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MAHAWELI ENTERPRISE DEVELOPMENT

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FRUIT DEHYDRATION IN SRI LANKA

A short-term consultancy report
by
Dr. Kamal Hyder

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INTERNATIONAL SCIENCE AND TECHNOLOGY INSTITUTE, INC.

WITH :

ERNST & YOUNG CONSULTANTS (Sri Lanka)
DEVELOPMENT ALTERNATIVES, INC.
HIGH VALUE HORTICULTURE, PLC.
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The Mahaweli Enterprise Development Project

The Government of Sri Lanka and the international donor community have given high priority to the development of the natural and human resources of the Mahaweli river basin. The first phase of this development, the construction of dams, irrigation and power systems, roads and other physical infrastructure, is largely complete. The second phase, settling the land and forming an agricultural production base, is well under way. The third phase, the major challenge for the 1990's, is the building of a diverse and dynamic economy, improving employment and income prospects for Mahaweli settlers and their families. In this phase the private sector has a leading role to play.

The Mahaweli Enterprise Development Project (MED) is a USAID-supported initiative of the Mahaweli Authority of Sri Lanka to promote investment and business development in agribusiness, manufacturing, tourism, minerals and services. MED directly assists small, medium and large-scale investors with technical assistance, marketing support, training, business advisory services and credit. MED also provides policy assistance to improve access to resources, such as land, water and capital, and the legal and institutional framework for enterprise development.

The official MED implementing agency is the Employment, Investment and Enterprise Development Division of the Mahaweli Authority. The main MED technical consultancy is provided by a consortium led by the International Science and Technology Institute, Inc., a private consulting firm with head offices in Washington DC. Other firms in the consortium are Agroskills, Development Alternatives, Ernst and Young, High Value Horticulture and Sparks Commodities. Marketing services are provided by SRD Research and Development Group, Inc.

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FRUIT DEHYDRATION IN SRI LANKA

by

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SEPTEMBER 1992

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PREFACE

This report was prepared by ISTI consultant Dr Kamal Hyder, a food industry specialist. The report was prepared for Ceylon Tobacco Company Limited which is carrying out pre-investment investigations on the feasibility of a fruit dehydration project based in the Mahaweli .

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1. INTRODUCTION

Tropical fruits such as Bananas (Musa Satium L), Papaya (Carica Papaya L), Pineapple (Annas Comosus L Merr), Mangoes (Mangifera Indica L), Guava (Pasidium Gaujava L), Passion Fruit (Passiflora Edulis), Jak fruit (Aetocarpus Heterophyllus L am) and Coconut (Cocus nucifera L) grow in Sri Lanka from coast to coast all over the Island as shown in Figure 1. Sri Lanka has a well established history of production of most of these fruits over centuries. However, their production under small holdings of a few acres by farmers scattered all over the country has mostly served the needs of the local population with fresh fruits during their respective seasons.

The processing and packaging of these fruits have been done at a very small scale. Some canning and bottling of fruit pulp and juices have been done at commercial level. Very little evidence of dehydration as a means of fruit preservation for mango, papaya, banana and pineapple was noticed in Sri Lanka. Except for drying tea leaves and fish, the dehydration industry virtually does not exist in Sri Lanka. Growing demand of dehydrated fruits for healthy snacks and baked goods in USA, Europe and other developed nations, prompts that a close look at the tropical fruit resources of Sri Lanka should be given with a view to producing dehydrated fruits for domestic consumption year round and at the same time earning foreign exchange by exporting them.

2. SCOPE OF THIS STUDY

The scope of this study is as follows :

2.1 To identify the resources of Sri Lanka's tropical fruits and quantify their production level.

2.2 To ascertain the availability of surplus tropical fruits for dehydration.

2.3 To determine the existing quality of the surplus tropical fruits suitable for dehydration.

2.4 To examine the possibility of commercial production of high quality tropical fruits which can be used for dehydration.

2.5 To propose a system for evaluating the tropical fruits of Sri Lanka by dehydrating them under simulated conditions of large scale manufacture, and market testing them.

2.6 To outline the concept of starting a fruit dehydrating plant that could be optimized for a profitable venture.

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2.7 To suggest the marketing channels for domestic and overseas customers of dehydrated products.

2.8 To prepare a plan of action for providing an outline in the final report as listed below :

(a) Outline processing parameters for selected fruits.

(b) Design a pilot plant for production of prototype products.

(c) Develop a marketing plan using market tests at central locations in Sri Lanka and abroad to establish quality packaging and pricing.

(d) Identify the cost factors and provide a format for profit and loss analysis.

(e) Prepare an outline for standard operating procedures of fruit dehydrating business.

(f) Train and give a workshop on fruit dehydration techniques to potential start up companies.

(g) Develop a strategy for successfully introducing dehydrating as a processing technique in Sri Lanka.

3. FRUIT RESOURCES FOR DEHYDRATION IN SRI LANKA

3.1 Mango, Pineapple, Papaya and Banana which appear to be in abundance during season and are wasted due to poor distribution system should be considered for dehydration. Jak fruit may be considered at a later date.

The Department of Census and Statistics (Smedley et al, 1991) and the Department of Agriculture (Balasooriya, 1992) report the fruit production as given in Table 1.

The production level does not appear to be phenomenal at the 1990-91 average per capita production level. Moreover, the estimated loss of 20 to 40 percent from field to consumer due to poor distribution and transportation system can further lower the per capita figure to minuscule levels. If dehydration can minimize this loss, it will certainly help the population from a nutritional point of view, by making these fruits available for consumption year round.

3.2 Mango and Pineapple Production in Mahaweli Systems B & C

Emphasis has been given for mango and pineapple production in these regions. Visits to the Agriculture Department nurseries confirmed the production of seedlings and suckers for increasing the plant count.

Ceylon Tobacco Company (CTC) farm near Girandurukotte is in the process of planting 50 acres of mango plants of which Alphonso variety is predominant. This farm is expected to reach peak production of 100 tons of mango per year by 1997. By inter cropping the orchard, CTC will also produce 40 tons per year of Kew variety of pineapple by 1993 which will reach 60 tons per year by 1995.

Agri Dev in co-operation with Agricultural Co-operative Development International (ACDI), USAID supported project, plans to farm 5000 acres near Bibile to produce pineapple suckers at the rate of 25,000 per acre.

These suckers will be available to potential farms in the area. Agri Dev has already started cultivation of 10 acres for this purpose using suckers from DAI under MARD project.

This effort with proper stimulation to farmers or other agribusiness ventures may be able to produce 250,000 tons of Kew variety of pineapple by 1994. If companies like CTC would take advantage of the availability of planting material and use the outgrow system, they would be able to produce good quality fruits for processing.

3.3 Papaya and Banana Production

These appear to be available from local farmers. Incentive for production, for processing under an outgrow system, has to be given to improve quantity and breed. (Hatfield,1991).

3.4 Types of Fruits for Dehydration

Fruits for dehydration require flavour, colour, texture and chemical composition that would perform well under organoleptic evaluation, after processing, packaging and storage, prior to consumption by the end user. The lack of commercial development of orchards in Sri Lanka makes it difficult to get a particular variety of fruit for processing. It is, therefore, a pioneering task for the agribusiness ventures to promote the production of such varieties. CTC has the experience and ability to provide support to the farmers in the outgrow program similar to tobacco leaf production.

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If Alphonso variety of mango, Kew variety of pineapple, Cavendish type banana and Hawaiian type of papaya are cultivated for dehydration, it will create the raw material base needed. Besides these, the local varieties of mango such as Karatha Columban, Malwana, Villard and Vellai Columban may be tested for adaptation to dehydration. Similar tests for other local banana and papaya should be considered.

4. THE UNIT PROCESS FOR DEHYDRATION

4.1 Dehydration of fruits can be accomplished in the following manner :

Sun drying, Air drying, Vacuum drying and Freeze drying.

For commercial operation with consistent quality control of well defined finished products, sun drying will not be suitable. Solar energy assisted dryers may be considered in future to achieve production efficiency from a cost point of view. Freeze drying is an expensive process which is not recommended at this stage.

Air drying using Cross Flow Dryers and Shelf Type Vacuum Dryers may be used for Sri Lanka. Treatment of fruits prior to drying may be carried out to enhance the quality of dried fruits in slice or chunk form. The suggested process is given in Figure 2.

4.2 Tests Prior to Initial Production

In order to evaluate the product quality of fruits in Sri Lanka, local varieties and the above mentioned improved varieties should be tested in the laboratory.

Two sets of experiments should be performed.

Experiment I

Fruits should be dried in cross current air dryer with and without enzyme inactivation in combination with sulphite and sugar treatment.

Experiment II

Fruits should be treated with sugar solution using osmotic stabilization technique, ascorbic acid and sulphite as preservative, as outlined above and then dried under vacuum.

Time, temperature and yield data should be calculated to generate drying characteristic curves. Final product should be tested for chemical , microbiological and organoleptic characteristics. Trials should be conducted on sliced and diced products of different shape size and thickness.

4.3 A systematic evaluation will yield the optimum processing parameters which will be entered in the standard operating procedures (SOP) manual for pilot production. Drying characteristic curves, conditioning of fruits as raw material and quality control tests of finished products, will all be standardized for the SOP manual.

The comparison of Experiment I and II will provide data for appropriate application of drying techniques for different types of fruits at pilot production levels.

4.4 The above experiments may be carried out at the University of Peradeniya under the Agricultural Engineering Department and Food Science Department with proper non-disclosure agreement to protect the propriety nature of the project.

Dr. Ben Basnayake of Agricultural Engineering Department and Prof. Upali Samarajeeva of the Food Science Department are both very competent and qualified faculty members who can supervise these experiments utilizing graduate and senior level undergraduate students. Appropriate grant money should be provided for this purpose.

CTC may choose to use them as consultant if they perform the experiments in their laboratory.

5. PROCESSING & PACKAGING FACILITIES

5.1 The most appropriate facility to process fruits should be on farms or near the collection centers. Because of terrain and transportation system which make movement of raw materials difficult, it is suggested that a pilot scale demonstration unit be installed near Girandurukotte CTC Fruit Orchard.

An alternate site may be selected near Kandy, where the pilot project can utilize University of Peradeniya staff. Kandy, being close to pineapple and mango growing areas can serve as a hub for demonstration and development in processing and packaging.

The ultimate scheme should be based on installation of dryers on farms and collection centers. The dried products should then be transported to a central location where final quality control and packaging can be done. This location will become the hub center for receiving dried products in bulk and distributing finished goods in its final packaged form as shown in Figure 3.

5.2 The final decision to set up a number of dehydrating plants should depend upon the following factors: fruit availability, energy source, labour source, transportation to and from the farm, location of outgrowing farmers and service facility for parts and repair.

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The central location of finished goods packaging plant should not only be convenient for farm dryer locations to bring in dry bulk fruits, but it should also be ideal for domestic and export distribution. The ideal location should have availability of the following: management personnel, packaging material source, shipping facilities, power source, labour force, and repair and maintenance shops. Kandy or Colombo may be candidates for this facility.

6. MARKET DEVELOPMENT FOR DEHYDRATED FRUITS FOR SRI LANKA

6.1 The international market for dehydrated tropical fruits is gradually developing. It is, however, based on ethnic and novelty segments of the food industry in Europe and North America.

Dried fruits in bulk will be treated as commodity and therefore, face the day to day fluctuation of supply and demand. Moreover, the profit margins are not high. Smedley and Somchit (1991) in their reports pointed out that the cost of fruits with processing and packaging would not make Sri Lankan products competitive enough. This observation appears to be reasonable at the current level of fruit production.

It is, therefore, suggested that the dehydrated fruits should be developed for domestic market with decent but inexpensive packaging in flexible pouches. Value added concept should be applied at retail level by following current trends of preparing snacks for munching or products similar to trail mixes used by hikers or backpackers overseas. Retail items like mixes of tropical fruits with nuts and raisins should be market tested in Sri Lanka. If it is successful in Sri Lanka, it can be subsequently exported with some innovation. Currently, such items are sold in the USA at convenience stores and gasoline stations. They retail at US$ 0.99 per 2 oz. packet. They are targeted to displace junk foods such as corn chips and potato chips. Private label distributors may be used for this purpose.

The current retail price of tropical fruits in California is given in Table 2.

In order to compete in the international market, the dried fruits will have to be produced in Sri Lanka at or below US$ 6.50/kg C&F New York or Los Angeles.

6.2 The domestic market for dehydrated fruits in Sri Lanka is wide open. It provides the opportunities for innovative product development, package development and application in recipes for home use. It can provide the tasty and nutritious products all year round. Marketing of such products during off seasons for certain fruits may even create a boom for selected items which are highly desirable to Sri Lankan palate. Product and market development studies should be conducted to establish products, packaging units and price points.

7. RATIONALE FOR CTC TO GET INTO FRUIT DEHYDRATING VENTURE

7.1 Table 3 shows that CTC has the expertise in growing fruits. The data generated by their nucleus farm near Girandurukotte proved that Alphonso mango could be produced below Rs. 10/- and papayas for Rs. 5/- per kilogram.

The 50 acre farm mentioned above is expected to be expanded to 100 acres very soon. Application for the expansion is in process at the final stage.

The farm will ultimately become CTC's demonstration orchard and the main source of planting materials and technical support to at least 400 farmers in the Mahaweli area who will participate in the outgrowing program for fruits. It is expected that the outgrowing program will be successfully maintained according to the CTC's Leaf Tobacco Program.

7.2 CTC has a fine tissue culture facility with two local Ph.D scientists at the CTC Foliage Production Centre. This is an excellent support facility for the nucleus orchard. Propagation of hybrids can be initiated in the laboratory and subsequently transplanted in the nucleus orchard. In fact, current experiments in the laboratory on developing a banana variety called "Williams" appear to be very encouraging.

The laboratory can be the nerve center of experimental development work not only for breed improvement but also for process and product development.

It has been indicated by CTC that the initial drying test using a laboratory scale dehydrator will be housed there. Additional staffing with food scientists, process engineers and bio-technologists can be done from the graduates of the local universities. With additional training on processing, handling and quality control , these local graduates will be able to manage the technical aspects of the venture.

7.3 The management structure for the tobacco leaf growing and processing operation places CTC in a unique position. A thorough understanding of the outgrowing process and the experience of managing it in Sri Lanka should be considered as a major pre-requisite for the success of fruit growing and processing venture.

Since this project cannot be based on merely processing the underutilized seasonal fruits, it is essential that a company like CTC be involved in the pioneering efforts of not only enhancing quality and quantity of fruits in Sri Lanka, but also processing, packaging and creating value added products.

The management in the field and at the headquarters at CTC appear to have the cadre of people available who can start up and provide leadership in this venture. Proper assistance in technical and marketing areas will further improve the chances of success.

7.4 A projected profit and loss statement for start up is presented in Table 4 based on 288 days operation and 3 daily shifts. The initial turnover of Rs. 25.3 million shows a profit of Rs.6.6 million. It will be a good start to begin with this benefit. With modular approach the business can be rapidly increased to four times its initial volume in 3 years.

7.5 Commitment is key to the ultimate success in a venture of this nature. CTC managements at all levels show enthusiasm and want to carry out the initial laboratory trials with technical assistance from USAID.

8. CONCLUSION AND RECOMMENDATION

8.1 Viability

The fruit dehydration project appears to be feasible due to the following reasons.

a. The scope of enhanced tropical fruit production is enormous:

b. In the absence of large orchards, a properly managed outgrowing system will generate enough fruits needed to start dehydration.

c. Dehydration as a technology is close to the tea drying industry and it can be adapted easily as opposed to freezing and canning.

d. Initial capital expenditure and subsequent expenses on packaging materials will be lower than other processing techniques.

e. The domestic and international markets can be developed with high quality products since it is a growth area.

f. CTC has competant staff and wherewithal for it.

8.2 Recommended steps prior to initial production at commercial level by CTC which is well positioned to proceed further.

The following format is suggested for testing and evaluation under CTC management prior to commercial production of dry fruits:

a. Fruit production data and quality evaluation should be done at CTC nucleus orchard for Alphonso mango, Kew pineapple, Hawaiian type papaya and Cavendish type bananas.

b. A laboratory model vacuum dehydrator with small packaging equipment costing about US$ 5000 should be installed at CTC Foliage Research Center to develop drying characteristic charts for fruits and to establish the quality control parameters for scale up. This should be done within 120 days of equipment installation. USAID support should be given in this regard.

c. The experimental data should be used to design the initial production model of dryer in modular form for expansion. Initial production can be started up in Girandurikotte Industrial Park where facilities can be developed for plant installation. CTC can apply for this immediately.

d. The samples generated during laboratory trials should be used to determine consumer reaction and market potential.

e. Technical assistance in plant design and start up of the initial production should be provided at the successful conclusion of the laboratory trials. The target date for this phase to commence will be December 1992 or January 1993, depending upon the progress made. At that time, a complete review of the project by the Fruit Processing Specialist would take place. Based on the results of the experiments in the laboratory and subsequent market tests, final design and decision to proceed further will be given.

TABLE 1

FRUIT PRODUCTION IN SRI LANKA

Fruits	Production (Metric Tons)		Average per capita (gm/person/day) based on 16M Sri Lankans
	1990	1991	
MANGO	90,000	90,000	16.00
PINEAPPLE	23,500	30,000	4.60
PAPAYA	25,000	48,000	6.25
BANANA	800,000	952,000	150.00

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TABLE 2

RETAIL PRICE OF DRIED FRUITS IN CALIFORNIA SEPTEMBER 1992

TYPE OF DRIED FRUIT	PACK SIZE	PRICE US$.
PINEAPPLE RINGS	12 OUNCES	3.29
PINEAPPLE SNACK CUBES	1/2 LB	2.49
DRIED MANGO	1/2 LB	3.89
BANANA CHIPS	8 OUNCES	1.49
PAPAYA SPEARS	12 OUNCES	3.29
PAPAYA SNACK CUBES	8 OUNCES	2.49

TABLE 3

COST OF PRODUCTION OF FRUITS PER ACRE BY CTC
(Based on minimum 25 acre farm size)

Land Preparation	Passion Rs.	Mango Rs.	Lime Rs.	Guava Rs.	Papaya Rs.
Cleaning	2000	2000	2000	2000	2000
Holing & Manuring	1750	700	1000	1000	1300
Windbreaks	200	200	200	200	200
Trellising	11750	-	-	-	-
Seedling & Planting material	1350	2500	900	500	500
Irrigation Planting & Re-supply	500	300	300	300	300
vacancies (labour)	180	100	200	200	200
Crop Management					
Weeding	800	800	800	800	800
Training Vines	1000	-	-	-	-
Fertilizer appl.	1100	700	1000	700	700
Pollination	2320	-	-	-	-
Maintenance	100	-	-	-	-
Harvesting	800	400	600	600	900
Packing	150	100	200	200	2000
	2500	8800	8200	7000	10000
Yield/acre in kgs.	5000	2000	3000	3000	15000
Price/kg (Rs)	10	10	15	08	05
Income (Rs)	5000	20000	45000	24000	75000
Profit (Rs)	25000	11200	36800	17000	65000

TABLE 4

DEHYDRATED FRUIT PROCESSING PROJECT PROJECTED PROFIT AND LOSS ACCOUNT

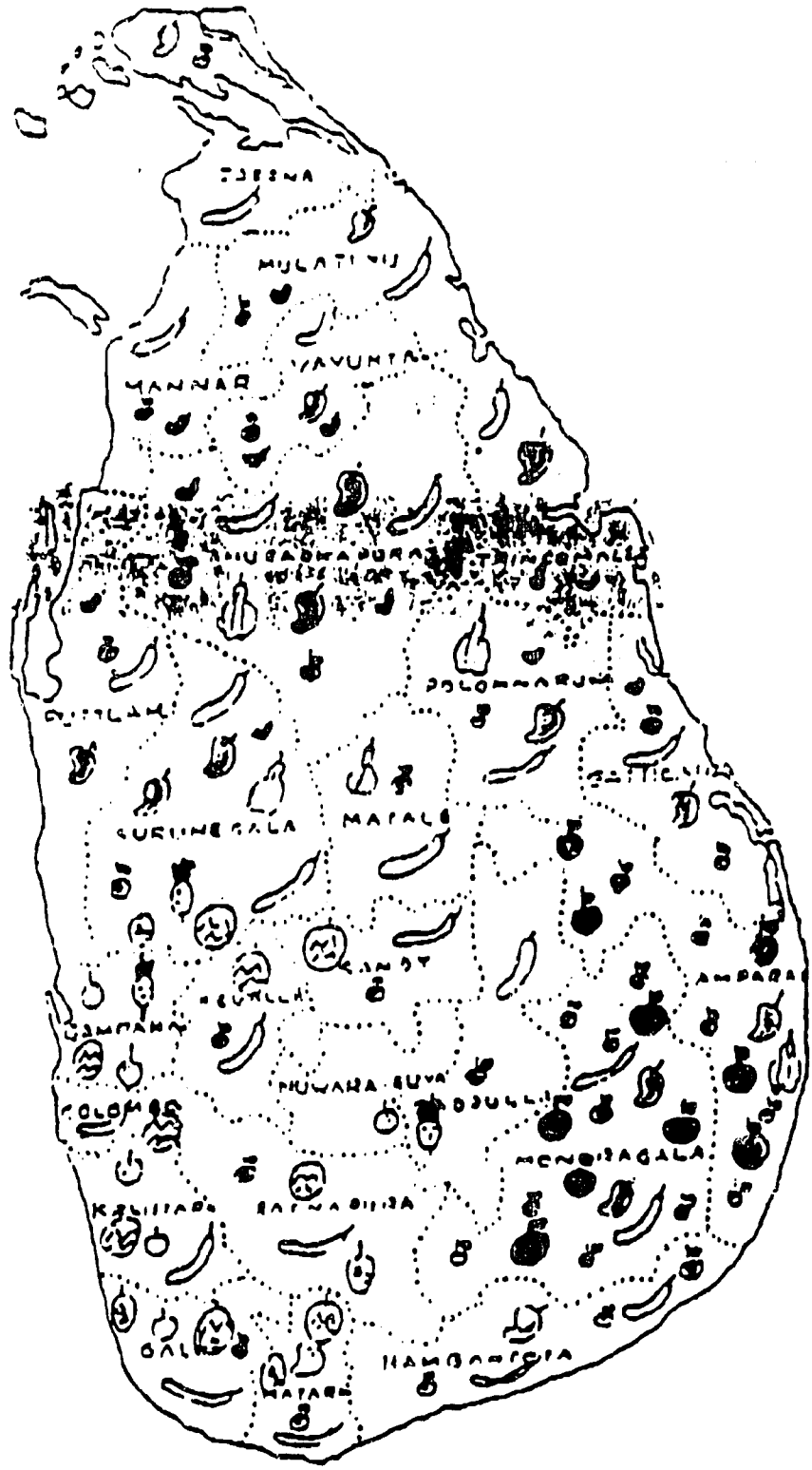
	Year 1 Rs. 000's	Year 2 Rs. 000's	Year 3 Rs. 000's
Turnover	25,272	55,598	90,069
Freight Ins. & Transport	2,008	4,479	7,488
Nett Turnover	23,264	51,110	82,581
Less: Variable overheads			
Fresh fruit	6,840	14,904	25,709
Labour	1,106	2,544	4,388
Chemicals	275	633	1,092
Packing materials	9	22	38
Electricity	2,074	4,769	8,227
Total	9,944	22,872	39,454
Contribution	13,320	28,247	43,127
Less Fixed overheads			
Administration	4,678	6,617	8,916
Marketing	2,000	2,500	3,125
Total	6,687	9,117	12,041
Trading Profit	6,633	19,130	31,086
Interest	2,000	0	0
Profit before tax	4,633	19,130	31,086

DEHYDRATED FRUIT PROCESSING PROJECT PROJECTED PROFIT AND LOSS ACCOUNT (contd.)

ASSUMPTIONS

1.	FRESH FRUIT PER BATCH	500 KG
2.	DRESSED FRUIT	50% OF FRESH FRUIT
3.	DEHYDRATED FRUIT	20% OF DRESSED FRUIT
4.	3 SHIFTS PER DAY PRODUCTION	24 DAYS PER MONTH
5.	LABOUR	16 UNSKILLED LABOURERS PER MACHINE
6.	PACKING	100 GRAMS PER BAG 10 BAGS PER BOX
7.	SEA FREIGHT	US$ 2,000/- PER SHIPMENT 5,000 KG PER SHIPMENT
8.	ALL MACHINES WILL BE RECEIVED FREE OF CHARGE	
9.	BANK OVERDRAFT OF RS.10 M WILL BE OBTAINED IN YEAR 1 AT 20% INTEREST	
10.	SELLING PRICE PER KG	US$ 6.50

FIGURE 1 MAP OF SRI LANKA SHOWING FRUIT PRODUCTION IN DIFFERENT AREAS



Legend: Passion fruit, Pineapple, Lime, Orange, Papaya, Banana, Mango, Bread fruit, Cashew nut

FIGURE 2

FLOW CHART OF SUGGESTED FRUIT PROCESSING

Fruit cleaned, peeled, sliced and diced
(Moisture level at approx. 80% level)

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Treatment in sugar solution at 70 degree
Brix approx.

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Dipped in Sulphite Solution
as preservative

↓

Dried in vacuum at appropriate temperature
and time (Moisture reduced to 10% level)

↓

Packed in sealed bags or containers

↓

Boxed and shipped

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