal is not available. All of the production is used in the human food industry and a large amount is imported in various forms, including oil as human food, to be used in the animal feed industry. Imported amounts and the value of them are presented in Table 5.13.

Table 5.13 Imported amounts (mt) and value (Rs.m) of soybean

Year	Amount (mt)					Value
	Seed	Oil	Flour	TVP	Others	(Rs.m)
1990	338.2	-	-	953.2	-	30.41
1991	3,016.6	-	-	2,122.8	-	108.63
1992	265.9	9.5	-	2,511.9	330.9	51.00
1993	2,983.5	19.2	-	2,209.2	2,159.8	127.93
1994	14,779.3	58.5	-	54,256.8	759.2	275.90
1995	2,669.2	164.4	-	1,888.4	481.5	73.21
1996	285.1	42.7	0.9	300.6	416.1	96.01
1997	200.0	44.1	3,354.2	-	275.6	106.46
1998	179.3	-	3,278.9	58.3	338.6	102.95
1999	1,829.5	-	25.4	-	616.8	71.95
2000	2,972.4	-	584.1	-	688.9	107.2

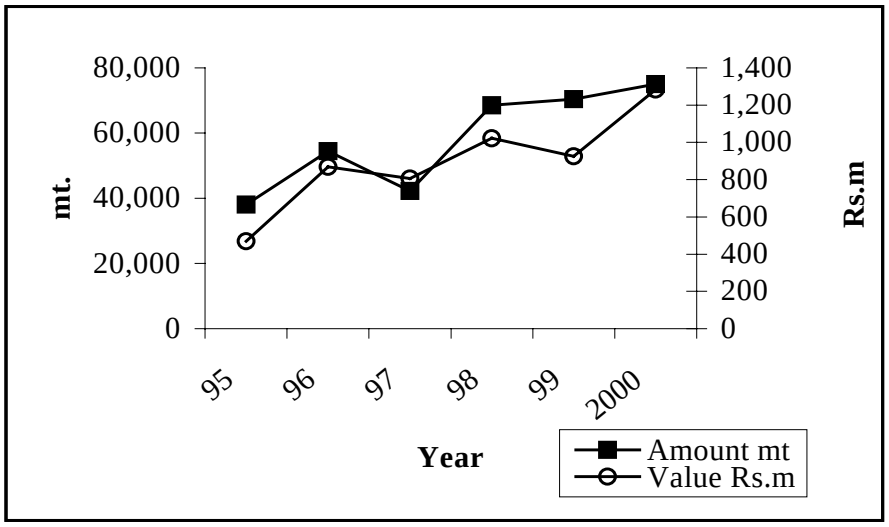
Source: Sri Lanka customs.

Table 5.14 Imported amounts and value of oil cake and other solid residues

Year	Amount	Value	CIF value
	mt	Rs.m	Rs/kg
1995	38,115	469	12.3
1996	54,518	869	15.1
1997	42,246	806	19
1998	68,545	1,022	14.9
1999	70,477	926	13.1
2000	75,075	1,284	17

Source: Sri Lanka Customs.

Figure 5.5 Imported amounts and value of oil cake and other solid residues



Source: Sri Lanka Customs.

Soybean seeds, TVP and oil are the other by-products which have been imported into the country during the last decade. However, according to Table 5.14 oil cake, mainly soymeal, has been imported in large quantities each year. The amount of oil cake imported each year was sufficient to fulfil the soybean meal requirement in the poultry feed industry.

A few cottage level small-scale food manufacturers use locally produced soybean to produce toffu, tempe, milk, ice cream and other snacks. Two medium-scale companies consume a major portion (more than 60 per cent) of locally produced soybean seed in their human food industry.

It is reported that the annual growth rate of the human food industry, which consumes soybean, is about 1-2 per cent. Therefore, locally produced soybean can not be utilized for the animal feed industry in the near future due to following reasons.

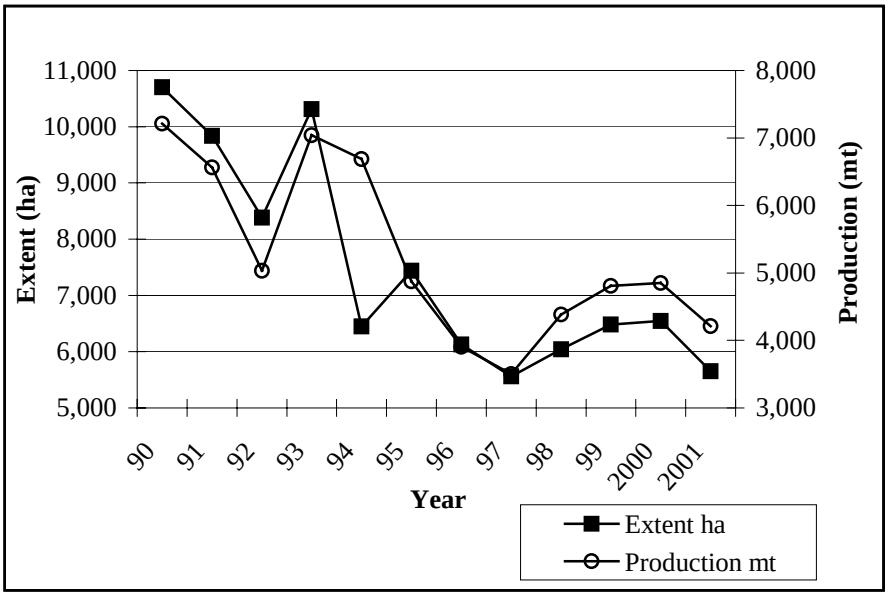
- Very slow growth rate of cultivated extent.
- Lack of oil extraction facilities in the country.
- No proper marketing network in the producing areas.
- Very high demand from the food industry.

5.3 Other grains and other pulses

5.3.1 Kurakkan

This is also a major rainfed crop grown during maha as a highland crop. On average, 85 per cent of the annual extent cultivated with kurakkan was in maha during the last decade and the balance was in yala with supplementary irrigation. A clear decreasing trend, both in cultivated extent and production, can be seen during the last decade (Figure 5.6 and Appendix Table 3)

Figure 5.6 Production and extent of Kurakkan during the last decade



Although the annual requirement is estimated as 11,000 mt, the total availability including imports each year was less than that in the country. The largest quantity (1,254 mt) imported after 1995, was reported in 1996. Eight hundred and fifteen tons were imported in 2001.

The total available kurakkan is used as food or in the food industry.

5.3.2 Other pulses

As is indicated in Chapter 4, the main other pulses grown in Sri Lanka are cowpea (*Vigna unguiculata*), green gram (*Vigna radiata*) and black gram (*Vigna mungo*).

Appendix Table 4 and Figures 5.7 and 5.8 indicate the extent cultivated and amount produced during the last decade in the country.

Black gram extent as well as production rose until 1993 and thereafter, a decreasing trend was reported. Both extent and production of green gram and cowpea were declining in a decreasing trend irrespective of their high value in the Sri Lankan diet.

Figure 5.7 Cultivated extent of other pulses during the last decade

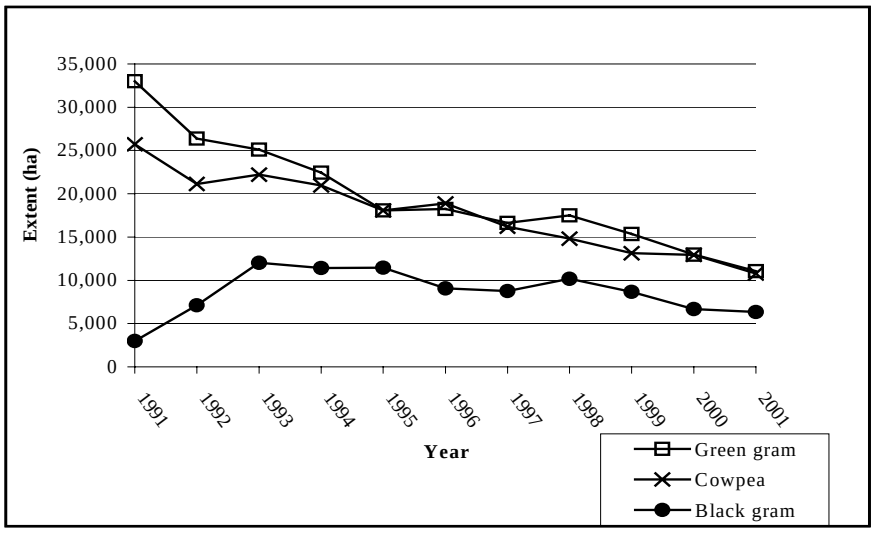
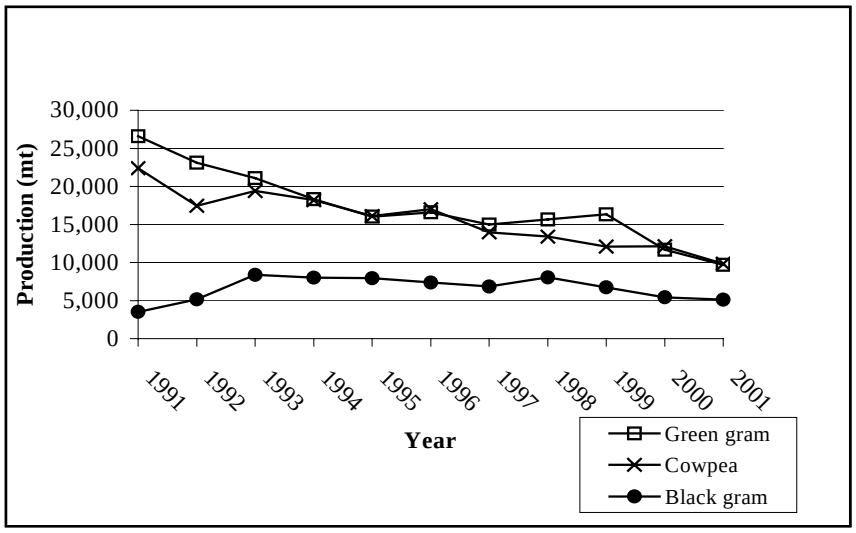


Figure 5.8 Production of other pulses during the last decade



All of these crops are grown in both seasons, maha and yala, but the major season is maha, as rainfed upland crops. During yala these crops are grown in lowland paddy fields with supplementary irrigation.

Table 5.15 Percentage grown in both seasons during the last decade (1991-2001) of other pulses

Crop	Percentage of total crop extent	
	Maha (RF)	Yala (Irri)
Cowpea	69.0	31.0
Green gram	73.5	26.5
Black gram	91.4	8.6

Source: Dept. of Census and Statistics.

Almost the entire production of black gram is available to the market during the months of February and March. Similarly, two thirds of the production of green gram is also ready during the same period.

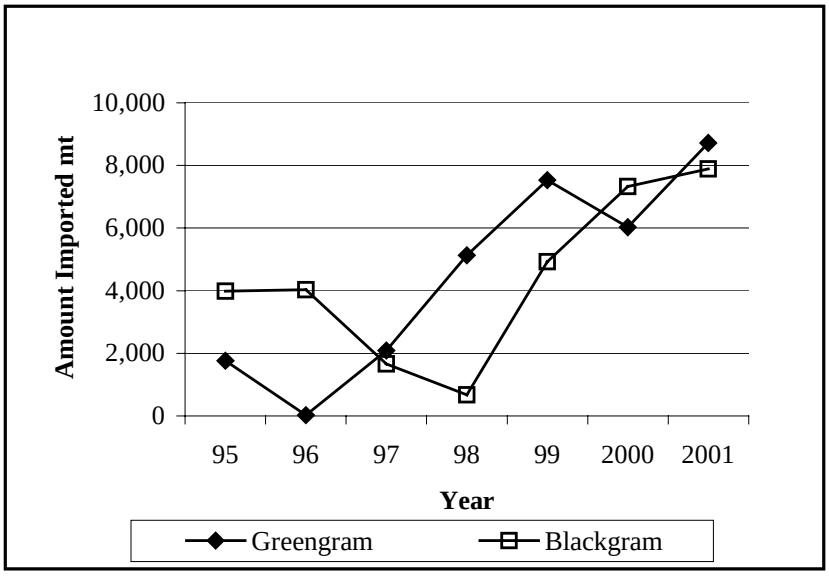
However, the decreasing trend is mainly due to the following reasons:

i. Receives low priority and there are free imports of lentil and other pulses to the country. Annual lentil imports total about 80,000 mt.
ii. Marketing difficulties due to a lack of proper arrangements in producing areas. Even though a high farm gate price is offered due to the non-availability of marketing arrangements, the extent of green gram and black gram is decreasing.
iii. Cultivation is restricted to marginal land mainly under rainfed conditions.
iv. Mostly cultivated by resource poor farmers.
v. Depends on rainfall and the rainfall pattern is erratic.
vi. Low attention of these resource poor farmers due to additional work as hired labourers in other places.
vii. Low demand, especially for cowpea, due to changes in food consumption habits.

Imports of other pulses

An increasing trend is visible in green gram as well as black gram imports in the recent past. One can argue that the importation is undertaken due to the low production of these crops in the country. In reality, it is not the case. Free importation is one of the main contributors to low production in the country

Figure 5.9 Imports of other pulses



Per capita availability of other pulses

Per capita availability of green gram and cowpea was 1 and 4.65 kg/year respectively during the last three years. (Dept. of Census and Statistics)

5.3.3 Roots and tubers

The root and tuber crops which are grown in Sri Lanka are manioc (casava), sweet potato, potato, kiriala (*Xanthosoma sagittifolium*) and innala (*Solenostemon rotundifolius*). At present, total production of potato and sweet potato is consumed as food. Manioc is utilized in the food industry and in some manufacturing industries. Non of these root and tuber products are utilized in the animal feed industry in any form.

Table 5.16 shows the production behaviour of the major root and tuber crops in the country.

Table 5.16 Extent (ha) cultivated and production (mt) of major root and tuber crops (both maha and yala)

Year	Potato		Manioc		Sweet potato	
	ha	mt	ha	mt	ha	mt
1995	7,428	81,657	32,850	29,8437	9,141	61,893
1996	7,925	100,755	30,915	28,8928	9,034	58,817
1997	6,469	66,484	28,855	27,0596	8,965	54,129
1998	2,328	25,899	30,064	24,9779	8,656	52,489
1999	2,171	27,171	29,432	25,7153	8,383	51,592
2000	3,642	48,409	29,542	249,110	8,263	51,809

Source: Dept. of Census and Statistics.

Manioc (Cassava)

Manioc is mainly grown as a rainfed crop throughout the island, excluding high elevation areas and mostly concentrated in the wet and intermediate zones. The major production systems of manioc have been identified as backyard crops and large-scale open land cultivation in the wet zone (Gampaha, Colombo, Kegalle, Ratnapura) districts, as well as intermediate zones (Kurunegala), which are mixed cropped with coconut and pineapple cultivation. Slash/burn cultivation, on a large-scale, in the dry zone is also viable. Peak production falls during the maha (Oct. - March) season.

No proper production programme has been implemented due to the non-identification of manioc as a priority crop in the country. However, the task force appointed for vegetable development in 1997, has estimated that productivity will be 14 mt/ha in 2005.

The same task force has recommended the following strategies to enhance productivity and improve quality:

i. Use of an improved production package which includes:
   - High yield and high quality varieties.
   - Correct agronomy practices.

ii. Introduction of high quality varieties and using pre and post harvest loss minimizing practices.

Although a high level of production of manioc is expected, its utilization in the feed industry is limited due to reasons given in Chapter 4.

Exports and imports of cassava

Table 5.17 Exports and imports of cassava during the last decade

Year	Imports		Exports		US$ Value
	Amount mt	Value Rs m	Amount mt	Value Rs m	
1990	-	-	-	-	40.06
1991	-	-	735.042	19.769	41.37
1992	-	-	487.128	13.754	43.83
1993	-	-	674.031	18.354	48.25
1994	-	-	675.652	23.868	49.41
1995	25	0.44	1,534.741	45.628	51.25
1996	-	-	1,085.494	34.910	55.27
1997	-	-	1,159.239	37.863	58.99
1998	21.5	0.40	1,153.261	41.236	64.59
1999	-	-	1,211.836	44.048	70.39
2000	0.105	0.03	1,213.674	46.044	75.77

Source: Sri Lanka Customs and Central Bank of Sri Lanka.

The situation of exports and imports of cassava is presented in Table 5.17. An increasing trend in the early nineties and the stagnation of exports in the late nineties prevailed. Cassava is exported in fresh form mainly to Middle Eastern countries.

A very low amount has been imported in only three out of 10 years in processed form for industrial purposes.

Production projections of roots and tubers up to 2005

The task force for vegetable development has projected the production of root and tubers including manioc. These projections are presented in Table 5.18.

Table 5.18 Projected production of roots and tubers up to 2005 (mt)

Crop	2002	2003	2004	2005
Potato	139,076	142,176	144,130	148,686
Sweet potato	118,526	121,638	124,872	128,063
Manioc	242,440	209,860	295,200	310,100
Kiriala	28,630	31,928	36,750	42,750
Innala	8,522	9,843	11,368	13,123

Source: Task Force (vegetables).

Table 5.19 Production pattern of potato and other tubers

Crop	Peak	Moderate	Lean
Potato	Sept, Oct, Nov	Dec, Feb, March, April, 1st half of May	2nd half of May, June, July, August
Sweet potato	Jan, Feb, Aug, Sept	Oct, Nov, Dec, March to July	-
Root and tubers	Jan to April, July to Sept, and December	May, June, Oct, Nov	-

Source: Task Force (Vegetables).

Table 5.19 shows the periods in which peak, moderate and lean production of potato and other root and tubers are available to the market.

6. Measures for Closing the Supply and Demand Gap

The internal supply of feed crops, namely maize and soybean, seems to be inadequate, as indicated in the analysis of demand and supply. In practice, about 80 per cent of the maize requirement and almost all of the requirement of soybean for the feed industry are imported annually. The gap between demand and supply of both crops will continue to widen unless a well planned production programme is implemented within the country. Even if a well planned production programme is implemented, the total requirement of feed crops for the feed industry can not be supplied locally mainly due to the following reasons:

i. Growing demand from the food industry.
ii Most of the maize growers are subsistence farmers and most of them do not have the basic facilities to produce quality seeds for animal feed.
iii. No basic facilities are available for oil extraction from soybean seed, thereby soybean cake cannot be produced in the near future in the country.
iv. There are limitations to the expansion of extent of both crops due to the erratic weather pattern.

Due to the above factors, feed manufacturers tend to import their requirement and this is likely to increase in the future. Therefore, it can be suggested that feed producers should be allowed to import a major share of their maize requirement and almost all of the soybean meal requirement in the future.

However, the following strategies and policy options are recommended in order to increase local production by increasing productivity as well as expansion of cultivated extent. Once again, the main feed crops, namely maize and soybean, are discussed separately.

6.1 Maize

6.1.1 SWOT analysis for maize

SWOT analysis is a tool and is an analytical method for an organization to measure its own strengths and weaknesses. Furthermore, this tool helps to identify the target environment and its characteristics. These characteristics are known as either threats or opportunities.

Following are the strengths, weaknesses, opportunities and threats which govern the maize development programme in the country:

Strengths

i. Direct private sector involvement in the following areas:
   * Purchasing in grain form and dry cob form.
   * Importation and distribution of high yielding hybrid varieties for planting.
   * A high demand for feed, as well as food, is being created by the expansion of manufacturing capacities.
   * Involvement in large-scale cultivation.
ii. Availability of high yielding, locally produced varieties.
   So far, the Department of Agriculture has released four high yielding open pollinated varieties, and is making arrangements to release a locally developed hybrid variety in the near future.

iii. The active involvement of cottage level feed mixtures.
It is estimated that the annual requirement just for this is about 80,000 mt of maize.

iv. Availability of high yielding hybrid varieties.
One variety is very popular and is readily available.

v. Rapid growth in the poultry sector and increasing demand for livestock products.
This leads to accelerated requirements of commercial feed which is a helping factor for maize expansion.

Weaknesses

i. Weakness in feed crop processing technologies.
Almost all of the feed crop producers in the country are resource poor, small-scale farmers. They use only traditional methods of harvesting and processing.

ii. Quality of food crop product is poor.
Mainly due to the previous reason, the non-utilization of new technologies in processing and when major harvesting in maha coincides with bad weather, the quality of food crops is not of the expected standard.

iii. Non-availability of proper storage facilities at the farmer level.
This is one of the major reasons for quality deterioration. Small-scale farmers do not have enough storage space to store bulky harvests of maize, other grains and pulses on their farms. Therefore, most of the feedstuffs are exposed to bad weather and other destructive forces.

iv. Poor market infrastructure in the producing areas.
This creates marketing problems and no one is there at the rural level to purchase the maize produced by rural farmers.

v. Changing government policies.
This creates very serious problems for programme planners, feed crop growers and feed producers to continue their long-term programmes in this sector.

vi. Limitations in extent expansion in the maha season under rainfed conditions, as indicated in Chapter 5.
The extent under all other field crops in the maha (wet) season may be increased but there is a limitation. Maize cannot be the only crop for this additional extent.

Opportunities

i. Land availability in the North and Eastern regions.
It is expected that the civil war, which has prevailed since 1983, will be settled in the near future with the ongoing peace negotiations. Some of the lands which are in the south part of the northern region and in the eastern region are traditional maize lands. These lands can be utilized again for maize cultivation and very high yields can be expected due to the fertility.

ii. Potential for yala maize expansion in paddy fields.
Forty six per cent of the cultivable extent in the major irrigation schemes (345,667 ha) is not cultivated with paddy during the dry season. According to the estimation, about 21,000 ha of such land could be utilized to grow maize.

iii. Tendency of increases in the world market price.
The benefits of price increases will be an opportunity for maize expansion and development programmes in the country. Feed millers will pay high prices for locally produced maize due to the comparative advantage of purchasing locally. Although the devaluation of the rupee against the US $ may render this process not economically viable, it may however, be an added advantage for further price increases.

iv. Positive government intervention in facilitating large-scale cultivation.
With the introduction of open economic policies, the Government of Sri Lanka has initiated a programme to encourage and facilitate foreign as well as local investors to establish enterprises in the country. Agriculture is one of the major areas where this type of investment is encouraged. One organization has started commercial level cultivation of maize with the facility package given under this incentive scheme.

v. Devaluation of the rupee against the US$.
This should increase the CIF price of imported maize and it will help to create excess demand for local maize.

Threats

i. Increasing demand for human food.
The food processing industry is expanding mainly because of increasing demand for various processed food items in the country. This situation has been created by income increases of the population. At present, the country has two private sector organizations and a semi governmental organization, which consume quality maize as the main raw material in their processing industry. This industry is expanding at 1-2 per cent annually and the price offered for maize is always higher than the feed industry. This may be one of the major threats to the feed industry if the feed industry depends totally on local maize.

ii. Free imports.
The current government is taking action to lift the maize import tax structure which is presently in operation. If free imports are allowed without any protective measures, the large-scale feed millers will tend to import their total requirement, without making any effort to purchase local maize. This will create an unsuitable environment for maize farming where purchasers offer a low price for local maize, which creates social unrest among maize farmers.

iii. Regional policies.
Sri Lanka has signed international trade agreements with SAARC countries as well as other countries. The conditions which are created due to these agreements may be ideal to narrow the gap between supply and demand by encouraging imports but may not create a favourable environment for local maize farming. If free imports are allowed, feed millers may tend to import their requirement without making arrangements to purchase locally. They will not support the development of local maize production and processing, as is expected in development programmes.

iv. High market prices of livestock products and low demand.
The price of all livestock products as a protein supplement should be affordable for the majority of consumers. If not, demand will not increase. Very recently, the demand for livestock products (poultry in particular) suddenly decreased due to the unsuitable economic environment prevailing in the country. Due to these reasons demand for local maize will not increase.

v. Wild animal threats to cultivation.
Wild animals, mainly wild elephants, regularly damage crops in major maize producing districts. This situation may worsen due to the increasing conflict between humans and wild elephants for survival in the future.

As is discussed in Chapter 4 and 5, there is already a very wide gap between demand and supply of maize for various purposes. Some of the measures which are suitable to narrow this gap can be suggested considering the outcomes of the SWOT analysis. These measures can be taken by the government, private sector and farming communities jointly or separately.

Due to the identified weaknesses and threats, the total requirement can not be produced locally. In such a situation, policy decisions have to be taken to allow feed millers to import maize. The government is currently implementing this policy to protect, mainly the poultry industry in the country. This policy has to be implemented with necessary alternatives to also protect local maize farming in the future.

Two main alternatives can be suggested to increase local maize production:

i. Increase or expand maize cultivation in both maha (wet) and yala (dry) seasons.
ii. Increase the productivity to a predetermined level by adopting technology packages. The predetermined levels of productivity may change from season to season, location to location and production system to production system.

6.1.2 Government and private sector involvement in maize development

The government can be involved in numerous ways to increase maize availability in the country. The most important is creating a favourable policy environment to maximize local production and to balance imports without creating an unnecessary import environment for importers.

Since maize can be considered as an economically viable crop, the government should give top priority to expand both extent and productivity.

If the maize production programme, which prevailed in the past, is allowed to continue, increased production can not be expected in the future. As is indicated in Table 4.2 the estimated production in the year 2010, for both the feed and food industry, will be 34,450 mt. Therefore, the government should create a favourable policy environment by creating consistence policies to initiate well planned production programmes which include a package of practices.

The package should consist of production technologies, marketing, storage and processing facilities for any given production system.

6.1.2.1 Area expansion

Maha (wet) season

The rainfed extent in maha may not be increased drastically due to competitiveness for natural resources, such as land and water, with other essential food crops. Table 5.10 in Chapter 5, clearly shows that only 25-30 per cent of cultivated land has been used to cultivate maize in maha during the last decade. The balance, 70-75 per cent, has been used to grow crops other than maize. This may be increased by another 30 per cent of the total cultivated extent during maha as a rainfed crop.

Both well and imperfectly drained low lands, which are in major and minor irrigation schemes, are cultivated with paddy during the maha (wet) season during which the northeast monsoon rains fall. However, it is well known that the entire available extent in major and minor irrigation schemes is not cultivated, even during the maha season due to various reasons. Table 6.1 shows the percentage of extent cultivated with paddy during maha and yala.

Table 6.1 Average extent cultivated with paddy during maha and yala seasons in low land paddy fields (1995-2000)

Scheme	Total available for cultivation (ha)	Maha		Yala	
		Cultivated (ha)	% not cultivated	Cultivated (ha)	% not cultivated
Major	345,677	253,979	26.5	186,747	46.0
Minor	186,937	124,120	33.6	51,975	72.2

Source: Dept. of Agriculture and Census and Statistics.

It is a fact that 60 per cent of land in major and minor irrigation schemes fall under the well drained soil category. Almost all of these schemes are located in the dry and intermediate zones of Sri Lanka. A major portion of these lands could be utilized to grow maize during maha in addition to rainfed upland cultivation.

Yala (dry) season

The percentage of land which is not cultivated during the yala (dry) season is much higher than in maha in both schemes. This is mainly due to insufficient rainfall in the season. However, a major share of this land could be utilized to grow maize with a proper on farm water management programme.

The task force for other field crops development appointed in 1995, suggested that at least 21,000 ha of this land could be used to cultivate maize with an assured water supply. As a policy, the Government of Sri Lanka has taken steps to promote maize cultivation in yala on well drained paddy fields. Table 5.11 in Chapter 5, shows that the extent under maize is increasing and there is an increasing trend in the percentage of land use for maize cultivation during yala.

Table 6.2 indicates the major districts and the suggested extent which could be used for maize in 2005.

Table 6.2 Suggested extent to be grown with maize during yala in major districts in 2005

District	Extent (ha)
Anuradhapura	7,300
Polonnaruwa	3,000
Monaragala	2,000
Badulla	2,000
Ampara	1,000
Mahaweli Projects	4,000
Hambantota	1,000
Others	1,400
Total	21,700

Source: Task Force (other field crops).

The suggested extent in yala may be further increased, especially in the Mahaweli irrigation projects and the Badulla, Monaragala, Anuradhapura and Polonnaruwa districts if a well coordinated production programme is implemented with the relevant agencies.

6.1.2.2 Productivity increases

An identified technology package is available for productivity increases. The Department of Agriculture facilitates and takes the lead in increasing productivity with the help of the private sector, NGO's and farmer organizations.

The productivity of maize in both seasons can be further increased by adapting the following components of the package:

- Use of high quality seeds for planting.
- Application of balanced fertilizer as recommended.
- Maintaining proper plant population.

- Managing weeds at the correct time.
- Proper land preparation for drainage improvement, in particular, during yala.

Other than the above cultural practices, farmers must be encouraged to adopt pre and post harvest techniques in order to produce high quality grains. A comprehensive farmer education programme must be conducted by the state sector and the following strategies, which are being implemented at present, must be strengthened or facilitated.

6.1.2.3 Implementation of a large-scale collaborative production programme with the private sector, non-governmental organizations and farmer companies or organizations

It is suggested to implement this in major producing districts, in large-scale yayas (tracks) with small-scale maize growers. Input supply and marketing should be one of the private sector mandates. State agencies and NGOs can be involved in farmer education as well as organizing the farming community for group activities. This is already being practiced in one of the major maize growing areas (Anuradhapura) and it can be expanded to other major and potential areas.

6.1.2.4 Expansion of high quality seed availability for planting

Hybrids

Hybrid maize varieties were only introduced to the country a few years ago (1995/96). Still, only one private sector organization is engaged in hybrid seed importation. The maximum amount distributed was 20,000 kg of seed, among all types of farmers. This indicates that, still less than 4 per cent of maize extent is under hybrid varieties.

The government should encourage and provide the required environment for other potential importers to import hybrids in order to create competitiveness and thereby reduce the price of hybrids.

The Department of Agriculture has developed a hybrid variety at the Field Crop Research and Development Institute (FCRDI) to be released in the near future. This technology should be given to the private sector for multiplication.

In Sri Lanka, private sector involvement in seed production of almost all of the CGPRT crops is minimal. The Government of Sri Lanka, under the new seed law and seed act, provides basic facilities for the private sector to be engaged in seed production programmes. This has to be strengthened.

So far, the following steps have been taken by the government in order to encourage the private sector to produce seeds:

- Release state farms/crown land to the private sector.
- Provide duty concessions for the importation of equipment/machinery, which are needed for seed production.
- Supply of basic seed materials (state owned technology) to the private sector for multiplication and distribution.

6.1.2.5 Expansion and strengthening of the existing forward sales contract system

The forward sales contract concept, which was introduced by the Central Bank of Sri Lanka, creates a favourable environment to expand maize extent as well as productivity. The following are assured under this system:

- Assured market and predetermined prices for quality maize.
- Continuous farmer education programmes.
- Financial assistance for purchasers as well as farmers at a low interest rate.
- Quality grains for millers and end users.

This has to be incorporated in the collaborative yaya production programme, which is suggested to be implemented in potential and major producing areas.

This forward sales contract system is being implemented for maize in selected districts but it can be further expanded. At present, Rs 25 million is given to a person for maize purchasing under this scheme.

The small-scale maize growers are organized in groups and they sign an agreement with the buyer. A state organization eg. The Department of Agriculture or state/commercial banks act as a facilitator in this exercise. The agreement is considered as a legal document.

6.1.2.6 Establishment of large-scale commercial cultivation of maize

At present, a foreign investor is engaged in large-scale maize cultivation on a state farm, which is leased long term under the facilities given by the Bureau of Investment (BOI). New technologies are being adopted on that farm. More investors should be encouraged to engage in this type of production system but social problems may arise due to shortages of natural resources, such as water and land.

6.1.2.7 Strengthening technology generation

Feed crop research, which is an important area in livestock product development as well as human food development, has not been given due attention.

Sufficient resources, including finance, are not allocated for technology generation on production as well as processing of maize by the state sector. This may continue for a long period due to financial constraints. Therefore, it is suggested to have a collaborative research programme with the private sector, mainly in the following areas:

- Development of high yielding, high quality hybrids and open pollinated varieties.
- Irrigation (micro irrigation systems) and fertigation.
- Seed storage for planting (seed technology).
- Grain quality improvement.
- Development of small, medium and large-scale processing and drying equipment.

6.1.2.8 Strengthening of extension services

The state agricultural extension service is a devolved subject under the 13th Amendment of the Sri Lankan Constitution to the provincial councils. Almost all CGPRT crops, except roots and tubers are grown in dry and intermediate zones of the country. Although maize is the main highland crop in a few major districts, extension activities are not given due consideration by the provincial administration. The reasons for this situation are a lack of priority, insufficient manpower and insufficient human resource development programmes.

This situation has to be corrected by introducing output-oriented programmes, under which incentives are paid for extensionists when the production target is achieved by the identified farmer group.

At present, five private sector organizations which are engaged in maize and soybean production, seed production and distribution and bulk purchasing have established their own extension service. This has to be appreciated. The government must take a decision to further strengthen this situation by encouraging other organizations to follow suit.

6.1.2.9 Establishment of rural/regional collection centres

The Government of Sri Lanka is gradually withdrawing it's involvement in agricultural marketing and is encouraging the private sector by adopting open economic policies. However, on special occasions, the government takes necessary steps to purchase agricultural commodities through government and semi government marketing agencies in order to protect farmers.

Similarly, feed millers collect raw materials (mainly local maize) through their local agents. Both the government and the private sector have their own collecting centres at the

regional level but not at the rural level. Collection centres at the rural level must be established so that the farmers can easily sell their maize to marketing agencies without facing any transport difficulties. It is better if these collection centres are established by feed millers through their local agents, non-governmental organizations and farmer organizations/companies with the help of government institutions.

6.1.2.10 Small and medium-scale machinery manufacturing for small-scale maize farmers

Small-scale maize growers use hardly any machinery or equipment in planting, harvesting and processing due to a lack of appropriate machinery manufacturers in the country. The Farm Machinery Research and Development Centre (FMRC) of the Department of Agriculture has developed a medium-scale thresher, seeder and intercultivator for small-scale farmers. Of this small-scale equipment developed by the FMRC, only the thresher is being manufactured by a small-scale manufacturer for commercial purposes. The private sector must acquire this technology and should produce appropriate machinery to be given to small-scale maize farmers.

It is observed that the quality of the maize grains is poor due to problems with drying during the rainy (main) season. A simple dryer must be developed to be used in processing.

6.1.2.11 Establishment of large-scale processing factories in major producing areas

The Government of Sri Lanka has given approval to establish a large-scale factory, which purchases maize in cob form, then threshes and dries it before the stock is supplied to the feed manufacturers. This provides a valuable service for maize growers as well as feed millers. Removing the grain from the cob without damaging it and drying it properly are the main components of the process fulfilled by this organization. This factory was established under the Bureau of Investment which provides a range of incentives for such investors. The government must encourage the private sector or foreign investors to establish at least two more similar processing factories in major maize producing districts.

6.1.2.12 Establishment of a statutory body to act as a regulatory body

There is a requirement for a legal body to regulate and coordinate all aspects of production and marketing of feed crops, as was highlighted at the workshop which was organized to discuss the major suggestions of this report with the participation of national level policy makers and scientists. As an initial step, the proposed body can be established for maize. The structure and functions of this legal organization shall be similar to the Tea Board in Sri Lanka. Basically the proposed functions of the statutory body are:

- Coordinate marketing at national and regional levels.
- Ensure the quality and quantity required by the end users.
- Provide legal strength for farmers as well as end users.
- Ensure fair price for growers.
- Suggest policy changes to the government when necessary.
- Create a favourable environment for crop insurance.

6.1.2.13 Establishment of a joint research and development fund

A fund, using a small percentage of import tax/consumer tax, may be established to be used in research and development of feed crops. This is being practiced in the plantation crop sector (tea) in the country. The establishment of such a fund may be one of the solutions for the financial constraints to feed crop research in the country.

6.1.2.14 Continuation of the present tax structure of maize imports for another three years

It is proposed to continue the import tax structure which was practiced up to March 2002, for maize imports. Fourteen per cent of the CIF price of maize is charged as the import tax. It can be considered as a favourable situation to maintain a fair price for locally produced

maize at present. The proposed tax structure can be withdrawn gradually for the smooth implementation of international agreements, such as GATT, in the future.

6.1.2.15 Implementation of trade agreements with regional countries

The total estimated maize requirement may not be produced locally due to constraints and limitations. Therefore, it is suggested to strengthen regional trading with neighboring countries without harassing the opportunities of local production increases. Mutual agreements may be arranged with the SAARC organizations and, if necessary, with other countries.

6.2 Soybean

The soybean requirement for the food industry can not be estimated using a methodological approach due to the non-availability of reliable data. However, an idea about the demand may be taken by analyzing local production and imports of soybean in various by-product forms to the country. A fluctuation can be seen in imported amounts during the last few years.

The annual requirement, in seed form, for the food industry is about 5,500 mt. Sri Lanka does not have the facilities to extract oil from the seed and convert seeds into other forms, such as soymeal, soymeat and soyflour.

The requirement of these by-products can not be projected but the supply is presented in Tables 5.12, 5.13 and 5.14 in Chapter 5. Some of the strategies and policy options for narrowing the gap between demand and supply in seed form can be suggested while allowing imports of by-products for various industries.

6.2.1 SWOT analysis for soybean development

The same “SWOT” analysis can be adapted to identify strengths and weaknesses as well as opportunities and threats which control or accelerate soybean development in the country.

Strengths

i. Less technical problems.
   Although soybean is a recently introduced crop to Sri Lanka, it used to be a popular crop for highland rainfed cultivation in the dry zone, mainly in the Anuradhapura district. In the early eighties, the cultivated extent of soybean, only in that district, was above 10,000 ha. It is an easy crop for all types of farmers to produce and comparatively less technical problems are experienced.

ii. Suitability for highland farming.
   Soybean was once a very popular rainfed highland crop where it was suited for stabilizing the slash/burn cultivation pattern.

iii. Direct involvement of the private sector in purchasing and providing other facilities.
   Private sector organizations, which are involved in food processing, provide basic facilities, such as inputs and arrange forward sales agreements to purchase soybean at a predetermined price. However, at present, this is being practiced only in the food industry.

Weaknesses

i. No processing facilities are available.
Sri Lanka does not have any oil extraction facilities at a commercial level or any other level. At the same time, cottage industries and medium-scale food industries are not well developed to absorb the production increases.

ii. Limitations in using raw soybean as a human food as well as in the feed industry.
It is a well known fact that raw soybean can not be consumed as a human food like other pulses.

iii. Poor keeping quality.
Due to its natural oil content, soybean can not be kept for a long period without loosing viability of seeds. This is a very serious problem for the supply of seed material for the following season's planting in the country.

Opportunities

i. Wider adaptability.
Wider adaptability is one of the main characteristics which provides the opportunity to grow soybean in a range of environments.

ii. Past experience of growing on a commercial scale.
Most of the dry zone farmers have experience in growing soybean as a rainfed crop during the maha season. Similar experience was obtained by the farmers in major irrigation schemes in the dry zone with the implementation of crop diversification programmes as government policy.

iii. Availability of land for irrigated farming in major and minor irrigation schemes.
Soybean extent can be increased during yala on suitable lands which are irrigated in major and minor irrigation schemes.

Threats

i. Expansion of the human food industry.
This may be a threat in the future too. There are no facilities to convert the seed into meal form. In normal circumstances, a higher price is paid for soybean seeds, which are used for human food preparation. This makes the farmers reluctant to sell their produce for any other purpose.

ii. Free imports or provide necessary facilities for seed imports.
This may lead to bulk importation, not only of by-products, but also of seeds without making arrangements for local purchasing.

iii. Increasing demand for pulses other than soybean.
Local production may not increase due to the price advantage offered for other pulses, mainly green gram and black gram at present. This may limit the available land both in maha and yala for soybean.

6.2.2 Government and private sector initiatives

Since the country does not have the basic facilities to produce by-products, the government should take a firm decision to allow importation of such soy items, in order to protect feed milling as well as some of the food production industries in the country. However,

the requirement in seed form should not be imported and arrangements must be made to produce locally.

The gap between demand and supply of soybean seed can be reduced by increasing local production. It is proposed to take the necessary options in production and marketing strategies which are geared towards production increases.

Soybean production enhancement programmes should have two components. They are:

- Increasing production through area expansion.
- Increasing production through productivity increases.

6.2.2.1 Policy recommendations

i. Provide facilities for by-product imports.
   It can be recommended that importing by-products, not only for the feed industry but also for the food industry, be allowed until processing (mainly oil extraction) facilities are established within the country.
   Strategies must be developed to produce the total requirement of soybean in seed form for the food industry in the country.

ii. Regional trade agreements.
   At present, large amounts of soymeal are imported, mainly from India, in order to fulfil the requirement of the animal feed industry. This may be further expanded by arranging regional trade agreements, particularly for this item, with other neighbouring countries.

iii. Implementation of a consistent policy package, even for imports.
   This will be a very important factor for the smooth functioning of continuous feed production to fulfil the growing demand from the livestock sector.

iv. Provide an incentive package to establish oil extraction facilities in the country.
   The incentive package should be given to private sector entrepreneurs to initiate oil extraction as well as the production of other by-products. The package given by the Beauro of Investment (BOI) is suitable for this purpose also.

6.2.2.2 Expansion of the development (production and marketing) package given by private sector food producing industries for increasing local production of soybean seeds

- Further expansion of the forward sales contract system among potential farmers.
  A similar programme, which was proposed for maize, can be implemented as a collaborative programme with the private sector, banks and government agencies.

- Establishment of local collection centres.
  The same centres which are proposed for maize can be utilized for soybean collection too. These centres may be owned by local individual collectors, farmer organizations/companies or by food producers (end users).

- Implementation of a seed production programme.
  Farmers are not in a position to keep their seed requirement for planting due to technical problems which reduces viability, even during a short storage period. In order to overcome this situation, the private sector with the technical assistance of state agencies can engage in seed production with better storage facilities.

- Implementation of continuous farmer education programmes.
  This has to be undertaken by the government and private sector organizations which are involved in soybean production and processing. The main components of this programme should be cultural practices, quality maintenance and storage of seeds.

6.2.2.3 Farmer participation in soybean development

Group formation for production as well as marketing and involvement in decision making processes are major areas in which farmers can offer their services for soybean development.

Cultivation in yaya assures easy and efficient marketing and quality of the produce.

As was indicated earlier, farmer participation in decision-making, programme implementation and marketing of soybean is currently unacceptable. Most items which have been described under maize are common for other feed crops, including soybean.

6.3 Roots and tubers

Locally produced root and tuber crops are consumed as food not as feed. Although the demand can not be estimated with the available information, production may be increased by adapting the following strategies.

6.3.1 SWOT analysis for root and tuber development

Root and tubers are not used in the feed industry and are not commercially grown crops, with the exception of potato. SWOT can be used to identify strengths, weakness, opportunities, and threats in order to implement a development programme in the future. While potato is grown in the hills and a few locations in the northern region, all other roots and tubers are grown mainly in low country, intermediate and dry zones. Therefore, the outputs of the SWOT may not be the same for all crops.

Strengths

i. Less technical problems.
   Manioc (Cassava) is a relatively simple crop for resource poor farmers to produce and hardly any technical problems are experienced, except disease.

ii. Suitable for high level as well as low level farming.
   Potato (*Solanum tuberosum*), sweet potato (*Ipomea botatas L*), innala (*Solenostemon rotundifolius*) and kiriala (*Xanthosoma sagittifolium*) can be grown successfully, both on high level and low level land with proper land preparation.

iii. Direct involvement of the private sector in kiriala (Xanthosoma sagittifolium) exportation is a strength for extent expansion.

Opportunities

i. Potential for short-term root and tubers in paddy fields during yala.
   Sweet potato, potato and innala can successfully be grown in paddy fields during yala.

ii. Higher prices offered for local potato than imported potato.
   This is mainly because of consumer preference for local potato.

iii. Price fluctuation of potato.
   Since all root and tubers are consumed as foodstuffs, potato prices always determine the demand for root and tubers other than potato.

Weaknesses

i. Non-availability of processing facilities for the feed industry.
Therefore, toxic substances in manioc (which is the only potential feedstuff) can not be removed and the available processing facilities are not suitable for manioc processing.

ii. Minimal availability of processing facilities for the food industry too.
Almost all of the production of potato and other root and tubers are consumed in raw form. A negligible amount is processed for other purposes.

iii. Low priority is given for these crops, except potato, by the state as well as the private sector.

iv. Long age nature of the available varieties of manioc (cassava).
All common varieties belong to the long age (about 9 months) group.

Threats

i. Free potato imports.
This creates a situation where cheap potatoes are available in the market. This decreases the demand for other root and tubers.

ii. Wastage of natural resources.
Soil erosion and long-term hazards for the natural environment are experienced in the hill country due to the ad-hoc nature of potato cultivation.

iii. Wild animals.
Wild boar damage of manioc and kiriala cultivation is common in the low country intermediate zone.

6.3.2 Government and private sector initiatives

Marketing and processing of root and tuber crops are attractive areas for the private sector to invest their resources. However, they may not show their willingness to invest in production programmes for root and tuber crops except, potato.

- Collaborative research and development programmes for production enhancement, product development and exploring the possibilities of using root and tubers, mainly manioc, in the animal feed industry must be implemented with the private sector.

- The government must play a major role in the introduction of high yielding, high quality varieties, the introduction of improved agronomic practices, minimizing pre and post harvest losses and implementing effective technology transfer systems in this sector.

6.4 Farmer participation in feed crop development

Farmer participation can be considered as an essential component of any commodity development programme in order to maintain smooth implementation and sustainability. The Government of Sri Lanka has realized the importance of farmer participation in agricultural development programmes. At present, farmer organizations are active mainly in major irrigation schemes and they are involved in decision making on water management and programming to some extent. Farmers have demonstrated their active participation in production programmes

such as the large-scale rice yaya and maize yaya programmes, where they have experienced gainful economic activities and financial benefits for their involvement.

However, farmer participation in decision-making and programme implementation in feed crop production is not satisfactory. At present, two farmer companies are involved in maize and soybean marketing. These farmer companies are facing serious threats as well as financial and infrastructure problems and must overcome some of the constraints which prevail in a competitive environment.

Non-governmental organizations (NGOs) can play a vital role in organizing farmers for feed crop development programmes. The government organizations and NGOs should act as facilitators in coordination between farmer companies/organizations and individual potential farmers and feed millers. The farmer organizations and companies should be independent bodies and should have their own funds. The government may help them by providing loans or grants to be used as revolving funds in an acceptable manner. Farmer companies/ organizations could be involved in the following feed crop development programmes:

- Involvement in the planning process and negotiate their requirements, such as a fair price for their feed crop products, quality parameters, etc.
- Establishment of a revolving fund for various activities in the production process. This is being practiced with maize farmers under the National Agricultural Production Programme (NAPP) which was started in 1999. This can be further strengthened.
- Supply of predetermined amounts of raw materials to feed millers so that confidence can be established in both parties.
- Farmer companies or organizations can take the responsibility of investing in costly components of the technology package, which is suggested for productivity increases and quality maintenance. These components are investments in processing and drying equipment, local storage and transport.

Individual farmers would not be in a position to make any quick response to any market change or development in the maize industry. The well organized farmer companies and/or organizations are in a better position to make quick responses, as they have resources and organizational capabilities. These organizations can respond not only to market developments but also to any manufacturing developments which are taking place in the feed as well as the food industry in the country.

6.4.1 How ordinary farmers will benefit from the potential of a widening gap between demand and supply

As indicated in Chapter 5, almost all of these feed crops (CGPRT crops, except potato) are grown by resource poor, small-scale farmers. Their farming practices can be considered as a low extent, input supply practice.

Therefore, the potential yield of feed crops, especially maize, is not obtained by these farmers. Due to low productivity of maize, the cost of production is comparatively higher than the expected level. However, due to the increasing demand in the feed as well as the food industry, food processors tend to pay a comparatively higher price for local maize. As it is indicated in Table 5.6, the farm gate price of maize has gone up from Rs 10.52 in 1996 to Rs 16.34 in 2000. This situation has encouraged these resource poor, small-scale farmers to adopt technological packages which include quality seed and fertilizer. Almost all of these small farmers maintain their plant population by sowing seeds in recommended row spacing.

Although it is not correctly reported, the productivity of maize has risen. The majority of growers are enjoying higher income levels generated through maize cultivation.

7. Conclusions and Recommendations

Although Sri Lanka is basically considered as an agricultural country, the sector's contribution, including livestock, to the GDP is not at a satisfactory level.

Analyzing the present status of the animal sector, feed industry and feed crop production and development, the following conclusions and recommendations can be made:

1. The contribution of livestock to the GDP is always about 2 per cent and in economic as well as social terms, this is not up to potential or the expected level. The potential of livestock has been relatively unexploited.

   Per capita consumption of animal protein in Sri Lanka is relatively low compared to developed and some of the developing countries. This shows a great potential for improvements in per-capita consumption.

   The authorities must take the necessary action to exploit the potential of livestock other than poultry in order to fulfil the increasing demand with the changing dietary habits due to increases in income of the population.

2. Due to slow or zero growth of the meat industry, animal protein production is dominated by the poultry industry in the country. However, even in the poultry industry, the broiler sub sector has been growing at very high rate (10 per cent annually) while the layer industry grows at a very slow rate (1 per cent annually). Furthermore, it can be concluded that the same growth rate can be expected in the broiler industry for the next few years. This situation must be clearly understood by the authorities and the necessary future arrangements must be taken.

   Although the amount of poultry feed and poultry products exported is low at present, there will be a tendency to increase this quantity in the future. Sri Lanka has competitive advantage in producing quality products using more advanced technology, although the cost of production is higher compared to other countries in the region.

3. The production of eggs and chicken, mainly broiler, is in the hands of the well-organized private sector in the country. It can be considered as a capital intensive, agri business located around urban areas due to favourable government policies. This has to be continued.

4. Any growth in ducks, turkey, guinea fowls and grails can not be expected in the future, although they are also considered as poultry species, due to low priority.

5. A rapid growth in demand for beef can not be expected due to publicity relating to disease and religious factors. This situation may create a favourable condition for further growth of the poultry industry in the country.

6. Production of pork, mutton and other meat is static, some increases in mutton production can be expected but due to the high market price, per capita consumption will increase at a very slow rate. All of them are reared under extensive conditions, mainly in rural areas.

7. Although the demand for fish and fishery products is increasing, local fish production only met a little higher than one third of the demand. Demand for compound feed will not be created in the future due to the nature of the fish industry in the country.

8. It can be concluded that developments occurred, especially in the poultry industry, mainly due to the involvement of the well-organized private sector in rearing birds, production and distribution of feed and processing and marketing of animal products. The role of the private sector has to be appreciated but further competition must arise to create more benefits to the consumers.

9. There is a tendency to change dietary habits among the population in all sectors due to increases in per capita income. Demand will rise further with the high-income levels and this may create a favourable environment to expand the poultry sector because of its dominating nature in the industry today.

10. Milk imports may have to be increased further to fulfil the local demand, unless the major issues such as a lack of suitable lands to grow quality forage, shortages of economical feed supplements and inefficiencies in the system of marketing are addressed and resolved. The production of milk using compound feeds has become uneconomical under the present market price of feed.

    The potential milk yield of intensively reared cattle is not yet realized mainly due to management problems. At present, these animals are rarely fed with compound feed. In order to obtain potential milk yields, at least the intensively reared milk cattle must be fed with compound feeds.

11. The local feed industry is vulnerable to changes in the availability and price of raw materials in the international market due to the high consumption of imported raw materials such as maize. Therefore, action must be taken to increase production of local raw materials.

12. An increasing demand can not be expected in compound feeds for pig meat, cattle, goats and species other than poultry due to their rearing systems and slow or zero growth that will continue in the future. However, the predictions indicate that there will be an increasing demand for poultry feed.

    The estimated consumption of maize in feeds in 2010 will be about 344,920 mt, which will be more than three times the present usage.

13. Possibilities are there to increase compound feed production up to a certain extent with the presently available feed milling structures because the total installed (450,000 mt) capacity is not yet fully utilized. However, it can be concluded that the feed milling capacity available in the country will not be sufficient in 2005 and beyond. Necessary arrangements have to be made to correct this situation.

    As the demand for feed grains for the animal feed industry is increasing, a programme to produce at least 60 per cent of the requirement is essential for the sustainability of the feed industry.

14. In view of the fact that the government is encouraging foreign investors to invest freely, even without a local partner, and providing a range of incentives, the feed industry should develop freely in the future. This policy should be continued.

15. Since the feed industry has been liberalized already, the GATT agreement and the WTO rules are not expected to have significant affects.

16. A high level of quality of compound feed, mainly produced by large and medium-scale feed millers, has been assured by the strict enforcement of the Animal Feed Law, which was enacted in 1986. However, the quality of the feeds, which are produced by cottage level producers (self mixing) are not at the expected level because they do not register under the feed law despite being expected to do so. However, it can be concluded that the law is being implemented in a manner that does not stifle the industry or investment.

17. Feed millers may increase the use of imported ingredients due to the high variability in quality and availability of locally produced ingredients. However, these imports may not be sustainable in the future due to an increasing demand for them from all over the world.

18. Locally produced, high quality ingredients, especially maize, may not be available in sufficient quantities for the feed industry in the future due to usage in the food industry. This situation may be aggravated in the future due to a three-fold demand increase of maize from the food industry by the end of the next decade. The growing food industry will be a threat to the feed industry in the future.

    Given that large quantities are consumed by maize growers, as they are one of the main food items, food processors can arrange their requirement through contract growing programmes, as they do at present. The authorities must assist them to strengthen their production programmes.

19. A higher farm-gate price of maize has been reported due to the high demand from the food industry. However, the CIF price may not be reported accurately due to under pricing of imported maize. This is clearly indicated by the devaluation of the rupee against the US dollar. Although the value of the US dollar has doubled, the CIF price has not increased comparatively. The actual situation has not been reported correctly.

20. Purchasing of local maize for feed can be controlled by the three major feed manufacturers, since two-thirds of the requirement is consumed by these three manufacturers. Feed production may also be controlled positively or negatively by these major producers. More industrialists should be encouraged to establish feed mills, not only to control the situation but also to fulfil the future requirement.

21. Although soybean is considered as poor man’s meat due to its high protein content, a sharp production increase can not be expected in the future. The main reason for this situation is a lack of processing facilities in the country. Therefore, the by-products, such as soymeal, which is used in feed industry, can not be expected to be produced in the country. Possibilities are there to increase the production of soybean seed up to a certain level because insufficient quantities are produced at present. Marketing problems may arise if raw seed production exceeds 5,500 mt per annum.

It can be recommended that imports of soymeal for the feed industry should be continued until processing facilities are available in the country. However, steps must be taken to produce the requirement for the food industry in seed form in the country.

22. The expansion of the food industry, which consumes soybean in the country, will not be a threat to the feed industry because the food industry consumes only soybean seed and not by-products.

23. The recommended amount of soybean meal in any feed ration can not be substituted by any other ingredient, mainly due to the essential protein required in a feed. Therefore, usage of soybean meal in the feed industry will not change in the future.

24. Root and tuber crops grown in Sri Lanka can not be used in the feed industry due to the high demand as human food in raw or processed form. Cassava is the only crop which can be used as an energy source in feed, but it is not used as a feed source due to some technical limitations.

    Steps must be taken to explore the possibilities of using cassava in animal feed due to the following reasons:
    i. To use cassava as an alternative source of energy in feeds.
    ii. To find a market for bumper harvests in the main growing district, Gampaha, where the poultry industry dominates.

25. The total requirement of feed crops in the feed industry can not be produced locally, even in the future. Present maize production can be increased with the implementation of a well-planned production programme. However, the balance of the requirement of maize also has to be imported. Total soybean meal requirement will be imported in the future until oil extraction facilities are established in the country.

    Policy decisions must be taken to protect both parties, namely local raw material producers as well as feed producers. Therefore, it is recommended that the present tax structure for maize imports be continued until the expected levels of local production are achieved within 3-5 years. The taxes can be phased out within a few years.

26. Private sector organizations, which are involved in the feed and food industry, have performed a commendable job to increase productivity as well as production. However, more private sector organizations must be encouraged to organize their production programmes through contract growing with small-scale farmers.

27. It can be concluded that one of the reasons for low yields of almost all feed crops grown in Sri Lanka is the use of low quality seeds for planting. The state sector alone can not supply more than 15 per cent of the requirement. The private sector can play a vital role in seed production of feed crops for planting.

28. Until the local hybrid variety is released for planting, the private sector must be encouraged to expand hybrid maize seed importation as well as distribution among growers. Since the provisions are given in the Seed Act, the production and distribution of the potential hybrid variety should also be given to the private sector for efficient and quick distribution.

29. Although the productivity levels of maize are increasing in both maha and yala, the extent cultivated has been in a decreasing trend since 1997/98. This may further decrease if a well planned production programme is not implemented with private sector involvement. However, possibilities are there to expand the maize extent during yala with minimum effort.

    Since farm earnings from maize are comparable with other crops, the authorities must take steps to increase maize extent in paddy fields, mainly in major irrigation schemes during yala. A well planned collaborative programme should be implemented in order to supply input, credit, technology and marketing facilities.

30. The price structure implemented by the government might have helped farmers to obtain a reasonable price for their maize. However, it is very difficult to conclude that the same structure has helped to expand maize cultivation in the country. It is estimated that a one percent rise in maize prices increases the area by only 0.24 per cent. Therefore, programmes must be implemented to enhance productivity.

31. The collaborative programmes implemented with the direct involvement of the private sector have contributed greatly to increase the productivity and create a better position for maize in Sri Lankan agriculture. This has to be continued in the future in both seasons.

32. Farmers use hardly any machinery in feed crop production in the country. The small-scale, as well as medium-scale equipment developed by the Department of Agriculture and Rice Processing Research and Development Centre must be popularized among growers and private sector manufacturers must be encouraged to produce such machines for sale.

33. Organizing farmers into yayas (production blocks) is an ideal tool to increase productivity, arrange marketing through forward sales contracts, maintain quality of the product and to have a well planed farmer education programme. This must be organized by the extension services with the help of other relevant agencies.

34. The main reason for low quality maize production during maha is the non-availability of processing facilities at the farmer level. Low adaptation of appropriate processing technologies and unsuitable storage at the farmhouse are other reasons which create an environment for low quality maize production.

    In order to avoid these situations, processing activities of maize can be handled by the private sector after buying in cob form. The private sector state agencies or cooperative organizations must be encouraged to establish processing and drying facilities in other areas, namely Mahiyangana (Badulla district) and Monaragala (Monaragala district). In the meantime, basic facilities such as hand operated seed removers, canvas materials for drying and assistance to build low cost cottage level storage must be provided to small-scale growers under the proposed forward contract system.

35. Technology generation must be strengthened by providing adequate financial as well as human resources to the feed crop sector. Since the state research stations are facing serious problems due to financial constraints, the private sector must be involved in collaborative research on the following areas:
    - Variety development.
    - Seed technology.

- Grain quality improvement.
- Development of equipment for planting and processing.

Introduction of new technologies and the provision of other services are essential to produce quality feed grains required for the feed industry. Therefore, a well-planned farmer education programme is essential.

36. With the present limitations on the number of extensionist having to cover large areas and focus on several crops, it is difficult to expect a rapid spread of technology. It is therefore, recommended that extension services identify the high potential areas for feed crops, especially maize, and concentrates their efforts in these areas initially.

    Meanwhile, the private sector must be encouraged to establish their own commodity based extension services. They can establish a nucleus farm for the easy spreading of technology.

37. Due to the high level of dependency on imported raw materials, mainly maize, the feed industry as well as the poultry industry is extremely vulnerable to fluctuations in availability and price of maize in the world markets. Meanwhile, local maize production may not be sufficient to fulfil the requirements for both the feed and food industry.

    For these reasons it is suggested that the possibilities must be exploited to use available other local raw materials in the feed industry. Potential, but either unutilized or under-utilized feedstuffs are as follows:

- Rubber seed meal
- Tea refuse
- Jack seeds
- Fruit seeds
- Fish waste
- Abattoir waste

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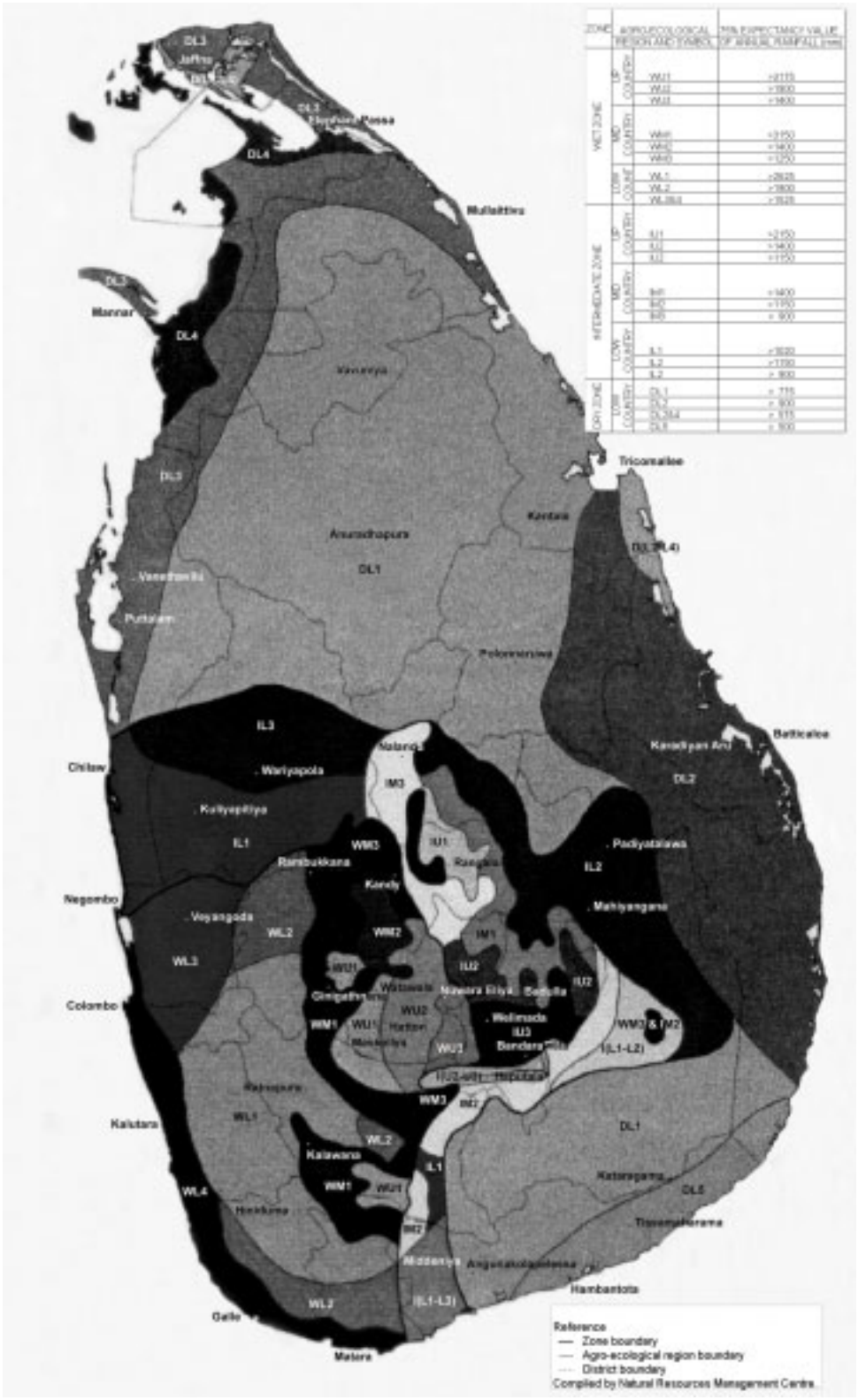
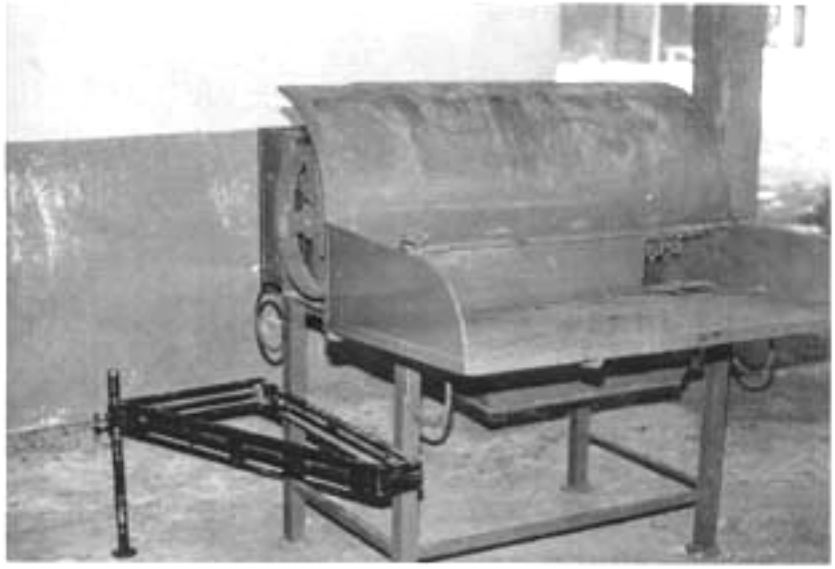
Appendices

Appendix Figure 1 Location of the maize belt in Sri Lanka

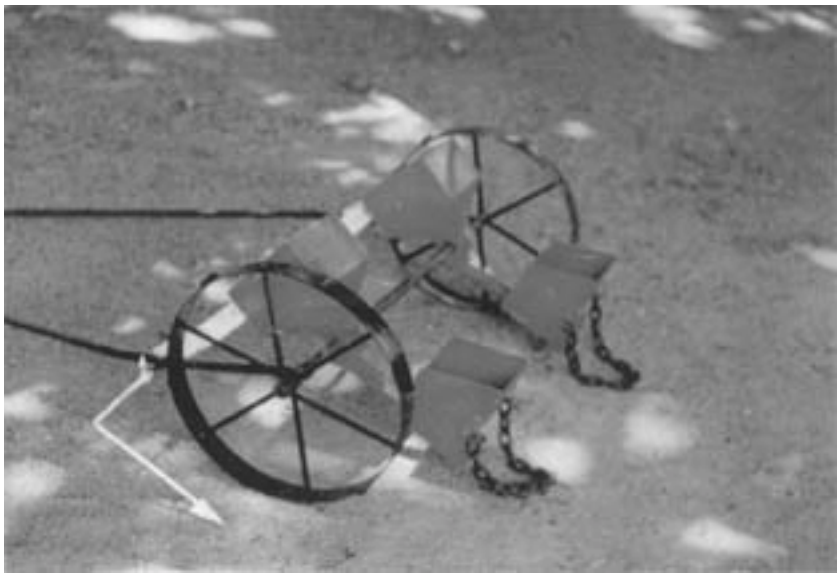
Appendix Figure 2 Agro-ecological regions of Sri Lanka



Appendix Figure 3 Medium-scale power thresher (multi-crop thresher)



Appendix Figure 4 Push type highland seeder



Appendix Figure 5 Inter cultivator

Appendix Table 1 Feed crop raw data set from 1980-2000

Year	Imports (maize) '000 mt	Farmgate price (maize)	Area (maize) ha	Urea price Rs/ton	Food '000 mt	Feed '000 mt
1980		2.69	19,433	2,140	20.52	
1981		3.48	24,081	2,785	21.27	
1982	2.85	3.18	26,685	2,850	23.93	
1983	0.42	3.31	26,235	2,850	27.99	
1984	4.58	3.39	32,881	2,850	37.98	
1985	15.95	3.73	33,061	2,850	21.4	22.75
1986	30	3.75	31,202	2,850	56.5	11.8
1987	13.7	4.03	34,665	3,650	18.61	34.89
1988	13.57	3.73	36,813	3,650	33.54	16.35
1989	6.9	3.75	29,107	15,800	22.69	13.09
1990	46.05	4.85	32,070	10,000	68.94	8.06
1991	53.33	5.81	28,565	9,850	22.09	10.7
1992	30.84	5.67	27,721	9,850	27.67	0.05
1993	80.76	7.35	32,594	6,850	31.26	82.57
1994	93.83	7.13	31,497	10,600	47.54	64.77
1995	80.06	7.28	35,938	11,000	45.74	65
1996	91.58	9.34	30,895	11,800	41.62	78.58
1997	90.24	10.52	25,796	7,000	29.02	82.92
1998	106.54	14.42	29,790	6,800	61.2	74.41
1999	125.63	16	28,904	6,300	61.9	89.92
2000	123.11	14.2	28,646	6,300	61.5	

Appendix Table 2 Sparsely used land (available for rainfed farming) in Sri Lanka

District	Extent (ha)
Hambantota	69,330
Monaragala	186,330
Badulla	84,430
Polonnaruwa	51,120
Anuradhapura	186,500
Kurunegala	112,710
Puttalam	58,700
Vavuniya	40,150
Mulative	22,400
Jaffna	10,510
Killinochchi	16,300
Mannar	11,590
Ampara	127,720
Batticaloa	38,920
Trincomalee	46,000
Comombo	750
Kalutara	14,840
Gampaha	120
Kandy	28,280
Nuwara Eliya	8,630
Matale	45,600
Galle	16,320
Matara	9,690
Kegalle	20
Ratnapura	101,750
Total	**1,288,710**

Source: Department of Census and Statistics.

Sparsely used land – land cultivated by chena or recently abandoned chena, sparsely used rainfed cropland (permanent dry cropping), neglected or abandoned tea, rubber, coconut lands and land under development.

Appendix Table 3 Production and importation of other grains

Year	Kurakkan			Sorghum		
	Extent (ha)	Production (mt)	Amount imported (mt)	Extent (ha)	Production (mt)	Amount imported (mt)
1990	10,705	7,212	na	68	54	na
1991	9,840	6,565	18	123	85	na
1992	8,386	5,034	na	145	103	na
1993	10,315	7,039	49	120	80	27,805
1994	9,450	6,686	50	140	98	88
1995	7,439	4,876	na	241	222	18,305
1996	6,129	3,906	499	204	194	10,094
1997	5,562	3,500	1,254	206	187	na
1998	6,042	4,385	695	106	77	na
1999	6,483	4,807	277	197	138	na
2000	6,544	4,849	552	163	212	na
2001	5,655	4,212	815	65	68	

Source: Department of Census and Statistics, Sri Lanka Customs.

Appendix Table 4 Cultivated extent (ha) and production (mt) of other pulses during the last decade 1991-2001

Year	Green gram		Cowpea		Black gram	
	Extent	Production	Extent	Production	Extent	Production
1991	33,032	26,584	25,727	22,407	3,005	3,536
1992	26,406	23,100	21,155	17,435	7,112	5,151
1993	25,108	21,076	22,214	19,387	12,045	8,400
1994	22,447	18,322	20,976	18,202	11,437	8,009
1995	18,097	16,013	18,105	16,110	11,453	7,942
1996	18,261	16,585	18,882	16,997	9,065	7,363
1997	16,636	15,000	16,209	13,971	8,780	6,844
1998	17,509	15,646	14,827	13,399	10,171	8,049
1999	15,362	16,325	13,149	12,106	8,658	6,730
2000	12,969	11,695	12,947	12,121	6,703	5,420
2001	11,065	98,716	10,792	9,839	6,361	5,127

Source: Department of Census and Statistics.

ZONE	AGRO-ECOLOGICAL REGION AND SYMBOL		75% EXPECTANCY VALUE OF ANNUAL RAINFALL (mm)
WET ZONE	UP COUNTRY	WU1	> 3175
		WU2	> 1900
		WU3	> 1400
	MID COUNTRY	WM1	> 3150
		WM2	> 1400
		WM3	> 1250
	LOW COUNTRY	WL1	> 2625
		WL2	> 1900
		WL3 & 4	> 1525
INTERMEDIATE ZONE	UP COUNTRY	IU1	> 2150
		IU2	> 1400
		IU3	> 1150
	MID COUNTRY	IM1	> 1400
		IM2	> 1150
		IM3	> 900
	LOW COUNTRY	IL1	> 1020
		IL2	> 1150
		IL3	> 900
DRY ZONE	LOW COUNTRY	DL1	> 775
		DL2	> 900
		DL3 & 4	> 575
		DL5	> 500