PN-ABP-101
82397

ROLE OF PUBLIC AND PRIVATE SECTORS IN HORTICULTURE DEVELOPMENT: UVA PROVINCE

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January, 1993

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ACKNOWLEDGEMENTS

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ACKNOWLEDGEMENTS

The consultancy team wishes to thank the many individuals and organizations whose collective efforts have made this study possible.

Particular recognition is given to the Honorable Percy Samaraweera, Chief Minister of Uva Province. Without his dedication and commitment to strengthening the horticultural sector in Uva Province the study would not have been initiated.

We wish to express our special appreciation to Mr. Gamini Wanniarachchi, Deputy Secretary (Planning), Uva Provincial Council and to Mr. D.M.W. Dassanayake, Provincial Director of Agriculture, both of whom worked with and supported the team throughout the consultancy.

Appreciation is also expressed to Mrs. S.U. Salih for her secretarial support while the team was based in Badulla.

We are grateful for the support and guidance from Dr. Preston Pattie, Chief of Party, Diversified Agriculture Research Project and his staff, particularly, that of Mrs. Shirley Amunugama, Mr. Sri Kanthan and Miss Khema Senanayake. A special thanks to Miss Senanayake whose efforts made possible the preparation of the final report.

Lastly, we wish to acknowledge the funding support given to this effort by the Sri Lankan Mission of the United States Agency for International Development through the Diversifed Agriculture Research Project.

We hope that the results of our work will contribute to the strengthening and growth of the horticulture industry in Uva Province.

ABBREVIATIONS AND ACRONYMS

ACDI	-	Agricultural Cooperative Development International
ARTI	-	Agrarian Research & Training Institute
ASEAN	-	Association of Southeast Asian Nations
BA	-	Badulla
BAN	-	Bandarawela
CARI	-	Central Agricultural Research Institute
CISIR	-	Ceylon Institute of Scientific & Industrial Research
DAI	-	Development Alternatives Inc.
DARP	-	Diversified Agriculture Research Project
DEA	-	Department of Export Agriculture
DOA	-	Department of Agriculture
FAO	-	Food and Agriculture Organization
GOSL	-	Government of Sri Lanka
ITC	-	International Trade Centre
MADR	-	Ministry of Agricultural Development and Research
MARD	-	Mahaweli Agriculture & Rural Development Project
MED	-	Mahaweli Enterprise Development
RARC	-	Regional Agricultural Research Centre
UNDP	-	United Nations Development Programm
USAID	-	United States Agency for International Development

EXECUTIVE SUMMARY

There is strong growth potential for the horticultural industry in Uva Province. This growth will be dependent upon strengthening the overall horticultural system which is comprised of the production function, the postharvest handling function and the marketing function. The performance of each individual function and the integration of the three will determine the system's overall performance and growth. Also recognized as being essential for sustainable industry growth is the increased involvement of the private sector.

Findings

At present, there is little attention being given to the marketing function. There is very little market based decision making at the sector level and at the individual producer level. There is a lack of farmer involvement in the marketing process. There is unfamiliarity with the fresh export markets and a lack of awareness regarding quality and consistency of supply requirements. There are price abuses in local marketing channels. In some areas there are postharvest handling losses and erratic product flow. In general, there is hesitancy of agribusinesses to utilize contract growers for production. In many cases, production units are not operated as businesses. There is an increasing prevalence of virus and bacterial diseases and inadequate water management, and, lastly, there are numerous infrastructural related constraints. Sri Lanka's competitiveness in the world's fresh and processed export markets, the well being of those involved in the production, processing and marketing chain, particularly the small farmer, and the future trend in local fruit and vegetable consumption will be dependent upon the extent of improvement in these areas.

Strategy to Strengthening the Horticultural Industry

Horticulture must be approached as an agribusiness requiring both profitability and sustainability. There must be cooperation between public and private sectors. There must be a willingness to accept that private sector can be allowed to earn a reasonable profit on an enterprise operation. There must be government interventions to support the private sector in horticulture. There must be increased aggressiveness from the private sector in identifying potential agro-enterprises, in determining technical and economic feasibility, and in planning, implementing and operating those that are determined to be viable. Following is a summary of strategy elements considered important for Uva Province.

* **Improvement of the horticultural system**
  - **production function**
  - **postharvest handling function**
  - **marketing function**

* **Realization that horticultural development is a long-term process requiring realistic goals**

* **Appreciation of the domestic market**

* **Appreciation of the export requirements**

* **Building on Uva Province's advantages**
    - **variation in topography and related soil-temperature regimes**
    - **skilled commercial vegetable growers**
    - **commitment from Provincial Government**

* **Injection of purposeful, integrated production components for profitability and sustainability**

* **Emphasize on improved postharvest handling**
    - **establishment of Postharvest Technology and Food Processing Centre**

* **Supporting the private sector combined with increased private sector aggressiveness**

* **Achieving horticultural development through agro-enterprises**

<u>Driving Forces</u>

The are two "driving forces" that will be key to implementing a strategy for horticultural growth in the Province:

Marketing Associations--Not a new concept, but one which is essential if the smaller grower is to begin integrating the horticultural production, postharvest handling and marketing functions. Through such an association a group of growers can identify the market opportunities and benefit from directly marketing their own produce. The association must be managed by a professional marketing manager and the farmer-owners must establish a structure whereby they oversee the entire process to ensure efficient management and the absence of corruption.

Agribusiness Groups--This second "driving force" is particularly important for building the fresh export component of the industry. The group is comprised of existing or potential commercial, private sector producers, exporters, importers, distributors, retailers, processors, manufacturers, input suppliers and commercial estates. Typically, they are characterized by a high degree of business management expertise, complemented by specific technical capabilities, and they have a sound financial base. Very important, is their aggressiveness in striving for growth, diversification and improved financial performance. These are the types of companies that can design, implement and operate an export oriented horticultural project and their participation is essential for the development of Uva Province's fresh export business.

Agro-Enterprise Opportunities

There are agro-enterprise opportunities existing in Uva Province that have the potential for commercial viability and profitability. Private sector should be encouraged to investigate these opportunities as they may be the basis for industry growth and involvement of the private sector in that growth process.

* **High Quality Potato Seed Stock Production Facility**
* **Containerized Seedling Production Facility**
* **Integrated Horticultural Production and Marketing Enterprises**
* **Packing House and Cold Storage for Fresh Fruits and Vegetables**
* **Juicing and Canning Facility for Fruits and Vegetables**
* **Small and Intermediate Size Fruit and Vegetable Dehydration Facility**
* **Large Pineapple Farm and Processing Factory**
* **Ornamentals - Live Plants and Cut Foliage**
* **Rose Production Project**
* **Packaging Supplier, Box Broker**
* **Spice and Other Minor Export Crops**

Actions for the Future

Strategy implementation will require actions from the Provincial Government, from the Central Government, from the donor community and from the private sector. Combined with the actions must be effective communication and coordination. Priority issues are the expansion of agribusiness, markets and marketing, erratic product flow, produces losses, insects and disease, and water.

Private sector actions need to focus on identifying enterprise opportunities, on properly planning and implementing those selected for development, on establishing marketing associations, on increasing the emphasis given to marketing and market-based decision making, on improving production scheduling and techniques, on expanding contract growing, on introducing improved handling procedures and systems, on assembling resistant varieties and control material for insect and disease management and on improving water management.

The rate of growth of the horticultural industry in Uva Province and in Sri Lanka as a whole will be significantly influenced by whether or not the public sector undertakes needed interventions. These interventions will need to relate to the collection and dissemination of market information, to production and postharvest handling research and training, to plant material availability, to water management, to infrastructural development and to investment incentives.

There are important donor community actions needed. These relate to funding assistance for the introduction of new technology, for constructing regional and central markets, for helping to establish a Postharvest Technology Center, for expanding the germplasm base and for funding hydrologic surveys and irrigation development.

What Does All of This Mean To The Small Farmer?

It is important not to loose sight of the small farmer in the process of developing the horticultural sector. The strategy suggests that the strong commercial farmers, the aggressive farmer groups and the agribusiness community are going to be the keys to building the industry. It emphasizes improvement of the overall system, integrating the production, postharvest handling and marketing functions. Involvement in and benefit from this process must not be out of the reach of the small growers in Uva Province.

As the industry grows and improves the small farmers will likely have increased opportunities for contract growing. They should benefit from improved infrastructure, greater competition and transparency in the marketing channels. The introduction of improved technology and improved production and postharvest handling practices could be just as significant to their operations as to the larger commercial enterprises. The farmer can benefit from the increased availability of improved seeds and seedlings and from the introduction of new varieties of fruits and vegetables. As linkages between quality and price are strengthened and as the consumption of fruits and vegetables increases due to improved system efficiency and increased income levels, the opportunities for the small grower should also improve, raising income levels and standard of living.

1. INTRODUCTION

The Statement of Development Directions which serves as a guide for the medium term development of Uva Province stresses the acceleration of the economic growth rate by building on existing advantages, by expanding non-farm activities in the rural areas and by enhancing the environment for increased private sector involvement in the growth process.

A major goal is to build a sustainable agro-industrial base in the Province. The strategy for achieving this is based on:

- increased emphasis on alternative farming
- introduction of market oriented agriculture, and
- introduction of export oriented agriculture

An integral part of this strategy is the development of the horticulture sector in Uva Province. This development must focus on the horticultural system which is comprised of production, postharvest and marketing functions. Integration of these functions leads to control and efficiency which results in sustainability and profitability.
The achievement of integration is complicated by many issues such as limited land availability, infrastructural constraints, many small producers, high produce losses, a lack of market based decision making, unfamiliarity with export market requirements and so on. But this integration and improvement of the system can be achieved and with it will hopefully come increased farm income and an improved way of life.

Consistent with these directions and strategies the Chief Minister has placed priority on strengthening and stimulating the growth of the horticultural industry in Uva Province through the private sector. In doing this he has sought the assistance of USAID to assess the existing horticulture sector and to offer recommendations for alleviating identified constraints and to then formulate an overall strategy for sector development. In addition, he has requested help in identifying specific agro-enterprise opportunities in the province that may provide the basis for stimulating private sector involvement.

The Diversified Agriculture Research Project (DARP) was identified as the most appropriate channel to provide this kind of assistance to Uva Province. DARP was designed before the devolution of authority to the Provinces took place. Therefore participation of the Provincial Governments in the Project was not written into official documents. However, the support shown for this kind of activity by the Department of Agriculture and United States Agency for International Development indicates the desire of public officials directing the Project to adapt to the new realities and policies of the country. Development Alternatives, Inc. the technical contractor for the DARP project, was pleased to provide a team of advisors to assist with this effort.

2. DESCRIPTION OF UVA PROVINCE

2.1 GENERAL

Uva Province is located in the southeastern part of Sri Lanka as depicted in Figure 2-1. Total land area is 8,500 square kilometres which makes it the fourth largest in Sri Lanka in terms of size. The province is divided into two districts, Badulla and Monaragala, with respective land areas of 2861 and 5639 square kilometres.

There are a total of 23 divisional secretaries divisions in the Province, 14 of which are in Badulla District and 9 in Monaragala. Figure 2-2 presents an organizational diagram of the Provincial Government.

2.2 POPULATION, EDUCATION AND LABOUR FORCE

2.2.1 Population

As of 1990, the total population of the province exceeded 1 million inhabitants with seventy percent residing in Badulla District and the remaining thirty percent in Monaragala District.

2.2.2 Education

The estimated literacy rate for Uva Province is 78 percent compared with 87 percent for the country as a whole.

2.2.3 Labour Force

The most current data available regarding labour force and unemployment is from the Department of Census and Statistics for the year 1986. According to this information, there is a labour force of approximately 294,000 individuals in Badulla District and approximately 118,000 in Monaragala District. The same information indicates a rate of unemployment in both Districts of 8.6 percent of the total.

2.3 AGRICULTURE AND AGRO-ECOLOGICAL REGIONS

2.3.1 Agriculture

Agriculture is the economic base of the Province. It consists mainly of paddy cultivation, plantation crops, highland crops and vegetables, minor export crops, livestock and forestry. Information provided from the Provincial Planning Department indicates that there are 25 major irrigation schemes resulting in approximately 13,000

FIGURE 2-1 LOCATION MAP, UVA PROVINCE

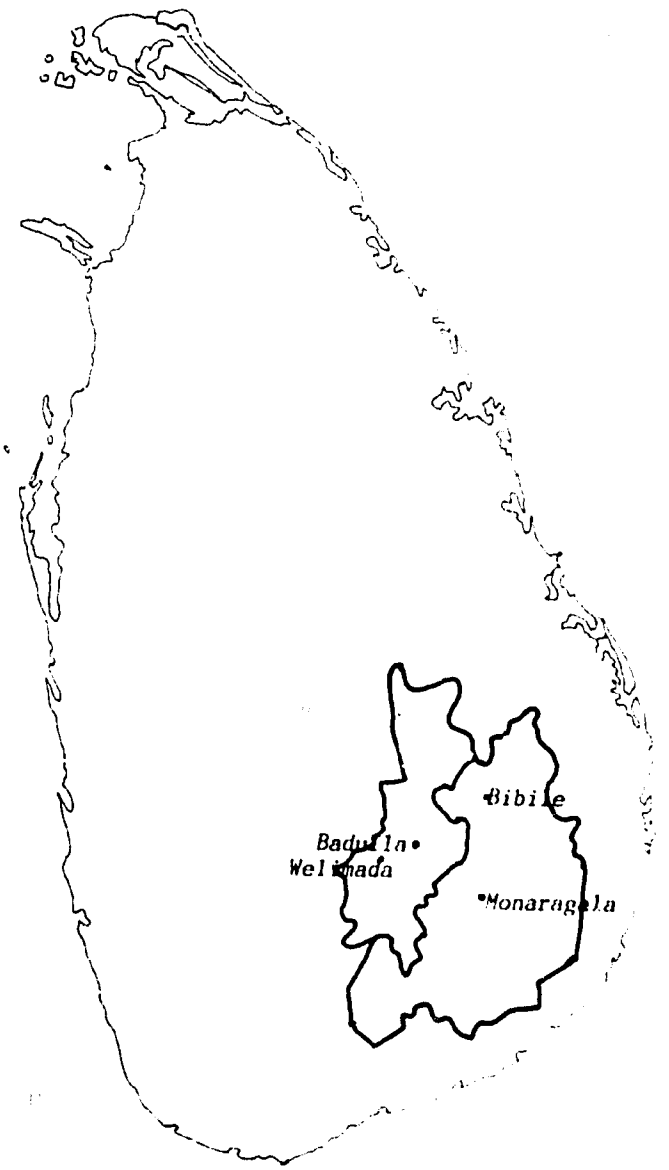
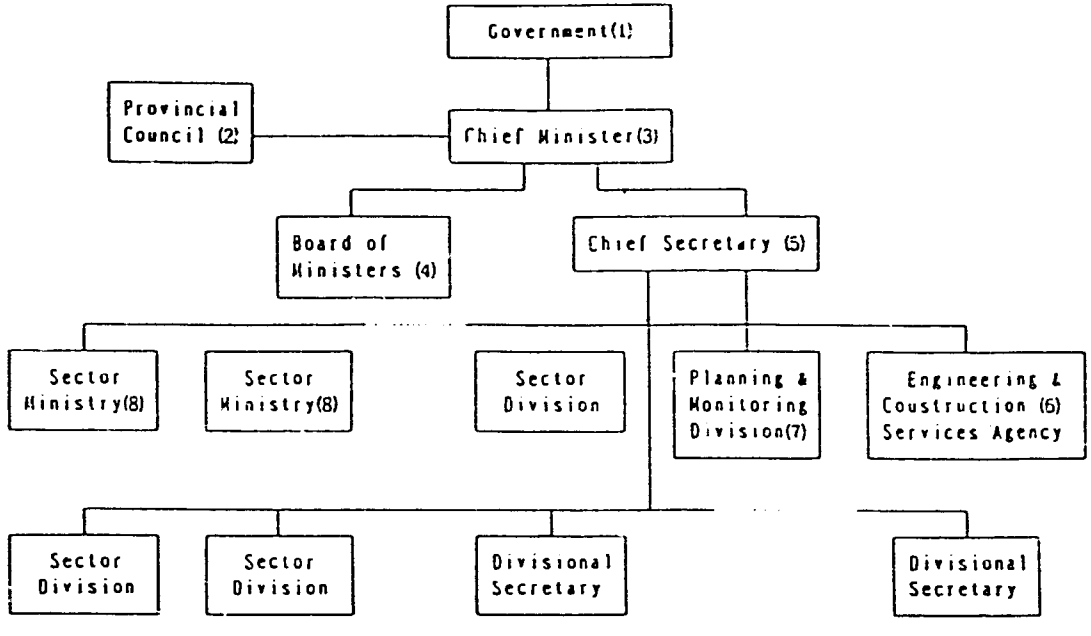


Figure 2-2 Provincial Government Organization



hectares of irrigable land and 19 minor irrigation schemes resulting in an additional 6,000 hectares. Nearly all of the tea land is located in Badulla District and occupies approximately 35,000 hectares. There are 147 tea factories in the District employing 187,000 individuals. About the same amount of land is under sugar cultivation in Monaragala District. In 1991 there were in excess of 200,000 agricultural workers in Uva.

2.3.2 Agro-Ecological Regions

Uva Province is an interesting mixture of 7 agro-ecological zones of which 21.5% are in the uplands, 16.5% are in the middle elevations and 62% are lowlands. Classified by rainfall 6% is considered wet, 66.5% has intermediate levels of rainfall and 27.5% are dry zone. The two districts are markedly different; Badulla District has 10% of its land in the wet zone,85% intermediate rainfall and only 5% dry zone. Monaragala District has 50% of its land in the dry zone, only 2% wet and the remaining 48% enjoys intermediate levels of rainfall. The unique elevation and rainfall relationships provide suitable environments for a wide range of fruit and vegetable crops.

The Province has two monsoon seasons in the year which are responsible for the rainfall. The rains coming from the southwest direction bring the "small" rains from April to September which are called Yala Season rains. The major rains fall during October to March coming from the northeast direction and are called the Maha Season rains, as Maha means big in Sinhalese.

In general, the rainy seasons dictate the cropping pattern as most of the horticultural production in the Province is rainfed, which makes the Maha the pivotal moisture source. In the highlands during Maha vegetables are heavily planted while in the lowlands in Maha rice predominates. During Yala vegetables may be grown in both highland and lowland areas in an effort to capitalize on residual soil moisture left from the Maha period.

The Badulla District has only 5% of its land receiving less than 40 inches of rainfall per year, 37% gets between 45-47 inches and the remainder receives more than 50 inches. The Monaragala District has 50% receiving less than 40 inches of rainfall, 47% get 43 to 47 inches and only 3% above 55 inches.

Total rainfall is of less importance to horticultural production than distribution. How many months have too much rainfall, too little or none determine what crops would be suitable if dependent on rainfall and how they could be managed. The concept of rainfall dependent agriculture (Response Farming) gears all practices to the level of rainfall expected. With supplementary irrigation dry zones actually produce horticultural crops easier than the wet or intermediate rainfall areas. In the dry zone, if furrow, basin or drip irrigation is used there is much less disease incidence because the leaves seldom get wet.

The term used to express deficit rainfall periods is "Below Agriculturally Effective Rainfall" or for short the BAER rating. When less than 4 inches (102 mm) falls in a given month, it is biologically ineffective, as evaporation exceeds water use and loss by the plant.

This brief text table compares the two Districts as follows:(1 inch= 25.4 mm)

Badulla District				Monaragala District			
Zone	% of District	Inches	BAER Months	Zone	% of District	Inches	BAER Months.
WU 3	10	63	1	WM 3	2	63	2
IU 2	8	63	4	IM 1	1	55	5
IU 3	25	50	4	IM 2	3	47	6
IM 1	15	55	5	IL 1	14	43	7
IM 2	12	47	6	IL 2	30	45	7
IL 2	25	45	7	DL 2	50	38	7
DL 1	5	38	7	-	-	-	-
TOTAL OR AVERAGE	100%	51.6	4.8		100%	48.6	5.6

Many crops can survive long periods of drought, but survival is not enough if you are trying to develop sustainable and profitable horticultural enterprises. For many crops, supplementary irrigation is mandatory if a steady supply of high quality raw products is intended for the demanding domestic or export market.

Table 2-1 and 2-2 in Appendix A provide more comprehensive rainfall and temperature information about the districts, for those who desire greater detail. A sectional map showing areas in the different agro-ecological zones is presented as Figure 2-3 in Appendix A.

The terrain has great influence on temperature. Some of the high attitude uplands reach 6000 feet, such as in nearby Nuwara Eliya, and that area and some adjacent areas in Uva Province experience some winter frost. In the Badulla District only 8% is classified mountainous, steeply dissected, but 52% is termed hilly, rolling and steep. The upland wet (10%) zone is rolling and the lowland dry is undulating but only covers 5% of the District. The lowland intermediate zone is classified as rolling, hilly and undulating and makes up the remaining 25%.

The Monaragala District is in generally less rugged than its Badulla sister. Only about 6% of this District is considered rolling, hilly and steep, the remainder(94%) ranges from rolling hilly and undulating which comprises 30%, to undulating only which is 50% and the remaining 14% which is rolling undulating and flat.

The terrain also determines much of the soil mantle supporting plant life and how well it holds moisture because of its structure and composition. The top soil in the upland region (43%) of the Badulla are reddish yellow podzols which are comprised of sandy loam soils exhibiting moderately rapid water infiltration and moderate to well drained conditions. The remaining 57% of the district are covered with the reddish brown earths made up of clay loam, sandy loam and sandy clays ranging in colour from reddish brown to greyish brown. These top soils suffer slower water infiltration and moderate to poor drainage. The sub-soils of Badulla have a range of sandy clay, gravelly loam and sandy loam. The soil depth in the uplands range from 6 to 8 feet; whereas, the mid elevations and lowlands are only 3 to 6 feet in depth.

In the Monaragala District, in which 94% are in the lowlands two major soil groups predominate. The combination of low humic gley with reddish brown earths in the low dry zone are composed of sandy clay, clay,and some sandy loam soils which make for poor drainage and slow infiltration but moderate water availability. The intermediate low zones IL-1 and IL-2 are quite different as the IL-1 is classified as red-yellow podzol-low humic gley; whereas, the IL2 has a significant layer of red yellow sand (regosol) beneath giving it excessive drainage. The low humic gley component adds to the poor drainage and slow infiltration of this 14% of the District.

For certain crops such as the cucurbits (cucumber squash, melon) family and the solanaceous (tomato, pepper, eggplant) family which respond favourably to high soil aeration, the well drained IL-2 region of the Monaragala given effective supplementary irrigation should be highly productive for these important vegetables.

Tables 2-3 and 2-4 in Appendix A were prepared for those who may be interested in further details about the soils and soil moisture characteristics of the Badulla and Monaragala Districts.

2.4 INDUSTRY

Approximately seventy five percent of the industries are located in Badulla District. Many of these businesses are for the manufacturing of food and beverages such as grain mill and bakery products and for the manufacturing of furniture and fixtures. The only large scale manufacturing industries are the two sugar factories in Monaragala District. There are plans to establish up to 38 garment factories in the Province. To date five have already begun operation.

2.5 INFRASTRUCTURE

There are a total of 2700 telephone subscribers in the Province of which nearly 90 percent are in Badulla District. Census data of 1981 reveal that only 10 percent of households in Badulla District have electricity and only 4 percent in Monaragala District.

3. EXISTING HORTICULTURE INDUSTRY IN UVA PROVINCE

3.1 PRODUCTION

3.1.1 Extent and Value

The province is one of the most important regions on the Island for commercial vegetable production. There are nine vegetables produced in Uva Province which supply a major portion of the national supply, seven of moderate importance and nine important but of lesser significance. In addition to 25 commercial vegetables there are 5 commercially important fruit crops. To appreciate this diverse horticultural area one needs to be reminded that these are produced in seven or more agro-ecological zones in two distinctly different seasons and two different Districts each with unique soil and terrain characteristics.

A brief look at the distribution and importance of this array of Uva food crops by District and season may be of interest.

FOOD CROP	BADULLA DISTRICT MAHA	BADULLA DISTRICT YALA	MONARAGALA DISTRICT MAHA	MONARAGALA DISTRICT YALA
COMMERCIALLY MOST IMPORTANT CROPS				
ASH PLANTAIN	MAJ	MAJ	MAJ	MAJ
BEANS, GREEN	MAJ	MAJ	MIN	MIN
BRINJAL	MAJ	MAJ	MAJ	MAJ
CABBAGE	MAJ	MAJ	MIN	MIN
KNOL KOHL	MAJ	MAJ	MIN	MIN
POTATO	MAJ	MAJ	NEG	NEG
PUMPKIN, RED	MAJ	MAJ	MAJ	MAJ
TOMATO	MAJ	MAJ	MAJ	MOD
MAIZE	MAJ	MIN	MAJ	MIN
COMMERCIALLY MODERATELY IMPORTANT CROPS				
BEET ROOT	MOD	MOD	MIN	MIN
BITTER GOURD	MOD	MOD	MOD	MOD
CAPSICUM	MOD	MOD	MOD	MOD
CARROT	MOD	MOD	NEG	NEG
CHILLIES	MOD	MOD	MAJ	MOD
RADISH	MOD	MOD	MIN	MIN
SWEET POTATO	MOD	NEG	MOD	MOB
COMMERCIALLY LESS IMPORTANT CROPS				
CASSAVA	MIN	MIN	MOD	MOD
COWPEA	MIN	MIN	MAJ	MAJ
CUCUMBER	MIN	MIN	MIN	MIN

GINGELLY	NEG	NEG	MAJ	MAJ
GROUND NUT	MIN	MIN	MAJ	MAJ
BIG ONION	MIN	MOD	MOD	MAJ
RED ONION	MIN	MIN	MOD	MOD
SNAKE GOURD	MIN	MIN	MIN	MIN
SOYBEAN	MIN	MIN	MIN	MIN

FRUIT CROPS	BADULLA	MONARAGALA
MANGO	MODERATE	MAJOR
PASSIONFRUIT	MINOR	MINOR
PINEAPPLE	MINOR	MAJOR
BANANAS	MAJOR	MODERATE
LIME, ORANGE	MAJOR	MODERATE

MAJ = MAJOR, MOD=MODERATE, MIN=MINOR, NEG = NEGLIGIBLE

For those who may be interested in the recorded area planted, production in metric tons per hectare and yield achieved in the two Districts (detail is presented in Table 3-i, of Appendix B).

A comprehensive listing of the tonnage produced and farm gate value received from the agricultural crops program in Uva Province is presented in Table 3-2 of the Appendix B. It was found that the effort of the two Districts produced nearly 200,000 metric tons of these diversified crops at a farm-gate value of 2.3 billion rupees. (US Dollars 53 million).

The farm-gate value is only one measure of an agricultural output. From records recorded at the Kandy and Colombo markets show that the price received by the farmer in Sri Lanka can be as low as 21% of the retail price. A rather typical tracking of price revealed that if the farmer received 6 Rs/kg for a product that this was released at wholesale for Rs.8 and then the price leaped to Rs.15 per kg at retail!

If one were to consider the elaborated worth of the Uva Crop agriculture it would be approximately as follows: (in US Dollars).

Farm-gate Value	$ 53,000,000
Wholesale Value	$ 71,000,000
Retail Value	$ 133,000,000

The output becomes more impressive at the magnified or elaborated levels but what is really important is what income generated is felt by Uva Province and its hard working farmers. The accelerators and the multipliers associated with agriculture (such as trucking, containers, agricultural chemicals, seed sales, etc.) magnify the value even further and reflect significantly in additional income and employment.

It may be of interest to know what crops are planted in each agroecological zone of each District. This comprehensive information is presented in Tables 3-3 and 3-4 in Appendix B.

3.1.2 Farm size

Most of the fruit and vegetable production in Uva Province is done on small farms. The denominator of size is referred to as the perch, of which 140 of these constitute an acre or 311 square feet. Approximately 85% of the vegetable production in Badulla District occurs on holdings of 100-200 perches which translates into 0.71 to 1.42 % of an acre.

The average size land holding in Badulla District is 1.7 acres, the average size holding in Monaragala District is 2.9 acres. Rice of course, is the pivotal crop in both seasons: unless a farmer has access to irrigation during the Yala Season, fewer vegetables and more drought tolerant field crops are produced.

The upland vegetable grower was very well characterized in an excellent report by Hettige and Senanayake, 1992. They found that the typical vegetable grower in the Bandarawela, Welimada and Haputale area had a family size of 5.1 persons, an average education beyond primary, and average age below 45 years. Single owner, full time growers dominated.

3.1.3 Quality of Farmer

The Sri Lanka Council for Agricultural Research Policy should be commended for their innovative study of the Bandarawela vegetable grower. This report shows that adoption rates of recommended production practices exceeded 80%. This indicates superior farmers, the results of an effective research and information delivery system, and an accessible supply base. It was interesting to note that adoption rates were lowest in the agricultural chemical based recommendations. The cost of production continues to increase, but when farmers cut back on inputs, yield and quality usually suffer, further aggravating the cost-price problem.

3.1.4 Yield Comparisons

The yields of farm crops are usually reported as total product per unit of land or period of time, but in horticultural crops the total yield may be less important than marketable yield. The marketable yield is that which is saleable and this too varies according to the utilization. In the export market, in which large shipping expense is added, only near perfect fruits and vegetables should start on the journey. If the product is for processing in which minor blemishes or imperfections may be removed the amount saleable would be different than the level of acceptance by the head chef buying vegetables for a salad at a five star hotel.

Marketable yields usually range about 80 to 85% of total yields. This means that the fruits and vegetables at harvest were marketable; the quality maintained from that point forward depends on the level of postharvest handling care until it reaches the consumer.

The average yield of crops is interesting and valuable as a measure of comparison to some standard, whether it be some theoretical yield, a national average or to compare production efficiencies between competing areas. Table 3-5 of Appendix B presents the yield range of Sri Lankan crops. A brief assessment of Badulla and Monaragala District yield comparisons with the national average is shown in the following table for selected crops:

VEGETABLE CROP	AREA OF PRODUCTION	SEASON MAHA	SEASON YALA
		(in Metric Tonnes)	
BEANS, GREEN	BADULLA	4.3	5.2
	MONARAGALA	4.5	4.7
	NATION	5.4	4.9
BRINJAL	BADULLA	7.3	8.8
	MONARAGALA	9.4	8.3
	NATION	6.9	7.1
CABBAGE	BADULLA	18.0	18.3
	MONARAGALA	10.0	5.2
	NATION	15.7	12.3
POTATO	BADULLA	10.7	14.0
	MONARAGALA	-	
	NATION	11.4	12.3
TOMATO	BADULLA	8.6	8.8
	MONARAGALA	6.2	8.9
	NATION	6.9	7.3

A scan of the above comparison shows that the Uva production exceeded the national yields 7 instances out of 10. Sometimes it is useful to compare one country with another to see how their yields and other factors may offer competition to Sri Lanka, or to see how far off potential one may be from the highest average yield. A comparison of 19 different fruits and vegetables grown in Sri Lanka, Thailand, India, the Caribbean and the United States is presented in Table 3-6 in the Appendix B.

It may be noted that some regions excel in certain crops and yet fall short in others. For example the onion in India must be very happy with the soil, climate and cultural

practices there; whereas, tomatoes, bananas, eggplant, papaya and mango seem to perform better in the Caribbean than in Sri Lanka. The US yields must be high in order to survive the high cost of labour, land and capital; thus are highly dependent on technology, labour substitution, and loss control.

In summary, Sri Lankan yields are low in many instances, but considering the diverse rainfall patterns in which they are grown, the island farmers are quite effective. One very significant factor should be pointed out, that without effective soil moisture management sustained and profitable horticultural production is very difficult to achieve.

3.1.5 Relative Capital and Labour Requirements

The decision maker in horticulture needs to have a wide range of facts at his disposal; among the most important are labour and financial requirements of the enterprise. Fruit crops which do not begin bearing until 5 to 7 years after planting the grafted planting material, require a yearly labour input from start through the long years until harvest and return on the investment begins. Vegetable crops are often annuals, and may even be grown one or more times in a given calendar year so must be considered differently. The labour requirements presented in Table 3-7 of Appendix B show the wide range of needs from a low of 29 mandays per acre for gingelly to the high of 373 mandays for an acre of leeks.

Input costs, gross income and net income associated with a variety of Sri lanka fruits and vegetables were compiled for Table 3-8, Appendix B, on a hectare basis as reported by the Ministry of Agriculture. It is easy to see how fruit and vegetable production can appeal to the small farmer when one looks at the high net incomes possible, even after the rather high total cost of production is subtracted from the gross income generated. Compared to paddy net income, horticultural incomes may look fairly good, but one must realize that perishable crop incomes can be very cyclical especially in the annual crops like vegetables. Wide swings in supply often follow a year of high profit when many newcomers try to enter the competition.

3.1.6 Cost and Income Relationships Due to Seasonal Influence

The horticultural production associated with adequate to high rainfall is quite different from the production dependent on the residual soil moisture from the Maha period. Except for a few crops which are sensitive to high soil moisture (such as grain legumes) yields are usually less than in the Maha Season, but because of diminished supply during Yala net incomes may be better than Maha as shown in Tables 3-9 and 3-10 in Appendix B.

The growers who have their own irrigation capability can usually command higher prices during the dry season because of their greater control over both yield and quality.

The rainfed vegetable grower can improve his production by matching his size of plot, inputs and specialized culture to the water expected. This is referred to as "response farming" and has been proven throughout the world. It is better to have a highly productive 0.4 acre than a very weak full acre of most crops. Small is beautiful except when a storm destroys a crop area; then a half acre that escapes may be the only supply of capsicum or tomatoes in the District.

3.1.7 Climatic and Soil Preferences of Crops

Most of the fruits and vegetables grown in Uva Province have been established through long years of trial and error. Some of the fruit crops were planted long ago and may or may not have been of the best variety or available planting stock. One should not be confused with the survival characteristics of crops; survival may not be enough if one has to make a profitable living from horticultural production.

To make a sustainable, profitable income from horticultural production one has to use the most adaptable crop; most suited variety (market acceptance as well as field suitability); the most effective soil moisture, nutrients and pest management; and all of this in a business like manner.

Each crop has conditions in which it performs best. The cashew is adaptable to a wide range of rainfall levels but is only moderately tolerant of poor drainage; whereas, the durian is intolerant of poor drainage but requires at least 2000-3000mm of well distributed rainfall. One cannot put a square peg in a round hole; one must know the basic climatic and soil related preferences of the crops one plans to consider for an enterprise.

To assist Uva Province growers (or potential fruit and vegetable growers) in their crop selection two separate tables were prepared; one for fruit and nut crops and one for the major vegetables of the Province, Tables 3-11, 3-12, Appendix B.

3.2 POST HARVEST HANDLING

Postharvest handling techniques are very poor and are unsatisfactory in preserving the quality of fresh fruits and vegetables. This is especially true in the methods of handling from the fields to the wholesaler. At harvest, most crops are put into bags or sacks known as gunnies. These gunnies typically are filled to a weight of about 50 kilos which means that they are so heavy it is difficult to carry and handle them gently. The produce is packed tightly in the gunnies. The transport of horticultural crops from farm to market is the same in Uva Province as in the rest of Sri Lanka. Crops are harvested, placed along the roadside where they are picked up and loaded into trucks for transport to local collection stations or to the Colombo or Kandy wholesale markets. To reduce the unit cost of transport, the trucks are loaded as full

as possible. Almost no effort is made to prevent damage to the product being transported.

During transport in trucks to the markets, the gunnies are stacked one on top of another so that the produce supports all the weight and therefore is damaged. Most people estimate the damage to be 20 to 40 percent of the total crop. A few crops such as tomatoes and papayas are transported in wooden boxes so the boxes support the weight of the product. Some interest now is being shown in Sri Lanka in using plastic boxes which usually are known as field boxes. This is the preferred and recommended method of handling to protect the produce from damage. Any perishable crop that is destined for export must be carried in strong field boxes that prevent damage during transport and handling. If this is not done, fruits and vegetable will continue to be of low quality in both the domestic and export markets. Competing in the world market will be impossible. Uva Province does not have any major processing facilities for fruits and vegetables. There is no significant processing such as canning, juice extraction, dehydration, brining, fermentation or freezing. Nothing is done locally to grade, size and pack for the fresh export market.

One small company, Uva Spices, near Bandarawela processes and sells spices and herbs. It could be expanded moderatively if additional raw products and capital were available. One thing in favour is that this company has a reputation for producing good products. There are some agribusinesses in other Provinces that should be considered because they strongly effect decisions to build similar facilities in Uva Province. In Colombo, there are several fruit and vegetable processing factories that are important users of raw materials such as pineapples, passion fruits, mangoes, papayas, oranges, baby corn and tomatoes. These include:

1. Lanka Canneries Ltd.,

2. Kelani Valley Canneries Ltd.,

3. Delmege Forsyth & Co.Ltd.,

4. Pure Beverages Co.Ltd., (Kist Foods) and

5. Cold Stores (Elephant Brand).

These processing companies are important to Uva Province because they are either active or potential markets for horticultural crops. Some of them are modern, some are not. All are labour intensive.

In addition to fruit and vegetable processing, there is a packing house in Sri Lanka with cold storage rooms that began operations in June,1992. It is part of the System B Mahaweli Agriculture and Rural Development Project (MARD). It is located at

Medagama near Polonnaruwa about 120 kilometres northeast of Colombo. It is operated by TESS (Pvt) Ltd and is being used to pack and ship fruits and vegetables for export. Cantaloupe (muskmelons),baby corn and zuchinni are the first crops to be shipped. This packing house has a hydrocooler, a precooler room and two cold storage rooms. Grading, sizing and packing is done by hand and is labour intensive. The markets are Singapore, Hong Kong and Dubai as of this writing.

Another packing house similar to the one at Medagama is under construction at Timbolketiya in Sabaragamuwa Province about 160 kilometres south of Badulla. It is a project of Aitken Spence Agricultural Development Ltd., and is scheduled for completion in February 1993. The plan is to grow fruits and vegetables on land irrigated by the Uda Walawe Reservoir and to pack and export them. Crops will be bananas, cantaloupes (muskmelons), baby corn and beans. Outgrowers will be used.

These two packing houses are mentioned because there is some interest in Uva Province to build one like them. The primary interest is in the cold storage rooms. The above-mentioned packing houses are too far away from Badulla and other production areas of Uva Province to be used for routine packing and cold storage. However, they can be used for test purposes for Uva Crops.

The Department of Agriculture has training centres that can be used for many different purposes. Postharvest handling and marketing are not currently being taught in these centres but could be in the future. Also, there are facilities in or near Uva Province where simple processing methods such as making juice drinks and marmalade can be taught. Drying of fruits and vegetables can be taught in these same facilities. This type of training is very helpful in assisting young people in starting small agribusinesses. Some of this has been done in the Mahaweli Project System C.

3.3 MARKETS AND MARKETING

3.3.1 Markets

As mentioned in Section 3.1, the total estimated farmgate value of fruits and vegetables produced in Uva Province during 1991 was 2.3 billion rupees. This represents nearly one third of Sri Lanka's total farmgate value for fruits and vegetables which is estimated to be 7 billion rupees. Utilizing the assumptions described in Section 3.1, the total retail value of Sri Lanka's fruit and vegetable production can be placed at approximately 17.4 billion rupees (US$ 405 million) with Uva Province's retail value reaching 5.7 billion rupees (US$ 53 million).

There is not sufficient data available to determine the exact quantities and values of Uva Province fruits and vegetables going to the domestic and export markets. The estimated value of the fresh fruits and vegetables exported from Sri Lanka in 1991 is 285 million rupees. The value of processed product being exported for the same

year is 300 million rupees, resulting in total exports of 528 million rupees. In terms of total value of fruits and vegetables produced in Sri Lanka, this suggests that 1.6 percent of the total is exported as fresh produce and 1.7 percent is exported in processed form. One could assume that the same percentages of exports would characterize Uva Province suggesting that 97 percent of the fruit and vegetable production from the Province is going for the domestic market and the remaining 3 percent for the fresh and processed export markets.

Details regarding the value of fresh and processed fruit and vegetable exports from Sri Lanka, product description and major markets for the exports are presented in Tables 3-13 through 3-16 of Appendix B. More than half of the total fresh vegetable exports have been lumped into the category of other vegetables without a breakdown of individual crops. They would however likely include such crops as green chilli peppers, snakegourd, bittergourd, luffa, leafy vegetables, leeks and butternut squash. Another category of fresh export crops includes mannioc, sweet potatoes and similar high starch roots and tubers which represented approximately 11 percent of the total value of fresh vegetable exported during 1991. Pineapples, avocadoes, mangoes, mangosteens and guavas represent one third of the value of fresh fruits exported during 1991 which reached nearly 70 million rupees in value. Dried fruit and nut mixtures represented nearly 40 percent of this total value. More than half of the 300 million rupee stated value for processed exports for 1991 resulted from the export of gherkins in brine. Fruit juices and vegetables, fruits and nuts preserved in or prepared in vinegar together represented more than 30 percent of the total processed export value.

The major export markets for Sri Lanka are the Middle East and the Maldives. Table 3-17, Appendix B, presents details regarding the value of the major vegetable and fruits which were sent to these two markets during the year 1989. There is a small quantity of fruits and vegetables being exported to other countries including Singapore. The MARD project system B has been exporting melons to Singapore and have been sending trials shipments of baby sweet corn and table grapes. There are numerous markets being targeted for the gherkin exports including Europe and the United States.

In addition, information on exports of floricultural products and minor export agricultural crops has been included in Tables 3-18 and 3-19, Appendix B.

3.3.2 Marketing

There is a functioning system for the marketing of horticultural produce in Sri Lanka. The structure has an excessive number of "pieces", there are inefficiencies and there is a lack of transparency in many of the stages. However, this system has had to evolve in such a way as to deal with numerous factors which complicate the marketing process. The major markets are not located near the primary vegetable growing areas. Most produce goes into Colombo with a significant portion coming back out to other major city markets. Nearly all vegetable growers have very small holdings with very

small amounts of produce. There are erratic product flow and a weak production base. Farmers have no means of transporting their produce to market and they often require financing of inputs. There are heavy postharvest handling losses, typically in the range of 30 to 40 percent.

There are several marketing channels being used by the growers in Uva Province. Many farmers send their produce directly to Colombo wholesalers, through transport agents. Some wholesalers are based in local towns and collect the produce directly from the farmer or through local brokers. There are also some wholesalers from other cities who have local agents in the production areas. Farmers have the option to take their produce to local producer fairs referred to as polas where wholesalers may buy directly or utilize local brokers. If possible, farmers will attempt to use more than one marketing channel. In many cases, long-standing relationships have developed between growers and wholesalers often where the wholesaler will advance credit for production inputs and for other personal and family needs. These various marketing channels have been described in an excellent study entitled "Highland Vegetable Production and Marketing Systems authored by S.T. Hettige and S.M.P. Senanayake.

The Colombo wholesale market which is referred to as the Manning Market is an extremely congested and unsanitary market. It is very overcrowded and according to Hettige and Senanayake there are more than 500 wholesale and 1300 retail stalls. The controlling authority for the market is the Manning Market United Traders Union. The Colombo Municipal Council levies a monthly rent for each stall.

There is little transparency regarding the pricing structure as the produce moves from the farmer to the consumer. Many farmers that were interviewed believe that they are being exploited by the wholesale dealers. Wholesalers are suppose to receive a 10 percent commission based on securing the highest possible price for the supplier. However, exploitation is believed to relate to incorrect weighing, to over estimates of spoiled and damaged produce and to under estimation of prices obtained. Farmers do seem to receive current market price information from Colombo through truckers and other means, but their distance from Colombo results in little control over these areas of supposed exploitation. Many farmers also believe that similar exploitation is done by the brokers or middle men who mediate between the farmer and the buyer and who often collect commissions from both sides. Although it cannot be confirmed, Hettige and Senanayake suggest that the buyers seem to continue maintaining their profit margins even in times of abundant supply when high consumer prices cannot be maintained by simply paying the producer a lower price.

Because of the distance between the production areas and the markets, truck transportation is an essential element in the system. At present, lorries are loaded as full as possible to maximize profit for each trip. This often results in overloading and considerable damage to produce. Observations of trucks being loaded with produce destined for Colombo revealed significant mis-handling of the produce, very tight stacking with little protection from damage while in transit. Tomatoes were being transported in wooden boxes, but they had been constructed of very rough wood material which caused considerable abrasion to the tomato skin during transit.

There is also a functioning export marketing system in Sri Lanka. The system is based upon private sector exporters which total in excess of 100 registered companies, although the majority of produce is handled by less than 10 of the total number (Experience, Inc., 1990). As previously indicated, the major export markets for Sri Lankan horticultural products are the Middle East and the Maldives. Much of the Middle East export produce targets the Sri Lankans, Indians and Pakistanis who are living and working in these countries. India is a major competitor in this region. The Maldives produce is targeted primarily for the tourist market.

The exporters interviewed indicated that they secure their product through several means. There are some direct arrangements with growers, such as for pineapple. Another example is the contract outgrower scheme being used by the gherkin processor/exporters. They typically provide the outgrowers with technical assistance and input credit and have a guaranteed buy back arrangement. In other cases, the exporters purchase their requirements from wholesalers, brokers and, in some cases, directly from the growers. The exporters complain of erratic product supply, lack of uniformity and quality and damaged produce.

The exporters indicate interest in looking at other markets especially for higher value fresh produce. However, they do not seem to have familiarity with these markets. They have not determined which crops offer the greatest opportunities. They are not aware of the supply demand situation nor of the competition. They do not seem familiar with the market requirements in terms of quality standards, presentation and packaging requirements. They do not seem to know nor have contacts with the major buyers in these market places. Exporters do not seem to always understand the importance of consistency and reliability of both quality and quantity of supply. They recognize the need to overcome production and postharvest handling problems to achieve the required standards, but do not seem willing to do much about correcting the deficiencies and aggressively going after such markets.

There is some export market information available through the Export Development Board. It was indicated that they subscribe to the ITC Market News Service, although limited funds necessitate the mail subscription rate which results in the information being two weeks old upon arrival. In addition, the export marketing specialist for the MARD/MDS Project, H. Harmon, has completed several comprehensive market reports for the Middle East and Asia. There are numerous market intelligence reports that have been prepared under the Mahaweli Enterprise Development Projects (MED).

There is very limited air cargo space available to many of the key potential export marketplaces, particularly to Europe. The situation is somewhat better for air shipment to the Middle East. There is frequent service for ocean shipping with sufficient refrigerated containers available. The small volumes will require special attention to techniques required for shipping of mixed loads.

4. CONSTRAINTS

The strengthening of the horticultural sector in Uva Province is dependent upon identifying and alleviating the major constraints impacting on the functions which comprise the total horticultural system--production, postharvest handling and marketing. There are a total of 16 constraints that have been determined to be of particular significance to the sector's present performance and to the strength of its future development.

4.1 INCREASING PREVALENCE OF VIRUS AND BACTERIAL DISEASES

The gradual build-up of pathogenic bacteria in the soil has been increasing in the vegetable production areas because of limited opportunity for crop rotation; accent on the solanaceous crops (tomato, pepper, eggplant and potato); and highly expensive chemical control methods. The main soil pathogen causing vascular wilt of these crops is a bacterium in the Pseudomonas group. The organism spreads rapidly in soil moisture, crop residue and splashing rain.

The increasing presence of unusual leaf yellowing and deforming symptoms is due to an insect borne virus. As farmers used stronger and stronger pesticides to control insects they killed off many useful as well as harmful organisms. Twenty or thirty years ago the main vectors of viruses (leaf hoppers, white flies and aphids) were only minor pests which were kept in check by natural enemies. As these natural balances were disturbed the minor insects become major players in the virus disease picture. The control of these virus bearing vectors or carriers is difficult, expensive and frustrating. In many parts of the world the viruses (of the Gemini Group) are so difficult to manage that growers must practice long term, expensive insect control programs or crop abandonment. If the virus is inoculated into the crop when it is small, a deformed and discoloured plant develops, thus curtailing profitable production.

4.2 INADEQUATE WATER MANAGEMENT FOR YEAR ROUND PRODUCTION

Long term profitable fruit and vegetable production is not possible without effective soil moisture management. Most fruits and vegetables are composed of 80 to 97% water, so even slight deficits are associated with uneven growth, reduced yields and poor quality products. Uniformity of supply and consistently acceptable quality require control over the crops growth and development and water is the keystone of this process.

Small growers may or may not be able to control soil moisture as well as properly equipped, larger operators, but both can use proper field drainage, water conservation measures and ways to extend the soil water availability. A larger operator with a tractor and sub-soil chisel can provide better sub soil moisture drainage than a small grower with hand tools.

4.3 INADEQUATE TECHNICAL ASSISTANCE THROUGHOUT THE SYSTEM (PRODUCTION, POST-HARVEST HANDLING AND MARKETING)

Throughout the world, both small and large farmers have felt the gradual contraction and partial withdrawal of public agricultural information support. Actually the information source has not really decreased, but it has changed form and has resorted to more of a mass media approach. Governments are being asked to provide more and more services, (usually more than the public wishes to pay for) so priority setting may have taken the friendly, knowledgeable extension agents away from their weekly farm visits and commandeered them into broader responsibility, away from farmer visibility.

There is a need to have more information of a technical nature about equipment and supplies that are used in handling fruits and vegetables. For example, a person who wants to make a detailed feasibility study or to draw up plans for a factory to make juices, jams and canned products has no way of talking to a local supplier of equipment. To design a factory, detailed information is needed about the type of equipment to select, functions performed by specialized machinery, materials used in constructing machinery, prices of machinery, and competitive features of similar machinery. The market for machinery does not exist in Sri Lanka so suppliers do not have sales representatives come here. Even catalogues for machinery are difficult to find.

There is limited market information available to the smaller grower. This lack of information relates to price, to quantity of produce on the market, and to the extent of hectarage under production for various crops. A similar information situation exists for the fresh and processed export markets. Little marketing assistance is available at either level.

4.4 INADEQUATE MECHANISM FOR PROCUREMENT OF APPROPRIATE PLANTING MATERIAL

In the days of providing a self sufficient food base for the nation, the selection of the appropriate or best shipping mango, grape or bean was not very critical. Many of the fruit trees in Sri Lanka are from seeds or from planting stock of untried productivity or even trueness to name. As the nation moved more and more into commercial agriculture the need for highest yielding, highest quality and highest uniformity of product became apparent. This has created a great need for certified potato seed, certified citrus, mango (and a host of other fruit and nut) rooted, grafted planting materials.

4.5 SMALL SIZE OF HOLDINGS AND LIMITED ACCESSIBILITY

Most of the farms in Uva Province are 2 acres or less which contributes to highly fragmented production and assembly of fruits and vegetables. In the Badulla District

60% of the terrain is hilly, mountainous dissected steeply and rolling. In the Monaragala District 94% of the land is rolling, hilly and undulating.

Access roads to many of the production areas, are winding, narrow and steep in grade. In many of the production fields the harvested produce must be carried by back-lift or shoulder-carry up several hundred feet of narrow path to reach a tarmac road to await assembly for truck transport. The produce may be out in the hot sun or rain for several hours before the transport arrives.

4.6 FAILURE OF FARMER TO UNDERSTAND THE BUSINESS ASPECTS OF FARMING

It is the very nature of the perishable fruit and vegetable industry to experience wide fluctuations in availability, quality and quantity. Vegetables being annuals for the most part, allow farmers to get in and out of production rather quickly. Tree fruit growers have a long term investment and investment recovery usually doesn't start for about 4 to 6 years after planting the grafted young trees.

A farmer may see that a neighbour who is growing a new type of brinjal or cabbage makes quite a handsome profit from his crop and allows him to put a new roof on his house. The next year neighbours on both sides of the Farmer will be growing the new brinjal and the market may experience an over supply and prices drop accordingly. If the Farmer stays into the production a next year, he may find that he is the only remaining producer and thus makes more profit again. Many farmers lack understanding of the business side of farming and are hampered in their decision making process.

The small vegetable growers interviewed did not have a record keeping system. They did seem to know what their input costs were, but generally did not put a cost on the family labour. The farmer's concern was not on calculating whether he would make a profit on a particular crop, but rather it was on whether he would have sufficient cash in hand from selling his crop to pay ever pressing family expenses.

4.7 HIGH PRODUCE LOSSES

Most of the damage and resultant losses to fruits and vegetables occurs during transport from the field to either the market or a processing facility. It is generally estimated that postharvest losses range between 30 to 40 percent of the production. Such high losses result from a combination of factors. Most of the production is transported in gunnies which offer no protection. The bags typically weigh in excess of 50 kilograms which make them too heavy for proper handling. Wooden crates are used for tomatoes, but the roughness of the wood still causes excessive skin abrasion during transport. Lorries are paid on the basis of weight which results in overloading and resultant damage to perishable produce. There is no understanding nor concern

regarding handling of produce by the labourers loading or off-loading the lorries. There appears to be little effort made to keep the produce in the shade. Losses are further aggravated by delays in pick-up. All along the handling chain there are no consequences for mishandling and damaged produce.

4.8 ERRATIC PRODUCT FLOW

The occasional over-production of fruits and vegetables is a worldwide problem and it is always painful to the grower who has invested time and money in a crop only to find that the supply exceeds demand and the price is too low to even get his costs back. The resulting oversupply causes problems for the farmer, the shipper, wholesalers, who provide to the retailers, exporters and processor.

If a few farmers make above average returns on a crop during the year,you can almost be sure that an over-supply the following year can be predicted. This natural cycle is due to economic stimulation. Among other causes are concentrated harvest of crops (caused by unusual weather conditions) and those large increases brought about by big shifts in cultivar, cultural methods or pest pressure.

4.9 HESITANCY OF AGRIBUSINESSES TO UTILIZE CONTRACT GROWERS FOR PRODUCTION

Contract growing is the practice of a farmer entering into a contract to produce crops for an agribusiness. By doing this, both parties know what to expect for acreage, approximate total production, dates of harvest, and prices. Quality also can be described in a contract. By doing this, both the farmer and agribusiness can plan their future operations and budgets to assist in decisions both parties must make. Some contract growing is done in Sri lanka for produce destined for the fresh export market and for the food processing market. Apparently, most contract agreements are verbal and seldom in written form. Many examples were cited where agreements were not honoured by one or both parties. The legal and enforcement framework does not seem to be in place for contract growing arrangements.

4.10 POOR CORRELATION BETWEEN QUALITY AND PRICE OF PRODUCE

The present horticultural system in Uva Province, and for that matter in Sri Lanka, does not convey a strong correlation between price and quality. There is some awareness of quality differences by the producers, marketers and consumers, but the system does not provide any incentive for the farmer to strive for highest quality nor for those individuals involved in the marketing channel to strive to maintain that quality. Of equal significance, the system does not have any consequences if the quality standards are not achieved nor maintained.

4.11 UNAVAILABILITY OF POST-HARVEST HANDLING TECHNOLOGY

There is a definite need for postharvest handling technology in Sri Lanka. In the past, studies have been made of this needs. Several reports starting in 1986, have recommended the establishing of a "Postharvest Technology Unit" to provide this information. None of the recommendations were implemented, so the lack of information is hindering progress in handling and processing fruits and vegetables.

4.12 POOR INFRASTRUCTURE

There are many vegetable growing areas in Uva Province that have limited accessibility. This creates difficulties for the farmers to get their produce to the collection or pick-up points and it also increases the possibility of produce damage during handling and transporting. There are areas in the Province having no electricity supply nor potable water. A reliable supply of both is critical to the processing industry if their unit operating costs are to competitive. Equally essential to the future growth of the horticultural industry are reliable communication systems. Integrated horticultural operations, particularly those exporting fresh produce, must be able to have instantaneous and consistently reliable communication with both international and local markets, transporters and suppliers. Operational losses can be staggering simply as a result of not being able to complete a telephone call or transmit a fax message.

4.13 LACK OF MARKET BASED DECISION MAKING AND LACK OF EMPHASIS ON THE MARKETING FUNCTIONS

Much of the agricultural production in most countries, such as Sri Lanka, is based more on tradition and last season's price than on planned, market driven guidance. It is for this reason that ill-suited varieties may be grown, poor timing of planting and harvest and poor quality products enter the market system. It is difficult for small farmers to obtain the information they need to make the vital decisions relating to what, when, how, where and how much to plant and requirements for the market. To have a profitable and sustainable horticultural industry, market oriented decision making must prevail.

The absence of integration of the production, postharvest handling and marketing functions results in the producer not understanding the importance of the marketing function and, secondly, it increases his or her frustration in not being able to control or influence any part of the marketing process.

4.14 LACK OF FARMER INVOLVEMENT IN THE MARKETING SYSTEM

The majority of horticultural producers do not market their own produce and rely upon one or more of the existing marketing channels. Farmers do seem to use more than one channel in an effort to secure the highest possible price. However, their

market influence and flexibility are limited due to small volume of produce, lack of storage facilities, lack of own transport, limited finances, insufficient market information and lack of experience and contacts in the marketing of produce.

4.15 OVER-DEPENDENCE ON CONGESTED CENTRAL MARKET AND FRAGMENTED MARKETING SYSTEM

The Colombo Central Market, normally referred to as Manning Market, is the primary clearing house for fresh fruits and vegetables produced in Sri Lanka. It is a highly congested, overcrowed and unsanitary market.

The marketing system is highly fragmented and there is little transparency in the pricing structure. There is widespread opinion that exploitation of the grower is common in most of the marketing channels.

4.16 LACK OF CONSUMER APPRECIATION FOR THE IMPORTANCE OF FRUITS AND VEGETABLES TO HUMAN NUTRITION

Sri Lanka ranks in the lower fourth among South Asian nations in both protein and total calorie consumption. Fruit and vegetable consumption in Sri Lanka has declined from 13% of the household expenditure in 1953, to 10.7% in 1970 and to 8% in 1982. Fruit and vegetable retail prices have increased markedly during the past 7 years. The children of Sri Lanka reflect the decreased vitamin A and C, protein and caloric intake. Recent studies show that almost 40% of the Islands' children are considered stunted as compared to the height of well fed Sri Lankan children of the same age.

The decrease in fresh fruit and vegetable consumption robs the citizens of mans cheapest source of vitamins, minerals, edible fibres and plant proteins; robs the farmers of a tremendous market opportunity; and depresses income and employment levels in the rural sector.

5. A STRATEGY FOR DEVELOPING THE HORTICULTURAL SECTOR

There is potential for growth in the horticultural industry in Uva Province. Achievement of such growth would of course be much easier if there were some magical crop that could be introduced or some particularly unique competitive advantage that could be enjoyed by Sri Lanka. The truth is there is not such a crop to be recommended nor such a unique advantage to be offered. Most horticultural crops are already being grown in Uva and those remaining have likely been under research. What is revealed from the constraints presented in the previous chapter is that the production function, the postharvest handling function and the marketing function, which together comprise the horticultural system, are not operating effectively as individual functions, nor are they operating effectively as a total system. Herein lies the strategy for strengthening the horticultural sector--improve the system.

At present, there is little attention being given to the marketing function. There is very little market based decision making. There is unfamiliarity with the fresh export markets. There are price abuses in the local marketing channels. There are excessive postharvest handling losses. Production units are not operated as businesses. All of these together are going to have to be overcome if Sri Lanka is going to be competitive in the fresh and processed export markets, if Sri Lanka's consumption level of fruits and vegetables is going to reach even the world's average, if Sri Lanka's small vegetable grower is to remain in business.

Horticulture must be approached as an agribusiness requiring both profitability and sustainability. The two necessary "driving forces" behind the agribusiness approach are marketing associations and private sector commercial firms. There must be cooperation between public and private sectors. There must be a willingness to accept that private sector can be allowed to earn a reasonable profit on an enterprise operation. There must be government interventions to support the private sector in the horticulture sector. There must be increased aggressiveness from private sector in identifying potential agro-enterprises, in determining technical and economic feasibility, in planning, implementing and operating those that are determined to be viable.

5.1 ELEMENTS OF THE STRATEGY

Following are specific elements of the strategy suggested to Uva Province for use in achieving horticultural development through agribusiness.

5.1.1 Improving the System

The horticultural system is comprised of a production function, a postharvest handling function and a marketing function. The system is specific to the target market which can be categorized as either domestic fresh, domestic processed, export processed

or export fresh. There are some enterprise characteristics that are common regardless of which market category is being targeted. An enterprise must build a firm production base, it must achieve maximum productivity at minimum costs, the product must get to the market with minimal losses and at the lowest possible costs and there must be a reputation established for quality and reliability of supply. On the other hand, each market category has a specific set of system requirements. An enterprise producing tomatoes for the domestic processed market must grow a variety of tomato that has been developed for processing and not for the fresh market. A project targeting the fresh export market must be designed and operated to exceed the market requirements in terms of quality, product type, uniformity and consistency of supply. The production scheduling must be based on market windows. There must be strict adherence to rules regarding pesticide use.

The integration of the production, postharvest handling and marketing functions maximizes the control of the parameters that comprise the process of producing a product and getting it to the consumer. This control is the basis for achieving profitability and sustainability. At present, most of the vegetable growers in Sri Lanka are not in control of the marketing of their produce and are reliant upon the existing marketing channels. As a result, there are many farmers expressing frustration with the low farmgate prices and the lack of control that they have on the prices received. Most local processors are not in control of their raw material requirements. There are cases where the processors are purchasing supply from the Central Market, a situation making profitability of operation unlikely.

It is important to note that horticultural specialization and integration of production, postharvest handling and marketing requires a high degree of management with both technical and business skills. It takes familiarity with the marketplace, daily access to market information, crop reporting data, reliable communication, financial resources sufficient to absorb the "ups and downs" that characterize the horticulture business. Commercial viability depends on being able to identify a situation and to immediately respond it.

The system's overall performance is only as good as the performance of each function comprising the system. In turn, the performance of each function will not achieve lasting performance if the overall system is not performing properly.

3.1.2 Long-term Development Requiring Realistic Goals

A most important element of the strategy is the realization that the development of the horticultural industry is a long-term process. Realistic goals must be established, particularly for the fresh export market. It will take time to get the system functions up to the level required for the fresh export market. The reality is that there will be very few enterprises that will become competitive in this market. As such, it would not be prudent for the Province to encourage all small farmers to grow for the fresh

export market. This policy could lead to dis-illusionment for the small grower since much of his or her produce will not likely be up to export standards at first.

Nevertheless, striving to enter the fresh export market is an important element of the strategy as it offers the potential profitability required to interest the private sector. Its quality and efficiency standards will upgrade the systems targeting the other three market categories.

5.1.3 Appreciation of the Domestic Market

The strategy must stress the importance of the large domestic market that exists in Sri Lanka. Seventeen million people is not a small market and it will continue to grow. Granted, the disposable income of a large portion of that population is low and the prices of fruits and vegetables are high. However, with time it would be expected that income levels will increase as a result of development efforts. Also, as the horticultural system improves there should be greater available quantities of fruits and vegetables, more efficiently produced and marketed, which together should result in prices more attainable by those having lower income.

The domestic market also has an increasingly important sector of middle to higher income Sri Lankans who are demanding a higher quality product and who are willing to pay a higher price for that quality. In future, this sector should continue to grow.

Another important element of the strategy related to the domestic market is import substitution. Many of the crops currently being imported into Sri Lanka, such as chillies and garlic, will grow well in Uva Province and their cultivation should be encouraged.

5.1.4 Appreciation of the Export Market

There must be a very real appreciation and understanding of the export market by anyone that is contemplating entry. There is very keen competition and the standards are high. Sri Lanka does not enjoy any particular competitive advantage that will set them apart from most others competitors. Certainly, the process must begin with those market opportunities for which Sri Lanka can be most competitive, but success will be dependent upon total familiarity with the selected market and then developing a system that can consistently meet or exceed their standards and requirements.

Familiarity must include size of market, present and likely competition, preferences for type of products, cultivars and quality, prices during different times of the year and from different sources, distribution channels and marketing structures, handling, packaging and storage requirements, terms of trade, import tariffs, phytosanitary requirements and, very important, market trends.

5.1.5 Building on the Existing Advantages

The decision to strengthen the horticultural industry in Uva Province is indeed appropriate as it offers numerous advantages for horticultural production.

There is variation in topography and related soil-temperature regimes which make it possible to locate an area suitable for growing most any type of fruit or vegetable.

There is a well established group of very skilled commercial vegetable growers in the province successfully producing horticultural crops.

There is the commitment from the Provincial Government to stimulate the growth of this sector.

The strategy must then build on these advantages.

5.1.6 Injection of Purposeful, Integrated Production Components

The strategy must provide for controlled production. Every factor which affects the growing process of a fruit or vegetable must be controlled to the extent possible. This includes water, soil fertility, quality and uniformity of seedlings, seedbed preparation, date, rate and depth of planting, insect, disease and weed control. This is the growing of crops under minimum stress which results in predictability. The crop is harvested per the planned schedule with the required uniformity and at the estimated level of production. Predictability is the basis for profitability and sustainability.

Controlled production must be preceded by market based decisions regarding crop selection and production scheduling. The selected crops must be grown in those areas of the province having the most ideal growing conditions. It is important to realize that the commercial production of vegetables should only be encouraged where there is water control during both the wet and dry seasons.

At present, many of the vegetable farmers in Uva Province are growing too many different crops. There are many cases where vegetables are being grown in poorly suited sites. An example is tomatoes which are frequently grown in the upper regions of the province where it is cooler and wetter. These conditions greatly increase the incidence of disease.

There are many examples in the Province where excessive fertilizer is being applied rather than managing for the most economical rates. There are many examples where farmers are practising preventive pest management which often results in excessive use of chemicals, both expensive and potentially damaging to the environment.

5.1.7 Emphasizing Improved Postharvest Handling

At present, there are very high postharvest handling losses in the horticultural sector throughout Sri Lanka. Estimates range from 30 to 40 percent loss.

A beginning step towards loss reduction is an increased awareness and emphasis on improved handling of horticultural products. The correlation between quality and price must be strengthened. There needs to be creation of a system of incentives and consequences related to produce handling. For the system to be effective it must be "tied to one's pocket book".

The use of plastic field containers must be expanded. The concept of a shade chain must be introduced as it is can benefit even the smallest vegetable grower and doesn't require heavy investment. With the development of the fresh export sector will come the requirement for a cold chain system. The level of investment is high, but necessary if an enterprise is to be competitive in the market place.

Also important for this element of the strategy is the establishment of both a Postharvest Handling Technology Information Centre and a Food Technology Centre.

5.1.8 Support to Private Sector Combined With Increased Private Sector Leadership and Aggressiveness

Development of the horticultural sector in Uva Province must be lead by the private sector. The fresh export sector is in its infancy and those firms leading its development will be required to "pioneer" many of the steps in the building process. The majority of the risk and responsibility will rest with these firms. As such it is important that strong cooperation exists between the public and private sectors. It is essential that there are government and donor agency interventions. These will need to relate to infrastructural development, investment incentives, research and training, regulatory functions, facilitation of technology transfer and improved access to appropriate financial instruments.

It will, however, be those in the private sector who will have to identify the opportunities, who will have to become familiar with the market, who will have to determine and make the decision regarding potential profitability versus risk and who will then have to design and implement the project.

5.1.9 Achieving Horticultural Development Through Agro-Enterprises

The basis for achieving horticultural development in Uva is through the concept of an agro-enterprise. Horticultural projects must be undertaken as a business. There must be profitability. This requires the integration, the control and the efficiency of a properly designed and operated agro-enterprise.

5.2 KEYS TO STRATEGY IMPLEMENTATION

The are two "driving forces" that will be key to implementing the recommended strategy.

5.2.1 Marketing Associations

Marketing associations are essential for the small vegetable growers to begin integrating the horticultural production, postharvest handling and marketing sub-systems. The concept is for a group of commercial horticultural growers to form their own marketing association, the purpose of which is to directly market the produce grown by the farmer owners. The objective is to have the growers benefit from retaining a portion of the money currently being channelled-off to the marketing middlemen. There would be a professional marketing manager hired and charged with managing the marketing activities. It would be the responsibility of the manager to identify the market opportunities, to determine the most beneficial contractual arrangements and to then manage the marketing transactions themselves.

There would be opportunities for both wholesale and retail level operations. Initial priority should be given to the domestic market with particular emphasis on that portion of the market demanding higher quality produce, such as supermarkets and hotels. As uniformity of quality and reliability of supply warrant, attention could be given to the fresh export market. The association's marketing manager must be an experienced marketing professional and must be well paid. The farmer owners must be directly involved in overseeing the entire process to ensure efficient management and the absence of corruption. There must be sufficient operational funding to enable such things as the leasing and perhaps eventual purchase of lorries for transport and the acquisition of proper packing containers in order to minimize postharvest losses.

In the beginning there will be a limited number of farmer organizations having the resources and ability to establish the type of marketing association described. Most will require facilitation, perhaps with operational credit, with organization and procedural issues and with the recruitment of a marketing manager. It will be important to begin the process with a dynamic group of growers who are committed to the concept and to making it successful. Their success will provide the encouragement and experience for further replication in the province and the country. With time there will be improved market opportunities for many of the smaller growers. Those producer groups not yet able to establish a marketing organization could begin by attempting to consolidate their production and to use the larger quantity to their advantage during transportation and marketing negotiations.

5.2.2 Agribusiness Groups

The second essential "driving force" in the development of the horticultural sector, in particular, for building the fresh export component is the agribusiness group. The term agribusiness is intended to imply existing or potential commercial, private sector companies that are involved in some business related to agriculture. These may include exporters, importers, distributors, retailers, processors, manufacturers, input suppliers and commercial estates. These agribusiness companies may be local, foreign and joint ventures. Typically, they are characterized by a high degree of business management expertise, complemented by specific technical capabilities. Generally, they have a sound financial base and are respected in their business dealings. Very important to this discussion is their aggressiveness in striving for growth, diversification and improved financial performance. These are the types of companies that can design, implement and operate an export oriented horticultural project and their participation is essential for the development of Uva Province's fresh export business.

There is already interest in Uva from several such firms. Investigations have included assessing the viability of utilizing the cold room and packing facilities located in System B of the Mahaweli Project for produce from Uva until such time as a similar facility could be economically viable in the Province itself. Further expansion of contract growing of gherkins is under consideration. These companies recognize the horticultural production potential in Uva Province. They recognize the importance of integrating the production, postharvest handling and marketing functions. They seem to recognize and understand the importance of having the knowledge of the market opportunities and requirements. They understand the importance of establishing a firm production base and the importance that contract growing will have on building that base. Certainly, their decisions will be dependent upon the results of their technical and economic analyses. Before any commercial venture will move forward there has to be a high degree of certainty that the operation will be profitable.

If the initial commercial horticultural schemes show profitability, there will be other agribusinesses coming to Uva Province; however, the business outcome of those "pioneering" companies will be critical to future development.

5.3 NEEDED PUBLIC SECTOR INTERVENTIONS

The growth rate of the horticultural industry in Uva Province and in Sri Lanka as a whole will be significantly influenced by whether or not the public sector undertakes needed interventions. These interventions relate to market information and marketing, to research and training, to technology information, to plant materials availability, to infrastructural development and to investment incentives.

5.3.1 Market Information

a) Improve availability of market intelligence; FAO has recently prepared a project document for UNDP funding and their possible involvement in implementation regarding marketing intelligence and food policy which could be very important and timely to this effort

b) Establish a crop reporting service utilizing the same infrastructure as for the market information system

c) Strengthen the export market information data bases to include general market data, characteristics and opportunities, supply/demand, consumer preferences, trade structure, importer requirements, competition, prices and promotion, market access, lists of importers, associations and relevant governmental bodies

5.3.2 Marketing

a) Establish a new Central Market and a system of Regional Markets

b) Develop a pilot program to test the suitability of an auction system

5.3.3 Research and Training

a) Priority on testing of bacterial wilt resistant varieties and on finding varieties resistant to virus complex

b) Coordination of spray program to clear production areas of host weeds of virus vectors

c) Varietal and cultivar testing of fruits and vegetables

d) Emphasis on shifting the role of extension officers to one of training, particularly, to the training of industry fieldsmen.

e) Provision of record keeping system and possibly forms for small farmers

f) Undertake studies to determine actual causes of produce loss; secondly, to determine if sorting in the field increases the farmer's income

g) Increase emphasis on education programs regarding the importance of fruits and vegetables to human nutrition and on promotion of drying and preserving techniques to increase year round availability of these products

5.3.4 Technology Information Centres

a) Establish Postharvest Technology Information Centre

b) Establish Food Technology Unit

5.3.5 Plant Material Availability

a) Improve availability of perennial planting material

b) Improve plant quarantine handling

5.3.6 Irrigation Development

a) Conduct hydrologic survey of Sri Lanka

b) Continued priority on development of irrigation schemes

c) Increased use of water retention devices and water harvesting techniques

5.3.7 Infrastructural Development

a) Continued priority on rural road construction program

b) Continued priority on electricity, water and communication distribution

5.3.8 Investment Incentives

a) Continue efforts to support and encourage private sectors involvement in the horticultural sector through provision of incentives related to concessionary financing, guarantees, exemption of import duties, promotional freight rates, release of exchange, tax incentives, and assistance for pioneering projects.

b) Improve communication between public and private sectors in order that each has a better understanding of one anothers needs, interests and capabilities.

5.4 WHAT DOES THE STRATEGY MEAN FOR THE SMALL FARMER?

It is important not to loose sight of the small farmer in the process of developing the horticultural sector. The strategy suggests that the strong commercial farmers, the aggressive farmer groups and the agribusiness community are going to be the keys to building the industry. It emphasizes improvement of the overall system, integrating the production, postharvest handling and marketing functions. Involvement in and

benefit from this process may seem out of the reach of most small growers in Uva Province. This is not the case.

As the industry grows and improves the small farmers will likely have increased opportunities for contract growing. They should benefit from improved infrastructure, greater competition and transparency in the marketing channels. The introduction of improved technology and improved production and postharvest handling practices could be just as significant to their operations as to the larger commercial enterprises. They can benefit from the increased availability of improved seeds and seedling and from the introduction of new varieties of fruits and vegetables. As linkages between quality and price are strengthened and as the consumption of fruits and vegetables increases due to improved system efficiency and increased income levels, the opportunities for the small grower should also improve raising income level and standard of living.

5.5 ACTIONS FOR THE FUTURE

To move from the desk where a strategy can be easily formulated to the field where it must be meaningfully implemented requires action from the Provincial Government, from the Central Government, from the donor community and from the private sector. Combined with the actions must be effective communication and coordination. The following matrix is not intended to depict a detailed action plan which is the next step needing to be undertaken. But it is offered as an indication of the types of actions and the priorities which will be important for inclusion in the plan. It is also presented to emphasize the need for action to be taken if there is going to be improvement in the horticultural system and if there is going to be growth of the horticultural sector in Uva Province and in Sri Lanka.

ACTIONS FOR THE FUTURE

Priority Issues	Private Sector Actions	Public Sector Actions	Donor Actions
Expansion of Agribusiness	- Identification of Opportunities - Pre-feasibility Investigations - Decision Making - Initiation of Feasibility Studies - Formulation of Financing Plan - Implementation and Operation	- Assistance on Collection and Dissemination of Market Information - Preparation of Export Profiles - Investment Incentives - Infrastructural Development	- Assistance on Feasibility Investigations - Introduction of Technology
Market and Marketing Issues	- Establishment of Marketing Associations - Increased Emphasis on Marketing Information and Functions - Market Based Decision Making	- Expand Market News Service - Create Crop Reporting Service - Establish Regional and Central Markets	- Funding Assistance on Regional and Central Markets
Erratic Product Flow	- Consolidation and Planning - Market Based Decision Making - Staggered Harvest Through Variety, Maturity, Seedling, Planting Dates - Increased Use of Storage and Dehydration Techniques - Contract Farming	- Research & Training on Production Planning and Scheduling and on Storage and Dehydration Techniques	- Technical Assistance
Produce Losses	- Use of Plastic of Field Boxes - Use of Shade Chain - Improved Handling - Introduction of Simple Grading System - Create a System of Incentive for Improved Handling - Establish Cold Chain When Warranted	- Research and Training on Improved Packing and Handling - Establishment of Postharvest Technology Centre - Facilitation of Cold Chain System	- Funding Assistance on Postharvest Technology Centre - Facilitation of Cold Chain System
Insects and Disease	- Production of Disease Free Seedlings - Assembly of Resistant Varieties - Assembly of Control Material	- Strengthen Germ Plasm Base - Research on Resistant Varieties - Coordinate Control of Host Weeds of Virus Vectors	- Funding Assistance on Germ Plasm Base
Water	- Use of Mulch - Improve Water Management - Supply of Irrigation Equipment	- Water Management Research - Construct Water Retention Structures - Introduce Water Harvesting Techniques	- Funding Assistance for Hydrologic Survey - Funding Assistance for Irrigation Development

6. RECOMMENDATIONS

The extent of improvement in the performance of the horticultural system and the rate and success of future growth will be dependent upon the effectiveness of measures taken to alleviate the major constraints confronting the industry. There are numerous actions that can be taken to transform constraints into opportunities. It will, however, take a concerted, cooperative effort between the public and private sectors. It will take foresight, initiative and tenacity from all parties involved.

6.1 CONTROL OF VIRUS AND BACTERIAL DISEASES

These two major constraints to the production of peppers, eggplant, potato and tomato in the Uva Province require strong corrective measures. In both cases the management procedures involve the grower, his or her neighbours, and research and extension (or company fieldsmen)personnel.

Bacterial diseases in the soil can endure many years in moist soil if host material is present. The cycle of pepper-tomato-eggplant-potato has to be broken by non-susceptible crops which may be in the bean, cabbage or okra category. This rotation is very difficult for a small farmer who has limited land and high need for cash income.

If rotation is not possible the farmer has an alternative called "solar pasteurization of soil". This is a non-chemical measure,and low in cost. After a plant row of moist soil is formed into a "bed" (6 inches high 16-18 inches wide) it should be covered with a sheet of 3 or 4 mil thickness clear polyethylene film and the edges and ends buried and covered tightly to insure a tight stretch of the film over the moist soil bed. If the process is done during the hot dry period and the sun beams down on the bed for at least 6-7 hours per day, the killing of weed seeds, fungal pathogens, soil bacteria and nematodes should be accomplished in 16 to 18 days. After the "cooking" period the TARP should be removed and stored for future use(which can be for 10-12 further applications). The cost per treatment is very little, the benefit is dramatic, and the technology can be readily adopted to small as well as medium size farms.

The solar soil treatment is not permanent but it does provide an alternative to costly chemical treatment and rotation. It may need to be done for each crop if the infection level is severe.

The supplementary practices of good drainage and use of resistant varieties should be used. Unfortunately the number of bacterial wilt resistant varieties of these important crops is very limited. A major research effort is being conducted world wide as bacterial wilt is of global importance. There are 5 known sources of resistance to BW in tomatoes and all need to be tested in global locations to help isolate germ plasm for use in Sri Lanka (and other tropical areas).

The virus problem is far more complex and difficult. Seedlings grown in a net house provide a pest free period of the first 6-10 weeks and their use should be encouraged. Host weeds of all three vectors (whiteflies, leaf-hoppers and aphids) should be cleared from production areas. This is very important and should be an area wide effort, one farmer alone who reduces weed hosts will make very little difference.

Insecticide applications should include egg killers, larval killers and adult killers, and seldom one material will do all three. This is expensive, so careful attention to coverage of lower (or underside) of leaves is most important. Oil sprays help to discourage whitefly egg laying and only approved agricultural oils should be used.

Over spraying(and spraying when not necessary) is wasteful and harmful. Growers should use simple daily crop scanning methods to determine the level of pest presence. Sometimes "no spraying" allows natural enemies to control pests better than expensive applications. Growers should not harvest crops too soon after pesticide application as poison levels may be present as the produce reaches the consumer. Each pesticide has a safe reentry time stated on the label. If high levels of residue are detected on exported produce the entire shipment can be rejected.

The research for varieties of these 4 crops which may have resistance to this virus complex (probably the Gemini Group)is also worldwide. This disease complex is crop limiting wherever these crops are grown so the research effort needs to be very strongly supported by the international community. Can Sri Lankan's be happy without tasty potatoes, tangy hot peppers mellow brinjals and colourful tomatoes?

6.2 WATER MANAGEMENT FOR YEAR ROUND PRODUCTION

Covering the soil with a mulch of rice straw, layers of paper or black polyethylene mulch helps to reduce surface evaporation; reduce erosion and compaction; improve soil aeration; provide a more uniform environment for roots and soil microorganisms and thus contributes to a more steady soil temperature, moisture and weed free environment.

Mulching prevents " rain splash" on the crop and protects fruit from contacting the soil, both of which help to reduce disease losses.Mulching can be used on vegetables, fruits and ornamental crops. Plastic film can be used for several seasons, organic mulches such as rice straw can be incorporated into the soil after the harvest of the crop thus enriching the soil and improving its water holding capacity.

Growers who attempt fruit and vegetable production during the dry season without some form of supplementary irrigation may risk their crop quality, quantity and profitability. It is not enough to have " crop survival" as profit depends on unit cost, yield, quality, price, timing and sometimes just plain luck.

Without proper soil moisture management the crop can be delayed, thus missing a profitable market period; or small in size which could reduce price received, or suffer severe growth cracks due to erratic water supply.

If a hydrologic survey were to be undertaken in Sri Lanka the potential for major irrigation schemes in the Monaragala District could be determined. If a large aquifer beneath the District (and lower Badulla) does not exist than the lowland intermediate and dry zones should only grow vegetables during Maha and situate fruit production near water sources. During the Yala, only dry season types of food and feed crops may be appropriate. The production of livestock feed from cassava, the millets and dry land legumes should be given serious consideration. Happy dryland production may be more profitable than low yields of high value fruits and vegetables.

" Response farming" and "minimum stress production" are practices being used to increase fruit and vegetable profitability. Response farming gears the entire production decision making process on what level of soil moisture is expected.

Long term rainfall records provide a fairly predictable level of expectancy. If this is a low figure than areas of production are reduced, fertilizer levels are reduced per plant, spacing is increased to minimize between plant completion, and mulching used whenever possible.

Minimum stress farming starts with a well balanced healthy transplant that would be ready to go into the field as early as the rainy season begins, to make best use of the available soil moisture. The newly transplanted seedling is usually provided adequate fertilizer, soil moisture and protection from wind, insects and diseases so that its growth and development is continuous and as close to ideal as possible.

Both of the above concepts could be applied to large and small fruit and vegetable production in Uva Province. The technology is low cost, available and simple; the rewards are usually well justified.

Government intervention is needed to help impound more of the water that falls abundantly during Maha and then washes down to the sea and is thus lost from sound agricultural use. Low cost dams could convert much of the rainless period into high productivity. The steeply dissected hills could provide gravity irrigation without dependence on power driven equipment.

Water harvesting could be practised by regions to enhance their ground water recharge. Ditches cut across slopes and filled with straw (or whatever) trap surface water, reduce erosion and provide major recharge to dug wells and horizontal wells.

6.3 TECHNICAL ASSISTANCE THROUGHOUT THE SYSTEM

To be sure that growers of fruits and vegetables are doing the best practices, using the desired varieties and planting at the desired times many contractors for specific crops have installed their own field staff to insure adequate raw product supply for their own use. In export production this may be very critical as raw product supply can make or break delivery contracts; business trust and confidence in the producing area; and level of profitability for the producer and seller.

A new role of Government extension officers is the training of the new cadre of personnel who interface with the farmer. The fertilizer salesman, the pesticide company man, or the cannery or exporter field staff need to know current and appropriate information about the crops production, post harvest and marketing requirements. In the USA this has become one of the most challenging new roles of Agricultural Extension and has helped the agribusiness world appreciate the need for valid technical information ancillary to their needs and it has helped University and Government Agricultural Works become more aware of the problems and opportunities in the enterprise arena.

In the future extension and company field personnel may have to utilize the Master Farmer approach to provide adequate coverage of needed technical information. Taiwan has brought this to a high level of effectiveness, for example one out of 5 farmers is selected for "Lead Farmer" training and he is expected to be ready to help his small group on a "soonest " basis. One out of 5 "Lead Farmers" is selected for "Master Farmer" training in which more advanced production, postharvest,and marketing training is provided. This level helps 25 farmers when needed. Problems that the Master Farmer cannot handle are directed to an Extension Officer. The system involves very little expense, provides some farmers with added prestige and helps the group to feel identification and pride. Worthy of consideration in Sri Lanka is this innovative approach to information delivery.

A good way to acquaint potential customers with products is to have periodic trade fairs or machinery expositions. For equipment for manufacturing or processing foods,a meeting about food technology is a central place to start. Manufacturers of equipment can be invited to attend and display their equipment used in processing foods. If Sri Lanka doesn't warrant a meeting only about food technology, meetings can be combined either here or in nearby countries. In March 1993 Thailand will host the 7th Asian International Packaging and Food Processing Show. This will be an excellent show for processors to learn more about modern equipment that Sri Lanka needs. An even better approach is to host meetings of this type in Sri Lanka. Government assistance would be necessary. In some developing countries, Japan International Cooperation Agency (JICA) has donated complete food technology laboratories including pilot plant equipment. Japanese equipment is used and it is staffed with Japanese technologists initially until local technologists are trained and become competent. The pilot plants

and equipment can be used by local entrepreneurs to develop food products and processes sufficient to build or improve their own businesses. When new equipment is needed for a processing factory, it is easy to decide on the proper equipment needed and to buy it from Japan. Sri Lanka needs a complete technical facility of this type for food technology for both fresh fruits and vegetables and for those that must be preserved by juicing, canning, etc. Machinery manufacturers send their salesmen to Sri Lanka only if there is a chance to make a profit. The Sri Lankan government can entice this kind of business by establishing special treatment, either temporary or permanent, that help the machinery supplier make a profit. This can be in the form of tax holidays, expediting through customs, or assisting a potential customer visit the manufacturer's facility. Another good way to acquire technical and operating information and training is to have the developing company send a trainee to a successful but similar company in a developed nation. The trainee should have a counterpart in the "training" company who supervises the training for a period of one to three months. Upon completion, both the trainee and counterpart would return to the developing country. Both would cooperate for a period of time in applying the best technical information and procedures to the developing company. Training courses, seminars and visits to on-going businesses should continue. The ASEAN Food Handling Bureau in Kuala Lumpur is very helpful. Also, their interests and capabilities are broad enough to cover many different types of businesses.

Recommendations related to marketing assistance have been presented in Section 6.13 and 6.14.

6.4 PROCUREMENT OF APPROPRIATE PLANTING MATERIAL

Highly skilled nursery workers are needed to produce pest free planting materials which are true to name, vigorous and reasonable in cost. This includes vegetable seedlings, nursery stock, grafted fruit tree stock and other planting materials. In general, much of the propagatable material will need to come from in-country sources often Government (Dept. of Agriculture) nursery but as demand increases private nurseries will become a major source.

The Plant Quarantine Division provides a list of vegetative materials which can be imported, as well as seed and potato seed allowed to enter Sri Lanka. In the case of potato seed which is imported, the growers feel that it is expensive and variable. The potato growers receive a range of sizes many of which are too big for the desired 28-45 mm diameter. Few growers cut large potatoes into seed as they feel rotting is likely.

An answer to greater uniformity of seed stock for potatoes is through the new technology of meristematic tip culture and TPS (True Potato Seeds). Both require several critical stages in which some careful monitoring is needed but once the small plantlets can be potted they can be transferred to the field for large scale increase.

Each young plantlet can produce from 15 to 20 uniform, small tubers for subsequent farmer grow out. These two technologies are a viable alternative to imported seed and promise to be cheaper, more uniform and more disease free.

With very simple facilities, a sound knowledge of potato seed production or customerized plant production very attractive enterprises could be developed in Sri Lanka, especially Uva Province which provides so much of the national vegetable supply. The nation will need these specialized inputs if it is to compete in export agriculture.

The vegetable seed industry has been given greater importation freedom during the past few years and availability of highly desirable hybrid (or open pollinated) varieties has improved. The time required to clear customs and seed health checking still needs to be speeded up and better holding conditions provided while awaiting clearance. All handlers of seed and vegetative materials must be aware of, and take part in, gentle handling, minimum compression, avoidance of high humidity, and short shelf life of many of the vegetable seeds and vegetative materials. Onion seed if allowed to get damp may cut its useful 1 year life to a few months. Bean seed dropped 2 meters can result in 50 to 60 % "bold heads" or seedlings that do not grow beyond cotyledon (seed leaf) expansion.

6.5 SIZE OF HOLDINGS AND ACCESSIBILITY

Very little can be done to alleviate accessibility or terrain constraints but farmers could make it easier by specializing in three or four crops instead of five or six; using labour saving devices to move produce up steep paths; and using smaller units of field boxes or bags for easier handling. In many cases, a rope and pulley could have been used to lift produce up a steep hill. If fields are highly restricted in how much crop rotation can be used, a semi-fixed incline ramp or grassy slope could be placed nearby these small fields to help eliminate long hauling problems up to the assembly point.

All products awaiting transport along to the highway should be shielded from the sun and rain, and protected from high winds which cause water loss of the fruits or vegetables. A convenient tree or shade from leafy branches is usually sufficient, but is often overlooked.

By specializing in 3 or 4 crops (which incidentally should be rotatable) the grower can develop labour saving as well as better production techniques to improve his unit cost situation. Fewer, better grown crops should help to provide higher quality, better yield and greater uniformity of product. Fewer crops should also make collection for transport more efficient.

There is a great deal of technology available concerning farm labour saving devices which are at the appropriate technology level. Korean farmers grow vegetables in

rugged terrain, too. They have devised a back frame that allows comfortable, gentle handling even while climbing steep slopes. Perhaps the Ministry of Agriculture Research Engineers could provide valuable advice on this high labour- high cost problem which relates to production and postharvest.

Simple wheeled carts are not used in Sri Lanka as much as they could be to alleviate back work. Carts could be manufactured by local metal workers using bicycle wheels or solid tires. Carts are not very useful on mountain paths but consolidation of products to be raised up to the road could then utilize carts to transport them to the collection point.

The Government is probably doing as much as its budgets will allow to improve roads and build more access roads, both of which should be encouraged.

6.6 BUSINESS ASPECTS OF FARMING

Farmers on small operations often do not even know if they have realized a true profit because of poor record keeping and lack of proper recognition of the value of their own labour (and that of their family)who made the production possible. Most farmers also fail to realize the magnification effect of inputs on yield, quality and uniformity.

Fruit and vegetable growers, especially small ones, seldom know how much they have invested in a kilogram of their product at the time of sale; therefore they seldom know whether a selling price is below their cost or above their cost in which a profit can be realized. In an effort to obtain "quick money" they may accept prices for below cost just to keep cash flowing into their farms.

Farmers of all sizes and types of enterprise should know how to keep basic farm records. They should keep track of their own labour, their family labour and labour hired. They usually know only how much the "out of pocket" costs were, such as fertilizer, seed, pesticides, and packing containers.

An example may be useful to show the type of inputs growers must be trained to use. Irrigated pole beans in Badulla in Yala 87 required 133 mandays to produce, out of which Rs.2,700/- were spent for non-family labour (59 hours) and 74 man days were family. The other input costs (fertilizer, pesticides,etc.,) totalled Rs.5208 per hectare. The crop yield of 2.63 MT\Acre sold at an average price of 6.6 Rs/kg for a gross profit of Rs. 17,451.

If the farmer subtracted only out of pocket costs from the 17,451 he would think he made a profit of 17,451 minus 7908 or Rs.9543. His labour and his family labour should be assigned a value at least the equivalent of hired labour. These 74 hours at Rs.46 per day were really worth Rs.3367. Thus the true profit would be 17,451 minus 11274 (5208 + 6066) or Rs.6176 per acre. The per kg cost of production was

Rs.4.3 which makes the given price attractive and fair. If the selling price received were Rs.3.6 per kg the farmer would know that he would be in the non profit zone and may wish to consider alternative markets.

Another common problem many farmers have with understanding gross and net profit is how input level usually relates to yield, quality and quantity. At the present time many vegetable growers in the Badulla District feel that input costs have increased more than their rise in price received. Actually both have increased significantly 1986-1991 but the greatest increase was in labour cost not in fertilizer, seed, and ag.chemicals.

When farmers feel that ag.chemicals and fertilizers are getting expensive they cut back on rates. This decrease in inputs usually results in lower yield, poorer quality and less uniform harvest. It would be much better to follow recommended rates on a smaller field if money is limiting. Many farmers do not realize that proper input levels don't cost, they pay.

To encourage better farm record keeping many governments provide simple farm record books to farmers. Private banks often do this and gain some meaningful advertising. Allied industry groups such as fertilizer, pesticide and equipment dealers often find this an attractive way to reach farmers and also show how inputs help profits.

6.7 REDUCING PRODUCE LOSSES

There needs to be an increased awareness and importance given to improved packing and handling techniques.

Emphasis needs to be given to creating a system of incentives and consequences related to one's pocket book for the transporting and handling of produce. Additional discussion regarding such a system is presented in Section 6.10.

An important recommendation for reducing produce losses is to transport the fresh fruit and vegetables in plastic "field boxes" especially designed for that purpose. These boxes stack when full so the contents are protected. When empty the boxes nest so they use only a minimum space in a lorry. Filled boxes weigh about 20 kilograms.

Produce losses could also be reduced by introducing some form of grading standards. These grading standards should be relatively simple for local use rather than the formal USDA or EEC standards.

Introduction of the "shade chain" concept is also recommended. This concept can be applied by even the smallest grower and requires very little investment. When the level of fresh export activity warrants, a packing house and cold chain facility will be required if quality of produce is to remain competitive in the international

market. A facility of this type already exists in System B of the Mahaweli Project. A similar facility is under construction by Aitken Spence at Timbolketiya in Sabaragamuwa Province. This is south of the Uda Walawe Reservoir.

A feasibility study should be made to determine the profitability of such a facility in Uva Province. The facility in the Mahaweli System B could serve as a model. A hydrocooler and three cold storage rooms should be included. The feasibility study should include the organizing and managing entity such as a private commercial group like Aitken -Spence. Another approach would be to have a USAID Project such as the MARD Project in System B serve as the central organization to coordinate all the various phases in production, processing and marketing.

6.8 IMPROVING PRODUCT FLOW

One of the most useful tools in preventing over supply under normal conditions is to let farmers know how much acreage is intended for planting by competing areas of the region, later information indicates how much acreage by crop has been planted and when such planting will be harvested and what supply may be expected. In the case of big onions in Sri Lanka an approximate raw product estimate can be prepared from per capita consumption per month which is approximately 1.5 lbs or 0.7 kg. If one knew the percentage of the island population which were of the age to consume onions, then one could make a fairly good estimate of monthly and yearly need. This could be translated into acreage need needs, harvest period, etc.

A workable projection could be used by planners who could signal production centres accordingly. Botswana, a small country in Africa uses this method very effectively to reduce devastating over-production periods which cause market glut and sadness.

A crop reporting service is vital to national planning. If warned, and a farmer still goes ahead with his plans he suffers the outcome at his own risk. Planning is an imperfect art for science, and cannot account for natural disasters that may alter supply and drive prices up almost immediately.

A significant problem in the Maha-Yala type of production is the short period in which non-irrigated crops can be planted to take advantage of the fall rains. This is further compounded by the small size of farm on which most vegetables are grown.

Many fruit trees were planted with little or no knowledge of their relative maturity. Early, mid season and late varieties are available for most fruit species but small plantings seldom use this information.

As the nation moves into export agriculture, well planned raw product supply becomes increasingly important. To insure planned delivery many concerns actually monitor production through well trained field representatives. Failure to provide a continual

supply of acceptable quantity and quality of raw product can cause cancellation of contracts or even penalty to the exporter who defaults on contracts.

The vegetable grower can "stagger" harvest periods by the use of different maturities of vegetables; different ages of seedlings, and thirdly, by different field sowing dates. The third alternative is quite limited to larger acreages, but the first two can be useful to small and large growers.

If a target market for fresh market tomatoes is 10 December - 25 February the grower would need to grow his own seedlings or place an order with a competent plant grower to ensure that has he healthy, well balanced 5 to 7 leaf plants with strong fibrous roots available at the times which will result in harvests peak every 10 days during the target period.

A trick in scheduling is to have a calendar in which all days starting from 1 January are numbered consecutively, through to December 31st being 365. As a short cut these numbered days are called NODA. NODA 194 is July 12, NODA 100 is April 9 etc. A table for this purpose is presented in the Table 6-1, Appendix C.

To illustrate this simple, low cost method let us assume that fall set tomatoes reach first harvest in about 75 - 80 days. The next assumption is that one would want to have five harvest peaks between 10 December to 25 January. It takes only 21 - 25 days to produce a seven leaf tomato seedling in the warm days of Spring but the period lengthens in the cooler longer days of Maha (or Fall).

Expressed in a brief text table the scheduling would be as follows:

TRANSPLANT PRODUCTION			FIELD SETTING PERIOD		DESIRED PEAK	
HARVEST DATE	NODA	DAYS 7 LEAF	NODA	DAYS SET HARVEST	TARGET DATES	PERIOD NO. OF DAYS
27 Aug	240	24-26	265	82	10 Dec	345-350
3 Sept	247	26-28	274	84	20 Dec	355-360
6 Sept	250	29-33	282	86	30 Dec	365-05
11 Sept	255	34-36	290	88	10 Jan	10-15
15 Sept	259	37-39	297	90	20 Jan	20-25

This system provides an orderly procession of activities but is not any more predictable than the weather during that period. With a plastic covered greenhouse you can shield the seedlings from rain and wind but dark, sunless days can slow seedling growth

and the plant grower must make program adjustments. Seedlings can be hurried along with extra nitrogen in the feeding solution, delayed with decreased phosphorus, temperature and watering.

Another method uses the young seedlings as an indicator to tell when the next sowing should be made to stagger harvests. Planting number one is allowed to reach first full leaf (2-3 cms long) before starting to plant number 2. When the second planting reaches this same stage (first full leaf 2-3 cm long) a third planting is made, meanwhile the 1st planting seedlings may be in the 4th leaf stage.

Some farmers plant early, mid-season and late varieties at the same time to stagger harvests; but this assumes that one has access to three maturities of a crop that are all accepted by the consumer, are high yielding and adaptable to the area.

An additional recommendation includes greatly increased emphasis on the use of storage and dehydration techniques.

6.9 CONTRACT GROWERS

The use of contract growing should be expanded. This will permit farmers, exporters and food processors to plan their business activities better. This should result in a more dependable and constant supply of raw products to the markets and processors at a predictable cost. The farmers also would know in advance what their income will be so they can plan accordingly. In total, this should increase business volumes and profits.

For any processing or export enterprise to be commercially viable it must have its own or control a production base that is sufficient to ensure operation at a break-even point. Ideally, this production base should be a central or nucleus farm totally managed and controlled by the enterprise. Additional product supply would then be acquired through use of outgrowers. There may be situations where the production base becomes more dependent on outgrowers due to restrictions on land availability for the central farm. In these cases especially, but also for all outgrower schemes, it is essential to exercise contractual arrangements to ensure that the required material is available per the planning schedule. Contracts require commitment from both sides and to be meaningful there must be a legal and enforcement framework put into place. Apparently, there are many cases in Sri Lanka where one or the other party has not honoured their contractual agreement. The acceptance and use of legally binding contracts supported with effective enforcement should relieve some hesitancy regarding use of contract growing. Equally important to relieving the hesitancy of the processors and exporters is for them to become more confident of their planning decisions. This is achieved through increased familiarity with their markets and competitors and through increased integration of the production, postharvest handling and marketing functions. Horticulture can be a profitable business, but it is a business with risks. Those in

the business or contemplating entry whose hesitancy related to such issues as contract growing are not alleviated through sound planning and implementation may want to consider another type of activity.

6.10 CORRELATION BETWEEN QUALITY AND PRICE OF PRODUCE

Establish local grades for horticultural crops destined for the local fresh market or for food processing. Even if there is no formal program of grading prior to getting to the market, just having some grade standards defined and occasionally used would lead to buyers differentiating between grades. The following grades are suggested:

1. Low/damaged grade
2. Medium grade
3. High grade
4. Full-ripe grade

Definitions of each are as follows:

1. Low/damaged grade

Consists of 85 percent that is below medium grade or is damaged. Is satisfactory for use in preparing meals for human consumption by cutting, cooking and seasoning.

2. Medium grade

Consists of 85 percent that is of average quality, is undamaged, and is satisfactory for human consumption by cutting,cooking and seasoning. Generally this is used in urban households.

3. High grade

Consists of 85 percent that is for above average quality, is undamaged and is satisfactory for human consumption by cutting, cooking and seasoning. Generally is used in elite trade such as export, hotels, institutions and tourist trade.

4. Full-ripe grade

Consists of medium grade or high grade of which 85 percent is full ripe and ready for consumption, is undamaged but is easily damaged and must be handled with care.

Creating an effective program of incentives and consequences related to striving for and maintaining quality is complicated by the absence of integration within the horticultural system. However, effectiveness can only be achieved if the incentives

and consequences result in money either coming into or going out of one's "pocket". Underlying all of this must be consumer understanding and acceptance that higher quality produce commands a higher market price. As the middle to higher income groups increase in size in Sri Lanka, this demand for and ability to pay for higher quality produce will also increase. What must then happen is that those producers, handlers and marketers of higher quality produce benefit from the higher prices paid by the consumer and for their efforts to bring that higher quality to the marketplace.

The majority of consumers in Sri Lanka are in lower income groups and are not able to pay higher prices for better quality fruits and vegetables. Striving for higher quality in the horticultural sector does not necessarily mean that fruits and vegetables are going to be further out of reach of the low income consumer. It means that in striving for this quality the efficiency of the production, postharvest handling and marketing of horticultural products will improve and should result in more product in the marketplace at reasonable prices.

6.11 POSTHARVEST HANDLING TECHNOLOGY

There is no quick and easy solution for this constraint. A previous report "Postharvest Needs Assessment for System B of the Mahaweli Irrigation Project in Sri Lanka" by Jack Ross and Joel Hamilton, dated July,1990 discusses recommendations. Those recommendations, which were to establish a postharvest technology unit in Sri Lanka, still are the preferred choices. A suggestion that would be inexpensive and easy to implement is to use information developed by the Association of Southeast Asian Nations (ASEAN) Food Handling Bureau in Kuala Lumpur, Malaysia. This organization has a computerized data base of postharvest technology that can be used in Sri Lanka. It is recommended that the Food Technology Department of the University of Peradeniya be given this responsibility and the necessary funding to pursue it.

6.12 INFRASTRUCTURE

The construction and improvement of roads should continue. Providing a dependable supply of electricity is important so that an emergency generator is not necessary for individual businesses. Potable water must be used in processing type businesses and the supply must be dependable.

Communications are absolutely essential and must include telephone, telefax and when appropriate, two-way radios. Communications are essential all through the production phase as well as the processing and marketing phases. For marketing, this includes both domestic and export marketing.

Public facilities must be available for farmers, businessmen, and government officials to hold meetings. These meetings could be for making business plans, dissemination of information,and training courses. The Province needs continuing support to

undertake effective infrastructure planning and implementation. Tools such as the Geographic Information System can be of assistance. Exposure of the planning staff to methods and experts in the planning field can be important. Establishment of a proper monitoring and evaluation unit could improve output. Physical infrastructural support to the Provincial staff could improve capacity.

6.13 MARKET BASED DECISION MAKING AND EMPHASIS ON THE MARKETING FUNCTIONS

It has been said that most farmers are good at growing,but poor at selling. In the past, marketing may have taken care of itself and the role of profit and loss was not as critical, nor was the market so demanding of a continual supply of high quality fruits and vegetables. This market sophistication can be expected to intensify in Sri Lanka, too, as living standards for the general population improve.

Marketing knowledge should be an intimate part of what the farmer does in production. The grower of cabbage must know what size of head sells best, what colour is desired, how many wrapper leaves should be left on the product, and when the demand is greatest and price best. If a farmer is targeting an early market he may want to plant on his lightest soils, if tonnage is the key to profit heavier soils are preferred.

Knowing what the market wants, how it is to be presented, how much may be needed and where it is to be marketed should be known before the crop is selected, variety determined and first seed sown. The more comprehensive this information the sounder the decision and the greater the chance of profit.

To assist farmers in their decision making the public sector (usually agriculture extension) usually holds farm meetings; generates field days, radio and TV programs; and prepares multi-level publications. Farmer organizations invite market personnel to discuss how and what makes a market successful. In Uva Province the trader is an importance source of market information., but one may question how comprehensive such information may be.

As export markets expand for Uva Province horticultural products, the need for closely linked production-postharvest-marketing operations will be increasingly critical. For example a tomato harvested for a local pola market may be picked hard ripe because it will presumably be consumed within a day or two. A tomato harvested for a domestic market 200-300 kilometers away that may have to go through the central market and then out to retail outlets may need to be picked when it is only pink in colour (which allows for 4-5 days to red ripen when the consumer uses it).

For export harvest maturity is quite critical. The time of harvest must be determined by the total time it takes to transport to the shipping point, holding period at point

of embarkation, time to transport to the place of sale and days from receiving point to consumers.

The picture can be further complicated if the product is not handled gently as injury causes accelerated ripening. If the product is kept too warm or too cold quality can be decreased. How the product is shipped with other products can make a big difference as immature fruit mixed with mature fruit can accelerate ripening and shorten shelf-life. Toxic fumes can cause serious disturbances in ripening, surface pitting and colouring of fruits and vegetables.

These details merely show the importance of knowing and using information to increase the chances for profit by the grower,shipper handles and marketer.

Export market information is difficult and often expensive to obtain. Usually only large organizations or government agencies have the manpower or means to find out what is wanted in Dubai, how produce should be packaged and cooled for Hong Kong, how many competing sources will have similar fruits or vegetables for the market window in Singapore, or would the sea shipment take too long and the mangoes would be too soft to sell when they get to London.

Global markets usually communicate through grade standards. A market in Tokyo may want two tons per week of sized papayas of uniform maturity from Sri Lanka during a five month period. Some markets use International Grade standards which give tolerances for defects, ranges of size and range of maturity. Many markets demand that all incoming produce be in new containers and even specify maximum and minimum weights they will accept.

To protect the grower and shipper an inspection of the departing shipment is made. This inspection states maturity condition and other important market features. A copy goes with the shipment, copies are retained by the shipper, inspector and usually the grower or grower organization.

When the shipment arrives at its destination another inspection is made referred to us as the receiving point inspection in contrast to the first or shipping point inspection. If the receiving point inspection shows that there was transport damage, this proof penalizes the transporter. If the quality is the same as shipping point quality the receiver accepts the load and the trip to the wholesale, retail or institutional buyer (hotels, etc.,) continues.

This entire chain needs to be understood by all involved in the export process, as success and profit depend on knowing and doing what is required.

Organization directly involved in the buying and selling of fruits and vegetables often conduct their own educational programs. In Western societies even the produce handlers

in the supermarkets are given training on how to care for fresh fruits and vegetables properly in order to extend their attractiveness, flavour and freshness as long as possible.

As Sri Lanka progresses into export horticulture a stronger appreciation of quality to higher price will develop. Until higher prices are rewarded for top quality, better harvesting and handling procedures may not be expected. Unfortunately high produce losses are merely passed on to consumers in higher prices; rather than correcting the problem, and the losses continue. Higher prices for the consumer reduces consumption and excludes many of the lower income buyers from this vital source of vitamins, minerals and digestible plant fibres.

The high schools, agricultural training centres and agricultural universities in most countries have not participated adequately in explaining the production -postharvest-market system, therefore; a trained supply of workers for the system is lacking. This must be remedied as soon as possible.

Agricultural extension and farmer training centres admit to shortfalls in their treatment of this vital area of information too.

Visits to markets by farmers, teachers and extension staff (professors, too!) would help to enlighten them; and handlers, shippers and exporters should be asked to give assistance in research planning and educational programs. Wholesalers and retailers should visit production areas to help them appreciate the farmers role.

Appreciation of the production-postharvest processing and marketing chain is needed, it is also good business for each element involved.

6.14 FARMER INVOLVEMENT IN THE MARKETING SYSTEM

To get farmers a bigger share of the wholesale price, consider farmer's associations set up specifically to market fruits and vegetables. A typical association could have those features:

a. Members consisting of farmers from a community in which crops common to all are grown(such as head cabbage, potatoes, green beans,tomatoes).

b. Number of Members can vary. A reasonable number to start with may be 20 to 40 members.

c. The main goal of the association should be to market the production of all members collectively to wholesalers and retailers. Any profits created after deducting operating costs should be returned to the members, so the association itself is a non-profit marketing organization controlled by its members.

d. A professional manager probably would be required to manage the association. The idea would be to retain enough of the price differential between farmer and wholesaler or retailer to more than pay for the cost of a manager. This so-called profit would be returned to the members to increase their share of the profits normally taken by collectors and other middlemen in the marketing chain.

e. Farmers need some cash immediately when their crops are harvested and sold. A satisfactory method of payment could be to pay them about half the expected final price immediately when the products leave the farm. The remaining payment can be put in a money pool (such as a weekly or monthly pool for head cabbage) and distributed to the farmer-members when the final price and costs are known.

f. The association should be made up of private sector members who establish a board of directors to appoint a manager. The board of directors should be responsible for the successful conduct of other association including book-keeping and accounting.

g. Certain decisions such as election of directors should be controlled by the members. This can be done by voting with each member having one vote regardless of his/her size of farm or influence.

h. Additional benefits can be attained with this type of non-profit marketing association by creating a purchasing service so the input requirements such as seed and fertilizer can be combined in large order to get lower purchase prices.

i. Some associations of this type have used the combined influence of the members to secure bank loans for operating capital.

j. This type of association should not be controlled or managed by the government. However, initial information for assistance is available from government organizations such as the Department of Cooperatives and from MARKFED, a cooperative marketing association.

k. The association should consider eventually owning and operating its own food processing facility.

Another important recommendation would be to eliminate import tariffs that penalize farmers and agro-business enterprises.

6.15 CENTRAL MARKET AND MARKETING SYSTEM

It is recommended that a new Central Market be established. Planning and discussions have been underway for sometime regarding the issue, but so far there seems to be little movement. It should be given a high priority. Secondly, it is recommended that a series of Regional Markets be established. This will relieve both the congestion and control that characterizes the Central market. Both of these recommendations will require public sector and donor support, but both can be significant factors in improving the marketing efficiency of horticultural products in Sri Lanka.

6.16 CONSUMER APPRECIATION FOR THE IMPORTANCE OF FRUITS AND VEGETABLES

The Chinese and Koreans consume the highest amount of fruits and vegetables; their diet is often one-third fresh or processed in this vital food category. In Sri Lanka fruits represent approximately 1.5% and vegetable 6.5%; whereas, condiments represent 8.2%. There are large amounts of vitamin C in green chillie peppers but much is lost in drying. Medical research throughout the world is showing the beneficial influence of fresh fruits and vegetables on reducing heart attacks, stomach ulcers and disease susceptibility in general.

Sri Lanka has a population of 17 to 19 million people, which holds a tremendous market potential for expansion in commercial fruit and vegetable production. This may only be realized if nutrition education is given emphasis in schools and in mass media approaches; if disposable income increases for the general population; and if fresh fruit and vegetable prices fall to levels which at least 75% of the population can afford to purchase them.

One would think that rural children in the major fruit and vegetable production regions would have average or better than average nutrition and physical development. Government health records show that Badulla and Nuwara Eliya rank highest for below weight school children. The farmer and his wife often know little of vitamins and minerals unless some health emergency has caused them to be alerted.

Rural families usually have vegetable gardens and a few fruit trees if they are land owners or leaseholders.These can be excellent nutritional sources. In Thailand to be sure that school children have at least one meal a day rich in vitamins and minerals, school gardens were given wide emphasis by the King. The King visits these gardens and awards prizes for outstanding teachers and groups.

Newspapers, radio and television can augment the educational effort. Teachers may need upgrading of their nutritional knowledge, and teacher training centres should prepare to assist. In many of the western countries women's organizations have been

very effective in increasing nutrition awareness. Young girls' groups often exhibit nutrition information at public gatherings such as markets and movie theatres.

When there is an excess of cabbage or prices are very low Koreans prepare a pickled form that provides a tasty spicy source of Vitamin C for use with rice during the long winter months. A low cost home solar dryer could be shared with other nearby villagers to utilize mangoes, papaya, banana, pineapple, beans, carrots, onions, sweet potatoes, beets and tomatoes. The dehydrated products can be kept at room temperature for many months if kept away from insects and rodents.

Most drying procedures are simple and quick, (6-12 hours) and the solar dryer is very cheap and easy to construct.

Small holders in rural settings should be the healthiest in the nation by using a well planned vegetable garden, back yard fruit trees and a solar dryer to help provide nutritious form of these two important food groups all year round.

7. AGRO-ENTERPRISE SUMMARY

If private sector is to be a leader in building the horticultural industry in Uva Province there must be existing opportunities for commercially viable and potentially profitable businesses. These agro-enterprise opportunities do exist in Uva Province. Profiles for eleven of the most promising are presented as follows: (Details for each of these eleven are presented in Appendix D).

7.1. HIGH QUALITY POTATO SEED STOCK PRODUCTION FACILITY

7.1.1 Description

Two rather new technologies are now available in Sri Lanka which could provide uniform, vigorous and disease-free potato seed at costs equivalent or less than current imported seed. One technology uses the tips of sprouted seed stems as the propagating unit; the other uses the true seed taken from the small green potato-like seed ball (or potato fruit) as the starting point. In both cases the starting seed stocks units are quite small and valuable and require careful husbandry to help them progress to future field seed stage. In the early stages, an insect free environment is needed such as a net house. The work is technical but not difficult to learn. A well trained technical manager would be needed.

7.1.2 Market

The market for uniform sized, disease free seed stock in Badulla District could be as much as 4,200 metric tons per year.

The marketing thrust should be superior performance; more uniformity in growing and harvesting; reduced disease potential; and better control over the delivery variety and condition of the seed needed.

7.1.3 Economics

If this production laboratory facility is build by a contractor, the capital costs are estimated to be 912,000 Rupees (US$ 21,209/-). If constructed by farmers, the cost would be half of that. Operating costs of the laboratory would be about 666,000 Rupees per year (US$ 15,488/-). The result is that seed tubers can be produced for as little is 6 Rupees/kg. Typically seed tubers cost 30 to 60 Rupees/ kg. However, two years are needed to get the first seed tubers ready to sell. This is further explained in the original proposal.

7.1.4 Facilitation

Assistance with initial capital investment may be necessary.

7.2 CONTAINERIZED SEEDLING PRODUCTION FACILITY

7.2.1 Description

Containerized seedling production can be used for easily transplanted vegetables,fruit trees, nursery stock and flower seedlings. This system results in faster plant development, more uniform growth,and superior crop yields.

The system starts with a plastic containers that has an opening in the bottom for the tap root to protrude (to control the length of the tap root). The sterilized planting media is composed of ground coconut husk, rice straw,and sand. The plastic pockets for each seedling are in a tray containing up to 60 pockets. An important point is that these trays are elevated above the soil so the tap root coming through the hole in the bottom doesn't grow when exposed to the air. Instead a very dense root system develops within the pocket containing the seedling thereby producing a strong vigorous plant.

7.2.2 Market

The market consists of large commercial horticultural enterprises, urban gardeners, and small producers. The price of the seedling is based on the size of the cell, planting media, and size of seedling. After this system is recognized, the demand should increase dramatically for seedlings of this type.

In the United States where the use of containerized seelings is very prevalent (approx. 93% of tomatoes, peppers, eggplants acreage) the cost is approximately 5-6 cents per plant (approx. 14 Rupees per plant). Production in Sri Lanka using local media, labour and structures should cost much less to produce and the selling price could be much lower. The price per plant seldom creates much sales resistance from a grower who has experienced the advantage of containerized seedlings.

Uva Province is almost in the center of vegetable production for the highlands and even for production areas further away, plant shipments would be practical. From the size of the vegetable areas in Sri Lanka 10-12 moderately large containerized enterprises should be sufficient, but the need for fruit, shade, flower and ornamental rooted cuttings could be many times this number.

7.2.3 Economics

Capital investment for each green house is estimated at Rs.340,000 using a contractor and approximately one half that amount if farmer constructed. For an operation with three green houses annual personnel and operating costs would be approximately Rs.800,000. Gross annual sales could exceed 1 million Rupees.

7.3 INTEGRATED HORTICULTURAL PRODUCTION AND MARKETING ENTERPRISES

7.3.1 Description

Opportunities abound for a wide range of highly efficient, market oriented horticultural enterprises. Those entrepreneurs who can produce the most high quality produce in the least time, with the least space, least labour and cost and with the least environmental stress will have decided competitive advantages. The secret to success in horticultural production is the use of knowledge to control the crop's growth and development from planting to consumer acceptance.

The modern efficient fruit and vegetable producer knows what the market wants, how it wants it and when there is a window of opportunity. This knowledge must come before field selection, variety determination and before the first seed or planting material is put in the soil. Once determined and the crop initiated, the challenge of control over the crop's growth and development begins. Controlled production places the most adaptable, highest yielding, best quality cultivars of the greatest market acceptance under cultural conditions which provide minimum stress. Built into much of the "crop control" concept is the possibility of prediction of both yield and harvest period.

Integrated production is highly purposeful and as many factors of crop growth and development are controlled as possible, so that production simulates " factory manufacturing". Crops subjected to integrated control are provided adequate soil moisture and nutrient management; appropriate pest management; and the best available cultural care. As the crop approaches maturity predictions of yield and harvest date help to prepare for orderly postharvest handling and signals to the market. Integrated production depends on using sound technology and is usually less expensive and more predictable than traditional production. The system uses market oriented decision making and comprehensive record keeping from which accurate and continuous assessment of enterprise effectiveness and financial worth.

7.3.2 Market

Following is a listing of vegetable crops and perennials that have promise for solid enterprises. In some cases research and adaptability testing may be necessary before commercial ventures can initiate actual operations. Some would be for the fresh export market, others for domestic consumption, some for canning, dehydration or pickling.

Vegetable Crops

Asparagus	Snowpeas	Muskmelon
Brocolli	Fancy Cabbage	Honeydew Melons
Brussels Sprouts	Bell Peppers	Watermelons
Cauliflower	Zuchini Squash	

Perennial fruit crops

A. Priority

Banana	Lime	Lemonlime
Pineapple	Cashew	Lemon
Mango	Papaya	Other Citrus
Passionfruit	Grape	Palmyrah
Rambutan	Grapefruit	Jak Fruit

B. Future Development

Avocado	Tamarind	Logan
Breadfruit	Durian	Macadamia
Woodapple	Carambola	Guava
Strawberry	Soursop	Persimmon
Mangosteen	Lychee	Sapodilla

At present exporters find supply lines of fresh fruits and vegetables difficult to deal with because they are erratic and quality uncertain. An exporter, or commission merchant selling to a large hotel chain , is expected to maintain an acceptable quantity and quality over long periods. When this supply is broken the market opportunity may be interrupted or lost entirely. In severe cases the supplier can be fined if contracts are violated.

As Sri Lanka moves into export horticulture the need for a continuous supply of high quality fruits and vegetables makes the need for controlled production postharvest and marketing more urgent. The system is less expensive than traditional cultural methods because of its full accountability and minimum waste attitude, but does require higher monitoring inputs to effect the needed control levels.

7.3.3 Economics

Detailed cost projections for such a broad array of horticultural crop enterprises are not presented here. The decision maker woud need to gather as much information as possible; conduct a feasibility study of the intended enterprise; interview as many people links in the production, postharvest and marketing sequence as possible; review

his resource base; and examine the supply of inputs potential (equipment, chemicals, labour).

The biggest decision would be the degree of commitment to the enterprise and how much control one wishes to have over the crop growth and development. If export product is intended, then a continual supply of high raw material must be programmed. If the production is intended for processing the production of satisfactory quality at least cost of growing and harvesting must be programmed. If production of high quality fruits and vegetables are to be geared for the "elite markets" such as resorts, hotels, airlines, cruise ships, etc., then the production must be carefully sequenced for an array of products handled quickly and carefully on a rather specific schedule, as time may be more critical than with other markets.

Integrated horticulture uses 10-15% more labour than traditional production, but the more effective use of inputs (fertilizer, water, pesticides) is only slightly more expensive in the controlled procedure. What is gained is more predictability of development, more uniforms yield and quality and highly accountable records from which to assess the profitability and sustainability of the enterprise. The skill and technology requirements are higher thus higher trained personnel would be needed although less skilled inputs are about the same as for traditional culture.

7.3.4 Potential Facilitation

Some horticultural enterprises would be entirely self-capitalized ventures; others with financing from private financial institutions; some may need development incentives to get started; still others may be "spear head ventures" which could bring others into similar ventures (export fresh or processed products) and thus may justify a certain amount of underwriting by the government or some donor agency.

7.4 PACKING HOUSE AND COLD CHAIN FOR FRESH FRUITS AND VEGETABLES

7.4.1 Description

Construct and operate a packing house similar to the one operating in System B of the Mahaweli Irrigation Project.

The purpose would be to provide fresh fruits and vegetables that are packaged and precooled ready for shipment to export markets abroad. The facility would be capable of receiving, sorting, grading, sizing, packaging, precooling, cold storing and shipping of export grade fruits and vegetables. Another packing house of this type will start operation in Timbolketiya in early 1993.

7.4.2 Market

The primary export markets would be Singapore, Hong Kong, Dubai and the Maldives. Europe is another market for consideration. The domestic market in Sri Lanka would not be supplied from here except for some high quality markets such as hotels and supermarkets.

7.4.3 Economics

The capital cost of this facility would be approximately US$ 350,000/- for land, building and equipment. A similar amount would be needed for refrigerated lorries and other support equipment for a total cost of US$ 700,000/-. No feasibility study has been made.

7.4.4 Facilitation Needed

Because this is a new venture for Uva Province, a potential investor type of agribusiness would need technical and monetary assistance in constructing and operating this facility. Donors assistance would be needed during the formative stages.

7.5 JUICING AND CANNING FACILITY FOR FRUITS AND VEGETABLES

7.5.1 Description

Construct and operate a juicing and canning facility for fruits and vegetables. This would be for crops such as pineapple, mango, papaya (Papaw), passion fruit, durian, jak fruit, rambutan, guava, wood apple,and exotic vegetables such as okra, bittergourd, brinjal and lotus root. Products would include juices, cordials, jams, jellies, marmalades, sauces, chutneys, and pickles. This type of facility is technically complex and should have the assistance of a modern food technology laboratory and pilot plant. These are not available in Sri Lanka.

7.5.2 Market

Most of the products would be for the domestic market in Sri Lanka. A small portion of the products would be exported to nearby markets in Asia and to Europe. In Europe the most important markets are expected to be Germany, Netherlands, France and Belgium. In 1991, exports of processed fruits and vegetables were 299 million rupees (US$ 7 million). Of this, 69 percent was gherkins in brine.

7.5.3 Economics

No feasibility studies are available to determine the profitability of a new juicing and canning facility. A study was made in 1991 that estimated the capital costs to be US$ 1.5 million for the necessary land, building, processing equipment and associated support equipment.To put this capital cost figure in the proper perspective, it would be necessary to review the proposal in detail. Also, a detailed feasibility study would have to made before making business decisions.

7.5.4 Facilitation Needed

As a general rule, this type of processing facility works on a small margin of profit. In view of the relatively high capital costs, a venture of this type probably would be undertaken by a multinational company or a consortium of Companies.

A modern food technology laboratory and pilot plant is not available in Sri Lanka. It would be necessary to go abroad for this type of information. Donor assistance would be most helpful, at least in the development phases.

7.6 SMALL AND INTERMEDIATE SIZE FRUIT AND VEGETABLE DEHYDRATION FACILITY

7.6.1 Description

To preserve fruits and vegetables for future consumption, there are opportunities for using small inexpensive solar dryers at household and village levels. Likewise opportunities exist for larger commercial dehydration of perishable crops using larger driers fired by kerosene or rice-hulls. The In-Service Training Institute at Peradeniya has developed a small solar drier and the necessary technology for use at household or village level. This type of drier will dry 2 kilograms per day with free solar energy as the only source of heat. Larger commercial driers will have higher investment and operating costs. A detailed feasibility investigation will need to be completed pprior to taking a business decision.

7.6.2 Market

The market for small solar driers is for households and village levels. The dehydrated product could be used in the homes or sold at pola fairs.

For larger commercial driers, the dried product could be sold domestically in Sri Lanka or exported abroad.

7.6.3 Economics

If the cost of raw material is included in the cost, the dried product still is competitive with costs in the domestic market. If the raw materials come from supplies during periods when there is excess that cannot be sold, dehydrating is a very good alternative. There is no cost involved in storing dried fruits and vegetables.

7.6.4 Facilitation Needed

In many cases, the cost of 1,000 Rupees for a small solar drier is too much. A plan should be developed to assist deserving households acquire a drier of this type. In addition, training should be done by the extension service to teach people how to use solar driers. The technology is not difficult but does require some training.

7.7 LARGE PINEAPPLE FARM AND PROCESSING FACTORY

7.7.1 Description

A commercial pineapple growing and processing factory is proposed. A commercial farm of 2,000 hectares would be farmed as the nucleus to produce 100,000 metric tons of fresh pineapple per year. In addition, outgrowers would produce another 100,000 tons of fresh pineapple by the year 2,000 for a total of 200,000 metric tons per year.

A factory would be constructed to make pineapple juice and canned solid pack pineapple.

A feasibility study has been made for this project and it shows favourable results.

7.7.2 Market

This processed pineapple would be sold on the world market. It is predicted that demand will exceed supply in 1993.

7.7.3 Economics

The predicted production cost of fresh pineapple is US$ 25/- MT total for direct costs and overhead. It is calculated that the processing factory would buy fresh pineapple for US$ 60/MT. Using those figures, out growers could earn US$ 833/- net profit per hectare per year.

7.7.4 Facilitation Needed

ACDI continues to support this project through the Commercial Small Farm Development Project. If this project is to succeed, many government agencies, private entrepreneurs, investors, banks, input supply businesses and donors would be involved. Work is proceeding to get a large multinational investor and/or operating company interested.

7.8 ORNAMENTALS LIVE PLANTS AND CUT FOLIAGE

7.8.1 Description

The purpose would be to supply live plants and cut foliage for export. This would be primarily to grow, package,and ship these products by air for use in decorating homes and businesses.

7.8.2 Market

In recent years, the Netherlands has been the major market along with othe. countries in Europe and Asia. In 1988 Sri Lanka's export value for onrnamentals was 106 million rupees (US$ 2.5 million).The volume has increased steadily since that time.

7.8.3 Economics

Cost information could not be obtained in time to prepare any type of profitability statement, but the potential exists for a highly successful enterpirse. A detailed feasibility study will need to be constituted.

7.8.4 Special Features

The purpose of shipping this plant material in the form of cuttings is to comply with buyer specifications or restrictions on the importation of soil because of harmful insects or diseases.

Plants cannot be shipped or stored with fresh fruits and vegetables because of damage from ethylene given off by plants.

7.8.5 Facilitation Needed

Air cargo space is needed for cuttings.

7.9 ROSE PRODUCTION

7.9.1 Description

It is proposed to establish a 5 hectare rose production unit and to export cut flowers to Europe and the Far East. The roses will be grown under a greenhouse. Drip irrigation with fertilizer injecTion will be used. The project will have grading, packing and cold storage facilities. The cut flowers will be transported by refrigerated lorry to the Colombo Airport and then by air to Europe and the Far East.

7.9.2 Market

The project would concentrate on the European and Far East markets. Germany would be the primary target in Europe. In the Far East the project would target Japan, Singapore,Hong Kong and Australia.

In Europe,a conservative wholesale price of US$ 0.35/- stem could be used for calculations.

7.9.3 Production

The production area under roof will be five hectares utilizing plastic greenhouses fabricated from local materials.

The site should situated in an area with the following growing conditions. The ideal temperature range would be 23 degrees C° (72 degrees F) during the daytime and 17 degrees C° (62 F) during the night. The green house must be designed to allow ventilation during the day if temperatures become to warm and also to be closed at night for heat retention if temperatures become low. Relative humidity should average between 65 to 75 percent. It is essential that the soils are well drained and porous.

Initially, the planting material should be purchased from quality nurseries in Europe. The planting density would be 60,000 plants per hectare.

Six months after planting, light harvesting can begin. Full production will be obtained after 15 months. A conservative yield projection is 1,300,000 stems per hectare per year. It is realistic to achieve 1.5 million per hectare.

7.9.4 Estimate of Project Costs

A.	Capital Expenditures	Rupees
	Land (10 hectares)	5,000,000
	Land development	450,000
	Greenhouses	15,750,000
	Buildings	2,000,000
	Reservoir	2,000,000
	Machinery and Equipment	4,500,000
	Vehicles	3,500,000
	Planting Material	42,000,000
	Total Capital Expenditures	75,200,000
B.	Estimated Working Capital	5,000,000
	Total Estimated Investment	80,200,000

General Profitability and Financial Conditions

Production by middle of Year 3	6,500,000 stems
Sales F.O.B. (9 Rs./stem)	58,500,000
Cost of Production(4 Rs./stem)	26,000,000

Profit is expected to be about 25 percent of the annual turnover. This is a high return on investment.

7.10 PACKAGING SUPPLIER, BOX BROKER

7.10.1 Description

Develop a business to provide corrugated boxes and packaging supplies.

The demand for corrugated fibreboard boxes and packaging materials is increasing. The trend is toward the construction of new packing houses for fresh fruits and vegetables. Manufacturing of industrial products is increasing both for foods and non-food products. All of these items require packaging. Plastic bags are another example of recent changes in packaging.

A brokerage business actually is the marketing department for a group of businesses.

7.10.2 Market

The market is Uva Province and the surrounding area is very broad. It includes fresh and processed foods, clothing, chemicals, spices, toys, cut flowers, and much more. As living standards become more sophisticated, the demand for packaging materials will increase.

7.10.3 Economics

As an example of the money to be made, assume a fruit and vegetable packing house buys 100,000 corrugated boxes each year.

At a cost of US$ 0.75/- per box and a commission rate of 5 percent, a box broker would get a gross commission of US$ 3,752/- for 100,000 boxes.

7.10.4 Facilitation Needed

This is a business that does not need financial assistance from donors or government agencies. It does need to be recognized as a constructive element of business and be given a chance to operate as such.

7.11 SPICES AND OTHER MINOR EXPORT CROPS

7.11.1 Description

In 1991 the export volume of a group of crops known as Export Agricultural Crops totalled 19,412 metric tons and had a value of 2,006 million rupees (US$ 47 million). These crops sometimes are called Minor Export Crops and include cinnamon, cloves,pepper, cardamon,nutmeg, cocoa, coffee, citronella,papain, arecanut and betel.

The production of Export Agricultural Crops has been increasing steadily. That growth is expected to continue. The Mid Country Perennial Crops Development Project (PERCROPDEP)which was initiated in 1989 with the assistance of the Asian Development Bank in the Districts of Kegalle, Kandy, Matale, Badulla and Monaragala continues its operations. The project intends to promote commercial production and improve marketing facilities of perennial crops which include most minor export crops such as pepper, nutmeg, cocoa, coffee and cardamon.

As the production of these crops increases, processing and marketing must increase.

7.11.2 Market

Mexico is the largest importer of Sri Lankan cinnamon. The bark is boiled in water and the extract taken like tea as a beverage. Other uses are in cakes and sweets, in curry powder, and incense and perfumes.

Nutmeg is sold whole and ground. Uses include flavouring of sweet dishes, pies,puddings, toppings, meat and vegetable dishes. It is an ingredient of many ground spice mixtures including mince meat spice, pastry spice, poultry dressing,sausage, bologna and frankfurters.

Cloves are used either whole or ground to provide flavour for foods in pickling, sauces,and ketchups. In medicine it is used as a carminative, aromatic and stimulant. A sizeable amount of the clove buds is used in perfumes, in dentistry, and as a clearing agent in microscopy.

Cardamon is used as a common ingredient of special seasonings and curry powders and for flavouring sweet meats, pastries, cakes, puddings, meat, curries, sausages, various kinds of foods and culinary preparations. Cardamon oil is used for flavouring coffee and tea. In medicine, it is used as a powerful aromatic, stimulant, carminative, stomachic and diuretic.

Of the total world trade in spice of about US$ 270 million, 37 percent is pepper. Brazil, India, Malaysia and Indonesia are the most important pepper producing and exporting countries. These countries produce 90 percent of the total world exports of pepper. Sri Lanka exports US$ 3.2 million worth of pepper. This is only 3 percent of the total world exports of pepper but still is a sizeable amount.

7.11.3 Economics

The value of exports for Export Agricultural Crops was 2,005 million Rupees in 1991. Cost and profitability figures are not available for spices.

APPENDIX A

DETAIL SUPPORTING DESCRIPTION OF UVA PROVINCE

TABLE 2-1 MEAN ANNUAL TEMPERATURES: UVA PROVINCE
(1992 SRI LANKA METEOROLOGICAL MAPS)
(7 YEAR AVERAGE)

MONTH	DISTRICTS	
	BADULLA	MONARAGALA
	RANGE ^0C	RANGE ^0C
JANUARY	17-20	20-25
FEBRUARY	20-22	22-25
MARCH	22-25	22-25
APRIL	22-25	25-27
MAY	25-27	27 over
JUNE	25-27	25-27
JULY	22-25	25-27
AUGUST	22-25	25-27
SEPTEMBER	25-27	27 over
OCTOBER	27 over	25-27
NOVEMBER	25-27	25-27
DECEMBER	22-25	25-27
AVERAGE	22-25	25-27

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TABLE 2-2 RAINFALL DISTRIBUTION UVA PROVINCE
(DEPARTMENT OF AGRICULTURE,AGRO-METEOROLOGY REPORT)
(7 year average in inches)

BADULLA DISTRICT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
						MONTHS							
UPLAND WET WU3	4	3	4	6	5	6	6	5	5	8	6	5	63
UPLAND INT.IU2	12	4	4	6	2	1	1	2	4	6	9	12	63
UPLAND INT. IU3	5	2	4	6	4	1	1	2	4	7	8	6	50
MID-ELEVATION INT.IM-1	12	5	4	5	1	0	0	0	1	6	9	12	55
MID.ELEVATION INT.IM-2	3	2	5	7	4	2	0	0	1	7	10	6	47
LOW INTERMEDIATE IL -2	2	1	5	8	3	1	0	0	1	7	12	5	45
LOW DRY DL-1	4	1	2	6	3	1	0	1	1	6	7	6	38
MONARAGALA DISTRICT													
MID-ELEVATION WET.WM-3	5	2	3	6	4	6	5	4	5	9	8	6	63
MID-ELEVATION INT.IM1	12	5	4	5	1	0	0	0	1	6	9	12	55
MID-ELEVATION INT.IM2	3	2	5	7	4	2	0	0	1	7	10	6	47
LOW-INTERMEDIATE IL-1	2	1	3	6	4	3	2	0	2	8	7	5	43
LOW-INTERMEDIATE IL-2	2	1	5	8	3	1	0	0	1	7	12	5	45
LOW DRY DL-1	4	1	2	6	3	1	0	1	1	6	7	6	38

NOTE: MONTHS IN WHICH LESS THAN 4 INCHES HAS BEEN RECORDED ARE CONSIDERED BELOW AGRICULTURALLY EFFECTIVE RAINFALL (BAER).

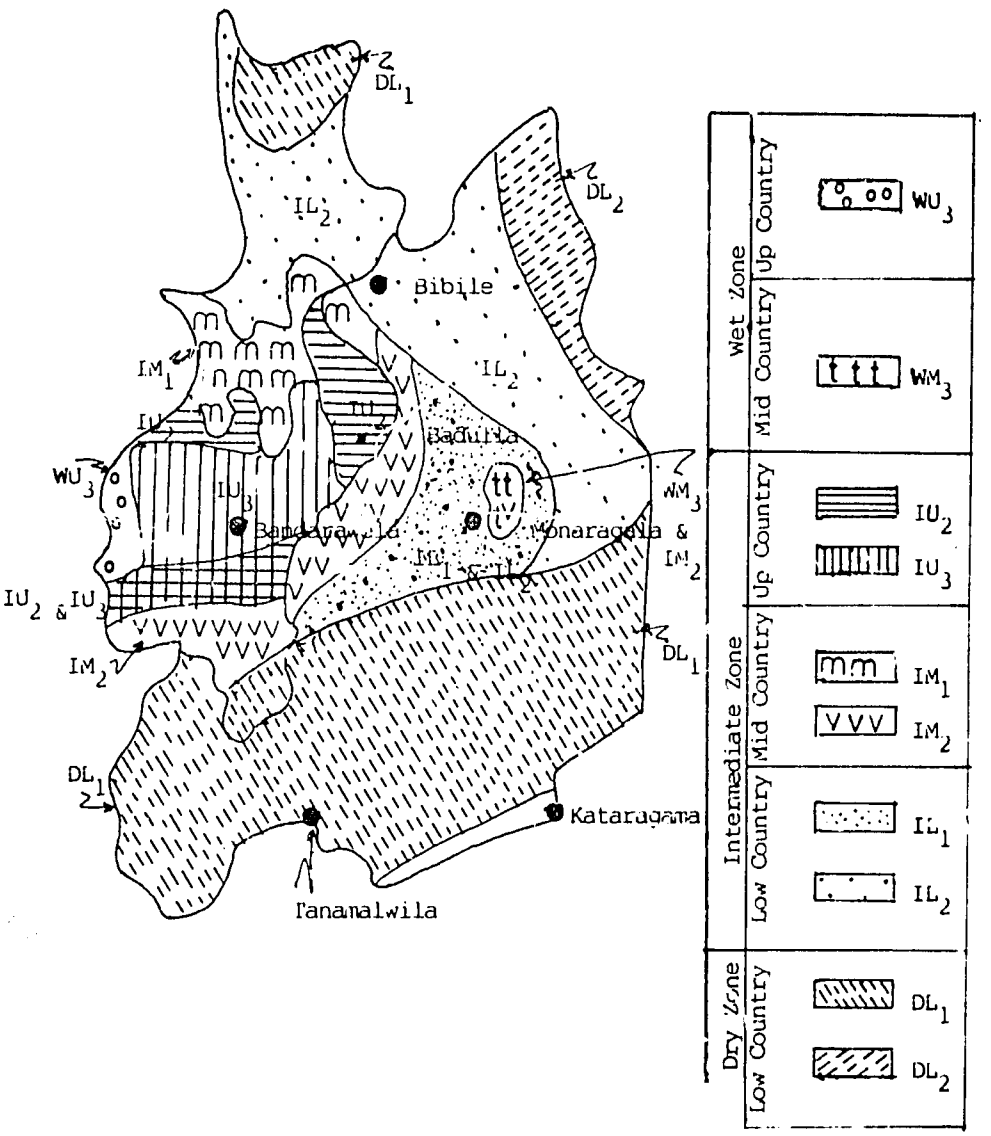
TABLE 2-3 SOIL AND TERRAIN CHARACTERISTICS-BADULLA DISTRICT

ZONE	WU-3	IU-2	IU-3	IM-1	IM-2	IL-2	DL-1
DESCRIPTORS	UPLAND WET	UPLAND INTERM.	UPLAND INTERM.	MID ELEVA. INTERM.	MID ELEVA. INTERM.	LOWLAND INTERM.	LOWLAND DRY
TERRAIN	ROLLING	MOUNTAINOUS STEEPLY DISECT. HILLY AND ROLLING	STEEPY DISSECTED. HILLY AND ROLLING	ROLLING. HILLY AND STEEP	ROLLING. HILLY AND STEEP	ROLLING. HILLY AND UNDULATING	UNDULATING -
AREA % (APPROX).	10	8	25	15	12	25	5
SOIL TYPE	RED-YELLOW PODSOLS WITH DARK B HORIZON	RED-YELLOW PODSOLS MOUNTAIN REGOSOLS	RED-YELLOW PODSOLIC SOILS	REDDISH BROWN EARTHS IMMATURE BROWN LOAMS	REDDISH BROWN EARTHS IMMATURE BROWN LOAMS	REDDISH BROWN EARTHS AND LOW HUMIC GLEY SOILS	REDDISH BROWN EARTHS AND LOW HUMIC GLEY SOILS
SOIL DEPTH FEET	5-8	6-8	6-8	3-5	3-5	3-6	3-6
DRAINAGE	WELL TO MODERATE	WELL TO MODERATE	WELL TO MODERATE	WELL TO MODERATE	WELL TO MODERATE	IMPERFECT TO POORLY	IMPERFECT TO POORLY
SOIL COLOUR	DARK BROWN	D.GREY BROWN DARK BROWN	D.GREY BROWN DARK BROWN	D.BROWN D.RED BROWN	D.BROWN D.RED BROWN	REDDISH BROWN GREY BROWN	REDDISH BROWN GREY BROWN
TEXTURE SURFACE	SANDY LOAM	SANDY LOAM CLAY LOAM	SANDY LOAM CLAY LOAM	SANDY LOAM CLAY LOAM	SANDY LOAM CLAY LOAM	SANDY LOAM SANDY CLAY	SANDY LOAM SANDY CLAY
TEXTURE SUB-SOIL	SANDY CLAY LOAM	MODERATE OR GRANULAR	WEAK TO MODERATE CRUMB	SANDY CLAY SOME GRAVEL	SANDY CLAY SOME GRAVEL	SANDY CLAY LOAM TO CLAY	SANDY LOAM TO CLAY
REACTION	VERY STRONGLY ACID	MEDIUM TO STRONGLY ACID	MEDIUM TO STRONGLY ACID	SLIGHTLY ACID TO NEUTRAL	SLIGHTLY ACID TO NEUTRAL	SLIGHTLY ACID	SLIGHTLY ACID
WATER INFILTRATION	MODERATELY RAPID	MODERATELY RAPID	MODERATELY RAPID	MODERATELY LOW	MODERATELY SLOW	SLOW TO MODERATE	SLOW TO MODERATE
WATER AVAILABILITY	MODERATE	LOW TO MODERATE	LOW TO MODERATE	LOW	LOW	MODERATE	MODERATE

TABLE 2-4 SOIL AND TERRAIN CHARACTERISTICS MONARAGALA DISTRICT

ZONE	WM-3	IM-1	IM-2	IL-1	IL-2	DL-1
DESCRIPTORS	MID ELEVATION WET	MID ELEVATION INTERMEDIATE	MID ELEVATION INTERMEDIATE	LOW INTERMEDIATE	LOW INTERMEDIATE	LOW DRY
TERRAIN	STEEPY DISSECTED, HILLY,ROLLING, UNDULATING	ROLLING, HILLY AND STEEP	ROLLING, HILLY AND STEEP	ROLLING UNDULATING AND FLAT	ROLLING HILLY AND AND UNDULATING	UNDULATING -
AREA % (APPROX.)	2	1	3	14	30	50
SOIL TYPE	RED BROWN LATOSOLS RED YELLOW PODSOLS IMMATURE BROWN LOAMS	REDDISH BROWN EARTHS IMMATURE BROWN LOAMS	REDDISH BROWN EARTHS IMMATURE BROWN LOAMS	RED YELLOW PODZOLS LOW HUMIC GLEY SOILS	RED YELLOW PODZOLS REGOSOLS IN SANDS	REDDISH BROWN EARTHS AND LOW HUMIC GLEY SOILS
SOIL DEPT (FEET)	1 -7	3-5	3-5	4-8	6-20	3-6
DRAINAGE	WELL TO MODERATE	WELL TO MODERATE	WELL TO MODERATE	VERY POOR TO MODERATE	MODERATE TO EXCESSIVE	IMPERFECT TO POORLY
SOIL COLOUR	DARK BROWN REDDISH GREY	DARK BROWN DK. RED BROWN	DARK BROWN DK. RED BROWN	DARK GRAYISH BROWN D. BROWN	DARK BROWN GRAYISH BROWN	REDDISH BROWN
TEXTURE SURFACE	SANDY LOAM SANDY CLAY LOAM	SANDY LOAM CLAY LOAM	SANDY LOAM CLAY LOAM	SANDY LOAM SANDY CLAY LOAM	SAND TO SANDY LOAM	SANDY LOAM SANDY CLAY
TEXTURE SUBSOIL	SANDY CLAY LOAM, CLAY GRAVEL	SANDY CLAY SOME GRAVEL	SANDY CLAY SOME GRAVEL	SANDY CLAY LOAM TO SANDY CLAY	SAND TO LOAMY SAND	SANDY LOAM TO CLAY
REACTION	SLIGHTLY TO STRONGLY ACID	SLIGHTLY ACID TO NEUTRAL	SLIGHTLY ACID TO NEUTRAL	SLIGHTLY TO VERY STRONGLY ACID	NEUTRAL TO SLIGHTLY ACID	SLIGHTLY ACID
WATER INFILTRATION	MODERATE TO RAPID	MODERATELY SLOW	MODERATELY SLOW	SLOW TO MODERATE	VERY RAPID	SLOW TO MODERATE
WATER AVAILABILITY	LOW TO MODERATE	LOW	LOW	LOW TO MODERATE	VERY LOW	MODERATE

FIGURE 2-3 AGRO-ECOLOGICAL ZONES, UVA PROVINCE



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APPENDIX B

DETAIL SUPPORTING DESCRIPTION OF EXISTING HORTICULTURAL INDUSTRY IN UVA PROVINCE

TABLE 3-1 EXTENT OF PRODUCTION AND YIELD BY DISTRICT4S
(DEPARTMENT OF CENSUS AND STATISTICS,COLOMBO)

		MAHA SEASON			YALA SEASON		
CROP	DISTRICT	EXTENT HECTARES (HA)	PRODUCTION METRIC TONNE/HA	YIELD METRIC TONNE/HA	EXTENT HECTARES (HA)	PRODUCTION (MTH)	YIELD (MTH)
BEAN	BADULLA	1286	5592	4.3	1130	5846	5.2
	MONARAGALA	15	67	4.5	15	71	4.7
	SRI LANKA	3812	20546	5.4	2960	14494	4.9
LEEKS	BADULLA	53	445	8.4	47	380	8.1
	MONARAGALA	2	6	3.0	0	0	0.0
	SRI LANKA	328	4901	14.9	366	5982	16.3
ASH PUMPKIN	BADULLA	5	32	6.4	8	28	3.5
	MONARAGALA	32	345	10.8	-	-	0.0
	SRI LANKA	389	3477	8.9	250	2604	10.4
RED PUMPKIN	BADULLA	138	2281	16.5	81	1117	14.0
	MONARAGALA	575	9565	16.6	152	1461	9.6
	SRI LANKA	4930	60233	12.2	2008	22830	11.4
ASH PLANTAIN	BADULLA	406	2947	7.2	289	1891	6.5
	MONARAGALA	1749	14236	8.1	733	5367	7.3
	SRI LANKA	9130	68209	7.5	6028	40689	6.7

TABLE 3-1 EXTENT OF PRODUCTION AND YIELD BY DISTRICTS (Continued)

		MAHA SEASON			YALA SEASON		
CROP	DISTRICT	EXTENT HECTARES (HA)	PRODUCTION METRIC TONNE/HA	YIELD METRIC TONNE/HA	EXTENT HECTARES (HA)	PRODUCTION (MTH)	YIELD (MTH)
CAPSICUM	BADULLA	237	686	2.9	159	488	3.1
	MONARAGALA	62	275	4.4	76	414	5.5
	SRI LANKA	1460	6046	4.1	1365	5199	3.8
GINGELLY	BADULLA	-	-	0.0	62	25	0.4
	MONARAGALA	1315	1184	0.9	894	536	0.6
	SRI LANKA	3563	2859	0.8	12759	10250	0.8
GREEN GRAM	BADULLA	196	157	0.8	14444	8130	0.6
	MONARAGALA	8058	7252	0.9	758	450	0.6
	SRI LANKA	34448	28487	0.8	9235	7983	0.9
POTATO	BADULLA	1398	14959	10.7	720	10080	14.0
	MONARAGALA	-	-	0.0	-	-	0.0
	SRI LANKA	1819	20820	11.4	1680	20640	12.3
SWEET POTATO (1990)	BADULLA	284	2652	9.3	-	-	0.0
	MONARAGALA	180	1436	8.0	9	45	5.0
	SRI LANKA	4103	32240	7.8	2129	19646	9.2
BRINJAL	BADULLA	320	2330	7.3	283	2482	8.8
	MONARAGALA	437	4085	9.4	151	1259	8.3
	SRI LANKA	5491	37964	6.9	3870	27618	7.1
BITTER-GOURD	BADULLA	61	325	5.3	40	224	5.6
	MONARAGALA	112	706	6.3	38	276	7.3
	SRI LANKA	1964	10696	5.4	1715	9857	5.7

TABLE 3-1 EXTENT OF PRODUCTION AND YIELD BY DISTRICTS (Continued)

		MAHA SEASON			YALA SEASON		
CROP	DISTRICT	EXTENT HECTARES (HA)	PRODUCTION METRIC TONNE/HA	YIELD METRIC TONNE/HA	EXTENT HECTARES (HA)	PRODUCTION METRIC TONNE/HA	YIELD METRIC TONNE/HA
SNAKE-GOURD	BADULLA	19	178	9.4	14	96	6.8
	MONARAGALA	75	910	12.1	31	507	16.3
	SRI LANKA	1399	10755	7.7	1387	11556	8.3
TOMATO	BADULLA	666	5748	8.6	501	4436	8.8
	MONARAGALA	234	1457	6.2	66	588	8.9
	SRI LANKA	2375	16490	6.9	2143	15744	7.3
CUCUMBER	BADULLA	45	401	8.9	66	312	4.7
	MONARAGALA	55	854	15.5	14	195	1.0
	SRI LANKA	1267	10956	8.6	1023	8031	7.8
CABBAGE	BADULLA	592	10665	18.0	371	6804	18.3
	MONARAGALA	1	10	10.0	5	26	5.2
	SRI LANKA	1522	23969	15.7	1225	15084	12.3
CARROT	BADULLA	190	1527	8.0	168	138	0.8
	MONARAGALA	1	7	7.0	-	-	0.0
	SRI LANKA	964	13718	14.2	644	6886	10.7
KNOL-KHOL	BADULLA	226	2007	8.9	195	1778	9.1
	MONARAGALA	3	25	8.3	6	49	8.2
	SRI LANKA	679	5779	8.5	766	6320	8.2
BEET ROOT	BADULLA	199	1057	5.3	117	1085	9.3
	MONARAGALA	6	41	6.8	4	26	6.5
	SRI LANKA	603	6239	10.3	729	6479	8.9

TABLE 3-1 EXTENT OF PRODUCTION AND YIELD BY DISTRICTS (Continued)

		MAHA SEASON			YALA SEASON		
CROP	DISTRICT	EXTENT HECTARES	PRODUCTION METRIC TONNE/HA	YIELD METRICT TONNE/HA	EXTENT HECTARES	PRODUCTION METRIC TONNE/HA	YIELD METRIC TONNE/HA
RADISH	BADULLA	206	1830	8.9	162	1695	10.5
	MONARAGALA	14	92	6.6	12	129	10.7
	SRI LANKA	1168	10121	8.7	1063	8853	8.3
RED ONION	BADULLA	29	177	6.1	33	330	10.0
	MONARAGALA	50	550	11.0	58	580	10.0
	SRI LANKA	3442	4672	13.6	2827	30163	10.7
CHILLIES	BADULLA	531	319	0.6	213	234	1.1
	MONARAGALA	1691	1184	0.7	366	300	0.8
	SRI LANKA	16061	11751	0.7	18115	21479	1.2
BIG ONION	BADULLA	1	10	10.0	57	570	10.0
	MONARAGALA	3	34	11.3	22	100	4.6
	SRI LANKA	74	740	10.0	2326	20879	9.0
COWPEA	BADULLA	161	106	0.7	89	70	0.8
	MONARAGALA	1484	1039	0.7	1061	848	0.8
	SRI LANKA	22190	14629	0.7	5412	5404	1.0
MAIZE	BADULLA	6019	6022	1.0	32	29	0.9
	MONARAGALA	5419	8129	1.5	16	14	0.9
	SRI LANKA	40159	48455	1.2	115	94	0.8
CASSAVA (90)	BADULLA	20	396	19.8	48	216	4.5
	MONARAGALA	196	3910	19.9	205	1436	7.0
	SRI LANKA	6505	74923	11.5	2348	15769	6.7

TABLE 3-2 PRODUCTION AND FARM GATE VALUE OF SOME IMPORTANT FOOD CROPS IN UVA PROVINCE
(ADOPTED FROM: DEPT. OF CENSUS REPORT 1991)

FOOD CROP	PRODUCTION (METRIC TONS)	FARMGATE PRICE (RS.PER MT.)	FARMGATE VALUE (RUPEES x 1000)
BEANS	11,576	6000	69,456
LEEKS	831	6000	4,986
ASH PUMPKIN	405	3000 (EST)	1,215
RED PUMPKIN	14,424	3000	43,272
ASH PLANTAIN	24,441	3500 (EST.)	855,435
CAPSICUM	1,863	14000	26,082
GINGELLY	1,745	12000	20,940
GREEN GRAM	15,989	15000	239,835
POTATO,WHITE	25,039	19000	475,741
POTATO,SWEET	4,133	5000	20,665
BRINJAL	10,156	5000	50,780
BITTER GOURD	1,533	6000	9,198
SNAKE GOURD	1,691	4000	6,764
TOMATO	12,229	7000	85,603
CUCUMBER	1,762	6500 (EST)	11,453
CABBAGE	17,505	4000	70,020
CARROT	1,672	7000	11,704
KNOL KOHL	3,859	3500	13,506
BEET ROOT	2,207	5000	11,035
RADISH	3,746	4000	14,984
RED ONION	1,637	11000	18,007
BIG ONION	714	14000	9,996
CHILLIES	2,037	37000	75,369
COWPEA	2,063	10000	20,630
MAIZE	14,194	4000	56,776
CASSAVA	5,958	2000	11,916
GROUND NUT	3,975	13000	51,675
BLACK GRAM	22	9000	198
SOYBEAN	23	9000	207
TOTAL	187,429		2,287,448
FRUIT CROPS			
MANGO	24	2000	48
PASSIONFRUIT	20	7000	140
BANANAS	35	3000	1,056
PINEAPPLE	30	3000	90
ORANGE,LIME	23	4000	94
TOTAL	132		1,428
GRAND	187,561		2,288,876

NOTE: FARMGATE PRICES OBTAINED FROM MIN.AGR.RES.REPORTS.
COST STUDIES 1986 - 1991

TABLE: 3-3 PRINCIPAL COMMERCIAL CROPS OF BADULLA DISTRICT, BY ZONE

AGRO-ECOLOGICAL REGION & ZONE (BY SEASON)	UPLAND RAINFED	UPLAND IRRIGATED	LOWLAND RAINFED	LOWLAND IRRIGATED	PERENNIALS
1. WU-3 UP COUNTRY WET					
A) MAHA	BEAN CARROT POTATO BEET CABBAGE	CARROT POTATO BEET CABBAGE PEPPER KNOLKHOL	BEAN CABBAGE POTATO BEET	BEAN CABBAGE POTATO BEET	AVOCADO BANANA APPLE PEAR TEA GRAPEFRUIT PEACH MANDARIN * PASSIONFRUIT
B) YALA	BEAN MINOR: PEPPER CARROT BEET	CARROT POTATO BEAN CABBAGE GARLIC BEET PEPPER LEEK	CABBAGE CAPSICUM KNOLKHOL	POTATO CARROT TOMATO BEAN LEEK PEPPER	
2. IU-2 UP COUNTRY INTERMEDIATE					
A) MAHA	BEAN CAPSICUM KNOLKHOL CABBAGE RADISH	BEAN CAPSICUM KNOLKHOL CABBAGE TOMATO POTATO	RICE CHILLIES	RICE TOMATO	AVOCADO BANANA PEPPER CARDOMON TEA COFFEE PEARS
B) YALA	GINGELLY KOLLU	RICE CAPSICUM CABBAGE KNOLKHOL RADISH TOMATO	BUSH BEAN KNOLKHOL RADISH	RICE RED ONIONS CAPSICUM SOYBEAN BRINJAL CUCURBITS CHILLIES BEET KNOLKHOL	PEACH *PASSIONFRUIT

AGRO-ECOLOGICAL REGION & ZONE (BY SEASON)	UPLAND RAINFED	UPLAND IRRIGATED	LOWLAND RAINFED	LOWLAND IRRIGATED	PERENNIALS
3. IU-3 UP COUNTRY INTERMEDIATE					
A) MAHA	RICE BEAN POTATO SW.POTATO KOLLU CASSAVA TOMATO	RICE TOMATO	RICE POTATO TOMATO BEAN CABBAGE	RICE POTATO TOMATO CABBAGE BEAN BEET CAPSICUM	AVOCADO BANANA PASSIONFRUIT PEAR TEA COFFEE *PERSIMMON GAUVA
B) YALA	CASSAVA SW.POTATO KOLLU	BEAN POTATO KNOLKHOL TOMATO CABBAGE CARROT GARLIC		BEAN POTATO BEET GR.CHILLIES CUCURBITS BRINJAL CABBAGE, TOMATO, CARROT GARLIC, LEEKS	*CARAMBOLA PINEAPPLE POMEGRANATE *LEMONLINE
4. IM-1 MID COUNTRY INTERMEDIATE					
A) MAHA	CHILLI TOBACCO BRINJAL CUCURBITS MAIZE COWPEA G.GRAM	CHILLI SOYBEAN R.ONION B.ONIONS	SOYBEAN CHILLI G.GRAM R.ONION RICE COWPEA	RICE	BANANA COCOA MANGO PAPAYA PEPPER SUGARCANE COFFEE TEA
B) YALA	COWPEA SESAME S.POTATO KOLLU	CHILLI BUTTERNUT SOYBEAN GR.GRAM R.ONION B.ONION BRINJAL	SESAME KOLLU	RICE COWPEA OKRA R. ONION B.ONION GR. GRAM CHILLIES SOYBEAN CUCURBITS	PASSIONFRUIT LIME *ORANGE *MANDARIN *PINEAPPLE
5. IM-2 MID COUNTRY INTERMEDAIATE					
A) MAHA	CHILLI TOBACCO CUCURBITS COWPEA MAIZE BRINJAL KURAKKAN GR.GRAM	CHILLIES COWPEA SOYBEAN GR.ONIONS	RICE CHILLI SOYBEAN GR.GRAM SPRING ONION COWPEA	RICE	BANANA PEPPER COFFEE SUGARCANE MANGO PAPAYA PASSIONFRUIT TEA COCOA
B) YALA	COWPEA GR.GRAM SW.POTATO KOLLU	CHILLI SOYBEAN R.ONION B.ONION GR.GRAM BRINJAL CUCURBITS	SESAME KOLLU	RICE COWPEA CUCURBITS B.ONION R.ONION G.GRAM CHILLI SOYBEAN OKRA	* LEMONLIME * MANDARIN * RAMBUTAN * ORANGE * PINEAPPLE * AVOCADO

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AGRO-ECOLOGICAL REGION & ZONE (BY SEASON	UPLAND RAINFED	UPLAND IRRIGATED	LOWLAND RAINFED	LOWLAND IRRIGATED	PERENNIALS
6. IL-2 LOW COUNTRY INTERMEDIATE					
A) MAHA	CHILLI BL.GRAM GR.GRAM GROUND NUT COWPEA MAIZE KURAKKAN SOYBEAN	CHILLI SOYBEAN SP.ONION	RICE CHILLIES GR.GRAM SOYBEAN COWPEA	RICE	BANANA CASHEW MANGO LIME COCONUT PAPAYA *PASSIONFRUIT *GRAPES *CARAMBOLA
B) YALA	COWPEA SESAME KURAKKAN KOLLU	CHILLIES GHERKIN SOYBEAN R.ONION B.ONION	SESAME COWPEA GRD.NUT GR.GRAM	RICE CHILLI B.ONION R.ONION, SOYBEAN, COWPEA G.GRAM, BRINJAL GHERKIN	
7. DL-1 LOW COUNTRY DRY					
A) MAHA	CHILLIES COWPEA BRINJAL GR.GRAM PIGEON PEA CUCURBITS MAIZE SOYBEAN GROUND NUT	CHILLIES B.ONIONS R.ONIONS	RICE	RICE R.ONIONS CHILLIES	BANANA MANGO PAPAYA WOOD APPLE CASHEW LIME CASTOR BEAN *LEMONLIME
B) YALA	COWPEA GR.GRAM GROUND NUT SESAME PIGEON PEA	CHILLIES B.ONIONS R.ONIONS CAPSICUM TOMATO	COWPEA GR.GRAM	RICE CHILLIES B.ONION R.ONION COWPEA GR. GRAM SOYBEAN TOMATO	

TABLE 3-4: PRINCIPAL COMMERCIAL CROPS OF MONARAGALA DISTRICT, BY ZONE

AGRO-ECOLOGICAL REGION & ZONE (BY SEASON)	UPLAND		LOWLAND		PERENNIALS
	RAINFED	IRRIGATED	RAINFED	IRRIGATED	
1. WM-3 MID COUNTRY WET					
A) MAHA	MAIZE COWPEA CUCURBITS GREEN GRAM OKRA BRINJAL	TOMATO CAPSICUM	RICE	RICE	PAPAYA ORANGE LIME BANANA RUBBER COCOA RAMBUTAN
B) YALA	COWPEA GREENGRAM OKRA BRINJAL	TOMATO CAPSICUM CABBAGE	RICE	RICE	*PASSIONFRUIT *MANDARIN *PINEAPPLE *MANGO
2. IM-1 MID COUNTRY INTERMEDIATE					
A) MAHA	COWPEA GREENGRAM	CHILLIES	COWPEA GREEN GRAM	RICE CHILLIES B ONION MAIZE COWPEA GREEN GRAM	BANANA COCONUT, MANGO LIME, PAPAYA COCOA, PEPPER *PINEAPPLE *PASSION FRUIT
3. IM-2 MID COUNTRY INTERMEDIATE					
A) MAHA	CHILLIES BRINJAL CUCURBITS GREEN GRAM COWPEA, OKRA, MAIZE	CAPSICUM TOMATO BEANS CABBAGE	RICE	RICE	BANANA COCONUT ORANGE COFFEE COCOA SUGARCANE PAPAYA
B) YALA	COWPEA GREENGRAM SESAME	TOMATO, BEAN CABBAGE CUCURBITS	RICE	RICE CHILLIES CABBAGE B ONION R ONION TOMATO	RUBBER AVACADO RAMBUTAN MANGO

Table 3-4 (contd./)

AGRO-ECOLOGICAL REGION & ZONE (BY SEASON)	UPLAND		LOWLAND		PERENNIALS
	RAINFED	IRRIGATED	RAINFED	IRRIGATED	
4. IL-1 LOW COUNTRY INTERMEDIATE					
A) MAHA	CHILLIES BRINJAL GREEN GRAM CUCURBITS CASSAVA S.POTATO DRIED NUT MAIZE COWPEA	CAPSICUM TOMATO	RICE	RICE	BANANA COCONUT COFFEE SUGARCANE COCOA, LIME * MANGO PAPAYA ORANGE RUBBER *PINEAPPLE
B) YALA	COWPEA GREEN GRAM SESAME	CHILLIES COWPEA B ONIONS R ONIONS	COWPEA GREEN GRAM	RICE CHILLIES COWPEA GREEN GRAM B ONIONS R ONIONS	
5. IL-2 LOW COUNTRY INTERMEDIATE					
A) MAHA	CHILLIES BRINJAL COWPEA GREEN GRAM CASSAVA MAIZE OKRA CUCURBITS	CHILLIES TOMATO CAPSICUM	RICE	RICE	COCONUT COFFEE MANGO PEPPER RUBBER BANANA LIME, PAPAYA COCOA, ORNAGE PINEPAPPLE
B) YALA	GREEN GRAM COWPEA SESAME	CHILLIES SOYBEAN B ONIONS R ONIONS COWPEA GREEN GRAM	COWPEA GREEN GRAM SESAME	CHILLIES COWPEA GREEN GRAM SOYBEAN B ONION R ONION	

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Table 3-4 (contd./)

AGRO-ECOLOGICAL REGION & ZONE (BY SEASON)	UPLAND		LOWLAND		PERENNIALS
	RAINFED	IRRIGATED	RAINFED	IRRIGATED	
6. DL-1 LOW COUNTRY DRY					
A) MAHA	CHILLIES	CHILLIES	RICE	RICE	BANANA
	GREEN GRAM	SOYBEAN			MANGO
	COWPEA	B ONIONS			PAPAYA
	GROUND NUT	R ONIONS			POMEGRANATE
	SOYBEAN				WOODAPPLE
	MAIZE				PINEAPPLE
	BRINJAL				LIME
	CUCURBITS				ORANGE
	PIGEON PEA				CASTOR
					*LEMONLIME
B) YALA	COWPEA	CHILLIES	NONE	RICE	
	GREEN GRAM	CAPSICUM		COWPEA	
	GROUND NUT	TOMATO		SOYBEAN	
	SESAME	SOYBEAN		B ONIONS	
	PIGEON PEA	B ONIONOS		R ONIONS	
		R ONIONS		CHILLIES	
				TOMATO	
				GREEN GRAM	

* SUGGESTED ADDITIONS BY CHAPMAN AND PINTO, 1992

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TABLE 3-5 YIELD RANGE OF MAJOR SRI LANKAN CROPS

COMPILED FROM:MIN.AGRIC. DAEP REPORTS 1992, MARD-MDS REPORTS 1991, AND FAO PRODUCTION YEAR BOOK 1986 (METRIC TONS/HECTARE)

CROP	YIELD RANGE	AVERAGE	CROP	YIELD RANGE	AVERAGE
BEANS	6-12	8	AVOCADO	4-11	7
BEETS	8-30	14	BANANA	7-16	13
BITTER-GOURD	6-20	15	CASHEW	4-14	8
BRINJAL	10-25	13	COCONUT	3-12	7
BUTTERNUT	3-12	8	JAKFRUIT	2-9	7
CABBAGE	17-50	27	MANGO	6-25	13
CAPSICUM	5-12	7	PAPAYA	11-25	13
CARROT	6-25	15	PASSION-FRUIT	8-75	11
CHILLIES (DRY)	0.4-1.8	1	PINEAPPLE	6-22	7
CORN SWEET	6-11	7	ORANGE	2-10	3
CUCUMBER	12-35	17	RICE IR.	9-12	11
CUCURBITS	9-16	11	RICE RF.	5-9	8
EGGPLANT (ENG)	7-14	12	COWPEA,DRY	1-7	3
EGGPLANT (JAPAN)	8-11	9	GREEN GRAM,D	1-8	2
GHERKIN	5-17	12			
KOHLRABI	18-27	10	GROUND NUT	1-14	7
LEEK	12-30	17	SOYBEAN	3-13	6
LUFFA CM	2-12	3	SESAME	1-2	1
MUSKMELON	8-26	12	MAIZE	1-3	2
ONIONS,BIG	4-12	10	CASSAVA	7-36	11
ONIONS,RED	3-10	8			
POTATO, IRISH	9-20	18			
POTATO, SWEET	4-16	11			
PUMPKIN	8-35	17			
RADISH	14-30	15			
TOMATO	7-35	11			
ZUCCHINI	4-10	7			

TABLE 3-6 HORTICULTURE CROP YIELD COMPARISONS

COMPILED FROM: MIN.AG.SRI LANKA, MIN.AGRI.THAILAND (AG. CENSUS REPORTS 1991, MARTIN: CARIBBEAN, MAYNARD AND LORENZ, USA

CROP	YIELD MEANS BY SOURCE (MT/ HECTARE)				
	SRI LANKA	CARIBBEAN	THAILAND	INDIA	USA
RICE	9	3	-	10	-
MAIZE	2	3	-	-	9
GREEN GRAM	2	1	-	-	-
CASSAVA	11	18	-	-	-
BEANS,GREEN	8	5	-	-	8
BEETS	14	-	-	-	19
CABBAGE	27	25	5	6	30
CAPSICUM	7	10	-	6	30
CARROT	15	-	-	-	35
EGGPLANT	12	35	-	-	25
OKRA	16	25	-	-	11
ONION BULB	10	30	-	60	39
POTATO, WHITE	18	25	-	-	34
TOMATO	11	40	14	30	30
BANANA	13	41	8	-	-
COCONUT	7	9	9	-	-
MANGO	13	15	7	-	-
PAPAYA	13	20	-	-	-
PINEAPPLE	7	70	62	-	-

Note: Missing inputs indicate that data was unavailable/

TABLE 3-7 RELATIVE LABOR REQUIREMENTS OF SOME MAJOR SRI LANKAN CROPS

(MEANS OF 5 CROPS) (MANDAYS/ACRE)

SOURCES: MININSTRY OF AGRICULTURE CROP ENTERPRISE BUDGETS 1991
MININSTRY OF AGRICULTURE, AGRIC. ECON.DIV.STUDIES 46-49

FOOD CROP	MANDAYS/A	FOOD CROP	MANDAYS/A
LEEKS	373	MANGOSTEEN	143
BANANA	370	RAMBUTTAN	141
SHALLOT	325	MANGO	138
BRINJAL	313	POLE BEANS	134
CAPSICUM	307	PAPAYA	115
BEETROOT	305	RADISH	115
BIG ONION	300	PASSION FRUIT	112
CARROT	295	SWEET POTATO	108
BUTTERNUT	270	COWPEA	98
PINAPPLE	250	GREEN GRAM	93
OKRA	235	PADDY RICE	72
CABBAGE	223	GROUND NUT	71
POTATO	223	BUSH BEANS	69
SNAKE GOURD	210	SOYBEAN	53
CHILLIES	197	BLACK GRAM	51
ORANGE	195	MAIZE	49
BITTER GOURD	190	SESAME	29
TOMATO	183		
RED ONIONS	181		

TABLE 3-8 RELATIVE CAPITAL AND LABOR REQUIREMENTS OF SPECIFIC SRI LANKAN HORTICULTURAL CROPS

(FROM: CROP ENTERPRISE BUDGETS 1992 MIN.AGR.ECON.STUDY NO.49)

CROP	YIELD (PER HA)	LABOR (RS/HA)	INPUTS (RS/HA)	TOTAL (COST/ HA	GROSS INCOME (RS/HA)	NET INCOME (RS/HA)	MEAN DAYS /HA	PRICE (RS/KG) *
BEETS	30 MT	31500	70125	101625	240000	138000	315	8
BITTERGOURD	30 MT	19000	51215	70215	180000	109785	190	6
BEAN BUSH	10 MT	6400	40370	56770	95000	38230	64	9
CABBAGE	50 MT	29500	38625	68125	150000	81875	295	3
CAPSICUM	12 MT	30700	34057	64737	96000	31243	307	8
CARROT	35 MT	29500	68250	97750	28000	182250	295	8
OKRA	16 MT	15000	27925	42925	80000	37075	150	5
BEANS, POLE	10 MT	18200	46250	64450	100550	35550	182	10
RADISH	40 MT	11500	19975	31475	60000	28525	115	1.5
SNAKEGOURD	30 MT	21000	50715	71715	90000	18285	210	3
TOMATO	25 MT	28000	40405	68405	112500	44095	280	4.5
BANANA	2000 BN	37000	55275	92275	114043	21768	142	80 BN
MANGO	83000 FR	13800	25236	39036	83000	43964	138	1 FR
MANGOSTEEN	59000 FR	14300	10907	25201	78667	53466	143	2 FR
ORANGE	54125 FR	19540	47828	67368	216500	149132	217	4 FR
PAPAYA	54125 KG	11500	36674	48174	171072	122898	115	8 KG
PASSION	13400 KG	11200	41559	52759	134000	81247	111	10 KG
PINEAPPLE	20625 KG	25040	28590	53630	123750	70120	250	6 FR
RAMBUTAN	9967 KG	14067	21840	23247	191143	167896	141	35 KG

* RUPEES,FARM GATE PER KILOGRAM OR UNIT OF CROP (FRUIT,BUNCH,ETC.,)

TABLE 3-9 COST OF CULTIVATION, MAHA (1990 - 1991)
MATERIAL INPUT COSTS-OUTPUT RELATIONSHIPS

CROP	SEED Rs/Ac	FERTILIZER Rs/Ac	PESTICIDE Rs/Ac	TOTAL Rs/Ac	YIELD PER Ac	GROSS INCOME Rs/Ac	NET INCOME Rs/Ac
PADDY, IR	345	14865	263	7818	74 BU	8453	634
PADDY, RF	454	876	221	7486	56 BU	8017	531
CHILLI, RF	357	1638	1162	13207	178 KG	20549	7342
GREEN GRAM RF	240	-	173	2949	193 KG	3995	1046
COWPEA, RF	180	-	171	2542	244 KG	4304	1762
SOYBEAN RF	416	-	-	4278	480 KG	5189	911
MAIZE RF	56	-	-	2699	509 KG	3115	416
POTATO IR	68608	21357	8410	121078	8039KG	291012	169993
POTATO RF	35457	6623	3685	56568	3850KG	106029	49460
CASSAVA RF	-	-	-	2323	14643KG	24893	22569
SW POT. RF	1650	1960	-	9661	4747KG	20695	11034
PUMPKIN RF	69	385	-	3209	6920KG	18140	14936
RED ONION IR	12425	6939	1268	37672	3968KG	40870	3198

FROM: DEPT. OF AGRICULTURE. DIVISION OF AG.ECON. & PROJECTS
STUDY NO. 47, 1992

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TABLE 3-10 COST OF CULTIVATION YALA (1990)
MATERIAL INPUT COSTS-OUTPUT RELATIONSHIPS

CROP	SEED Rs/Ac	FERTILIZER Rs/Ac	PESTICIDE Rs/Ac	TOTAL Rs/Ac	YIELD PER Ac	GROSS INCOME Rs/Ac	NET INCOME Rs/Ac
PADDY, IR	447	1394	649	7426	83BU	11669	4242
PADDY, RF	341	4676	204	6995	53BU	7755	759
COWPEA, RF	132	-	158	2566	209KG	3170	604
GREEN GRAM RF	168	-	121	2128	197KG	3821	1693
SOYBEAN, IR	432	299	-	4044	549KG	7713	3669
CHILLI, IR	398	289	3849	21634	401KG	26482	4848
GR.NUT, RF	907	-	493	5818	467KG	7323	1505
SEASAME, RF	136	-	-	1577	121KG	2115	538
B. ONION, IR	2196	2918	1578	22037	290KG	40675	18638
POLE-BEAN, IR	2376	3771	321	18706	2662KG	28749	10043
POTATO, IR	50674	18841	1024	89963	7209KG	174025	84061
RED ONION, IR	23188	3209	-	38598	2902KG	90571	51974
SW.POTATO, RF	1203	827	-	7814	4653KG	18472	10658

FROM: DEPT. OF AGRICULTURE. DIVISION OF AG.ECON. & PROJECTS
STUDY NO. 47, 1992

TABLE 3-11 RELATIVE CLIMATIC AND EDAPHIC PREFERENCES OF SOME FRUIT AND NUT CROPS (ADOPTED FROM: MARTIN 1987 VIDA HB 642,PAGE,P.E,1984 AUSTRALIAN HB Q 183018)

CROP	GENUS	YEAR TO BEARING	RAIN FALL FOR HIGH YIELD	RESPONSE TO POOR DRAINAGE	TEMPERATURE HUMDITY REFERENCE	ADAPTABILITY TO POOR SOILS	ACCEPTABLE OR BEST ELEVATION
Avocado	Persea	4	Moderate well dist.	Intolerant	25°C Day, 15°C Night	Wide	Lowlands
Banana	Musa	1	2000 - 2500mm	Moderate	Warm Humid	Wide	Low to 1800m
Breadfruit	Artocarpus	7	1500 - 2500mm	Intolerant	Above 5°C	Needs deep, high humus	Lowland
Cashew	Anacardium	3	Low to High	Moderate	Hot 15 - 32°C	Adaptable	Low to mid-elevation
Coconut	Cocos	8	1500 plus, Well dist.	Intolerant	Hot	Needs well aerated	Low to 300m
Custard apple	Annona	5	Modarte to High	Sensitive	Hot 18 - 30°C	Tolerant sands best	Lowland
Date Palm	Phoenix	7	Low	Tolerant	High Temperature	Wide	Low to mid
Durian	Durio	6	2000-3000 Well dist.	Intolerant	Hot 22-40°C	Wide	Lowland to 300m
Grapes	Vitis	4	Dry but Well dist.	Sensitive	Hot, Dry	Light soils best	Low to mid-high
Guava	Psidium	3	1000-1800 Well dist.	Moderate	Warm to hot	Wide	Lowland to 1000m
Jak fruit	Artocapus	7	Moderate	Sensitive	Moderate, Warm - Humid	Wide	Lowland
Lime	Citrus	4	Moderate Well dist.	Sensitive	Warm	Light soils best	Lowland
Mango	Mangifera	5	Low - high, Needs dry to flower	Moderate	Hot	Deep soils best	800m best, low 1200m
Mangosteen	Garcinia	5	Moderate to High	Moderate	Hot, Min. 20°C	Wide	Low to Mid.
Orange	Citrus	4	Moderate to Well dist.	Sensitive	Warm with cool during fruit maturation	Light soils best	800 to 1200m
Papaya	Carica	10 mon.	High	Moderate	Hot	Wide	Low to Mid.
Passionfruit	Passiflora	1	Moderate Well dist.	Moderate	Warm	Wide	Low to Mid.
Pineapple	Ananas	1 1/2	Low to Moderate	Moderately sensitive	28° Day, 20° Night	Light Tolerant Acid soil	Low to Mid.
Rambutan	Nephelium	4	High, 3000 - 4000mm	Sensitive	Hot 22 - 30°C	Needs High Org. matter	Low to 500m
Tamarind	Tamarindus	4	Dry, Drought tolerant	Sensitive	Hot tropical	Wide	Lowland

TABLE 3-12 RELATIVE CLIMATIC AND EDAPHIC PREFERENCESOF SOMF IMPORTANT VEGETABLE CROPS

CROP	GENUS	PLANTING HARVEST DAYS	RAIN FALL FOR HIGH YIELD	RESPONSE TO POOR DRAINAGE	TEMPERATURE HUMDITY REFERENCE	ADAPTABILITY TO POOR SOILS	ACCEPTABLE OR BEST ELEVATION	YIELD MT/HA
Asparagus	Asparagus	(2-3 years)	Moderate to Heavy	Moderate	Cool Nights, Hot Days	Prefers light rich soil, om	Low to Moderate	5 mt
Beans, green	Phaseolus	50	Low to Moderate	Moderate	Moderate	Low to Moderate	Low to Moderate	3 mt
Beans, lima	Phaseolus	75	Low to Moderate	Moderate	Moderate to High	Low to Medium	Low to High	3 mt, dry
Bean, Hyacinth	dolichos	50	Low to Moderate	Moderate	Moderate to High	Low to Medium	Low to High	1 mt, dry
Beets	Beta	60	Low to Moderate	Sensitive	10-29°C Optimum			16 mt
Bittergourd	Momordica	60	Low to Moderate	Moderate	Hot to Moderate	Moderately Adaptable	Low Land	10 mt
Broccoli	Brassica	60	Low to Moderate	Moderately Sensitive	Hot Days, Cool Nights 10 - 29°C	Moderate	Mid to Highland	10 mt
Cabbage	Brassica	80	Low to Moderate	Sensitive	Hot Days, Cool Nights 10 - 29°C	Moderate	Mid to Highland	25 mt
Capsicum	Capsicum	95	Moderately High	Moderately Sensitive	Warm to Hot	Toerant, best on rich loam	Low to High	10 mt
Corn, Sweet	Zea	75	Moderately High	Sensitive	High to Moderate	Needs High Fertility	Low to High	10 mt
Egg Plant	Solanum	90	Low to High	Moderate	Hot to Moderate	Wide Tolerance	Low to Medium	35 mt
Okra	Abelmoschus	60	Low to Moderate	Moderate	Hot	Wide	Low	25 mt
Onion	Allium	100	Low to Moderate	Moderate	Cool to Moderate	High Fertility early	Low to Mid Elev.	40 mt
Potato, White	Solanum	100	1.5 to 2.5 cm per week	Moderately sensitive	Hot days, Cool nights	Moderate Fertility	400 to 2000m	20 mt
Potato, Sweet	Ipomoea	150	Low to moderate	Sensitive	Warm to hot	Tolerance wide	Low to 1000m	35 mt
Pumpkin	Cucurbita	120	Low to moderate	Sensitive	Warm to hot	Sandy Loam best	Low to moderate	45 mt
Tomato	Lycopersicon	90	High to moderate	Moderately sensitive	Hot days, Cool nights	Wide Tolerance	Low to highland	30 mt

TABLE 3-13 VALUE OF EXPORTS OF FRESH AND PROCESSED FRUITS AND VEGETABLES (1985 - 1991)

Year	Fruits, Vegetables & Root crops		Total
	Fresh Rs. Mn.	Processed Rs. Mn.	Rs. Mn.
1985	63.1	11.4	74.5
1986	71.1	29.3	100.4
1987	75.1	61.6	136.7
1988	96.0	50.9	146.9
1989	138.2	140.0	278.2
1990	170.0	306.0	476.0
1991	285.5	299.7	585.2

SOURCE: SRI LANKA CUSTOMS RETURNS

TABLE 3-14 VALUE OF EXPORTS OF FRESH VEGETABLES 1991

Product Description	Value Rs. Mn.
Potatoes Fresh or chilled	1.73
Tomatoes fresh or chilled	1.34
Onions, shallots, garlic fresh or chilled	19.56
Cabbages, cauliflowers fresh or chilled	0.33
Lettuce and chicory fresh or chilled	1.25
Carrots, turnips, beetroot, raddishes fresh or chilled	1.09
Cucumbers, gherkins fresh or chilled	0.98
Loguminous vegetables fresh or chilled	0.25
Other vegetables fresh or chilled	155.25
Vegetables steamed or frozen	1.62
Dried vegetables, sliced, cut, broken or powdered	3.77
Dried loguminous, shelled or steamed	5.24
Manioc, sweet potatoes and similar high starch roots, tubers fresh or dried	23.5
Total	215.91

SOURCE: SRI LANKA CUSTOMS RETURNS

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TABLE 3-15 VALUE OF EXPORTS OF FRESH FRUITS (1991)

Product Description	Value Rs. Mn.
Bananas, plantains, fresh or chilled	1.67
Pineapples, avacados, mangoes, mangosteens and guavas fresh or chilled	23.42
Citrus fruits fresh or dried	1.43
Grapes fresh or dried	0.10
Melons, papaws fresh	0.18
Apples, pears and quinces fresh	0.38
Appricots, cherries, peaches, plums fresh	0.23
Other fruits fresh	14.70
Fruit and nuts steamed or frozen	0.47
Fruits and nut mixtures dried	27.01
Total	69.59

SOURCE: SRI LANKA CUSTOMS RETURNS

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TABLE 3-16 VALUE OF EXPORTS OF PROCESSED FRUITS AND VEGETABLES (1991)

Product Description	Value Rs. Mn.
Gherkins in brines	188.64
Fruits and nuts provisionally preserved by sulpher dioxide gas in brine	0.12
Vegetables, fruits, nuts and other edible fruits preserved in or prepared in vinegar	51.24
Tomatoes prepared or preserved	0.16
Other vegetables prepared or preserved frozen	0.20
Other vegetables prepared or preserved and not frozen	0.81
Fruits, nuts, peels, other parts preserved in suger	0.22
Jams, fruit jellies, marmelade, fruit and nut puree whether or not containing sugar	5.56
Fruits, nuts and other edible parts of plants otherwise prepared or preserved	5.86.
Fruit juices, orange, passion, tomato, pineapples	46.84
Total	**299.65**

SOURCE: SRI LANKA CUSTOMS RETURNS

TABLE 3-17 EXPORTS OF FRESH FRUITS AND VEGETABLES FROM SRI LANKA (1989) IN RS. (Million)

Products	Middle East[2]	Maldives[2]	Other	Total[1]
VEGETABLES				
Potatoes	-	1.07	-	1.07
Tomatoes	0.083	0.007	-	0.09
Onions	0.24	0.1	0.2	0.58
Vegetables	57.16	32.84	9.5	99.4
Cassava	2.49	-	1.91	4.4
Total Vegetables	59.80	34.00	11.6	105.5
FRUITS				
Pineapple	10.0	1.62	0.48	12.20
Avocado, Gnara	0.05	0.04	0.08	0.17
Citrus	0.38	0.53	0.03	0.94
Other fruits	9.1	7.31	2.36	18.77
Ginger	0.09	0.06	0.35	0.50
Total Fruits	19.4	9.6	3.3	32.5
Grand Total	75.5	43.5	15.0	138.0

[1] Numbers do not add up due to rounding

[2] Vegetables for Middle Eastern markets are leeks, luffa, green chilli peppers, snakegourd, bittergourd, leafy vegetables, butter nut squash, etc. Vegetables for the Maldives are predominantly exotics such as leeks, cabbage, carrots, radish, butter nut squash, lettuce etc., in additon to the local vegetables mentioned above.

SOURCE : EXPERIENCE INC.. 1990

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TABLE 3-18 EXPORTS OF FLORICULTURAL PRODUCTS FROM SRI LANKA (1985 - 1991)

PRODUCT DESCRIPTION	FOB VALUE (RS. M) 1985	1986	1987	1988	1989	Estimated 1990	1991
Bulbs, corms, tubers	0.25	0.20	0.68	0.45	0.59	0.76	20.76
Live plants	18.47	49.24	75.11	79.20	75.14	95.54	103.13
Branches, leaves	10.43	13.0	11.30	29.31	31.75	64.14	77.74
Cut flowers	14.52	34.14	29.94	29.35	37.56	31.04	(Est.) 41.40
Total	43.67	96.58	117.03	138.31	145.04	191.48	243.03

SOURCE: SRI LANKA CUSTOMS STATISTICS

TABLE 3-19 EXPORT AGRICULTURAL CROPS VOLUME AND VALUE OF EXPORTS (1988 - 1991) (MT AND Rs.M)

COMMODITY	UNITS	1988	1989	1990	1991
CINNAMON	Volume MT	6810.7	7542.4	6500.5	7889.3
	Value Rs(Mn)	674.7	1059.8	1188.1	1436.2
CIN-LEAF OIL	Volume MT	131.7	161.7	46.2	107.3
	Value Rs(Mn)	36.8	43.8	13.0	29.2
CIN-BARK OIL	Volume MT	2.7	2.6	0.7	2.5
	Value Rs(Mn)	18.9	23.8	7.4	35.2
CLOVE	Volume MT	2251.0	310.6	2286.1	1037.1
	Value Rs(Mn)	252.7	15.9	235.2	63.6
CLOVE OIL	Volume MT	0.0	0.0	0.0	0.0
	Value Rs(Mn)	0.0	0.0	0.0	0.0
COCOA	Volume MT	185.0	122.9	174.9	108.7
	Value Rs(Mn)	7.7	6.3	8.5	3.6
COFFEE	Volume MT	4202.4	2035.1	1496.0	2710.9
	Value Rs(Mn)	232.3	93.8	44.5	77.7
PEPPER	Volume MT	2692.3	1478.8	1242.0	2058.3
	Value Rs(Mn)	291.5	151.7	99.7	139.0
PEPPER OIL	Volume MT	0.0	0.0	6.7	1.8
	Value Rs(Mn)	0.0	0.0	1.8	2.0
CARDAMON	Volume MT	138.8	126.3	32.7	29.0
	Value Rs(Mn)	22.0	19.4	9.0	6.9
CARDAMON OIL	Volume MT	0.6	0.4	0.2	0.5
	Value Rs(Mn)	2.3	1.1	1.1	3.6
CITRONELLA	Volume MT	108.8	72.6	49.6	54.9
	Value Rs(Mn)	29.1	13.3	8.5	11.9
LEMON GRASS	Volume MT	3.9	0.5	0.0	0.0
	Value Rs(Mn)	1.1	0.2	0.0	0.0
NUTMEG/MACE	Volume MT	489.7	390.5	269.9	489.3
	Value Rs(Mn)	59.2	46.0	22.7	24.3
NUTMEG OIL	Volume MT	18.5	12.7	2.6	4.5
	Value Rs(Mn)	18.2	12.3	2.3	2.5
PAPAIN	Volume MT	24.0	0.0	0.0	0.0
	Value Rs(Mn)	5.0	0.0	0.0	0.0
ARECANUT	Volume MT	1512.0	714.0	3077.4	2585.2
	Value Rs(Mn)	16.4	15.4	78.9	92.4
BETEL	Volume MT	2473.0	2297.6	2491.4	2332.4
	Value Rs(Mn)	100.0	92.3	80.7	77.6
TOTAL : MECS	Volume MT	21045.3	15268.4	17676.9	19411.7
	Value Rs(Mn)	1768.4	1595.0	1801.4	2005.7

SOURCE: DEPARTMENT OF EXPORT AGRICULTURE, PERADENIYA.

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APPENDIX C

DETAILS SUPPORTING RECOMMENDATIONS

TABLE: 6-1 DAY CALENDAR USEFUL TO CROP SCHEDULING IN ANNUAL CROPS

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1	32	61	92	122	153	183	214	245	275	306	336
2	2	33	62	93	123	154	184	215	246	276	307	337
3	3	34	63	94	124	155	185	216	247	277	308	338
4	4	35	64	95	125	156	186	217	248	278	309	339
5	5	36	65	96	166	157	187	218	249	279	310	340
6	6	37	66	97	127	158	188	219	250	280	311	341
7	7	38	67	98	128	159	189	220	251	281	312	342
8	8	39	38	99	129	160	190	221	252	282	313	343
9	9	40	69	100	130	161	191	222	253	283	314	344
10	10	41	70	101	131	162	192	223	254	284	315	345
11	11	42	71	102	132	163	193	224	255	285	316	346
12	12	43	72	103	133	164	194	225	256	286	317	347
13	13	44	73	104	134	165	195	226	257	287	318	348
14	14	45	74	105	135	166	196	227	258	288	319	349
15	15	46	75	106	136	167	197	228	259	289	320	350
16	16	47	76	107	137	168	198	229	260	290	321	351
17	17	48	77	108	138	169	199	230	261	291	322	352
18	18	49	78	109	139	170	200	231	262	292	323	353
19	19	50	79	110	140	171	201	232	263	293	324	354
20	20	51	80	111	141	172	202	233	264	294	325	355
21	21	52	81	112	142	173	203	234	265	295	326	356
22	22	53	82	113	143	174	204	235	266	296	327	357
23	23	54	83	114	144	175	205	236	267	297	328	358
24	24	55	84	115	145	176	206	237	268	298	329	359
25	25	56	85	116	146	177	207	238	269	299	330	360
26	26	57	86	117	147	178	208	239	270	300	331	361
27	27	58	87	118	148	179	209	240	271	301	332	362
28	28	59	88	119	149	180	210	241	272	302	333	363
29	29	60	89	120	150	181	211	242	273	303	334	364
30	30		90	121	151	182	212	243	274	304	335	365
31	31		91		152		213	244		305		366

APPENDIX D

DETAILED AGRO-ENTERPRISE PROFILES

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Appendix D

HIGH QUALITY POTATO SEED STOCK PRODUCTION FACILITY

1. DESCRIPTION

Potato production in Uva Province is one of the most profitable vegetables in the Upland Wet and Intermediate rainfall areas of the Badulia District Highlands. The average cost of production during the Maha Season (non-irrigated) and in the irrigated Yala Season is approximately 90,000 Rupees per acre of which seed costs are 57.8%. At present most of the certified seed is imported. Farmers note that there is a great deal of variability in the imported seed and that there are many seed tubers much larger than the desired 28-45 mm diameter they use as whole seed. Most Uva growers do not cut seed into smaller pieces because of the high incidence of rot.

1.1 Concept

Two rather new technologies are now available in Sri Lanka which could provide uniform, vigorous and disease free potato seed at costs equivalent or less than current imported seed. One technology uses the tips of sprouted seed stems as the propagating unit; the other uses the true seed taken from the small green tomato -like seed ball(or potato fruit) as the starting point. In both cases the starting units are quite small and somewhat vulnerable and require careful husbandry to help them progress to future field seed stage. The early stages of both systems require an insect free environment (net house or screened greenhouse); competent technical workers; and the simple laboratory type glasshouse; potting materials and benches to keep the growing seedlings above the soil surface. Sterilized soil can be achieved by baking, steaming or solar means and is an important element in the production sequence. This type of enterprise would require a well trained technical manager who would know how to integrate the various steps of the process,who could train workers in each vital operation, and who could handle the greenhouse as well as field production. This technical staff would probably need an administrative or business type manager to look after procurement of supplies, arrangement for sales, storage and transportation and record keeping. Each lot of seed requires careful parental and performance records. Due to the great cost of seed of imported potatoes these rapid multiplication methods in country should have a considerable potential for profit. The market for uniform sized, disease free seed stock in Badulla District alone could be as much as 4200 MT per year.

1.2 Market

The uniformly sized, disease free seed stock should be sold in well aerable crates or mesh bags to protect the small tubers and allow proper conditioning prior to field planting. The seed producer would have to have an appropriate seed storage room that would be protected from small animal and insect damage and theft. A diffused light storage would be prepared as the seed tubers reach market maturity so that growers could appreciate the superior performance of this special seed source. The Sri Lankan

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seed potato producer would have the advantage of nearness to market; reduced shipping and storage costs; a competitive price (or much less) and technical assistance nearby.

The marketing thrust would be superior performance, more uniform planting, growing and harvest potential, reduced disease potential and better control over delivery, variety and condition.

1.3 Production Arrangement

One seed grower could handle the 1st year laboratory and net house multiplication stage, but it would probably not be as efficient as two distinct operations. The first year is the most detailed and would require the best trained personnel. In the field production stage of multiplication a very good farmer who has patience, an orderly mind and high interest in growing a superior seed would be required.

This field stage could be done through carefully screened contract growers. Seed potato production requires daily monitoring in the laboratory, net house and field production and the presale storage operation. The fields for field increase would have to be carefully selected for drainage, freedom from past soil borne diseases, nematode and heavy weed infestation. The rows in which the seed stock are planted for increase should be chemically treated or pasteurized by the solar method.

During the field production stage, trained plant pathologists and entomologists should be contracted for periodic checks on the health and condition of the growing crop. Immediate removal of diseased or damaged plants (roguing) should be practised.

1.4 Timetable

Various stages of young seedlings (mother plants, secondary mother plants) could be produced and sold from the laboratory stage of production for net house seed increase. This field or laboratory stage takes about 6 months.

The second stage takes the secondary mother seedlings into soil boxes for multiplication, and at this stage strong rooted cuttings are produced. These usually go to a seed farm and may be field set but may go into larger containers for one more generation. The small tubers from these basic seed are then planted in soil beds from which 8 or more B size tubers may be expected. It would be most economical to plant these again for more increase so that each small seed tuber could produce 20-26 commercial sized seed tubers in the 28-45 mm size.

The entire operation for these methods would require from 24 to 30 months before significant return on investment should be expected.

2. ESTIMATE OF PROJECT COSTS

In the beginning the seed producers could make a functional laboratory in a room in his house that could provide even temperature, humidity and florescent light. If the operation expanded a propagation room with climate control could be a part of the net house or greenhouse building.

Estimates for a simple sterilizer (autoclave), basic laboratory glassware (test tubes and flasks) and florescent lighted benches,with climate control would be in the 350,000-400,000 Rupees range depending on start up size. The multiplication rate is geometric, thus a few becomes many very quickly. A lab room 4 M by 6 M would be a good initial start of a building had to be constructed the start up cost could be considerably more.

A net house using fine nylon mesh for the sides and sheet film for the roof could be constructed of bent conduit for roof trusses or 3cm X 3cm timber (or heavier) but heavy shading should be avoided. A net house with plastic roof and nylon net side walls and ends, 8 meters wide by 17 meters long should be adequate to initiate the enterprise. The nylon net costs approximately Rs.400/square meter, for 2-3 ml thickness. UV resistant polyethylene (good for two years or more) ranges from Rs.150-200 per square meter. Timber and labour to form the rafters and roof bars, build benches of wood frame with latticed bottoms would depend on materials available on the farm and skills of the farmer. This writer has seen hundreds of such structures built entirely by the farmer and his family. A brief sketch of a suitable net house is attached. (Figure D-1-1).

The net house must be insect proof. All materials must be carefully fitted to prevent gaps. Doors must be tightly closed and a double stage entrance with an outer and inner door is preferred. A disinfecting foot basin to dip shoes of entering workers is necessary.

Soil can be sterilized by steam, baking or solar methods. A bottom fired discarded pick up truck bed can be covered and used as a baking unit to avoid the cost of a steam sterilizer.

The net house should be placed away from excessive tree shade as low light can cause spindly stems and soft tissue which are more prone to fungal infection. The water source for the seedling production should be low in soluble salts and chemical residues from crop spraying. The application of water and fertilizer for the growing seedlings can be done by manual or automatic (but expensive) systems. The cost of labour may rank second to the construction of the net house in the start up period as a competent technical person should be provided a reasonably high salary (possibly Rs.15000 per month) and the supporting staff adequate, loyalty enhancing salaries; both levels should be programmed to receive a percentage of sale on successful output in order to

encourage vigilance and pride in the enterprise. Product identification should be an important part of the entire production and marketing scheme. Carelessness should not be tolerated.

The appropriate location would probably be in the intermediate zone uplands near a serviceable road. The laboratory space and net house land requirement are minimal but the land for field increase needs to be carefully selected and rotatable for at least 2 years between potato, tomato, pepper and eggplant crops. The grow-out land should have good drainage, supplementary irrigation and a serviceable entry road.

The estimate of cost for this type of on farm enterprise is difficult as so much depends on the skill of the farmer in construction, learning the technology and utilizing local building materials. If the laboratory room had to be built from ground up instead of remodelling an existing structure the price would be much higher of course.

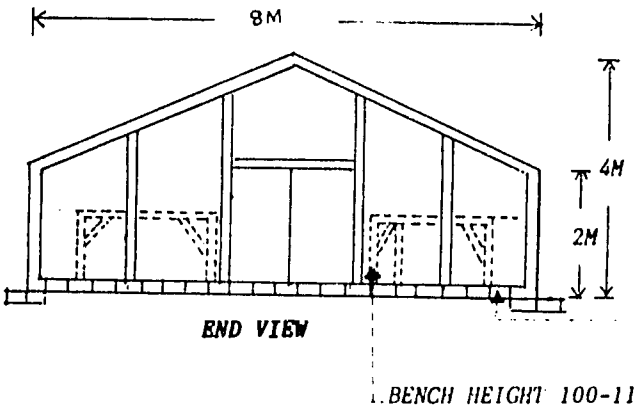
Perhaps a dual estimate would be helpful, one estimate for self constructed and the other for contractor construction. It may be assumed that the land for stages 1 and 2 would be provided by the seed propagator,and stage 3 may be on a contract basis.

ESTIMATED COST FOR POTATO SEED STOCK PRODUCTION FACILITY (Rupees)

Facilities Supplies & Equipment	Farmer Constructed Basis Rs.	Contractor Basis Rs.
Cost of Laboratory Room 10 X 10 Meters	170,000	400,000
Cost of Laboratory equipment,small AC	86,000	86,000
Cost of Laboratory Supplies	9,000	9,000
Cost of Net House	150,000	344,000
Cost of Benches	39,000	62,000
Cost of Hardware (Hinges,nails etc.)	2,500	4,000
Cost of Cartons, containers, Trays	7,000	7,000
Sub Total	463,500	912,000

FIGURE D-1-1

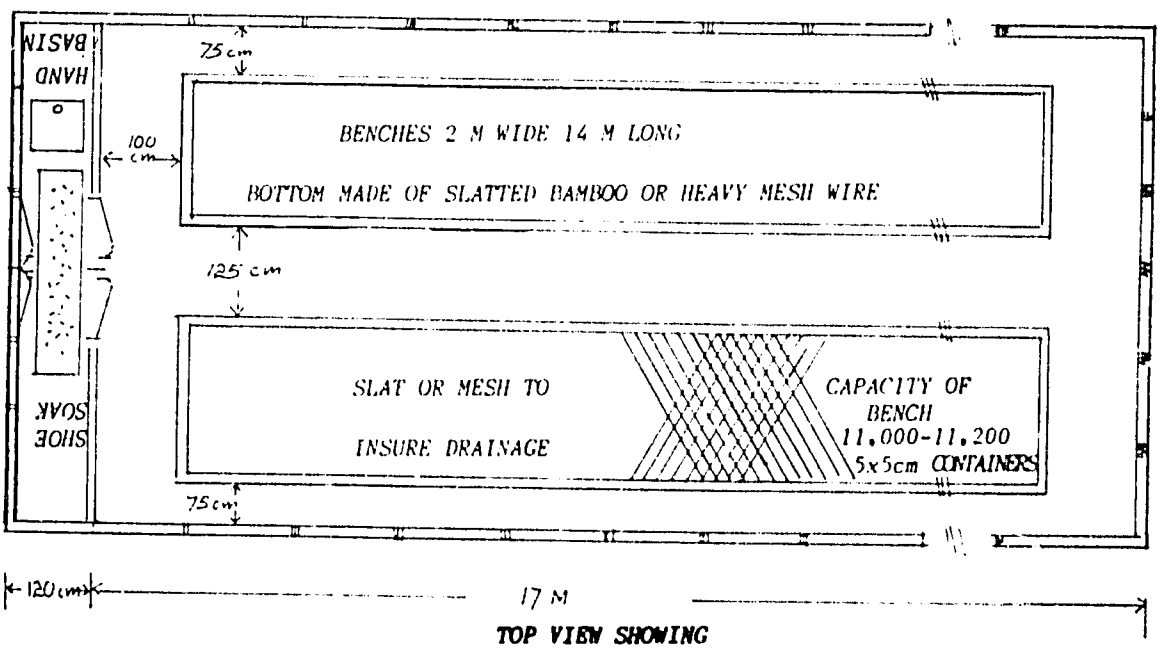
STANDARD PROPAGATION SCREEN HOUSE WITH INSECT EXCLUDING NETTING



END AND SIDEWALL : NYLON FINE NET

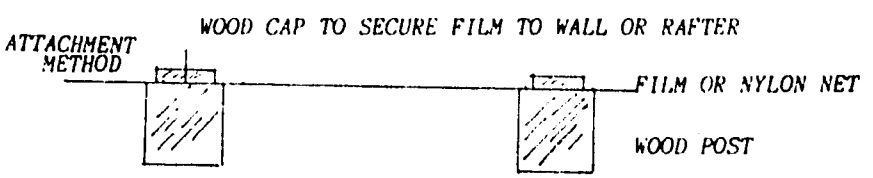
ROOF : UV-RESISTANT POLYETHYLENE SHEET FILM

TRUSSES MAY BE MADE OF WOOD, PIPE CONCRETE BLOCK OR POURED CONCRETE FOOTING



TOP VIEW SHOWING

a. DOUBLE ENTRY DOOR TO RETARD INSECT ENTRY
b. SLATTED BENCH DETAIL 2BENCH HOLD 22,000 CONTAINERS 5x5cm



Recurring Costs

Personnel:

Technical Manager	(1)	15,000 X 12 MO	= 180,000
Technical Staff	(3)	5,000 X 12 MO	= 180,000
Labourers	(3)	3,000 X 12 MO	= 108,000
Administrative Manager	(1)	10,000 X 12 MO	= 120,000
Clerical Staff	(1)	4,000 X 12 MO	= 48,000

Utilities (Electricity)	1,500 X 12 MO	= Rs. 18,000
Chemicals and Expendables	1,000 X 12 MO	= Rs. 12,000
Sub-total		Rs. 666,000 per year

Total **Rs.1,129,500 (farmer constructed)**
Rs.1,570,000 (contractor constructed)

3. GENERAL PROFITABILITY

Seed potato production requires much more care and inputs than table stock potato growing. Table stock yields range from 7 to 18 MT acre with an average cost of production close to 90,000 Rupees per acre. Recent Ministry of Agriculture figures show that Badulla District grows about 2100 hectares of table stock potatoes.

The average labour requirement of 223 maydays per acre would probably be in the 300 mandays range considering the special care and crop monitoring required to produce premium seed stock. If we assume that an average potato grower plants 700-900 kilograms of seed (which should be almost 2000 Kgs) at 30-60 Rupees per Kg for an average cost of 52000 Rupees and the resulting yield averages 12 MT. per acre than he is only getting a 7 fold increase in his seed to table stock output. This is quite low by world standards as the output magnification should be 15 to 20. Occasionally the District gets 17-19 per hectare.

Starting with the laboratory stage each stem tip may be responsible for 360-480 rooted cuttings in the 1st year. Each of the cuttings should yield 7-8 small tubers which when planted would yield 20-26 commercial sized seed tubers. If these were further multiplied one could realize 42,000 seed tubers in the B size seed category 28-45 mm from one tiny stem tip carefully nurtured through this simple process. The true potato seed method has a similar multiplication pattern and also requires 2 seasons to make a profitable impact. With an average yield of 12 MT at an average seed price of 45

Rupees per kg. the seed field would gross 540,000 per acre and a net of 540,000 minus 50,000 cost of production equals 490,000 Rupees/acre. These are conservative estimates as seed often costs 60 Rupees Kg and yields may be in the 15-20 MT/Ha range.

Nearness to market and accessibility to expertise on these two methods should enable the entrepreneur to capitalise on both saving of time and money to the farmer. The imported seed averages 30-50 gms. per seed tubes, the desired range is 20-30 grams. The farmer averages about 1,100 of the most desirable from this seed packet, whereas the graded smalls generated by the TPS or Tip Culture method would give almost 1700 seed tubers. By being more uniform, planting would be more uniform and crop development and yield should be more uniform.

It has been estimated that "method" seed tubers can be produced for as little as 6 Rs/Kg. Very few agricultural enterprises afford this much of a margin on cushion.

4. ECONOMIC DEVELOPMENT CONSIDERATIONS

These new technologies could reduce potato seed imports thus reducing foreign exchange expenditure. If unlimited potato seed imports were allowed (which has strict limitations now) the technologies may not prove as profitable but the strongest selling feature remains. This technology seed should be more uniform, disease free and vigorous than imported seed. Yield tests have shown these seed to be superior worldwide.

As the adoption of tip or TPS seed increases and enterprises expand ultimate seed costs could be reduced giving further competitive advantages.

Each 8x20 meter plant house with a 4 month capacity (two or more cycles per year) would probably employ 6 to 10 workers, and the field stage would employ approximately 300 mandays of family or hired labour for each acre of production. Other accelerators and multipliers would include increased construction,materials, transportation and advertising revenues.

5. SPECIAL RISKS INVOLVED

These are times when the infrastructure in Sri Lanka experiences serious shortcomings such as electrical failure, water cut off and delivery interruption due to road blockage. If the electricity did fail for 4 to 5 days and a standby generate was not available the tender plantlets in the laboratory stage could be jeopardized.

Epidemic outbreaks of bacterial wilt, foliar diseases and cyst nematode infection could jeopardize the need for seed stock.

If the technical manager provides cross training for the technical staff the absence of one member may not be serious for a short period. The net house is less dependent

on electricity than the stage 1 operation. Human failure can happen but efforts can be made to prepare for emergencies and rapid repair, absenteeism, and erroneous dosages etc.,

Natural calamities could destroy the laboratory, net house and field storage facilities and decimate the field operation, but man has an indomitable spirit of optimism and courage which calls him to meet challenges not shrink from them.

6. POTENTIAL FACILITATION

Start up capitalization may be needed to encourage persons to undertake this somewhat complex enterprise. Tax incentives, concessionary loans, and decreased import duties would be very helpful during the first three years.

Technical assistance is available at two of the local research stations. Marketing pathways have been established for almost a decade, and potato growers appreciate the value of good seed.

CONTAINERIZED SEEDLING PRODUCTION FACILITY

1. DESCRIPTION

1.1 Concept

Profitable and sustainable horticultural production depends heavily on how well the grower controls the growth and development of his fruit or vegetable crop. In vegetables, it is often important to have a series of harvests to avoid market glut; to be able to produce crops before others;and to be able to extend the season beyond other growers production periods. In the export market, and also for the upscale domestic fresh market, it is generally important to have products as uniform in shape, maturity and appearance as possible. Another very important factor is that every plant in the field is in place, doing what it is expected to, and not be a skip or blank space which earns no profit for the farmer.

The vehicle for providing these important features is called containerized seedling production. The seedling one starts a crop with (or the young grafted tree) is very much like raising children; they need to be fed properly, trained, cared for and given frequent attention so that they will grow into strong and productive adults. In containerized production each plant is given an individual space to grow in; and each plant must be able to be removed from this space without damage to the roots, stem or leaves; and each young plant is prevented from touching the soil until field setting time.

Containerized seedling production can be used for easily transplanted vegetables; difficulty transplanted vegetables; fruit trees; fresh trees; nursery stock; flower seedlings and nearly all crops started as seed or vegetatively propagated materials. The system has been proven and adopted by horticultural entrepreneurs world wide.

The system sells itself. When a vegetable grower sees the faster development, greater uniformity of growth and superior yields of containerized seedlings over ground bed produced plants he seldom goes back to the old style lifted seedlings.

The system starts with the container, which must be large enough to provide adequate material for a healthy root system; must be larger at the top of the container than the bottom for easy removal of the young plant without damaging the root ball; and the bottom must have an opening for the tap root to protrude.

The "material" in the container or "cell" is not soil but a substitute for soil. In Sri Lanka one could prepare an ideal growing media using coir (coconut husk grindings, well rotted rice straw compost and clean coarse, river sand). The reason for a soilless media, instead of a soil, is repeatability of results; freedom from soil borne bacterial

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and fungal diseases; nematodes and weeds; lighter weight; easier handling and water control.

Let us remind ourselves that this practice promotes control over the crop and creates a factory-like repeatability. This practice is highly dependent on knowing what to do, when to do it and how to do it. The procedures are simple, low cost and highly effective.

Soon after the seed is placed into its cell (which may be a rigid tray holding 10-60 cells or small individual pots) the tiny root emerges first and bends downward. The containers must be suspended above the soil so air can pass beneath the cells, the young roots should not be allowed to touch the soil as this would defeat a vital control feature of the system.

A typical cell for a tomato, pepper or eggplant is usually 5cm wide, 5cm long and 7-8 cm deep. The bottom of the cell containing the open hole should be approximately 3cm wide by 3cm wide. The media filled cell will provide adequate root growing space for 7-8 weeks. Cells for cucumber, squash, pumpkin, watermelon,and strawberry are usually 6 X 6 X 8 cms depending on how long they are to be held.

As the root extends downward and the small seedling begins to emerge from the soilless media, the single large root (or tap root) passes through the hole in the bottom of the container and reaches the air. Air kills the young tap root and this causes the development of a very dense fibrous root system within the cell. One might say that this is the most important feature of the system, as it is this dense, fibrous root system that gives the young plant it's great survivability; fast development; and vigour. It is the root system that makes the high yield, uniformity and profit.

Containerized plants have to be provided sound nutrient management and pest management; water management is seldom a problem because with suspended plants and free drainage, over watering problems associated with soil bed plant production are seldom encountered. Soft, leggy, stretched plants are seldom related to overwatering in this system.

The more uniform the media, seed source,and methods of handling the operation, the more factory-like the operation becomes. Seedlings can be programmed for target field setting dates, for particular harvest periods, or for extra early or extra late season plantings.

Seedlings are usually sorted into sizes, number of leaves, diameter of stems or some "marker" stage. To get a uniform field of a crop some "control growers" select plants within a narrow tolerance of stem diameter, putting large stemmed seedlings in one field, medium in another and thin plants are reserved for further growing in the plant house.

To provide greatest control over the seedling environment the containerized system usually requires a shelter of some type. In the West the polyethylene covered greenhouse is used, but the young seedlings do just as well in the tropics with a poly sheeted roof and insect proof netting on the sides and ends of the structure.

The method of suspending the trays or pots can be done with bamboo lattice benches, wire benches or T-rails made from steel T formed flat stock. Suspension is very important in this system. A tap root that touches the soil will penetrate the soil and a fibrous root system will not develop; the roots will be damaged when the plant is removed; and if the soil has soil borne diseases the young seedling may become infected.

The system is highly adaptable to forestry, agronomy and ornamental horticulture as well as to fruit and vegetable production. The system can be started small or large; capitalization is fairly low; risk is fairly low; but knowledge and tender loving care are of the highest premium.

1.2 The Market

Very little advertising for containerized plants is needed after the first year of operation. Some plant growers grow seedlings only for commercial horticultural enterprises such as vegetable fruit or flower growers; others grow only for the urban gardeners who want a few plants of this or that to grow near their house; some grow entirely for institutions such as for landscapers, for banks, factories,hospitals, etc. There is usually not a large market for government landscaping as they usually grow their own.

The seedlings grown for commercial growers are usually called"spec" plants as the farmer may wish to supply his own seed, want a certain stage of development, desire a specific size cell, or other specifications. For example, a Haputale vegetable grower may want to be first on the market with a hybrid muskmelon for the hotel trade in Colombo. If he specifies a 3 leaf seedling for a field setting date, the plant grower would know that a widely spaced seedling with a strong root system needs to be started 23-24 days ahead of time; given a low but complete nutrient feeding every 2-3 days; and watched carefully for crowding. If the seed leaves of a cucumber family (melons, cucumber, squash) shade the seed leaves of an adjacent seedling the first fruits are very likely to be too small for profitable sale.

The seed leaf (the first, somewhat smooth and rounded leaf one sees after the seedling emerges) is a very important marker for plant controlled growth. If the seed leaf (or cotyledon) is deformed, damaged or shaded the first harvest of many vegetables will be altered. If the young seedling is given too much water, too much nitrogen or too little light the seedlings will drop off and a smart farmer will not buy these out-of-balance plants as he knows they will not be the most productive.

An aggressive business person knows that one may need to give away (free, no cost) a few items the first year to get people to try a new candy bar or new school pen or to see how superior a containerized seedling plant can be. Word of mouth advertising takes over if the product is better tasting (or whatever). The containerized seedlings of vegetables, flowers, and small shrubs are easy to merchandise and can be sold in containers or as easily removed plants if they are to be planted within a few hours. Small trays about 25 cm by 10cm containing 6-8 healthy and attractive seedlings are called consumer packs, but commercial growers prefer the trays (or pot holding trays) which hold 60 to 70 seedlings. Many trays are made out of plastic and can be used 35-40 times,with periodic soaking in clorox type solutions to insure cleanliness.

Product identification is extremely important for repeat sales at the retail and wholesale level, but growers generally know who the reliable,quality plant growers are and remain loyal to them, especially for specification production.

Most seedling producers find retail sales at the greenhouse to be a detraction from the operation, thus often set up separate sales facilities for the smaller lot sales of variety items. The commercial grower plant sales are often higher volume lower unit price than the retail market.

1.3 Price

Containerized seedling production is as close to factory production as most growers will ever experience, and as such, cost per unit figures are usually easy to generate. The price for a seedling is based on size of cell, media, nutrients and ag.chemicals consumed, labour to produce and time required to grow the product.

In the United States where the use of containerized seedlings is very prevalent (approx. 93% of tomatoes, peppers, eggplants acreage) the cost is approximately 5-6 cents per plant (approx 14 Rupees per plant). Production in Sri Lanka using local media, labour and structures should cost much less to produce and the selling price could be much lower.

Very few agricultural enterprises can match this production for low entry cost, speed of recovery on investment and profit. A half million seedlings can be produced in a very small facility in less than two months time utilizing 3-4 skilled trainable workers and a very knowledgeable technical manager.

The price per plant seldom creates much sales resistance from a grower who has experienced the advantage of containerized seedlings, as one early pepper or tomato usually pays for the seedling! Most good farmers see that containerized seedlings don't cost, they pay.

1.4 Demand and Supply

Uva Province is almost in the center of vegetable production for the highlands and even for production areas further away plant shipments would be practical. From the size of the vegetable areas in Sri Lanka 10-12 moderately large containerized enterprises should be sufficient, but the need for fruit, shade, flower and ornamental rooted cuttings could be many times this number.

Quality seedlings would probably crowd out lower quality seedlings. Farmers often turn to quality seedlings rather than depend on ground bed seedlings that they have produced. It just takes one or two crops to convince even the most stubborn farmer that the few Rupees per plant is money well spent.

1.5 Project Timetable

Location of a site accessible to a main road, availability of a good source of water, freedom from shade over the structure, procurement of poles or timber,sheet film and netting,establishment of input linkages could take 3 to 6 months. The procurement of containers (trays or small sleeves) and development of media could be a significant constraint. In Africa polyethylene bags with part of the bottom cut away, banana leaf cups and stapled treated paper strips were used as low cost containers and were quickly assembled.

2. ESTIMATE OF PROJECT COSTS

The cost of getting started would depend a great deal on what the future entrepreneur had on hand, such as site, water supply, standing timber, etc. A moderately small greenhouse facility is presented in rough detail in Figure D-2-1. Most Sri Lankan agriculturists attempting this type of enterprise probably have basic construction skills and tools, if not, then a contractor should be used.

The seedlings grow just as well in a makeshift plastic greenhouse as they do in an 860 Rupees per square foot aluminum and glass greenhouse. It is important to make the structure as insect free as possible because the tiny whitefly that spreads the crippling leaf curl virus is very difficult to control and infects the plant in only 15 minutes of feeding time.

Green houses can be made entirely from bamboo, highway reinforcing steel mat or well planed timber. One of the simplest lowest cost production facilities involved a Quonset (half circle) type construction in which bent pipe comprised the rafters, with spacer bars separating these curved pipes one meter apart. A furrow 15-20 cms deep on either side of the structure was used to lock down the edges of the polyethylene tarp. The film was stretched tight over the ribs and held firmly by the soil (dampened and tamped) along the attachment edge walls. The end walls used a minimum of timber to which netting and doors were attached. The farmer, his wife and teenage son constructed the greenhouse and the bamboo caned benches themselves.

The greenhouse illustrated in Figure D-2-1 is 8m wide by 17m long and can produce 22,000-23,000 seedlings per cycle. The 5X5cm size for tomatoes, peppers, and eggplant and the 6X6 cm or larger size for (melons,etc) would alter the potential output, of course. The size container for fruit tree stock, nursery materials or forestry species each have their own characteristics, tree seedlings for forest plantings may be 5X7 cm at the top of the cell but the cell may be 8 to 20 cm deep.

ESTIMATE COST FOR CONTAINERIZED SEEDLING PRODUCTION FACILITY (Rupees)

Facilities, Supplies & Equipment	Farmer Constructed Basis Rs.	Contractors Basis Rs.
Cost of Materials	50000	75000
Cost of Timber	60000	135000
Cost of Labour	40000	100000
Cost of Trays etc.	20000	20000
Cost of Agric. c Chemicals	10000	10000
Sub total	Rs.180000	Rs.340000

Personnel

Technical Manager (for 3 greenhouses) 12000 X 12	=	144,000
Technical Workers (for 3 greenhouses)9000 X 12 X3	=	324,000
General Labourers (for 3 greenhouses) 4000 X 12X 3	=	144,000
Sub total		Rs.612,000

Utilities

If site has well and electricity already on hand the water charges could be nil, but electricity could be a significant recurring cost for lights and water pump,etc.

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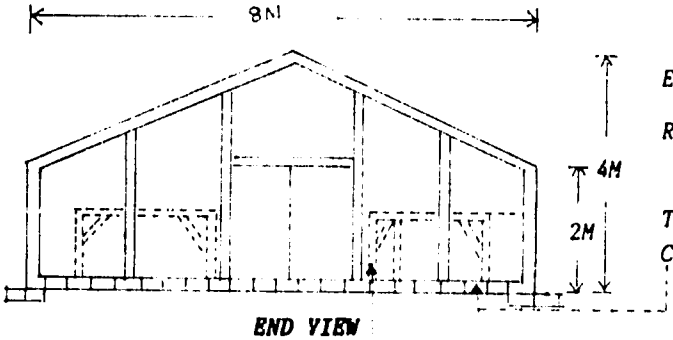
FIGURE D-2-1

STANDARD PROPAGATION SCREEN HOUSE WITH INSECT EXCLUDING NETTING



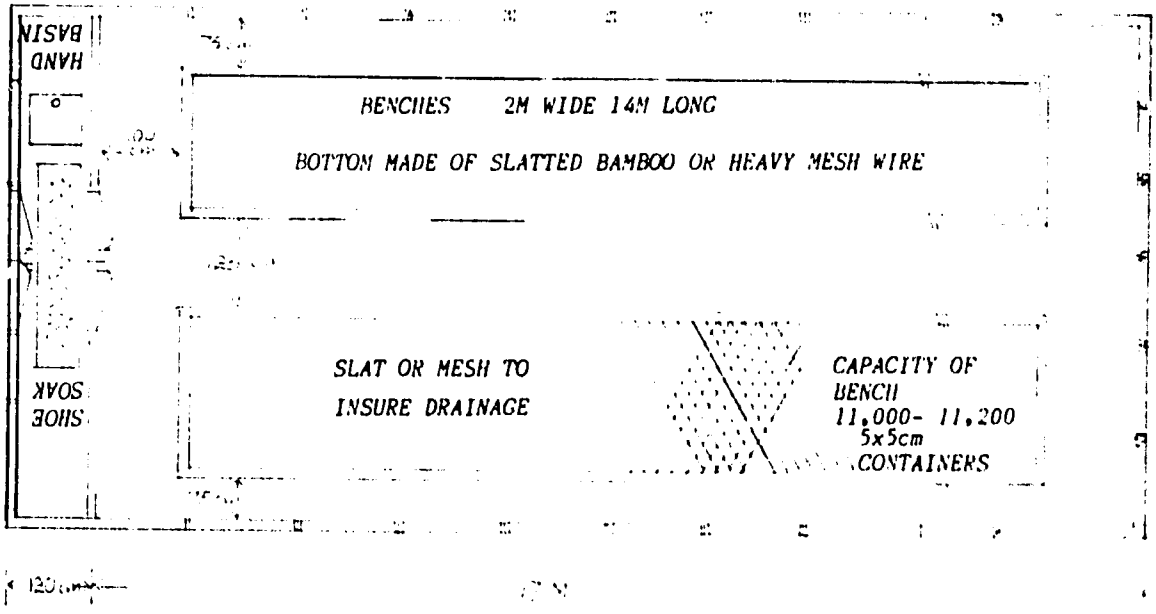
END AND SIDEWALL : NYLON FINE NET

ROOF : UV -RESISTANT POLYETHYLENE SHEET FILM

TRUSSES MY BE MADE OF WOOD, PIPE CONCRETE BLOCK OR POURED CONCRETE FOOTING

END VIEW

BENCH HEIGHT 100-110 CMS

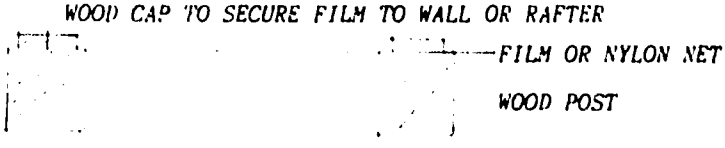


TOP VIEW SHOWING

a. DOUBLE ENTRY DOOR TO RETARD INSECT ENTRY

b. SLATTED BENCH DETAIL 2 BENCH HOLD 22,000 CONTAINERS 5x5cm

ATTACHMENT METHOD



3. GENERAL PROFITABILITY

If the assumption were made that an entrepreneur could start out with three 8 M X 17 M greenhouses each with a capacity of 22000 seedlings per house and could produce at least 4 cycles of "crop" per year the following would be possible. Let us assume also that the entrepreneur either took part in the construction and used some family labour in the seedling production.

Cost of facilities 250000 X 3 house	= Rs. 750,000
Annual Cost of staff & labour	= Rs. 612,000
Annual Utilities, Miscellaneous,supplies	= Rs. 200,000
TOTAL	= Rs.1,562,000

Let us assume the sale of 95% of the seedlings produced
22,000 X 3 X 4 cycles X 0.95% = Rs. 250,800

If the price received was 4 Rs. per Seedling = Rs.1,004,000 gross sales

If the price received was 3 Rs. per Seedling = Rs. 753,000 gross sales

If the structure was well constructed of treated timber or pipe it should have a useful life of 7-8 years,although the plastic sheet tarp for the roof would have to be replaced every other year if ultra-violet resistant polyethylene was used. Trays if cared for can be used for 30-35 cycles, and the price per seedling becomes almost negligible.

If the entrepreneur had to borrow only a small amount of capital to get started with, his money charge could be small but if high interest rates were used repayment could be punishing. Transport of the finished seedlings is usually the farmers responsibility but if retail sales were intended transport charges would need to be considered.

The figures above may be too conservative because a good plant grower would have at least 4-2 month vegetable seedling cycles and then fill in the other four months with fruit or ornamental plant propagation activities.

The gross could be easily over one million Rupees per four cycles and if costs were estimated on the highside, the potential annual return could approach Rs.200,000/-.

4. ECONOMIC DEVELOPMENT CONSIDERATION

The economic benefit to the containerized plant grower is significant; (and to those employed in the operation) but a far greater accelerator and multiplier effect is usually felt in more controlled production by the farmer. Controlled production makes possible

a more orderly supply of fruits and vegetables which helps in entering markets and retaining market share.

As the area becomes better known for its uniform supply of high quality fruits and vegetables its potential increases. The area could also acquire a reputation for superior seedlings and vegetatively propagated fruit and ornamental plants.

5. POTENTIAL RISKS

Economic downturns; catastrophic storms; epidemic level disease pressures; or extended periods of dark cloudy weather; or severe air pollution can upset this type of enterprise seriously. The great uniformity of this type of production also carries with it a possibility of "blanking", (such as if a soilless media became accidently contaminated with a herbicide an entire cycle could be unsateable).

The grower has to maintain a constant vigil to catch problems before they get beyond control. By cross-training technical staff, the departure or absence of one member would not cripple the venture. A comprehensive knowledge of the insect, disease and physiological disorders that may be encountered should be thoroughly understood and constant monitoring practised. Critical supplies must be close at hand or stocked at the site. Instruction to workers must be thorough and closely checked for accuracy because small miscalculations of pesticides and nutrient solutions can spell disaster, too.

Incentives to do a careful job can be encouraged among workers by awarding bonuses for quality level or quantity produced.

6. POTENTIAL FACILITIES

Containerized seedling production could play a vital role in the up-grading of the horticultural potential of the area and should be given moral support. In addition there may be a requirement for financial assistance with the initial capital cost.

Most of the seedling production operations start out in small ways and grow larger year by year as the entrepreneur expends his knowledge, his market and his reputation for superior seedlings.

INTEGRATED HORTICULTURAL PRODUCTION AND MARKETING ENTERPRISES

1. DESCRIPTION

1.1 Concept

Horticultural products have a lower per capita consumption in Sri Lanka than nearly every other country in the South Asian and South-eastern Asian region. Accurate consumption figures are not available, but it appears that total fruit and vegetable consumption (as measured by expenditures for food) is less than 10 kg per person per year. The actual figure is, of course, much greater as most land owners or lease holders have home vegetable gardens and a few fruit trees for family consumption. The portion of these commodities in the total food consumed by Sri Lanka is approximately 10-15% whereas in many other Asian countries fruits and vegetables contribute 30-35% of the total.

Sri Lanka now has over 17 million people. It is estimated that more than 3 million more appetites will be added in the next 10 years. These figures show that Sri Lanka has a large home market for fruits and vegetables in addition to the export opportunities being considered. Unfortunately, the economic studies on food consumption show that the lower income groups cannot afford fruits and vegetables; thus a great part of the market may remain somewhat unavailable until the general economy improves; disposable income increases; appreciation of the role of fruits and vegetables in human health widens; and retail prices make these commodities more accessible.

Opportunities abound for a wide range of highly efficient, market oriented horticultural enterprises. Those entrepreneurs who can produce the most high quality produce in the least time, least space, least labour and cost and least environmental stress will have decided competitive advantages. The secret to success in horticultural production is the use of knowledge to control the crops growth and development from planting to consumer acceptance.

1.2 Methods

The modern efficient fruit and vegetable producer knows what the market wants, how it wants it and even how and when it wants its products. This knowledge must come before field selection, variety determination and the first seed or planting material is put in the soil. Once determined and the crop is initiated, the challenge of control over the crop's growth and development begins. The difference between a mango tree in someone's backyard and a mango tree in a well managed orchard is an example of this "control". The backyard mango may be only one of a number of varieties (perhaps a seedling, too); it may receive occasional fertilizer and water, or it may suffer frequent stress; and the pest management may be minimal or excessive.

Controlled production places the most adaptable, highest yielding, best quality cultivars of the greatest market acceptance under cultural conditions which provide minimum stress. By reducing the wide swings in soil moisture, nutrient availability, soil aeration and environmental stress crop growth and development can be a steady progression toward the desired yield, quality and uniformity of raw product. It is under these practices that inputs and profits in horticultural production maximize.

The nation has an abundance of commercial vegetable operations but few commercial orchards. The crop spectrum is extensive, there are already grapes on dry hill sides, potatoes and cabbage in the areas with cool night temperatures, and rambutan in the hot, wet lowlands. The production is diffuse, fragmentary in supply and profitability quite incosistant. The difference between the current enterprise approach and the controlled production method is purposefulness. The key to controlled methodology is to plan your work and work your plan.

1.3 The Market

At present exporters find the supply lines of fresh fruits and vegetable difficult to deal with because they are erratic and quality uncertain. An exporter, or a commission merchant selling to a large hotel chain, is expected to maintain an acceptable quantity and quality over long periods. When this supply is broken the market opportunity may be interrupted or lost entirely. In severe cases the supplier can be fined if contracts are violated.

Controlled production is not magic or perfect but it does afford as much control over supply as humanely possible Nothing can be done about natural environmental disasters, epidemic pestilence or civil strife but nearly all of the normal production factors can be managed with watchfulness, use of the correct technology, and timely attention to details.

Built into much of the "crop control" concept is the possibility of prediction of both yield and harvest period. In some crops which have starch to sugar conversions dictating quality and acceptance harvest date can be very critical. Green peas for the cannery may change from a high sugar status to an undesirable, over-mature, starchy product after 1900 heat units of growth have elapsed. The harvest would be scheduled to be made just before that growth period occurs. Fortunately most crops do not require that close action but maturity determination is a vital factor in successful marketing with most horticultural corps.

Maturity must relate to market time distance. If a tomato is to be sold at the local pola market tomorrow it may be allowed to reach a full red maturity. If the product has to travel to Colombo and go through two or three days of handling before it reaches the consumer then it should be picked and carefully handled in the early blossom colour stage. If the product is expected to be on a container ship for four days, and has one

or two days movement through channels at destination, and has required one day travel from assembly point in the production area and one day awaiting the transport at the Port of Colombo then the grower shipper better plan on harvesting the fruit at the mature green stage.

1.4 Components

Controlled production is actually more technology dependent than input dependent. Many of the practices use fewer inputs than do other methods because the correct amount of fertilizer at the proper time may require less fertilizer; careful monitoring of crop fields tells when and if pesticides may or not be needed; harvesting before the field heat has built up in a crop saves costly refrigeration for cooling.

Controlled systems are usually matched with sound record keeping, continual analysis of the cost benefit relationship and a search for on-going improvement of the program. Through careful analysis of records of climate, soil, field history, labour and input use the entrepreneur can plan better, avoid costly mistakes and help to understand cause and effect relationships when something does go wrong.

There is a delicate balance between adequate specialization in order to achieve efficiency, critical mass of product to command a market and yet being diverse enough to enjoy risk spreading. The secret seems to be in finding the most compatible sub-enterprises. The way this is done is to assess peak harvest periods, labour load of the crop and cash flow relationships. The following table depicts peak harvest periods for some of the major fruits and vegetables in Uva Province: (From Technoguide 91 and DARP Reports 88-91).

A more detailed depiction of the planting and harvesting periods for Up-country Intermediate horticultural crops is shown in Figure D-3-1.

Vegetable crop	Peak Harvest Period	Fruit Crop	Peak Harvest Period
Beans, Bush	Feb 1 - June 15	Banana	1 May- 30 July (all year)
Beets	Jan 1 - June 15	Cashew	1 May- 30 June
Brinjal	all months	Coconut	all months
Cabbage	Feb 1 - June 1	Mango	1 Jan -30 Mar 1 May - 30 July
Chillies	all months	Guava	all months
Okra	1 Dec - 31 May 1 Aug - 30 Oct	Pineapple	1 April - 1 Aug
B Onion	1 May - 1 Nov	Papaya	1 Apr - 1Aug.
Potato	1 Feb - 1 Mar 1 Oct - 30 Nov	Lime	May - June (all year)
Tomato	15 Feb - 15 Oct	Passionfruit	1 Aug - 30 Sep

One would probably try to "equalize" shipping periods by selecting best fit of enterprise cropping patterns. The needs for starting the crop also have unique requirements and must be considered.

The relative labour requirements of these same crops would be typically part of the selection process, too. If controlled production were to be practised these figures from the Ministry of Agriculture Enterprise Budgets 1991 would be high in some cases and low in other, so should only be considered as an element of a process not precise data.

FIGURE D-3-1 - PLANTING AND HARVEST PERIODS FOR UP-COUNTRY INTERMEDIATE HORTICULTURAL CROPS
(ADOPTED FROM TECHNOGUIDE 1990, MAYNARD AND LORENZ 1990)

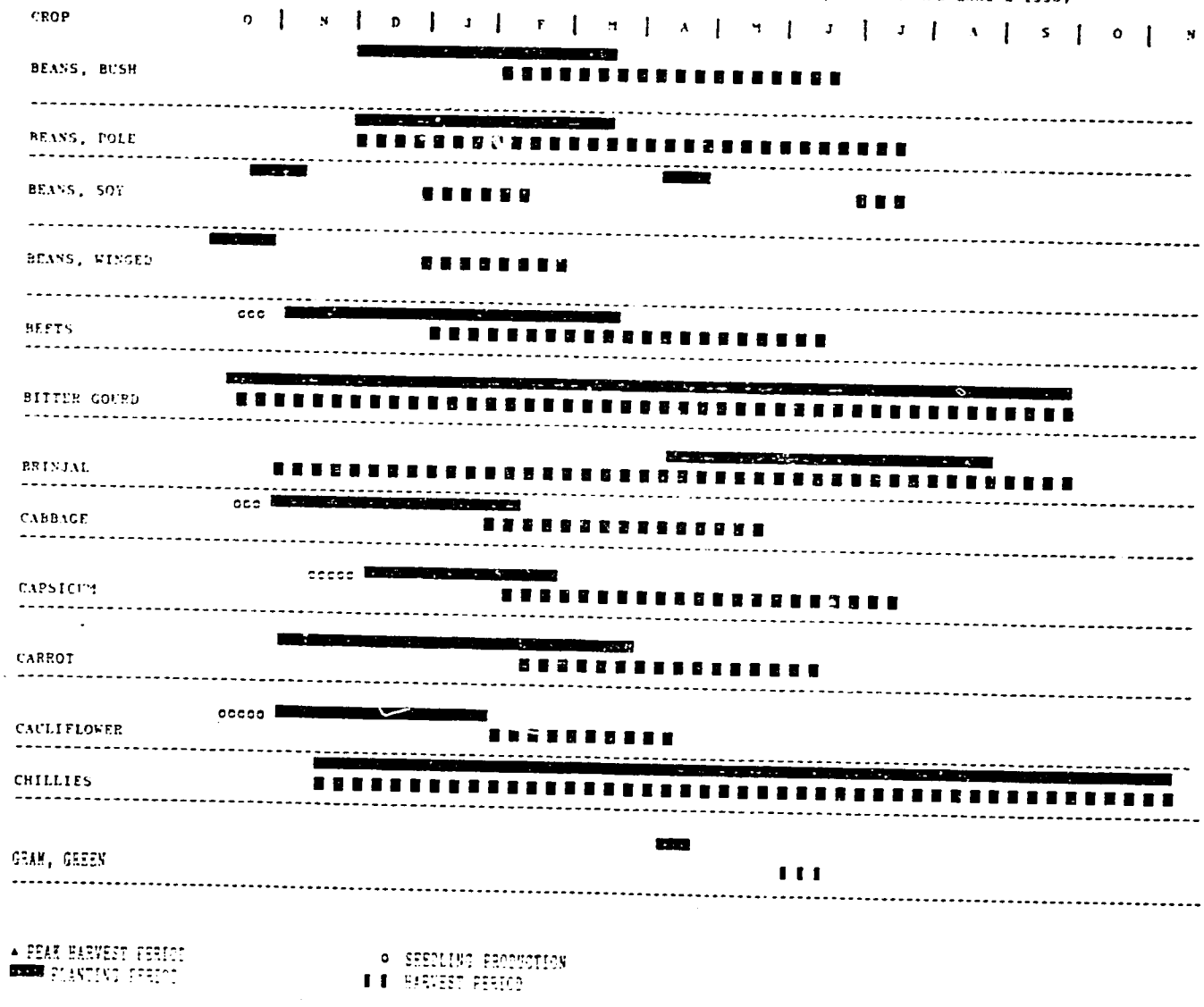
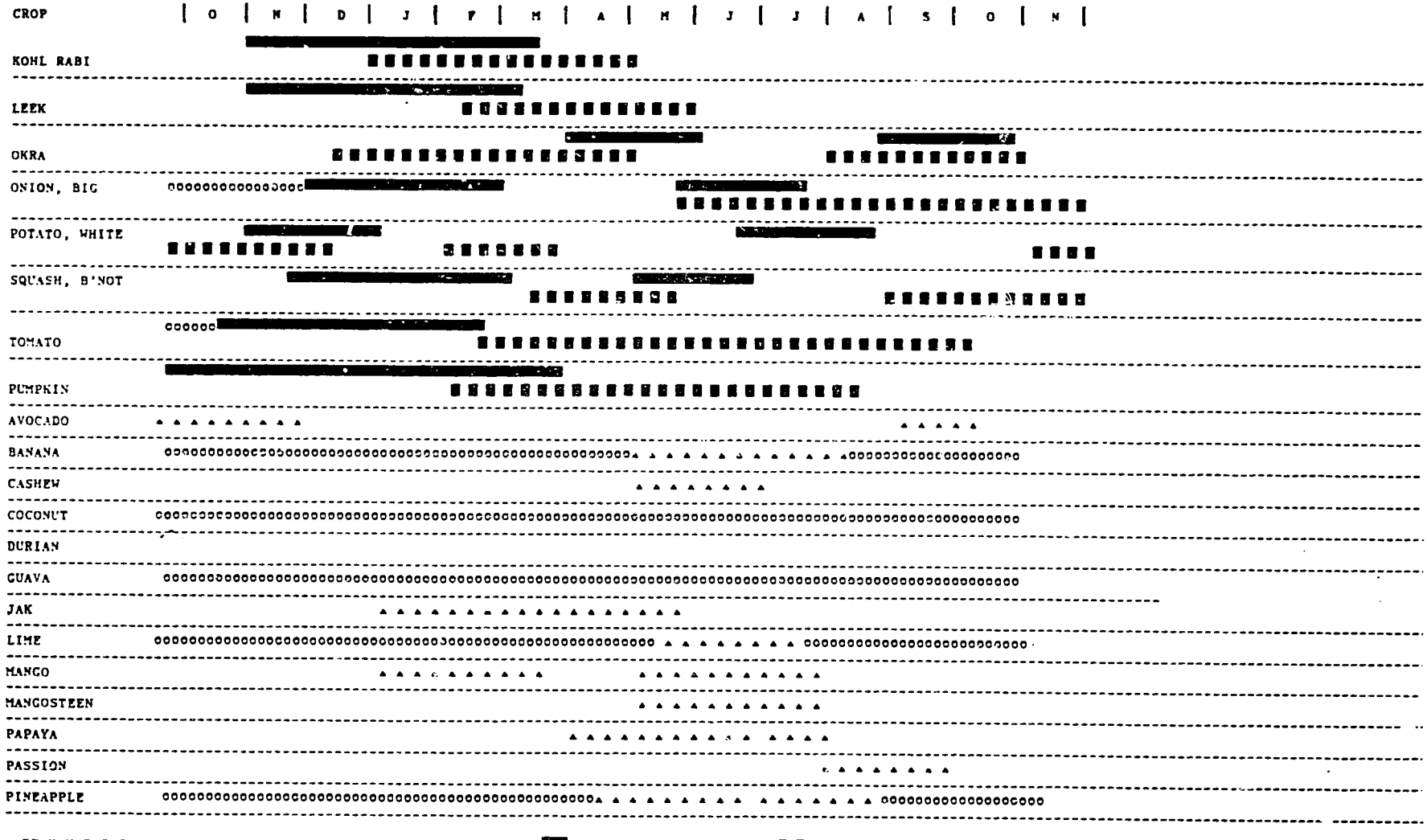


FIGURE D-3-1 - (CONTINUED)

AGRO-ENTERPRISE
OPPORTUNITY 3 APPENDIX D



▲ PEAK HARVEST PERIOD PROFIT o SEEDING PRODUCTION PLANTING PERIOD HARVEST PERIOD

Crop	Labour Requirement (man days per crop or year)	Crop	Labour Requirement (man days per crop or year)
Bush beans	69	Banana	370
Beets	305	Cashew	not available
Brinjal	313	Coconut	not available
Cabbage	223	Mango	138
Chillies	197	Guava	not available
Okra	235	Pineapple	250
Big Onions	300	Papaya	115
Potato	223	Lime	190
Tomato	183	Passionfruit	112

The relative cost of production factors would be an "automatic consideration" of a business person thinking of a horticultural enterprise. A few comparisons are presented but as these change drastically with time they can only serve as discussion points:

Crop (1991)	Cost of Production (per crop) in Rs/ha	Crop (1991)	Cost of production (per crop) in Rs./ha
Beans	56,770	Banana	92,275 (year)
Beets	101,625	Mango	39,036 (year)
Cabbages	68,125	Papaya	48,174 (year)
Okra	42,925	Pineapple	53,630 (year)
Bittergourd	70,215	Passion	52,759 (year)

As so much of the cost of production is due to labour the controlled production method maintains a continual program of maximizing labour efficiency; substituting labour saving devices as much as possible, and in high labour cost areas the substitution of machines for manual labour. In Sri Lanka the need to provide employment rather than use machine should be given high priority, unless the situation jeopardizes the success of the enterprise.

Yield and quality are usually associated with the best match of crop requirements and the environmental components available. For example, grapes, jak fruit and rambutan are highly sensitive to poor drainage and would not do as well in Badulla District DL-1 zone as they are likely to do in the Monaragala District IM-1 and IM-2 where drainage is good. Bananas grow best in warm humid low elevations but are adaptable up to 1800 meters; whereas jak fruit, anona, durian and tamarind are more restricted to the low lands.

At this point one should elaborate on the strong difference between purposeful, controlled enterprises and the more traditional approach. Sri Lanka has the potential to grow the full range of tropical and sub tropical fruits and vegetables. Most of them do grow (or at least survive) in most agro-ecological zones but may not be profitable if dependent on rainfall or low inputs.

With irrigation, proper fertilizer rates, effective pest management, improved cultural practices and well managed, integrated programs one could take most of the well drained soils of Badulla or Monaragala District and make an effective enterprise. Collecting all of the facts about crop requirements, labour, inputs required; matching the environmental needs with the appropriate agro-zone; and deciding on the most effective crop production approach is a large part of the controlled systems method.

The modern horticultural manager has many well proven practices to help manipulate crop growth and development. Most entrepreneurs try to own or manage as much of the product, postharvest and marketing sequence as they can. If continued plantings of fruit tree grafted stock is needed many try to have a functional nursery to provide high quality, clean, true to name materials when they want them, in the quantities they want and at their own managed price. If a tomato grower wants to provide top quality tomatoes to the hotel and elite markets he needs to be able to have top quality transplants of his own.

To have a continual supply of well, shaped peppers, cucumbers and melons the grower should use mulch to insure a uniform root environment for these crops which require high root oxygen and an even nutrient and moisture supply. To have the sweetest (or tangiest) onions which will stand up well in market channels one must control the soil moisture during final bulb maturation.

In many of the controlled operations profit can be enhanced by temporary or moderate term storage. Well cured potatoes, tight necked onions and bruise-free, healthy crops of all types keep better than those handled less carefully. Poor products can't be helped with even the best of storage facilities. Only properly harvested products justify expensive storage and shipping facilities.

2. ESTIMATE OF COSTS

To attempt to present cost projections for a broad array of horticultural enterprises would be naive, probably misleading, and certainly of little specific help to the decision maker. The biggest decision would be the degree of commitment to the enterprise and how much control one wishes to have over the crop growth and development. If export product is intended, then a continual supply of high quality raw product must be programmed. If the production is intended for processing the production of satisfactory quality at least cost of growing and harvesting must be programmed. If production of high quality "almost vine ripe" fruits and vegetables are to be geared for the "elite markets" such as resorts, hotels, airlines, cruise ships, etc., then the production must be carefully sequenced for an array of products handled quickly and carefully and presented on a rather specific schedule, as time may be more critical than with other markets.

The decision maker would need to gather as much information as possible, conduct a feasibility study of the intended enterprise; interview as many people links in the production, post harvest and marketing sequence as possible; review his resource base; examine the supply of inputs potential (equipment, chemicals, labour) and lastly; pray for the wisdom to make a wise decision.

3. PROFITABILITY AND FINANCIAL CONDITIONS

Most agricultural endeavours are subject to the whims of nature, inconstancy of human preference and wide variations in the global supply of money and competing products. Horticultural enterprises can suffer economic cycles of short term as well as long period disruption. Vegetable crops are noted for their two out of three profit cycles, which means that in year one a grower may be the sole supplier and make high profit. In year two, watchful neighbours enter the production arena and the over supply causes low prices, low profit. In year three, few of the new comers persist, and those who do stay in make a modest profit as the demand and supply adjust. The cycle repeats and repeats; however, the real professionals who are superior managers and have control over their production and at least a part of their marketing opportunity, do not suffer much. Once a strong market linkage is established for superior quality, buyers remain loyal, especially if they understand this cycle.

Fruit growers, especially with perennial crops do not experience this short cycle problem as their investment is longer term; however, they have a longer period before income can be expected (tree fruits may require 4-6 years before bearing): This situation is less likely to attract persons who want to make a quick fortune. The long term cycle in tree fruits can be disrupted by major changes in consumption due to rise and fall of disposal income of the target market; development of competition from the adjacent countries; change in land ownership on which the orchard may be located; major insect,

soil borne or foliar diseases (bacterial, fungal or viral) epidemics; major climatic changes (typhoons, air pollution etc); and changes in quarantine regulations for export fruits.

It is very easy to list a group of crops that have promise for solid enterprises but many require hard research and adaptability testing before commercial ventures can initiate actual operations. More than a dozen consultants have made recommendations for horticultural crops which can or should be expanded. Some would be for export fresh market, others for domestic consumption, some for canning, dehydration or pickling.

There are research and adaptability trials on many of the fruits and vegetables now growing in Sri Lanka, but there is quite a difference between crops barely adaptable and barely profitable and those which can be produced profitably.

Some of the vegetable crops which have been singled out as good candidates are:

Asparagus	Snowpeas	Muskmelon
Brocolli	Fancy Cabbage	Honeydew Melons
Brussels Sprouts	Bell Peppers	Watermelons
Cauliflower	Zuchini Squash	

The perennial fruit crops were evaluated and categorized into those suitable for major development in the near future and those "potentially significant future development". They are presented as follows:

A. <u>Major Development</u>

Banana	Lime	Lemonlime
Pineapple	Cashew	Lemon
Mango	Papaya	Other Citrus
Passionfruit	Grape	Palmyrah
Rambutan	Grapefruit	Jak Fruit

B. <u>Future Development</u>

Avocado	Tamarind	Logan
Breadfruit	Durian	Macadamia
Woodapple	Carambola	Guava
Strawberry	Soursop	Persimmon
Mangosteen	Lychee	Sapodilla

Tables 3-11 and 3-12 show the climatic and soil related preferences of 17 vegetables and 20 different fruit crops. Adaptability to poor soils, poor drainage, best elevation (low land and highland) rainfall needs, and temperature preferences are considered.

For example, the date palm prefers low rainfall, high temperatures, lowlands and tolerates moderately poor soil and poor drainage.

Most crops respond to proper soil nutrient and moisture management, pest management and the appropriate cultural practices, so "tolerates poor drainage" does not mean that yield and quality couldn't be improved with better conditions.

4. ECONOMIC DEVELOPMENT CONSIDERATIONS

The enterprises proposed in this brief presentation are all technology dependent. This means that there would have to be well trained leadership in the decision making and execution stages of the enterprise. Effective business managers and trained administration personnel would be needed. A cadre of worker-leaders would be needed as foremen to supervise the labour. In the actual operation of a controlled production, postharvesting and marketing enterprise there is usually quite a subdivision of labour. It may be that one crew looks after land preparation, planting, nutrient and water management; another looks after pest management, another looks after cultural practices (pruning, staking, thinning, etc); and another crew looks after harvesting and handling, packing and preparation for market.

Many jobs are generated, and employment in these operations raises the technology level of the workers which increases their lateral mobility. Very smart operators enhance work loyalty and diligence by providing above average salaries and bonuses for high quality production (even a small percentage of sales has been found to be a positive incentive).

These enterprises are technology dependent but do not require high tech gadgetry to ensure success. Modern pest management is based on a simple magnifying glass, a clip board, a trained eye, careful observation and a high interest in keeping pest levels at an economically acceptable level.

One could go on and on about the accelerators and multipliers that accompany all business ventures; such as trucking, suppliers of chemicals, containers etc.

5. SPECIAL FEATURES, RISKS AND ISSUES

Entrepreneurs must be part gambler to even consider a new venture. Having the correct knowledge about the requirements of the enterprise is second in importance to capitalization, because wrong assumptions can be costly or even disastrous. There is an ancient adage that a good carpenter measures twice but saws once. Another important facet is to know what supplementary assistance may be available if needed. In the case of horticultural enterprises there are many highly trained professional researchers, professors and extension specialists in Sri Lanka who can give valuable

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advice. The allied industries (fertilizers, equipment and chemical dealers) are another very fruitful source of counsel. These are but a few examples of resources.

An effective "library" of appropriate publications on the crop to be grown is needed. Trade journals are valuable avenues of new information about varieties, market trends, practices and equipment innovations. An alert and committed horticultural entrepreneur does as much travelling to markets, competing areas and research field days as he can afford. Another very important risk minimizing effort is to be sure that several or many people are cross-trained for each segment of the operation just in case of emergency absences or other interruptions.

Risks are part of all business ventures. How one handles all levels of stress determines success and sustainability.

6. POTENTIAL FACILITATION

Some horticultural enterprises would be entirely self-capitalized ventures (which include credit from private financial institutions); some may need some development incentives to get started; still others may be "spear head ventures" which could bring others into similar ventures (export fresh or processed products) and thus justify a certain amount of under writing by the government or some donor agency.

One could start in a very small way into some highly specialized horticultural enterprise such as the production of high quality cucumbers, tomatoes and lettuce in a plastic greenhouse and arrange for delivery to a special restaurant for highest profit. This type of enterprise has been profitable and the control over excess rain, and avoidance of pests through netting, and careful monitoring of soil fertility and moisture can result in some impressive gross incomes.

Some entrepreneurs capitalize through a partner system; rich relatives, sale of stock or whatever. No matter how the funding comes about the debt repayment become a significant business expense. Interest expense is usually kept at a minimum if at all possible and should be paid off as soon as possible as long as it does not jeopardize the cash flow of the new enterprise.

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PACKING HOUSE AND COLD CHAIN FOR FRESH FRUITS AND VEGETABLES

1. DESCRIPTION

1.1 Concept

Sri Lanka is geographically located so it is possible to export its fresh horticultural products to Asia and to the Middle East. Europe is further away but still close enough to be considered as a market. Horticultural crops have been exported for the fresh market for several years,particularly to Singapore, Hong Kong, the Maldives and Dubai.

Labour costs in Sri Lanka are low, so the production costs of labour intensive operations are low compared to countries like Taiwan and Thailand. As a result, there is considerable interest in increasing Sri Lanka's exports of fresh horticultural crops. To accomplish this, a small packing house with cold chain abilities would be helpful in preparing good quality fresh products for export.

1.2 The Market

The following table depicts the current level and past trends of fresh fruit and vegetable exports from Sri Lanka.

Year	Export Values (In Rs. Millions)
1979	4.7
1980	14.1
1981	27.9
1982	47.0
1983	48.4
1984	52.2
1985	63.1
1986	71.1
1987	75.1
1988	96.0
1989	138.2
1990	170.0
1991	285.5

Source: Medium Term Plan for the Development of Fruit and Vegetable Exports from Sri Lanka, by Rohan Fernando, June 1992

The main markets for the next few years are expected to be Singapore, Hong Kong and Dubai. Of those, Singapore has the largest volume. The following table shows the Singapore imports of fresh fruits and vegetables for 1989.

SINGAPORE - 1989 IMPORTS OF FRESH & VEGETABLES
MAJOR SELECTED ITEMS IN TONS AND 000'$ SINGAPORE

ITEMS	TONS	$
Potatoes	18,186	9,490
Tomatoes	6,316	3,633
Onions	63,681	38,315
Garlic	33,029	33,579
Other alliaceous veg.	5,228	5,747
Cauliflower	4,925	10,953
Cabbage	12,254	9,047
Leafy Vegetables	51,670	35,663
Carrots	9,212	11,960
Other Roots/Tubers	5,805	2,950
Fruited/Leguminous Veg.	33,059	15,504
Chillies	7,029	7,073
Other Fresh Veg.	1,754	6,412
Sweet Corn	313	719
Vegetables Sub Total	252,461	191,045
Oranges	44,085	74,219
Mandarins	3,817	3,966
Grapefruit	828	1,394
Other Citrus	1,879	1,569
Bananas	24,914	8,351
Apples	42,383	62,632
Grapes	9,001	35,048
Melons	31,631	13,855
Papaya	15,723	5,931
Pears & Quinces	23,129	39,134
Stone Fruit	2,880	9,785
Berries	313	2,585
Pineapples	13,028	2,151
Dates & Figs	7,623	9,559
Avocadoes,Guavas,Mangoes & Mangosteens	11,047	9,509
Durians	34,493	44,845
Logan	2,813	5,596
Lychees	2,796	5,547
Other Fruit	17,992	15,861
Fruit Sub Total	290,375	351,537
TOTAL	542,836	542,582

SOURCE: TABLE 3, THE SINGAPORE MARKET FOR FRESH FRUITS AND VEGETABLES, BY HENRY HARMON,JULY,1990

Mr. Henry Harmon also has made studies of the Maldives and Dubai. The reports of those studies contain valuable information about volumes and prices.

Japan is a good market for products of high quality. One problem relates to fruit flies (which are prevalent in Sri Lanka). Japan does not permit imports of products that can be host for the fruit flies. For Sri Lanka, this means that products such as papaya, mangoes and oranges cannot be exported to Japan. Singapore, Hong Kong, Dubai and Europe do not have fruit fly restrictions.

A good person to contact for marketing strategy of fresh horticultural exports is:

Mr. Henry Harmon
Mahaweli Agriculture & Rural Development Project
24 Bullers Lane, Colombo 7, Sri Lanka
Telephone : 508885 or 443406

Another source of information is the Sri Lanka Fruit and Vegetable Producers, Processors and Exporters Association.

1.3 Description of the Packing house and Cold Chain Facility

If Uva Province were to build and operate a small packing house and cold chain, the facility probably would be very similar to the one at Aralaganwila near Polonnaruwa provided by the MARD Project. A second packing house and cold chain of similar design is now under construction by Aitken Spence at Timbolketiya in Sabaragamuwa Province near the Uda Walawe Reservoir.

A packing house of this type would be useful in several ways:

a. For preparing fresh fruits and vegetables for export. Functions performed here would include hauling from the field in plastic field boxes, washing, grading,sizing, application of decay control chemicals and wax, hydrocooling when needed, packing in corrugated boxes, palletizing, precooling, cold storage and shipping.

b. For storing crops for a week or two when a glut exists in the domestic market. This could be of value at certain times but must be considered an added benefit of cold storage. Also, the cold rooms may not be available when needed.

c. For storing crops temporarily prior to processing. Again, the cold rooms may not be available when needed.

Crops that show promise for processing in a packing house with cold chain capabilities include melons (cantaloupes), pineapples, mangoes, papayas, bananas, grapes, mangosteens, rambutan, green beans, baby corn, sweet corn, asparagus, zucchini, eggplant, broccoli, cauliflower, okra, brussel sprouts, cabbage, snowpeas, bell peppers, chillies, taro, onions and many leafy vegetables.

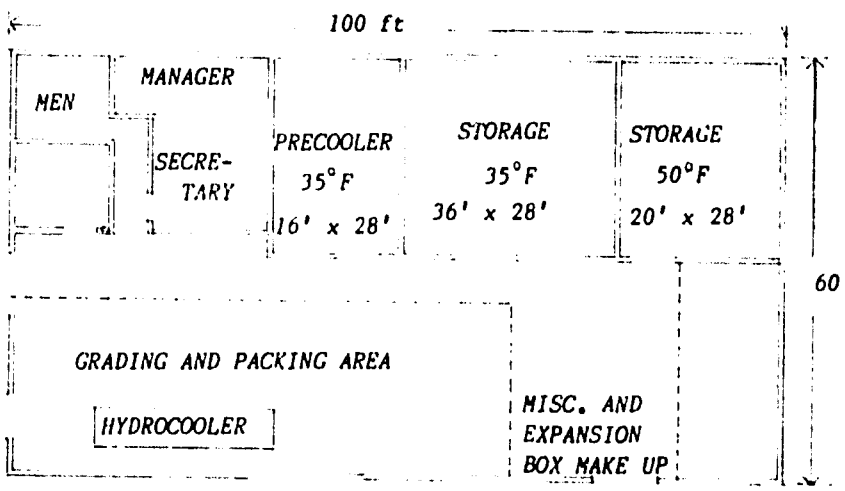
Some of the benefits that would result from the use of a packing house and cold chain are as follows:

* Elimination of substandard grades and therefore increase in overall quality
* Prevention of decay
* Increased shelf life of the products
* Enhanced appearance
* Uniform sizing
* Uniform grade and quality
* Ability to package as required by customers
* Ability to fill larger orders with the required size and quality of products
* Recognition of the packer's label or brand in the market
* Increased profits

The same type and design of the MARD packing house and cold storage rooms at Aralaganwilla should be considered for Uva Province. The crops and general purposes are very similar.

A layout of the MARD packing house in Figure D-4-1.

FIGURE 4-1 A LAYOUT OF THE MARD PACKING HOUSE



Source : Packing house and cold chain requirements system B
by Frederick Henry, March 1991 MARD/MDS Projects

Two studies were made prior to building the MARD packing house.

1. "Postharvest Needs Assessment for System B Mahaweli Irrigation Project in Sri Lanka" by Jack Ross and Joel Hamilton, July 1990.

2. "Packinghouse and Cold Chain Requirements System B" by Frederick E. Henry, March 1991.

The following discussion has information taken from those two reports and adapted to the situation in Uva Province.

A packing house of this type would have a production capacity of about 40 metric tons of packed produce per 8 hour day. Plastic field boxes of 50 pounds per box would be used to transport product from the field to the packing house. About 5,000 field boxes would be required:

Crops packed could include:

Cantaloupe (Muskmelons)
Pineapples
Mangoes
Papayas (Papaws)
Bananas
Grapes
Asparagus
Zucchini
Eggplant
Broccoli
Cauliflower
Sweet Corn
Baby Corn
Okra
Brussel Sprouts
Cabbage
Snowpeas
Bell Peppers
Chillies
Taro
Onions
Leafy Vegetables

The packing house should have a hydrocooler, one pre-cooling room and 2 cold storage rooms. The remainder of the equipment should be simple, low cost and labour intensive,

at least for the first year or two. Grading, sizing and packing can be on flat tables that are multi-purpose for use with a variety of crops.

A few crops such as cucumbers, citrus, bell peppers and tomatoes may require an application of wax and fungicide. Additional mechanized equipment would be needed for this purpose. This can be added at a later date.

Shipping containers would be corrugated fibreboard boxes that can be manufactured in Colombo. These boxes can be formed and sealed by hand so no equipment is needed for that purpose.

2. ESTIMATE OF PROJECT COSTS

A packing house and cold storage facility would require a major investment. A detailed feasibility study should be made to determine the profitability. This should include the crops to be processed, the crop volumes needed to generate a profit, the number of days of operation per year, month and week, the marketing channels, and the method of providing the necessary inputs of the correct quality, quantity,and time frame.

The total capital cost of the packinghouse and equipment is estimated to be about $ 350,000 US(15 million Rupees). This includes the building, hydrocooler,one precooler room and two cold storage rooms, simple tables for grading and packing, an emergency generator for electricity, and a water treatment plant. Land costs are not included.

Other capital costs depend on the specific project and situation. Assuming it would be necessary to purchase land on which to build the packinghouse, purchase two refrigerated lorries,three 4 wheel drive vehicles, 4 motorcycles, office equipment, a telephone line and miscellaneous equipment,an additional capital expenditure of US$ 350,000 is estimated thereby making a total capital cost of US$ 700,000 (30 million Rupees).

Entrepreneurs in Uva Province can visit and observe the MARD facility at Aralaganwila. It has been in operation since June,1992. Results so far are encouraging but is too early to form conclusions about profitability or the overall success.

Operating capital would be required. The cash flow can be quite high if the capacity of 40 metric tonnes per day is attained and payment is made when raw materials are delivered to the packinghouse.

3. ECONOMIC DEVELOPMENT CONSIDERATIONS

The economics of Uva Province would be benefitted by this project. Farmers should have increased profits, agribusinesses would bring more money into the community, new jobs would be created, and the quality of crops that are exported would be upgraded. Increased volume of supporting industries is another benefit.

4. SPECIAL FEATURES AND ISSUES

This project would create increased cooperation between farmers and agribusinesses. Probably a private agribusiness would have an investment in it and also have management and marketing responsibilities. Contracts with farmers for growing the raw-product would be used, thus assuring both the farmer and the packinghouse of a continuing relationship. It is expected that new crops would be needed thereby requiring assistance of agricultural research and extension. In general, there would be an increase in cooperation between farmers, agribusinesses,support businesses, and government agencies.

5. POTENTIAL FACILITATION

Because this is a new venture for Uva Province, a potential investor type of agribusiness would need technical and financial assistance in constructing and operating this facility. Donors such as USAID probably would be interested in helping during the formative stages.

JUICING AND CANNING FACILITY IN UVA PROVINCE

1. DESCRIPTION

1.1 Concept

As the production of horticultural crops increases, there is a greater possibility of having a juicing and canning factory in Uva Province. There now are several such facilities in the Colombo area Some are fairly modern and some are quite old and have old equipment that should be replaced. All nave one common problem. It is difficult to get a continuous supply of raw product. However, very little contract growing is done for this purpose.

With the low labour rates in Sri Lanka, it is possible to have labour intensive operations. Therefore, a feasibility study should be made for Uva Province to determine the following:

1. Is there sufficient production of horticultural fruits and vegetables to assure a supply of raw product of satisfactory quality?

2. Can a processing factory be profitable in the Uva Province?

1.2 The Market

Domestic Market

The demand and expansion of the domestic market depends on the following:

- Increase in income and the standard of living

- Availability of processed products at reasonable prices.

- Urbanization and change in eating habits.

- Growth of tourist trade, hotels and supermarkets.

The availability and prices of horticultural crops, especially fruits, directly affects the demand for processed products. Generally processed fruit is more expensive than fresh fruit because of the added cost of labour, input materials, and packaging.

The demand for jams is mainly from the middle and upper classes who eat bread with jam. It is estimated that only 5% of Sri Lankan people eat jam, but this is changing as children become accustomed to eating bread and jam in school.

Cordials are used both by urban and rural people, especially by those who do not have refrigeration. Passion fruit is the most popular cordial.

Export Market

A processing factory should make products both for the domestic market and export market.

Processed Fruit & Vegetable Exports
(In Rs. Millions)

YEAR	EXPORT VALUES
1979	24.4
1979	24.4
1980	39.9
1981	47.4
1982	79.7
1983	31.2
1984	13.3
1985	11.4
1986	29.3
1987	61.6
1988	50.9
1989	140.0
1990	306.0
1991	299.7

Source: Appendix (V), Medium Term plan for the development of Fruit and Vegetable Exports from Sri Lanka, by Rohan Fernando, June 1992

Although most of the processed products now are designed for the local market, exports are important. In 1991, exports amounted to 300 million Rupees (about 7 million US Dollars).

Appendix D

Breakdown of Exports of Processed Fruits & Vegetables-1989 in Rs. (Million)

Product	FOB Value Rs.(Million)
Gherkins in brine	122.65
Fruit Juice	13.25
Jams, Jellies,Marmalade, Pulp	2.86
Vegetables, Pickles (in Mustard & Oil)	2.04
TOTAL	140.8

Note that gherkins represented 87 percent of the processed exports., Jams, Jellies, Marmalade and Pulp were only 2 percent. Fruit Juice was 9 percent of the total.

The attached table D-5-1 shows that Germany and the Netherlands are the biggest importers of tropical fruit juices and concentrates.

The main tropical items sold in the international market that are of interest to Uva Province are:

1. Pineapple pieces and juice
2. Passion fruit juice
3. Mango pieces and juices
4. Peeled tomatoes and tomato concentrate

Pineapple is by far the largest volume item. The main producers of pineapple are Thailand, Philippines and USA in that order. Sri Lanka is not a major contender but does provide a small amount.

Passion fruit juice and pulp are the second most important processed products of tropical fruit. Passion fruit juice and pulp are normally extracted, sterilized by heat, and held in frozen storage (1-8' C) in 20 kg. containers. Manufacturers usually specify microbial counts before final use. It is used mostly in blended fruit juice drinks, ice cream, jams and yoghurts.

Mangoes are used in the production of chutneys, fruit canned in syrups, juices, cordials and jams both for domestic and export use. Mango production in Uva Province produces fruits that are of mixed varieties. That is a problem. Another problem is the lack of uniformity in size and quality. It is unlikely that present mango production has sufficient quality and uniformity to support a canning factory.

TABLE D-5-1 EEC IMPORTS OF TROPICAL FRUIT JUICES/ CONCENTRATES

In metric tons	1986	1987	1988	Jan-Sept 1989
West Germany	10,182	12,308	9,337	9,538
Netherlands	6,963	6,729	6,473	6,680
France	9,927	6,561	7,338	1,697
Belgium	4,514	4,350	N/A	983
Denmark	892	1,118	1,133	636
UK	1,637	1,031	1,968	428
Italy	1,659	1,826	1,394	338
Spain	*	*	*	253
Other countries	284	51	N/A	246
Total	36,058	33,974	27,664	20,803
Brazil	5,129	4,694	3,375	4,837
Yugoslavia	1,043	1,097	873	3,057
Colombia	418	1,432	1,413	2,579
Poland	1,398	1,413	1,336	2,220
Peru	2,132	433	522	1,187
Thailand	364	509	138	1,178
Ecuador	525	380	241	454
Venezuela	149	527	64	535
USA	156	153	134	345
Sri Lanka	617	729	410	240
Mexico	*	*	156	164
India	237	169	486	137
Other countries	1,012	2,021	1,276	4,052
Total	13,180	13,557	9,924	20,803

* Included in "other countires"
Source Food News 1991

Papaya is used in tropical fruit cocktail, mixed fruit cordial and mixed fruit jams.

In the processing factories of Sri Lanka, the biggest unfilled demand is for pineapple, passion fruit and papaya.

Tomatoes and oranges always are in demand. Other fruits that have a modest demand are durian, jak fruit, anoda, (anona), rambutan, guava and wood apple. There is a growing demand for canned exotic vegetables.

1.3 Production Component

The demand for fruits in Sri Lanka far exceeds the supply both for fresh and for processing. This includes pineapple, mangoes, papayas, oranges, rambutan and guava. The demand for passion fruit is fairly constant but the supply varies with prices and disease problems. Guava production is very small. The best guava for juice, Beaumont from the University of Hawai, is not grown in Sri Lanka. Juice and drink made from Beaumont guava is excellent.

Uva Province doesn't grow much fruit but has good potential for growing more. Irrigation water is the biggest constraint, especially in the Monaragala District. Until fruit production increases to a level that it can provide an adequate supply of good quality fruits, a processing factory could not survive if it depends mostly on fruits. Tomatoes alone,or in combination with vegetables, probably would not be profitable. A detailed study should be made to evaluate the profitability using present supply of raw products and also using predicted future supplies of raw products.

1.4 Processing Facility

One of the possibilities of an agro-enterprise for Uva Province is a facility to make fruit juices and pulps or purees. This can be a complete factory to make finished consumer items. Also, it can be somewhat less complete and make intermediate products for use by other manufacturers who make finished consumer products. Whichever approach is taken, the task is both complex and expensive.

A study was made in December, 1991 that is very detailed and is appropriate for Uva Province. This study "Integrated Study" is a report based on the work of the Business Development Division of John Keels Holding Ltd. with consultancy assistance from Michael Smidley, Benjamin Hatfield and Wachai Somchit. It was published in December, 1991 for the Mahaweli Enterprise Development Project. This study is very voluminous but can be useful in showing what would have to be done to build a juicing and pulping factory in Uva Province.

This report is more detailed than would be possible in the limited time available for the Uva Province Study. Therefore, it is recommended that anyone interested in a processing factory for fruits and vegetables should read that report.

Table D-5-2 shows some of the operations that can performed in a processing factory. Figure D-5-1 depcits a flow chart showing what must be done during the processing of juices and pulps. Part of the purpose in showing this is to impress upon people that a factory actually is quite technical and that a simple cottage industry is not satisfactory for international trade. Various legal restrictions are spelled out in the Food Act and the Consumer Protection Act to insure that processed foods are safe for the consumers. A simple cottage industry cannot satisfy those restrictions.

A water purification system would be required. Standards for water are shown in Table D-5-3 to insure it is included in future feasibility studies.

2. ESTIMATE OF PROJECT COSTS

In the study mentioned earlier, "Integrated Fruit Drying, Juicing and Fulping Project: Prefeasibility Study" of John Keels Holding, Ltd., assisted by Smidley etal in December 1991, the total cost was about 66 million Rupees (about $ 1.5 million US). For initial consideration this cost is satisfactory. It includes the equipment and operations shown in Figure D-5-1.

The capital cost of the buildings site infrastructure, processing and associated machinery and its installation costs are summarised below:

	Rs. 000
Site and buildings cost	3518
Imported machinery-miscellaneous	8382
Imported juice/pulp processing line	32880
Local Machinery & Equipment	15012
Contingency 10%	5979
	65770

3. ECONOMIC DEVELOPMENT CONSIDERATIONS

The economics of Uva Province would be benefitted by this project. Farmers should have increased profits, agribusinesses would bring more money into the community, new jobs would be created, and the quality of crops that are exported would be upgraded. Increased volume of supporting industries is another benefit.

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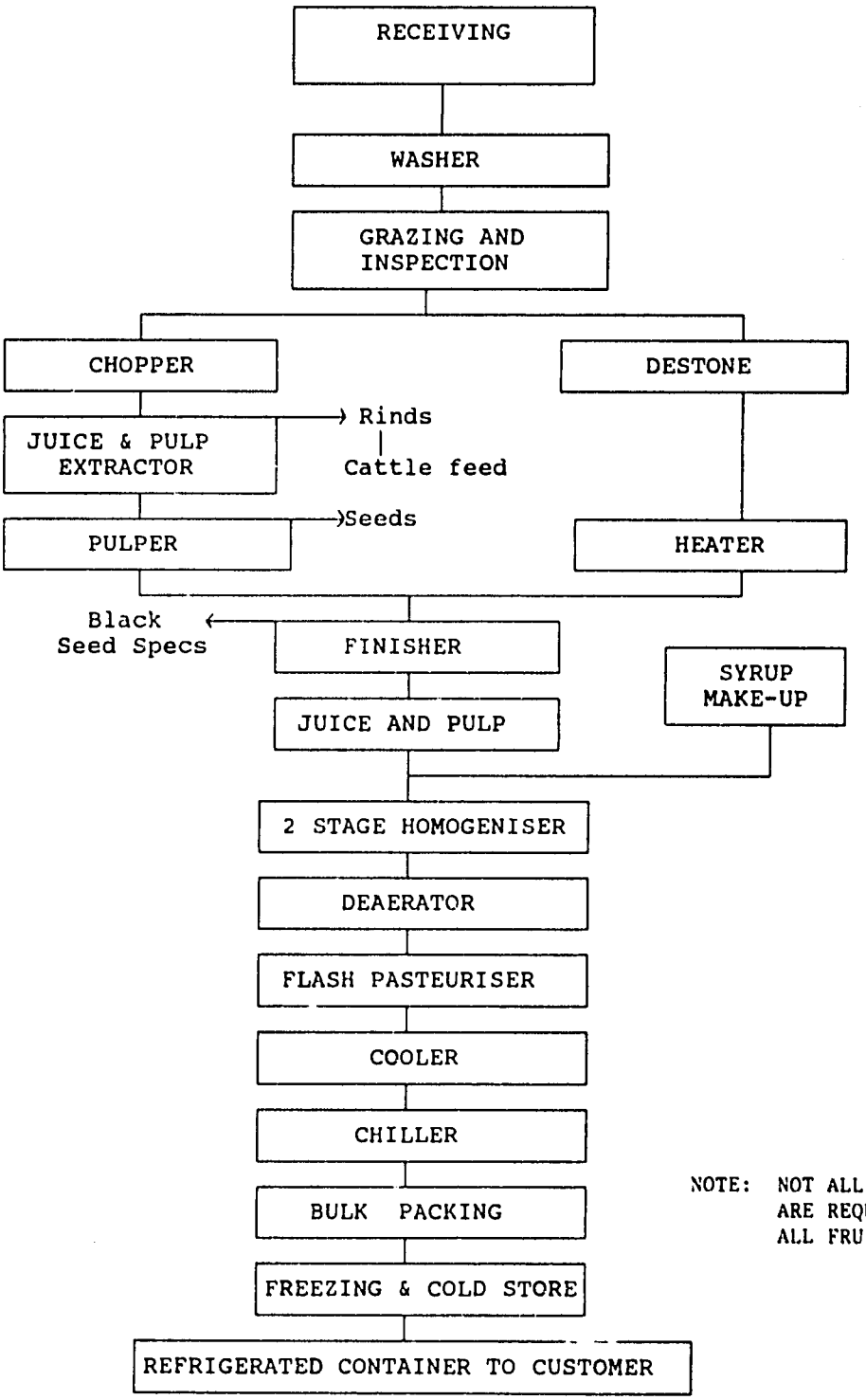
TABLE D-5-2 TYPICAL OPERATIONS IN FOOD PROCESSING TO CONVERT RAW MATERIALS TO CONSUMER PRODUCT

Mechanical Separation	Physical-chemical separation	Mixing Operations	Disintegrating Operations	Forming Operations
Centrifuging	Distillation	Agitation	Breaking	Casting
Deaeration	Evaporation	Beating	Chipping	Extruding
	Dehydration	Blending	Cutting	Flaking
	Crystallization	Dispersing	Crushing	Rolling
Draining	Freezing	Diffusing	Grinding	Moulding
Evacuating	Leaching	Emulsifying	Milling	Sawing
Filtering	Extraction	Homogenizing	Macerating	Shaping
Percolation	Ion Exchange	Kneading	Pulverizing	Slicing
Pitting	Electrodialysis	Stirring	Shredding	
Pressing	Membrane permeation	Whipping	Spraying	
Screening	Reverse osmosis			
Sedimentation				
Sifting				
Skimming				
Sorting				
Trimming				
Washing				

FIGURE D-5-1

FLOW CHART FOR JUICES AND PULPS OF PASSION FRUIT, PINEAPPLE, PAPAYA, MANGO AND GUAVA



NOTE: NOT ALL STAGES ARE REQUIRED FOR ALL FRUIT PRODUCTS

SOURCE: INTEGRATED FRUIT DRYING, JUICING AND PULPING PROJECT: PRE-FEASIBILITY STUDY BY SMEDLY ET AL DEC. 1991

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TABLE D-5-3 TECHNICAL REQUIREMENTS FOR WATER STANDARDS

Drinking water must be in compliance with drinking water standards provided by the World Health Organisation (WHO) and in particular must not exceed the following limit values. Treatment to eliminate coliform bacteria is a definite requirement.

-	pH	:	6,5: 9,5
-	Hardness (ppm $CaCO_3$)	:	300
-	Chlorides (ppm Cl)	:	200
-	Sulphates (ppm 504)	:	250
-	Fe (ppm Fe)	:	0.1
-	Mn (ppm Mn)	:	0.05
Water hardness		:	28-30 D French

4. SPECIAL FEATURES AND ISSUES

This project would create increased cooperation between farmers and agribusinesses. Probably a private agribusiness would have an investment in it and also have management and marketing responsibilities. Contracts with farmers for growing the raw product would be used, thus assuring both the farmer and the packinghouse of a continuing relationship. It is expected that new crops would be needed thereby requiring assistance of agricultural research and extension. In general, there would be an increase in cooperation between farmers, agribusinesses support businesses,and government agencies. That would be good.

5. POTENTIAL FACILITATION

Because this would be a new venture for Uva Province, a potential investor type of agribusiness would need technical and monetary assistance in constructing and operating this facility. Donors such as USAID probably would be interested in helping during the formative stages.

SMALL SCALE AND INTERMEDIATE SIZE FRUIT AND VEGETABLE DEHYDRATION

1. DESCRIPTION OF THE OPPORTUNITY

1.1 Concept

Fruits and vegetables produced in Uva Province can be preserved by dehydration. The technology ranges from large-scale industrial driers to small-scale driers suitable for use at the village or household level. Initially, small-scale household or village driers have immediate potential.

1.2 The Market

This technology can be used now for drying fruits and vegetables in homes and in central locations at the village level.The cost of equipment and operating costs of small solar driers is very low. Driers can be constructed locally by village craftsmen using local materials for a cost of about 1,000 Rupees.

Drying converts products which are highly perishable and have low value per unit weight into products which are light weight, high value and can be stored and transported easily.

Many households frequently have a need to preserve fruits and vegetables in small quantities for future consumption. By using a small solar drier, this can be accomplished at very low cost. Additionally, there is no continuing cost for storage as would be needed for refrigeration (which often is not available).

The population of Uva Province is estimated to be 1,060,000 of which 711,000 are in Badulla District and 349,000 are in Monaragala District. The number of households is 69,717 and 46,065 respectively, most of which are rural. The farm sizes average 1.7 acres and 2.9 acres respectively.

With over 100,000 rural households, there is a great potential for solar driers that are inexpensive to construct and have no operating costs other than intermittent labour by a resident of the household. If one-fourth of the homes had small solar driers, this amounts to over 25,000 driers. Each drier can dry 2 kilograms of fresh fruit each day for a total of 50,000 kg per day(50 metric tons per day). The point to be made is that a large amount of food can be dried and preserved with a small capital cost. The dried food can be used for cooking at home or sold in local markets. Dried pineapple, mango and papaya should sell as sweets, while dried vegetables could be used in traditional curries.

1.3 Production Component

Some work on solar drying with small-scale driers has been done in Sri Lanka. Researchers at the Central Agricultural Research Institute have investigated the drying properties of several fruits and vegetables.

The Inservice Training Institute (ISTI), Peradeniya, trains extension personnel in the use of solar driers for farm and village level processing of fruits and vegetables. The drier which they recommend can be built by village craftsmen using local materials for a cost of approximately Rs. 1000. It can dry about two kg of fresh fruit per day.

The Rice Research Institute (RRI) has experimented with small-scale solar driers for drying paddy. Their experimental models included those with the solar collector separate from the drying chamber, forced air circulation to increase efficiency and acity, and the use of drying agents to remove moisture from the incoming air. Forced air circulation increases construction and operation costs and restricts use to situations where electricity is available.

CISIR has developed several successful small-scale solar driers, both with and without forced air. Their convection models, similar to those used by ISTI, have an estimated acity of 5 kg per day and cost less than Rs. 1000.

The designs proposed by ISTI and CISIR are "direct" solar driers in which the sun shines directly on fruit placed on racks in a glass covered box. PIP, which has had considerable experience with solar drying of fruits and vegetables in South Asia, recommends an "indirect" drier. This design, which features a convection flow of warm air from the collector into a separate drying chamber, has an estimated acity of 8 kg per day.

The ISTI solar drier is shown in Figure D-6-1

FIGURE D-6-1 THE IST1 SOLAR DRIER

SOLAR DRIER INSERVICE TRAINING INSTITUTE

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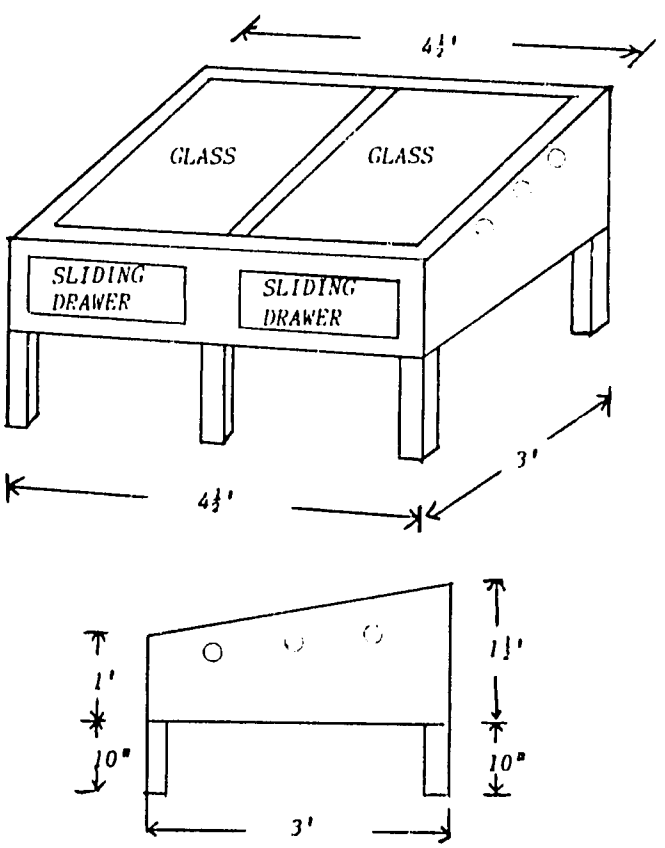

A variety of procedures must be followed for drying different fruits and vegetables. Most crops must be specially prepared to speed drying, to preserve or enhance colour and flavour, and to enhance keeping qualities. Cutting the fruit or vegetable to be dried into properly sized pieces is crucial. Pre-drying with sulphur, sulphite or heat is often used. Anti-oxidants such as ascorbic acid or lemon\lime juice are often used to prevent browning of dried fruits.

It is important to know when to stop the drying process. Over-drying may cause colour, flavour and palatability losses and shattering of the dried product. Under drying results in spoilage. The amount of material to be dried and the expected drying time depend on temperature, humidity and extent of cloud cover. Products which dry unevenly must be subjected to pre-storage conditioning to equilibrate moisture levels throughout the product. Success in achieving proper dryness is largely a matter of feel, experience and training.

Most vegetables should be dried to not more than 4-5 percent moisture and moisture in fruits should be reduced to 15-20 percent. Fruits require less drying because their sugar content helps to retard spoilage. The water content and approximate drying ratio of some common fruits and vegetables are given in Table D-6-1.

TABLE D-6-1 WATER CONTENT, DRYING RATIOS AND MAXIMUM DRYING TEMPERATURE (C) FOR A VARIETY OF FRUITS AND VEGETABLES

Crop	Moisture content (%)		Drying ratio	Max.drying temperature
	Initial	Final		
Cauliflower	80	6	0.1	65
Carrots	70	5	0.32	75
Green beans	70	5	0.32	75
Onions	80	4	0.21	55
Garlic	80	4	0.21	55
Cabbage	80	4	0.21	55
Sweet Potato	75	7	0.27	75
Potato	75	13	0.29	75
Spinach	80	10	0.22	-
Cassava	62	17	0.46	-
Cassava Leaves	80	10	0.22	-
Chillies	80	5	0.21	65
Grapes	80	15	0.24	70
Bananas	80	15	0.24	70
Guavas	80	7	0.22	65
Okra	80	20	0.25	65
Pineapple	80	10	0.22	65
Yams	80	10	0.22	65
Nutmeg	80	20	0.25	65
Coffee beans	55	12	0.51	-
Copra	30	5	0.74	-
Groundnuts	40	9	0.66	50

Source:PIP

Proper storage of dried materials is essential. It prevents further drying, rehydration and insect attacks. Exposure to light may cause bleaching. Properly dried and stored fruit should keep with little deterioration for several months and possibly for a year or more.

Successful introduction of small-scale drying on a wide scale in Uva Province will require an extension program to teach drier operators the appropriate procedures for preparing, drying and storing the most common fruits and vegetables.

Almost all crops grown in Uva Province can be solar dried. Initial emphasis should be on drying crops which are surplus to household needs or are available at low prices. One or a group of households might use a drier to preserve excess production of crops such as mangos, bananas, papayas, cassava, eggplant or bitter gourd. Crops such as onions or tomatoes could be bought for drying when prices are low. Solar driers could also be used to dry red chillies. Dried products can be consumed within the household or sold both in local and distant markets.

Solar drying is accessible to most household because of its low capital cost and ease of operation. The benefits of solar drying include a more nutritious and diverse diet and food cost savings from a steady supply of home grown fruits and vegetables.

2. ESTIMATE OF PROJECT COSTS

2.1 Estimate of Costs for Small Household Solar Drier

Solar drying can augment household income. Investment costs are confined to the cost of the drier and operation expenses are low. The costs of fruits or vegetables are either their purchase price or the price they would have obtained if sold fresh. Other input costs may include costs of sulphur, sulphite, anti-oxidants and packaging materials.

Table D-6-2 presents the costs for drying pineapple using ISTI's small household drier.

TABLE D-6-2 ESTIMATED COSTS OF DRYING PINEAPPLE USING ISTI'S SMALL HOUSEHOLD SOLAR DRIER DESIGN

	Assumptions	Calculated	Subtotal
Cost of Drier Construction(_Rs./year)			
Construction cost	1,000	-	-
Life of drier (yrs)	5	-	-
Cost of capital (% per year)	20	-	-
Annual interest/ amortization	-	334	-
Annual repairs	-	100	-
Total drier costs	-	-	434
Capacity of Drier			
Days operation/year	150	-	-
Capacity /day (kg wet)	2	-	-
Input required/year(kg wet)	-	300	-
Ratio dry to wet material (%)	22	-	-
Production of dried product/year (kg)	-	66	-
Cost of Input Material			
Price (Rs/kg wet)	2.5	-	-
Preparation costs (Rs/kg wet)	0.1	-	-
Total cost of input material (Rs/kg wet)	-	2.6	-
Cost of input material (Rs/year)	-	-	780
Opportunity Cost of Dried Product Inventory			
Cost of capital (% per year)	20	-	-
Average holding time (months)	3	-	-
Opportunity cost of holding(Rs/yr)	-	-	39
Labour Cost			
Days of labour/drier batch	0.2	-	-
Labour cost (Rs/day)	40	-	-
Labour cost (Rs/yr)	-	-	1200
Other Costs			
Packaging material (Rs/yr)		-	- 33
Total Cost of Dried Product			
Rs/yr			2486
Rs/kg dry			37.67

SOURCE: POSTHARVEST NEEDS ASSESSMENT FOR SYSTEM B MAHAWELI IRRIGATION PROJECT IN SRI LANKA BY JACK ROSS AND JOEL HAMILTON,JULY 1990

2.2 Estimate of Costs for Medium Size Driers Using Fuel

Drying using fuels is also possible, though generally more costly. However, high fuel costs could be eliminated by using agricultural waste. Rice hulls, a waste product that is a disposal problem for rice mills, could be used. The RPRDC has done research on using rice hulls to fuel a fluidized bed furnace for drying parboiled rice. Such a furnace could be adapted to a moderate-scale fruit or vegetable drier. Both larger solar driers and waste fired driers have enough potential to warrant further investigation.

Another possible drier is an off-the-shelf petroleum fueled model. It might be economically feasible in spite of higher fuel costs. Keels Agro Products Ltd., uses a kerosene fuelled drier at its mushroom production facility. Information from this source indicates that this type of drier could be used for fruits or vegetables.

Estimates of the cost of drying pineapple using a Keels type drier are shown in the following table. The estimated cost of the drier (available from Taiwan) is Rs. 200,000. Buildings would cost an additional Rs.200,000. It is assumed that the drier's acity is 300 kg of fresh product and that it would dry 200 batches per year. Each batch would require 3 person-days of labour. The drier uses 70 liters of kerosene to dry 300 kg of mushrooms.Since the amount of water to be removed from pineapple is less than mushrooms., we have assumed 60 liters per batch or 0.2 liters per kg. Electricity is needed to power the kerosene burner and perhaps an additional air blower. With these assumptions the cost of producing dried pineapple is Rs. 33.3 per kg. This cost would decline somewhat if the utilization rate were increased, e.g if 300 batches were dried per year, the cost would decline to Rs. 30.5 per dry kg. While the cost of this facility is about one-third greater than the solar drier cost, it should still be profitable to operate. One attractive feature of the larger drier is its ability to meet quality and cleanliness standards required for export.

Table D-6-3 presents costs of drying pineapple using a kerosene fueled drier.

TABLE D-6-3 ESTIMATED COSTS OF DRYING PINEAPPLE USING A KEROSENE FUELED DRIER WITH 300 KG ACITY

	Assumptions	Calculated	Subtotal
Cost of Drier Construction(Rs/year)			
Construction cost (Rs.)	400,000	-	-
Life of drier (yrs)	10	-	-
Cost of capital (% per year)	20	-	
Annual interest/ amortization	95,409	-	
Annual repairs	-	15,000	-
Total drier costs	-	-	110,409
Capacity of Drier			
Days operation/year	200	-	-
Capacity/day (kg wet)	300	-	-
Input required/ year (kg wet)	-	60,000	-
Ratio dry to wet material (%)	22	-	-
Production of dried product/year(kg)	-	13,200	-
Cost of Input Material			
Price (Rs/kg wet)	2.5	-	-
Preparation costs (Rs/kg wet)	0.1	-	-
Total cost of input material(Rs/kg wet)	-	2.6	-
Cost of input material (Rs/year)	-	-	156,000
Opportunity Cost of Dried Product Inventory			
Cost of capital (% per year)	20	-	
Average holding time (months)	3	-	
Opportunity cost of holding (Rs/yr)	-	-	15,708
Labour Cost			
Days of labor/drier batch	3	-	-
Labor cost (Rs/day)	50	-	-
Labor cost (Rs/yr)	-	-	30,000
Other Costs			
Packaging material (Rs/Yr)	-	-	6,600
Supplemental fuel (units/kg wet)	0.2	-	-
Cost of fuel/yr @ Rs 6.5/unit	-	-	78,000
Electricity for forced air (kwh/kg wet)	0.02	-	-
Cost of electricity/yr @ Rs. 36/kwh	-	-	43,200

Total Cost of Dried Product: Rs. 2486/yr. Rs. 37.67/kg dry

SOURCE: POSTHARVEST NEEDS ASSESSMENT FOR SYSTEM B MAHAWELI IRRIGATION PROJECT IN SRI LANKA BY JACK ROSS AND JOEL HAMILTON, JULY 1990.

3. GENERAL PROFITABILITY

As markets for dried fruits and vegetables are undeveloped in Sri Lanka, it is not possible to definitively determine the economic feasibility of drying. However, costs of production estimates are consistent with what local people will be willing to pay. Dried vegetables should find a market at Rs.30-50 per kg, and dried fruits at Rs. 40-60 per kg or higher. At such prices, drying of fruits and vegetables can be a viable method of marketing fruits and vegetables from Uva Province.

The conclusion is that the use of small-scale driers probably is economically feasible. Note that the calculated costs include purchasing the raw product and assigning a value for labour to operate the drier.

If additional fuels such as kerosene or electricity are used, costs are increased but still show a good possibility of being profitable. A detailed feasibility study should be made.

4. ECONOMIC DEVELOPMENT CONSIDERATIONS

Solar driers should be used in Uva Province. They can help relieve losses by preserving food inexpensively during periods of peak production in which market glut is a problem. Also, because small solar driers have no on-going operating costs, they can be used at any time when a small amount of fresh product is available. When not in use, there are no costs. Except when packaging is needed, there is no cost to store dried products. Refrigeration is not necessary.

Small solar household - scale driers can provide local markets with dried product and thereby provide income to the household. For entrepreneurs, small-scale driers can serve as the first step toward a larger scale commercial enterprise. Prospects are good for larger solar driers or for driers fuelled by conventional fuels and by agricultural waste.

5. SPECIAL FEATURES

The best features of small-scale household driers is that they are low capital cost and use free solar energy to dry the products. Also, there is no cost involved for simple storage in a home.

6. POTENTIAL FACILITATION

Even though a small-scale household drier costs only about 1,000 Rupees to construct, many families cannot afford them. Also some training would be required to use driers.

It is recommended that training courses be provided for household members to teach them how to use solar driers and to store the dried products. It is further recommended that household members and villages be assisted by the government in obtaining small solar driers. This can be in the form of grants or loans.

LARGE PINEAPPLE FARM AND PROCESSING FACTORY

1. DESCRIPTION OF THE OPPORTUNITY

1. Concept

A large pineapple growing and processing project has been proposed for Uva Province. The area near Bibile and Medagama have been selected as a good site for a commercial farm growing about 2,000 hectares of Smooth Cayenne (KEW) pineapple and for constructing a processing factory. The final products to be produced are solid pack pineapple and pineapple juice. Outgrowers will join the project later.

Fresh pineapple production is predicted to be about 100,000 metric tons by the year 1996 and then level off (for 2,000 hectares). By the year 2000, outgrowers can provide another 100,000 metric tons for a total of 200,000 MT.

A feasibility study was made of this project by Dr. J.B.Smith of Agpro Associates in January,1992 for ACDI and USAID.

1.2 The Market

The overall market under consideration is the world market for solid pack pineapple and pineapple juice. The primary markets are Europe, Japan and the US.

By 1993 it is predicted that world demand will exceed production.

1.3 Production Component

The center of production is proposed to be 2,000 hectares of government owned land. This would be farmed and managed as a nucleus commercial farm much the same as is done by Dole in the Philippines. Another 2,000 hectares would be farmed by out-growers. Total production by the year 1996 would be 200,000 metric tons of fresh pineapple.

For the commercial farm of 2,000 hectares, farming would use large scale mechanized equipment much like the Philippines (Dole and Del Monte).

Planting material is the main constraint for initial production and expansion. At the Mahaweli System B MARD Project there are 100,000 pieces of Smooth Cayanne (KEW) planting material growing. This will multiply at the rate of 400 percent per year. In order to plant a 2,000 hectare commercial farm, ACDI has established a secondary nursery at Bibile for expansion to a 300 acre plant nursery. These nurseries should

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provide about 4 million suckers to plant 60 hectares of commercial pineapple farm per month starting in January 1993.

This is too optimistic so commercial plantings may be delayed one year. Planting will require about 65,000 plants per hectare.

The original planting schedule is projected to produce 27,000 metric tons of fresh pineapple in 1994 and 100,000 metric tons in 1996.

1.4 Description of Processing Facility

It is proposed to build a pineapple canning and juice processing facility in Bibile or Medagama.

Direct agricultural costs per metric ton of fresh pineapple is predicted to be in the order of $ 18 US. This includes land clearing, planting, growing and harvesting costs. This is a low cost by world standards. Additional overhead cost of $ 7 US/MT should result in a total production cost of $ 25 US/MT.

Beginning in 1995 the 2000 hectare nucleus farm should be fully operational and will produce planting material (pineapple crowns) so outgrowers can start planting. The outgrower plantings should total about 3,400 hectares by the year 2000. At that time the total fresh pineapple production should be 200,000 metric tons per year.

The estimated cost of a pineapple cannery and juice facility is $ 6.5 million US.

2. GENERAL PROFITABILITY

It is predicted that farmers can grow fresh pineapple for a total cost of $ 25 US/MT.and sell it to the cannery for $60 US/MT. Using those figures, outgrowers could earn US$ 833 net profit per hectare per year.

Net returns should be in the black (positive, making a profit) during 1996 for the cannery. The nucleus farm should be in the black about 1997. The overall capital investment should be in the black in 1996. (See Dr. J.B.Smith feasibility study dated and revised 8/92). Gross profits in the order of US$ 18 million per year should be generated after 1999. In calculating these returns, an interest rate of 15 percent was used.

3. ECONOMIC DEVELOPMENT CONSIDERATIONS

The investment climate is favourable in that considerable understanding and enthusiasm have been shown by the Hon'ble R.M.Dharmadasa Banda, who is Minister of Agricultural Development and Research. He also serves the Uva District as M.P. Other government offices also have been very cooperative and supportive. Five thousand acres of land have been promised by the Ministry of Policy Planning and Implementation.

This project would make gainful use of land and create new jobs in Monaragala District. The community would benefit considerably from direct added income and from additional business created from the cash flow of new jobs. The overall prosperity of the area would be enhanced. This is best illustrated by a similar pineapple project by Dole near General Santos City in Souther Mindanao in the Philippines. A project started there about 30 years ago by Dole has created many new jobs, new houses, cars and other obvious improvements in local standards of living.

4. SPECIAL FEATURES, RISKS AND ISSUES.

Extended periods without rain can be a problem with any crop in rainfed conditions. It is claimed that pineapple can tolerate up to two months without rain, which would only slow its growth slightly. There is a good possibility of having dry periods in excess of two months in the proposed pineapple area. In fact, during the summer of 1992 there was a continuous period of 5 months with essentially no rain in the area. Having a moderate amount of irrigation water available would greatly reduce the risk of decreased yields during extended dry periods.

The specific site is located in the Dry Zone in the Monaragala District. The area runs north and south, parallel to the A5 highway and more or less between that road and the National Park in which is located the Senanayake Samudra. Bibile and Medagama, in Uva Province, serve this area and one or the other would be the logical site for a processing factory.

It is correct that this area has many features that should contribute to growing good pineapple. The feasibility study is very well done and is very professional. It is available from this address:
Robert C Flick, Chief of Party
Agricultural Cooperative Development International Commercial Small Farm Development
3, MC Leod Road Colombo 4, Sri Lanka.
Telephone: 584516 or 508755
Fax : 508756

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5. POTENTIAL FACILITATION

Two organizations already involved in this project are ACDI and USAID. They have assisted in getting the feasibility study made by Dr. J.B.Smith. ACDI continues to support this project through its mandate of Commercial Small Farm Development.

If this project is to succeed, many government agencies, private entrepreneurs (probably a multinational company) investors, banks, input supply businesses and donors would be involved. Work is proceeding in an effort to get a large multinational investor and/ or operating company interested

ORNAMENTAL - LIVE PLANTS AND CUT FOLIAGE

1. DESCRIPTION OF THE OPPORTUNITY

1.1 Concept

The use of live plants and cut foliage for decoration already is an on-going industry so needs no introduction here. The climate of Sri Lanka is very good for producing tropical plants which are excellent for this purpose.

1.2 Description of the market

Table D-8-1 shows Sri Lanka exports of live plants and cut foliage. The 1988 exports totaleed 106 million Rupees($ 2.5 million US). This has been a steadily increasing volume and is reported to have grown since 1988. In the data available from the Sri Lanka Customs Department, the biggest customer by far for Sri Lanka is the Netherlands.

1.3 Conclusions

Ornamentals consisting of live plants and cut foliage clearly have possibilities in Uva Province. They should be pursued as a business opportunity. Exports of over 100 million Rupees per year indicate that this is a thriving business.

There is a good source of information for live plants and cut foliage including cut flowers. This is:

Market News Service
International Trade Center
UNCTAD/GATT
Palais des Nations
1211 Geneva 10,
Switzerland

The market news service is transmitted weekly by telex to 23 developing countries that produce and export these products,and by a newsletter to 23 other developing countries.

TABLE D-8-1 EXPORTS OF LIVE PLANTS AND CUT FOLIAGE FROM SRI LANKA
(1984 - 1988)

FOB Value Rs. Mn.

DESTINATION	1984		1985		1986		1987		1988	
	Value	%	Value	%	Value	%	Value	%	Value	%
Netherlands	4.38	17.50	8.36	23.92	33.32	53.01	47.82	55.33	49.77	46.5
Denmark	3.53	14.10	3.64	12.61	10.14	16.11	9.76	11.29	9.77	9.14
Germany F.R.	3.84	15.34	4.25	14.70	6.43	10.22	7.15	8.27	4.79	4.48
Switzerland	0.32	1.27	1.44	4.98	2.04	3.24	3.69	4.26	0.32	0.30
Belgium	0.84	3.35	1.49	5.15	1.64	2.60	2.93	3.39	1.79	1.67
Hongkong	0.32	1.27	1.62	5.63	1.17	1.86	1.29	1.49	4.62	4.32
France	0.19	0.75	0.20	0.69	0.90	1.53	3.66	4.23	2.47	2.31
U.K.	0.50	1.99	-	-	0.93	1.47	1.02	1.18	0.41	0.38
Singapore	-	-	0.22	0.76	0.36	0.57	0.91	1.04	2.51	2.35
Japan	3.28	13.10	1.42	4.93	0.34	0.55	0.70	0.81	7.43	6.95
Others	7.82	36.33	6.26	26.53	41.97	11.44	7.48	8.71	23.01	21.54
Total	25.02	100	28.9	100	62.24	100	86.41	100	106.89	100.00

Source : Sri Lanka Customs Statistics

ROSE PRODUCTION UNIT

1. DESCRIPTION OF THE PROJECT

1.1 The Project Concept

The project is based upon establishing a 5 hectare rose production unit in Sri Lanka and exporting the cut flowers to Europe and the Far East. A two phased development program is proposed with the first 2 hectares being established in the year one and the remaining 3 hectares during the second or third year. The roses will be grown under greenhouse utilizing drip irrigation with fertilizer injection. The project will have grading and packing facilities and cold storage. The cut flowers will be transported to the airport by refrigerated vehicle. Variety selection and production scheduling will be determined by the market requirements.

1.2 The Market

The project would concentrate on both the European and the Far Eastern markets. Germany would be the primary target market in Europe. Due to Sri Lanka's close proximity to the Far East and Australia, the project would also target Japan, Singapore, Hong Kong and Australia.

Germany is the world's largest importer of floricultural products. Even in 1985 the total cut flower imports amounted to $766 million (ITC). The most popular cut flowers in Germany are roses. In 1985, total rose imports reached 708 million stems valued at 270 million DM. Importer requirements are per the EEC recommended standards. The principal supplier to Germany is the Netherlands. Consumers prefer the large flowered, long-stemmed varieties that are pink, red, orange, yellow and white.

Table D-9-1 shows the trade in cut flowers for the other targeted markets. The value of imports into these countries is much less than Germany, but they can be important markets for Sri Lanka.

The project must be based on producing consistently high quality flowers and on supplying the market requirements. There are many possible marketing channels for distributing and selling cut flowers in Europe and the Far East. It will be critical for the project sponsor to fully investigate the each to determine the most appropriate for the project.

The prices vary throughout the year being lowest during the summer time when local production comes on market and highest during the winter. In addition, there are numerous high demand times such as Christmas, Valentine's Day, Mother's Day when premium prices are paid. It is critical to base production scheduling on these market

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highs and lows. The project will be based on year round production, but the plants allowed to rest during the summer period resulting in a lower level of harvest. A conservative average per stem market price is US $0.35.

1.3 The Production Component

The total production area will be 5 hectares. It is proposed to have a two phased development with the initial phase totalling 2 hectares and the second phase an additional 3 hectares. The development schedule would span a two to three year period.

The production would be under controlled growing conditions utilizing plastic greenhouses fabricated from local materials, a computerized drip irrigation system, grading and packing facilities including cold room and refrigerated transport.

The site should be situated in an area with the following growing conditions. The ideal temperature range would be 23 degrees C (72 degrees F) during the daytime and 17 degrees C (62 F) during the night. The greenhouse must be designed to allow ventilation during the day if temperatures become to warm and also to be closed at night for heat retention if temperatures become low. Relative humidity should average between 65 to 75 percent. It is essential that the soils are well drained and porous. Roses require a very high level of soil fertility. Soil analysis and resultant nutrient adjustment is critical. The pH should be in the range of 6.0 to 6.5.

The roses should be grown under drip irrigation. It is essential to analyze the water to be used for irrigation with attention to nitrates, nitrites, potassium, calcium, magnesium, manganese, sodium chloride, sulphates, boron, iron, copper, zince, pH and conductivity. A fertilizer injection system should be incorporated into the irrigation system.

Varietal selection and production scheduling should be based on the market requirements. Planting material should be 1 to 2 year old grafted plants and dormant eyes. Initially, the planting material should be purchased from quality nurseries in Europe. The planting density would be 60,000 plants per hectare.

Six months after planting light harvesting can begin. Full production will be obtained after 15 months. A conservative yield projection is 1,300,000 stems per hectare per year. It is realistic to achieve 1.5 million per hectare.

1.4 Postharvest Handling

The project must have grading and packing facilities and there must be cold storage on the production site. The required storage temperature is 1 - 3 degrees C. Grading will be done according to stem length, flower size and colour. Following grading and bunching the roses will be packed for export. Cartons will contain 250 to 500 stems

and will be shipped with ice pack. They will be transported to the airport in refrigerated truck.

1.5 Project Timetable

The project would be developed over a 2 to 3 year period. The first phase would be the establishment of 2 hectares of production area. The infrastructure preparation should begin in time to enable the first planting in the month of June. This would result in a light harvest during the December, an important time in the market.

The second phase would be scheduled for the second or third year after project start-up depending on the performance of the first phase and the financial situation of the project sponsor.

2. ESTIMATE OF PROJECT COSTS - Phase 1 and 2 (5 hectares)

A. Capital Expenditures

	Rupees
Land (10 hectares)	5,000,000
Land development	450,000
Greenhouses	15,750,000
Buildings	2,000,000
Reservoir	2,000,000
Machinery and Equipment	4,500,000
Vehicles	3,500,000
Planting Material	42,000,000
Total capital Expenditures	75,200,000
B. Estimated Working capital	5,000,000
Total Estimated Investment	80,200,000

3. GENERAL PROFITABILITY AND FINANCIAL CONDITIONS

Production by middle of Year 3	6,500,000 stems
Sales F.O.B. (9 rps/stem)	58,500,000
Cost of Production (4 rps/stem)	26,000,000
Profit Before Interest and Depreciation	32,500,000

The profit as a percent of turnover and the annual return on equity will be dependent upon the financing plan and the terms of the loan, however, in could be expected that both will be on the order of 25 percent.

4. ECONOMIC DEVELOPMENT CONSIDERATIONS

An important economic benefit of the proposed project is the creation of employment opportunities. There will be opportunities for both skilled and unskilled individuals. There will be the opportunity for technology transfer. Ninety percent of the project's production will be exported which will generate significant foreign exchange.

5. SPECIAL FEATURES, RISKS AND ISSUES

At present, the limited availability of air cargo space is the most serious factor affecting the project's viability. Certainly, this problem has faced every country which has a newly emerging horticulture industry. As the industry grows the problem is resolved; however, those sponsors pioneering the industry have to find innovative ways to overcome the constraint.

TABLE D-9-1 WORLD TRADE IN CUT FLOWERS[A] BY VALUE 1981 - 1985
(In US$ M.)

Importing/ Exporting Countries/areas	1981	%	1982	1983	1984	1985	%
World Imports (CIF) of which:	1,180.59	100.0	1,188.10	1,236.55	1,291.53	1,297.10	100.0
EEC (10. AS OF 31.17.85)							
Germany F.R.	596.02	50.5	553.90	544.41	516.04	467.35	36.0
France	79.39	6.7	85.31	84.34	83.22	95.47	7.4
United Kingdom	59.03	5.0	59.73	67.91	73.65	91.03	7.0
Netherlands	51.38	4.4	52.72	51.66	61.84	51.50	4.0
Italy	19.83	1.7	23.52	23.50	22.91	37.69	2.9
Belgium-Luxembourg	33.72	2.9	31.59	28.08	27.12	26.15	2.0
Denmark	8.32	0.7	9.27	10.83	12.54	15.45	1.2
Ireland	3.38	0.3	3.30	3.44	3.27	4.01	0.3
Greece	0.18	-	0.02	0.47	0.65	0.72	0.1
United States	128.58	10.9	1[illegible].77	196.15	2[illegible]3.66	283.64	21.9
Canada	18.37	1.6	20.80	26.14	30.10	25.43	2.0
Japan	17.72	1.5	14.74	16.65	18.81	22.50	1.7
Switzerland	59.34	5.0	63.26	66.03	63.34	63.70	4.9
Austria	38.21	3.2	38.43	39.85	35.96	36.58	2.8
Sweden	31.67	2.7	30.75	29.80	29.10	29.65	2.3
Norway	11.19	0.9	11.81	12.48	12.31	12.45	1.0
Singapore	2.55	0.7	4.51	5.23	5.94	7.12	0.5
Finland	6.19	0.5	6.17	6.39	6.88	6.28	0.5
Hong Kong	3.24	0.3	4.65	6.04	5.87	6.24	0.5
Saudi Arabia	2.90	0.2	3.20	5.00[B]	3.40[B]	3.40[B]	0.3
Australia	1.67	0.1	2.66	2.57	3.24	3.16	0.2
Kuwait	0.75[C]	0.1	1.11[C]	1.34[C]	1.41[C]	1.28[C]	0.1
United Arab Emirates	0.91[C]	0.1	1.17[C]	1.10[C]	0.91[C]	0.95[C]	0.1
Spain	0.49	-	0.57	0.46	0.52	0.79	0.1

contd/..

Appendix D

Importing/ Exporting Countries/areas	1981	%	1982	1983	1984	1985	%
World exports (FOB) of which:	1,063.04	100.0	1,070.99	1,106.47	1,118.87	1,149.59	100.0
Netherlands	681.86	64.1	682.07	697.76	701.52	744.35	64.8
Colombia	108.57	10.2	111.48	120.55	129.49	138.30	12.0
Israel	81.64	7.7	81.29	73.16	65.08	65.37	5.7
Italy	70.87	6.7	74.78	85.34	78.02	57.75	5.0
Spain	11.99	1.1	15.05	18.29	22.24	22.22	1.9
Thailand	18.51	1.7	14.58	15.46	16.60	18.08	1.6
France	14.85	1.4	14.16	13.90	15.16	12.09	1.1
Kenya	6.14	0.6	5.99	6.37	8.70[B]	8.80[B]	0.8
Taiwan Provinces (China)	6.17[D]	0.6	5.46[D]	6.44[D]	6.67[D]	6.65[D]	0.6
Germany F.R.	4.65	0.4	4.69	5.31	6.82	6.50	0.6
United States	10.80	1.0	11.05	11.11	10.49	6.14	0.5
South Africa	6.89	0.6	5.94	6.20[B]	5.70[B]	6.10[B]	0.5
Singapore	7.79	0.7	7.19	6.57	7.15	5.46	0.5
United Kingdom	4.45	0.4	3.73	3.98	4.46	5.20	0.5
Peru	2.16	0.2	2.33	2.63	3.56	5.20[B]	0.5
New Zealand	1.61	0.2	2.07	2.87	3.87	4.74	0.4
Mexico	1.98[D]	0.2	3.12[D]	3.52[D]	4.59[D]	4.22[D]	0.4
Costa Rica	0.39[D]	-	0.72[D]	0.92[D]	1.89[D]	2.52[C]	0.2
Brazil	3.30	0.3	2.26	1.87	1.80[D]	2.30[D]	0.2
Ethiopia	-[D]	-	0.33[D]	0.20[D]	0.62[D]	2.29[D]	0.2
Morocco	0.37	-	0.60	1.28	1.11	2.21	0.2
Malaysia	1.13	0.1	1.20	1.42	1.46	1.50[B]	0.1
Mauritius	0.37	-	0.54	0.62	0.67[D]	1.28[D]	0.1

Source: UNSO/ITC Comtrade Data Base System

A - Cut flowers and flower buds of a kind suitable for bouquets or for ornamental purposes, fresh dried, dyed, bleached, impregnated or otherwise prepared.

B - ITC estimate.

C - Based on export figures of major world suppliers.

D - Based on import figures of major world importers.

PACKAGING SUPPLIER, BOX BROKER

1. DESCRIPTION OF THE OPPORTUNITY

1.1 Concept

Develop a business to provide corrugated boxes and packaging. With the development of small packinghouses and cold storage facilities in Sri Lanka, a greater need exists for packaging materials. The most common box used to package fresh fruits and vegetables for export is the corrugated fibreboard box. These boxes can be manufactured in Colombo. Usually the people who need these boxes are not familiar with packaging specifications and don't have enough time to make trips to Colombo to work with the box suppliers to arrange good packaging supply linkages. A broker who sells boxes would be helpful in arranging for the supply of boxes to agribusinesses in around Uva Province. In addition the broker could be a supplier of plastic bags and other packaging supplies for assorted purposes.

1.2 Description of the market

The market would be anyone needing supplies for packaging. Packers and shippers of horticultural products, both fresh and processed would be a major customer for corrugated boxes.

Plastic bags and sheets are used for many purposes. Special packaging materials are always in demand for assorted purposes.

A broker may take only a small commission on products that move directly from the manufacture to the customer. Large volume would make it profitable to a broker.

1.3 Description of Production Component

Packaging supplies could be produced in Sri Lanka, primarily in Colombo, or they could be imported. Sources such as Europe, Malaysia, Japan, Australia and the US are possibilities. For corrugated boxes this would be sheets of corrugated fibreboard material that are cut into the correct shape and printed with the necessary information by the manufacturer. These sheets can be folded by hand to make finished boxes prior to use.

Plastic bags and sheets can be manufactured in Colombo or imported from abroad.

2. ESTIMATE OF PROJECT COSTS

This project would have low capital costs to a broker. It would require a telephone, a fax machine, an office,and a small warehouse. A car would be needed for travel to visit customers and manufacturers.

A total capital cost, not including a car or pickup truck, would be about US$ 2,000 (86,000 Rupees). Operating capital would be needed for about one year. A good way to start is for an existing business to develop a brokerage for boxes and packaging as an new branch of a business that already is profitable.

3. GENERAL PROFITABILITY AND FINANCIAL CONDITIONS

The brokerage business can be very profitable for a person who has existing connections with the supplier and the customer. If 25,000 boxes are sold at a cost of US$ 0.75 per box, a five percent brokerage commission is US$ 938 gross. A packinghouse should use at least 100,000 boxes per year so commission or that number of boxes is US$ 3,752 gross.

In considering what a broker's commission rate should be, keep in mind that the broker represents the marketing branch of a manufacture. Most manufacturers would be pleased with a marketing cost of 5 percent of the product.

4. ECONOMIC DEVELOPMENT CONSIDERATIONS

This business by itself would not have a major impact on the economics of Uva Province. However, it would be an important supply link in the overall industry of growing and marketing horticultural crops.

5. SPECIAL FEATURES AND ISSUES

A brokerage business must keep itself current with what is happening in the business world of its customers. In doing this, a broker visits customers and businesses of all kinds. The end result is that the broker becomes a catalyst in helping people in all the associated businesses to know what is happening in their business world. There is a constant exchange of information because the broker needs it to conduct his business and increase his profits. This is not the complete answer to disseminating information but it is a part of it.

6. POTENTIAL FACILITATION

This is a business deal and doesn't need financial assistance from donors or government agencies. It does need to be recognized as a constructive element of business and be given a chance to operate as such.

SPICES AND OTHER MINOR EXPORT CROPS

1. DESCRIPTION OF THE OPPORTUNITY

1.1 Concept

In 1991 the export volume of a group of crops known as Export Agricultural Crops totalled 19,412 metric tons and had a value of 2,006 million Rupees ($ 47 million US). These crops sometimes are called Minor Export Crops and include cinnamon, clovers, pepper, cardamon, nutmeg, cocoa, coffee, citronella, papain, arecanut and betel. The following chart shows these crops.

The production of Export Agricultural Crops has been increasing steadily. That growth is expected to continue. The Mid Country Perennial Crops Development Project (PERCRODEP) which was initiated in 1989 with the assistance of the Asian Development Bank in the districts of Kegalle, Kandy, Matale, Badulla and Monaragala continues its operations. This project intends to promote commercial production and improve marketing facilities of perennial crops which include most minor export crops such as pepper, nutmeg, cocoa, coffee and cardamons.

As the production of these crops increases, processing and marketing must increase.

1.2 The Market

Mexico is the largest importer of Sri Lankan cinnamons. The bark is boiled in water and the extract taken like tea as a beverage. Other uses are in cakes and sweets,in curry powder,and in incense and perfumes.

Nutmeg is sold whole and ground. Uses include flavouring of sweet dishes, pies, puddings, toppings, meat and vegetable dishes. It is an ingredient of many ground spice mixtures including mince meat spice, pastry spice,poultry dressing, sausage, boloqua and frankfurters.

Cloves are used either whole or ground to provide flavour for foods in pickling, sauces, and ketchups. In medicine it is used as a carminative, aromatic and stimulant. A sizeable amount of the clove buds is used in the cigarette industry by Indonesia. Clove oil is used in perfumes, in dentistry,and as a clearing agent in microscopy.

Cardamon is used as a common ingredient of special seasonings and curry powders and for flavouring sweet meats, pastries,cakes,puddings,meat,curries,sausages,various kinds of foods and culinary preparations. Cardamon oil is used for flavouring coffee and tea. In medicine, it is used as a powerful aromatic, stimulant,carminative,stomachic and diuretic.

Of the total world trade in spice of about $ 270 million US, 37 percent is pepper. Brazil, India, Malaysia and Indonesia are the most important pepper producing and exporting countries. These countries produce 90 percent of the total world exports of pepper. Sri Lanka exports US$ 3.2 million worth of pepper. This is only 3 percent of the total world exports of pepper but still is a sizeable amount.

2. GENERAL PROFITABILITY

Dependable figures for production, costs and profitability are not available. Table D-11-1 presents the value of Export Agricultural Crops for the last few years. The total value of these exports was 2,005 million Rupees in 1991. In contrast to this figure from the Department of Export Agriculture at Peradeniya, the Central Bank of Sri Lanka lists this value at 3,409 million Rupees for the same period. This is a difference of 70 percent from the Department of Agriculture figures, so caution should be used when evaluating these statistics.

Cost and profitability figures are not available for spices.

3. SPECIAL FEATURES, RISKS AND ISSUES

The major supplier of spices in Uva Province is Uva Spices in Bandarawela.This is a growing business that processes and markets spices. Chillies are 90 percent of their business. The chillies are imported from Pakistan because not enough good chillies are available in Sri Lanka.

The spices handled by Uva spices are cinnamon, cardamon, cloves, nutmeg, maize, black pepper, and garlic. The next step is to for them to process and sell herbs which are claimed to have a bigger market than spices. Herbs under consideration are coriander, basil, lemon grass, marjoram, sage, oregano, sesame and hibiscus. It is claimed that both temperate and tropical herbs can be grown in Uva Province.

One of the obvious advantages of herbs and spices,is that,after processing, it can be stored without refrigeration. The shelf life is several months or longer, so the finished products can be stored for a reasonable period of time.

4. POTENTIAL FACILITATION

Most spices take several years after planting to be productive. A tax holiday would be helpful for farmers planting spices.

When trade shows or special promotions are organized for fruits and vegetables, consideration should be given to Export Agricultural Crops (Minor Export Crops). It is difficult for new producers to enter the world market because of loyalties to present suppliers.

TABLE D-11-1 EXPORT AGRICULTURAL CROPS VOLUME AND VALUE OF EXPORTS (1988 - 1991) (MT AND Rs.M)

COMMODITY	UNITS	1988	1989	1990	1991
CINNAMON	Volume MT	6810.7	7542.4	6500.5	7889.3
	Value Rs(Mn)	674.7	1059.8	1188.1	1436.2
CIN-LEAF OIL	Volume MT	131.7	161.7	46.2	107.3
	Value Rs(Mn)	36.8	43.8	13.0	29.2
CIN-BARK OIL	Volume MT	2.7	2.6	0.7	2.5
	Value Rs(Mn)	18.9	23.8	7.4	35.2
CLOVE	Volume MT	2251.0	310.6	2286.1	1037.1
	Value Rs(Mn)	252.7	15.9	235.2	63.6
CLOVE OIL	Volume MT	0.0	0.0	0.0	0.0
	Value Rs(Mn)	0.0	0.0	0.0	0.0
COCOA	Volume MT	185.0	122.9	174.9	108.7
	Value Rs(Mn)	7.7	6.3	8.5	3.6
COFFEE	Volume MT	4202.4	2035.1	1496.0	2710.9
	Value Rs(Mn)	232.3	93.8	44.5	77.7
PEPPER	Volume MT	2692.3	1478.8	1242.0	2058.3
	Value Rs(Mn)	291.5	151.7	99.7	139.0
PEPPER OIL	Volume MT	0.0	0.0	6.7	1.8
	Value Rs(Mn)	0.0	0.0	1.8	2.0
CARDOMON	Volume MT	138.8	126.3	32.7	29.0
	Value Rs(Mn)	22.0	19.4	9.0	6.9
CARDOMON OIL	Volume MT	0.6	0.4	0.2	0.5
	Value Rs(Mn)	2.3	1.1	1.1	3.6
CITRONELLA	Volume MT	108.8	72.6	49.6	54.9
	Value Rs(Mn)	29.1	13.3	8.5	11.9
LEMON GRASS	Volume MT	3.9	0.5	0.0	0.0
	Value Rs(Mn)	1.1	0.2	0.0	0.0
NUTMEG/MACE	Volume MT	489.7	390.5	269.9	489.3
	Value Rs(Mn)	59.2	46.0	22.7	24.3
NUTMEG OIL	Volume MT	18.5	12.7	2.6	4.5
	Value Rs(Mn)	18.2	12.3	2.3	2.5
PAPAIN	Volume MT	24.0	0.0	0.0	0.0
	Value Rs(Mn)	5.0	0.0	0.0	0.0
ARECANUT	Volume MT	1512.0	714.0	3077.4	2585.2
	Value Rs(Mn)	16.4	15.4	78.9	92.4
BETEL	Volume MT	2473.0	2297.6	2491.4	2332.4
	Value Rs(Mn)	100.0	92.3	80.7	77.6
TOTAL : MECS	Volume MT	21045.3	15268.4	17676.9	19411.7
	Value Rs(Mn)	1768.4	1595.0	1801.4	2005.7

SOURCE: DEPARTMENT OF EXPORT AGRICULTURE, PERADENIYA.

APPENDIX E

INFORMATION RESOURCE LIST

FOR ENTREPRENUERS

Resource List for Entrepreneur

1. Packinghouse, Horticultural Machinery & Supplies

   a. Vegetable Growers Buyers Funds from Meister
   b. Fruit Growers Buyers Funds from Meister
   c. 2 Trade Magazines American Veg Grower, American Fruit Grower from Meister
   d. Pest Control & Ag Chem Handbook & Directory - Annual (Bible of Industry) Meister Publishing Co. 37733 Euclid Ave, Willoughby, Ohio.

2. American Society of Horticulture Science, Mt Vernon Virginia, 7-8 Symposia on Tropical Fruit & Vegetable Production, Marketing & Postharvest.

3. Tropical Products Institute, London England
   20-30 outstanding publications on fruits & vegetables production, postharvest and marketing - temperature as well as tropics

4. USDA - Several hundred publications on production postharvest marketing of fruits and vegetables; especially important is tropical Products Transport Handbook #668 1987,
   Brian M. McGregor, Export Services Branch USDA Office of Transportation

5. Handbook of Tropical Food Crops, FW Martin 1984,
   CRC Press Boco /Raton Flo

6. Supplier of Food Processing Equipment
   ALBERTO BERTUZZI SpA
   20047 Brugherio
   Milano, Italy

7. Evaporators for Concentrating Juice
   JEDINSTVO
   SAMOBORSKA CESTA 145
   41000 ZAGREB, YUGOSLAVIA
   telephone 573-222

8. Packinghouse Equipment
   MR. CLIVE MURRAY
   PSF EQUIPMENT (THAILAND) CO. LTD
   PO BOX 12-1074
   501 SUAN PIH POST OFFICE
   BANGKOK 10121, THAILAND
   telephone: 235-0200

   (They also represent GEORGE and COURTIER PTY, LTD of Australia)

9. Packinghouse Equipment and Decay Control Waxes
MR. ARTHUR DAWSON
DECCO DIVISION
ATOCHEM NORTH AMERICA
1713 SOUTH CALIFORNIA AVE
MONROVIA, CALIFORNIA 91016
USA
telephone (818)358-1838
(818)359-7248

10. Packinghouse Equipment
MR. JEFF BATCHMAN
EXETER ENGINEERING, INC
109 W. PINE
EXETER, CALIFORNIA
telephone (209)592-3161
fax (209)592-3223

11. Packinghouse Equipment and Food Processing Eqpt
MR. HIROSHI HARADA
FMC FAR EAST
TOKYO, JAPAN

12. Laboratory Analysis for Chemical Residue
C.L. Technology
ATTENTION: SRI PHUNTNER
280 SMITH AVE
CORONO, CALIFORNIA 91720
telephone (714)734-2803

13. Food Processing Equipment
PASSY COMPANY
SWITZERLAND

14. Postharvest Handling Information
POSTHARVEST INSTITUTE FOR PERISHABLES
UNIVERSITY OF IDAHO
129 WEST THIRD ST.
MOSCOW, IDAHO 83843, USA
telephone: (208)885-6791
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21. Carton Supplier for Cartons Manufactured in Europe or USA
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APPENDIX F

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