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**Study on the
Potential Business Opportunities
Using Locally Available Resources
Southern Province**

**Submitted
By**

**Matara District Chamber of Commerce and Industry
Matara
Sri Lanka**

September 2003

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INTRODUCTION

Matara District Chamber of Commerce and Industry (MDCCI) wish to undertake a comprehensive study on the potential business opportunities using locally (in the Southern Province) available resources.

United Nations Industrial Development Organisation (UNIDO) under the Sri Lanka Integrated Development Support Programme is supporting the MDCCI to become an effective promoter of Entrepreneurship in the Southern Province. UNIDO's main objective in this intervention of micro small and medium enterprise development is to assist, promote and development of private sector in the provinces, as development in the past was largely limited to Colombo. MDCCI is also a partner of the UNIDO "Ruhunu Business Incubator" along with the Ruhunu University, Ministry of Enterprise Development, Industrial Policy and Investment, Southern Development Authority and Japan Lanka Industrial Development Centre to expand diversity and/or innovate MSMEs in the Southern Province. MDCCI in collaboration with the District Chamber of Galle and Hambantota is expected to provide technical and business advisory services, channel available financial resources and incentives, networking and information sharing among and between public and private sectors for their business development.

In order to satisfactorily and effectively design and plan activities, MDCCI requires baseline information with regard to the business opportunities in the province. Taking into consideration, the basic information known of local resources of the province, it is necessary to gather and evaluate the exact information through a professional study. Other than the study done by Project SMED (SMED is a project of the Federation of Chambers of Commerce and Industry of Sri Lanka and Friedrich Naumann Stiftung) in 1995 there is no complete study done recently on the subject.

In 1995 then government gave priority to the development of the Southern Province and a Presidential Task Force was established. As a first step in the establishment of a Southern Development Authority (SDA).

Present Scenario:

In Sri Lanka there is a high degree of disparity with regard to the distribution of income which has resulted in vast differences in Poverty Levels. Income poverty incidents of the Southern Province is 26 compared to 14 in the Western Province (Source : connecting to growth Sri Lanka's Poverty Reduction Strategy). Southern Province which is popularly famous for most successful businessmen in Sri Lanka remain poor compared to the Western Province. The unemployment (Table 1 below) is alarming.

Unemployment Rate by Province

| Province | Year | | | | |
|----------|------|------|------|------|------|
| | 1996 | 1997 | 1998 | 1999 | 2000 |
| Total | 11.4 | 10.5 | 9.2 | 8.9 | 7.6 |
| Western | 12.2 | 10.7 | 9.3 | 8.9 | 8.0 |
| Southern | 14.8 | 13.6 | 13.6 | 12.7 | 11.1 |

Source : Extracted from Department of Census and Statistics

However, the province is not poor in human or physical resources. Even the tapped resources are not harnessed fully resulting in very low value addition.

According to the study done by Project SMED in 1995 titled "Industrial Raw Materials and Investment opportunities in the Southern Province" has identified opportunities in agricultural production, medical plant, industrial minerals such as vein quartz and chemicals from sea.

Considering the unemployment and prevailing poverty levels of the province, the results of the study will be an important source of information to the MDCCI, potential investors and policy makers.

Scope of the Survey:

The scope of this survey is to identify specific business opportunities, using the resources available within the Southern Development area (to be defined) that has the potential to generate and sustain (economically and environmentally) viable industrial ventures.

Out of the many types of raw material known to be available in the Southern Region only those with the potential to generate and sustain viable industries but so far not fully exploited, will be considered in this study. Long standing crops like Tea, Rubber and Coconut will also be considered as they are not harnessed fully. After identifying the potential industrial raw material resources, the type and shape of the industries they could generate, will be identified and are presented in the report with brief project profiles.

Chapter 1

BACKGROUND PROFILE OF THE SOUTHERN PROVINCE

1.1. PHYSICAL FEATURES

Southern Province, as the name implies, covers the Southern belt of Sri Lanka. It stretches from the Bentara ganga, in South and South Easterly direction, to Kumbukkan Oya in the East, and is bounded by the Sabaragamuwa hills and the Uva Plains to the North and the Sea to the South. It covers an area of 480,000 hectares. According to the topography of the land it could be divided into three major physiographic zones.

1. The coastal plains which includes the main coastal belt.
2. The intermediate zone or the hinterland which rises from about 50 metres to about 300 metres.
3. The hilly region to the North having an elevation of 300 metres to 1000 metres.

Several rivers and streams flow to the sea through this region, the important of them being Walawe and Nilwala.

1.2. CLIMATE

The Southern Province has a topical climate, with the average annual temperature in the region of 28°C. According to the annual rainfall figures the region could be subdivided into the three major climatic zones prevailing in Sri Lanka. The entire Galle District and most of the Matara District fall in the Wet Zone, receiving an annual rainfall in excess of 75 inches. Some regions of Matara and Hambantota Districts fall in the Dry Zone, receiving an annual rainfall between 50 to 75 inches, while the other regions of Hambantota District fall in the Arid Zone, receiving rainfall of less than 50 inches per annum. In the wet regions the rain is well spread throughout the year, but most of the precipitation is from the South West Monsoons. The Dry and the Arid regions get most of their rain from October to December, during the inter Monsoon periods. (see map Fig. 1.1.).

1.3. SOCIO ECONOMIC PROFILE

Southern Province is made up of Galle, Matara and Hambantota Districts, with a combined population of over 2 million people. The Galle and the Matara Districts are more developed and have a population density of about 550 persons per Sq. Km., while the Hambantota District is very much less developed and has a population density of about 180 persons per Sq. Km.

Both the Galle and Matara Districts have a well developed school system and maintain a good standard of general education while the educational facilities in the Hambantota District are comparatively poor. In the Southern Province, there is one University, the Ruhuna University, complete with faculties of Medicine, Science, Commerce, Arts and Engineering and four Technical Colleges, one each, at Galle,

Matara, Beliatta and Balapitiya. Old established colleges, both for boys and girls at Galle and Matara, maintain high academic standards, almost in par with the big schools in Colombo.

The Colombo – Tissa trunk motor road passes through a good part of the province, running adjacent to the coast line. Several highways radiate out of the main trunk road leading to the hinterland. A super highway connecting Matara with Colombo via Galle has been planned, and the construction work has just commenced. This highway will run parallel to the existing Colombo – Tissa highway, but will run through more to the hinterland of the country, through scenic landscapes. The Railway too serves the coastal belt of the province well, but presently it terminates at Matara. A project is in progress to construct new lines and extend Railway services upto Kataragama, a major religious destination, venerated both by the Buddhists and the Hindus.

Telecommunication facilities in the province too have been recently upgraded. Galle, Matara and Hambantota have International Direct Dialing facilities.

Galle harbour, the second most important harbour in the country is to be developed soon. Besides the port, there is a large fishery harbour and cold room complex in the port premises, for the benefit of the fisheries industry. There are additional fishery harbours in the region, at Beruwela, Balapitiya, Mirissa, Tangalla, Hambantota and Kirinda.

A Free Trade Zone complex has been recently established at Koggola, close to Weligama, but is not fully operational yet. Outside the FTZ the only other large scale industries in the province are the Cement grinding and packing plant at Galle, Harischandra Mills located in Matara and the Plywood complex at Gintota. Besides these there are a few garment factories established under the 200 Garment Factories Programme.

With the sunny and sandy beaches, the unpolluted sea, the Wild Life Sanctuary and National Parks at Yala, the entire coastal belt of the Southern Province is a tourist paradise. The phenomenon has given rise to a multitude of tourist Resort Hotels, Motels and Guest Houses along the entire coastal belt of the Southern Province stretching from Bentota right upto Kataragama.

Sri Lanka is among the most bio diverse of Asian countries, having the greatest biodiversity/10,000 sq km for mammals, flowering plants, amphibians and reptiles and ranking second for biodiversity of birds. This project undertook a first feasibility scooping of the Southern Region for its ecotourism appeal. This related to the degree to which there is potential international visitor lure and attractiveness. This involved assessment of sites by applying criteria used by The Nature Conservancy (Drumm and Moore 2002).

Source: Report on Ecotourism Development Strategy Sri Lanka Tourist Board.

Agriculture is still the main occupation of the people of the Southern Province, accounting for just over 50 percent of the employment opportunities. The people of this region are generally more industrious, especially gifted in arts and crafts, and are more entrepreneurial than those in the rest of the country. The unemployment

rate, specially among the educated youth, is comparatively high, being at about 25 percent of the active population.

The answer to the growing unemployment problem lies in speedy launching of several employment generating projects in the region. Development of viable industries in the region is one effective way of meeting this need, and should be considered as a priority area. The most appropriate strategy for this would be to develop those industries based on the natural resources found in the region. Maximum utilization of local raw materials is considered to be one of the most important factors in the industrial development of any country.

POPULATION AND ANNUAL GROWTH RATE

| District | Population | | Average Annual Growth Rate 1981-2001 (Percent) |
|--|-------------------|-------------------|---|
| | 1981 Census | 2001 Census | |
| Galle | 814.531 | 990.539 | 1.0 |
| Matara | 643.786 | 761.236 | 0.8 |
| Hambantota | 424,344 | 525,370 | 1.1 |
| Moneragala | 273.570 | 396.173 | 1.8 |
| Ratnanura | 797.087 | 1.008.164 | 1.2 |
| SDA Region | 2.953.318 | 3.681.482 | 1.2 |
| SRI Lanka | 13.157.065 | 16.864.687 | 1.2 |
| % of the Region from all Island | 22.5 | 21.8 | |

Source: Dept., of Census & Statistics – 2001

Courtesy: Southern Development Authority.

LANDS COULD BE UTILISED FOR INVESTMENT

| District | HECTARES | | | | | | |
|--------------|--------------------|-------------|--------------------|--------------|------------|---------------|-------------|
| | Middle Class Lands | Crown Lands | I.D. Permits Lands | L.R.C. Lands | P.C. Lands | Private Lands | Other Lands |
| Matara | 1730.07 | 193.03 | 698.34 | 199.92 | 91 | 5499.52 | 438.73 |
| Galle | 1593.03 | 514.06 | 1659.02 | 242.02 | 102 | 1366.04 | 297.09 |
| Hambantota | 754.84 | 110.03 | 3117.72 | 87.14 | 0 | 2631.16 | 166.10 |
| Total | 4078.21 | 817.93 | 5475.26 | 529.26 | 193 | 9497.08 | 902.73 |

Courtesy: Southern Development Authority.

TOTAL LAND AREA

| District | Land Area excluding Inland water (Hectares) (A) | % $\frac{A \times 100}{C}$ | Area under Inland Water (Hectares) (B) | % $\frac{B \times 100}{C}$ | Total Area (Hectares) (C) C = (A+B) |
|--------------------------|--|-------------------------------|--|-------------------------------|--|
| Galle | 161,700 | 97.9 | 3500 | 2.1 | 165,200 |
| Matara | 127,000 | 98.9 | 1300 | 1.0 | 128,300 |
| Hambanto | 249,600 | 95.7 | 11,300 | 4.3 | 260,900 |
| Moneraga | 550,800 | 97.7 | 13100 | 22.3 | 563,900 |
| Ratnapura | 323,600 | 98.8 | 3,900 | 1.2 | 327,500 |
| SDA | 1,412,700 | 97.7 | 33,100 | 2.3 | 1,445,800 |
| Sri Lanka | 6,270,500 | 98.2 | 290,500 | 1.7 | 6,561,000 |
| % of the SDA Area | 21.5 | | 11.4 | | 22.0 |

Source: Statistical Abstract 2000

Courtesy: Southern Development Authority.

PRINCIPAL INDICATORS OF INDUSTRIAL ACTIVITY

| DISTRICT | NO. OF ESTABLISHMENTS WITH 5 OR MORE PERSONS ENGAGED | | | NO. OF EMPLOYMENT | VALUE ADDED (Rs.'000) |
|--------------|--|---------------|---------------|-------------------|-----------------------|
| | NO. OF UNITS | REGION WISE % | COUNTRY WISE% | | |
| GALLE | 852 | 40% | 7% | 16,311 | 2,967,798 |
| MATAR | 535 | 25% | 4% | 9,402 | 1,173,579 |
| H'TOTA | 185 | 8% | 1.5% | 2,416 | 136,271 |
| MO'GAL | 204 | 9% | 1.7% | 4,998 | 859,314 |
| R'PURA | 379 | 18% | 3% | 11,883 | 2,144,943 |
| TOTAL | 2155 | 100% | 17.2% | 45010 | 7,281,905 |

Courtesy: Southern Development Authority.

Chapter 2

RAW MATERIAL RESOURCES IN THE SOUTHERN PROVINCE

2.1. CLASSIFICATION

Raw Material Resources identified as available in the Southern Province, could broadly be classified into the following categories. Well known products such as Aromatic plants are not dealt in this study.

1. Agro Products
2. Medicinal Plants
3. Minerals
4. Chemicals

2.1.1. Agro Produce

Southern Province is a surplus area for cereals. Cereals such as rice and green gram are suitable for conversion to flaked products to manufacture instant breakfast foods. Also, there are opportunities for the introduction of more profitable new varieties of crops such as gherkins, cantaloupe, Baby Corn, Okra, Melons etc., which has a proven market potential.

There is potential for the development of the following agro industries –

- Cultivation of high value fruits and vegetables for export as well as for the local market, in fresh state
- Processing of fruits and vegetables collected from outgrowers for export.
- Integrated projects incorporating cultivation and processing of fruits and vegetables.
- Instant foods and health foods from lentils available in the area.

Agricultural produce could further be sub-divided into;

- i) Fruits & Vegetables
- ii) Cereals & Lentils

Traditional crops like Tea, Rubber and Coconut, though found in abundance in this region, are not considered in this study, as their industrial potential is well known and are widely exploited. Only new crops and processing techniques hitherto unexploited or under exploited are identified for consideration. Rice, though is a long

standing traditional crop, is considered under cereals, because it is felt that certain value adding processing techniques could be proposed for it.

2.1.2. Medicinal & Aromatic Plants

Medicinal plants are those bearing active ingredients of medicinal value. Most of these plants are those often used in the traditional medicines including the Aurvedic system of medicine. In recent years, scientists working independently as well as in association with international research organizations have succeeded in isolating and extracting the medicinally active ingredients of these plants.

Aromatic plants are those bearing essential oils. The term “essential” is derived from “essence”. Essential oils have their role in perfumery, and food flavouring.

Several well known medicinal plants grow wild in the Southern area, the climatic and soil conditions being very favourable for them. Thus there is good potential for growing and processing of these plants on a commercial scale.

Medicinal plants identified for commercial exploitation are:

- Aloe (Aloe Vera Linn)
- Minimal (Catharanthus Roseus)
- Senna (Senehe Kola) (Cassia Angustifolia)
- Katuwelbatu (Solanum Xanthocarpum)
- Ranawara (Cassia Auriculate)
- Godakaduru (Strychnos Nux Vomica)

Essences of aromatic plants have a ready demand all over the world as they are widely used in food flavouring, perfumes, disinfectants, deodorants, insect repellents etc.

Aromatic plants which have a potential for commercial exploitation in the South area;

- Cinnamon
- Citronella
- Lemon Grass
- Vetiver (Savandara).

2.1.3. Minerals

Most of the minerals found in the South are not yet identified as reserves. Two of the minerals identified as occurring in appreciable quantities and of desirable quality to generate viable industries are ;

- Limestone (CaCO_3) of different forms
- Vein Quartz

The following industries can be established with crystalline limestone.

Production of Kiln lime
Production of limestone power and aggregates
Dimension stones.

Considering the relative purity and the freely available large deposits of vein quartz it is possible to manufacture several intermediate products using this as the main raw material. Some of the products are as follows:

High markup glass
Fused quartz
Quartz crystals.

About ten different kinds of minerals are known to occur in the Southern Province. Some of them like clay are already found well exploited, some are not of desired quality or not found in adequate extents for economically viable exploitation. Two kinds of minerals, known to occur in abundance in the region are identified as having the potential to generate new industries. They are;

- i) Limestone
- ii) Vein Quartz

2.1.4. Chemical Industries

Brine is a material available in abundance in the sea right round the island, but specific locations in the Hambantota region have those unique supportive features, that enable its economical exploitation for valuable chemicals.

The raw materials identified above will be further subdivided and analyzed in the chapters to follow, identifying the appropriate and viable industrial ventures that they could sustain. In considering the raw material resources and strategies for development it is felt that the Southern Development Area is the more appropriate region for consideration and is treated as such in the report.

AREA UNDER PERENNIAL CROPS BY DISTRICT

Hectares

| District | Tea | Rubber | Coconut Area | Coffee | Cinnamon |
|--------------------------|--------------|--------------|--------------|------------|--------------|
| Galle | 22139 | 12025 | 9642 | 177 | 9825 |
| Matara | 20816 | 5610 | 13820 | 457 | 7767 |
| Hambantota | 273 | 46 | 20962 | 275 | 1710 |
| Southern Province | 43228 | 17681 | 44424 | 909 | 19302 |

Contd./-

| District | Pepper | Cloves | Manioc | Sweet potatoes | Others Yams | Ginger | Turmeric |
|-------------------|--------|--------|--------|----------------|----------------|--------|----------|
| Galle | 418 | 198 | 152 | 17 | 12 | 02 | 02 |
| Matara | 751 | 728 | 78 | 12 | 06 | 03 | 03 |
| Hambantota | 1312 | 45 | 559 | 67 | 14 | 154 | - |
| Southern Province | 2481 | 971 | 789 | 96 | 32 | 159 | 05 |

Source: Southern Province in Figures – 2000

Courtesy: Southern Development Authority.

Chapter 3

AGRI-BUSINESSES

3.1. GENERAL BACKGROUND OF AGRIBUSINESSES

The major plantation crops grown in the area namely, tea, rubber and coconut along with the acreage under forest plantations occupy another 10% of this cultivated extent. This leaves only 18% of the productive land for all other agricultural crops inclusive of those under paddy, cinnamon and mixed cultivations. The lack of water and the semi-arid nature of the terrain in the fertile areas coupled with unfavourable soil conditions in places where water is present, leaves vast extents of land still sparsely cultivated.

Paddy occupies a major share of the cultivated agricultural land in the South. The next is cinnamon which occupies a large extent of land. The mixed cultivations such as coffee, jak, kitul and cashew etc., come next and vegetables, tobacco, sugarcane and highland crops occupy the rest. In the case of highland crops, the important ones are the other field crops (OFC's) such as chillie, maize, cowpea, black and green gram and ground nut. Bigonions, red onions, potatoes, soyabean, gingelly too are cultivated, in the province, in small extents but, they have a ready market as raw produce.

The seasonal fruits and vegetables grown in the Southern Province are of importance to the agro industry. Of these, fruits such as jak, wood apple, nelli, beli, papaya, mango and vegetables such as bitter gourd, melon, tomato and murunga are the ones available in plenty. Major part of this production is in small farms and home gardens. However, the Southern Province contributes to a fair share of the national production of 800,000 mt of fresh fruits and vegetables.

The above land use pattern in the southern province shows that although large extents of land remain uncultivated or under cultivated it may not be possible to convert these extents to productive land by establishing orchards or groves or by introducing new cultivation practices only. In such a scenario, it is therefore prudent to consider agrobased industries for the Southern Province by:

- i) Diversifying the existing industries in the agricultural sector
- ii) Introducing new manufacturing and processing techniques to add value to the marketable surplus of fruits and vegetables in the province.
- iii) Establishing new projects to process presently unutilized agricultural by-products.

Rain fed wet regions of the Southern Province are densely populated, and all the arable lands extensively cultivated with the traditional crops like tea, rubber, coconut, paddy, cinnamon and citronella. Thus the availability of large tracts of land for new developments is extremely limited. However, large tracts of undeveloped and under-developed lands are still available in the Dry and the Arid regions of the Southern Development Area. Some of these lands are served by irrigation channels fed by large, newly constructed reservoirs like the Udawalawe,

Chandrikawewa and Lunugamwehera and many ancient tanks, such as Ridiyagama, Mamadala, Kiriibbanwewa, Suriyawewa, Urusitanowewa, Hambegamuwa and others. Thus the southern region dry zone is the area with the potential for the development of new agri-businesses.

3.2. VIABLE AGRIBUSINESS

There exist the following opportunities for agri-businesses in the Southern Province.

1. Several enterprises could be established for the organized purchasing, collection, processing and marketing of the fruits and vegetable crop already produced and available in the region, nurturing the existing growers as a network of outgrowers. The crop thus collected may be processed as fresh fruits and vegetables and sold in the local markets or exported. It may also be further processed to one or more of the following products and suitably packed for the market shelves.

- Jams and Jellies
- Fruit Juice Concentrates
- Cordials
- Canned Dried Vegetables
- Sun Dried Vegetables
- Dehydrated Fruits and Vegetables
- Fruit or Vegetable Purees/Pastes
- Sauces and Chutneys

2. There could be scope for more enterprises to be established as integrated agri-businesses in the region, if they undertake to grow their own crops and process them for the market. Adequate tracts of land in the newly developed irrigation schemes or outside the schemes for self development, could be leased from the state on submission of viable project proposals. Suitable privately owned land too are available for purchase or leasing if so desired. Outgrower networks could be developed under these schemes too. These schemes have still better opportunities for the introduction of more profitable new varieties of crops such as Gherkins, Cantaloupe, Baby corn, Okra, Melons etc., which have proven export potential.

The availability of land for new farms is practically in the Hambantota District. Suitable lands for different varieties of crops should be carefully selected, matching the specific needs of the crops, in terms of the soil, the climate, water etc., with the prevailing on-site conditions.

To summarise the findings, the agri business projects identified as viable in the Southern Development Area are:

Safeguards to be adopted are; Strict observance of mining regulations, efficient collection of dust by installing dust collectors, and suppression of excessive noise.

5.5. A PROJECT PROFILE FOR THE PRODUCTION OF DIMENSION STONES

5.5.1. General Information on the Industry

A popular definition of a dimension stone is “a natural building stone that has been selected, trimmed or cut to specified or indicated shapes or sizes with or without one or more mechanically dressed surfaces.”

Unfortunately, this is so general that it encompasses everything from the crude shaping of a fieldstone for a rudimentary animal shelter to the polishing and gauging of a marble floor tile for a fine presidential palace. Materials constituting dimension stones are equally varied and may include granite, fieldstone, travertine, quartzite, pumice, soapstone, slate, limestone, serpentine (verde antique) bluestone, cantera, adoquin, onyx, marble and standstone. In addition, there is the reconstructed and reinforced marble (for example, Breton MRF) and reconstituted granite in resin (Granitech).

Marbles are limestones which have acquired a granular or crystalline texture and are composed of minute calcite interspersed with coloured veins of other minerals with flakes of talc and mica. Dimension stones / tiles are popularly used for decorative purposes, preferably as wall tiles of buildings. Only the very fine grained marble are suitable for the production of dimension stones or tiles as the coarse grained are too fragile to handle.

Due to the presence of different other minerals as inclusions, certain coloured marbles are also possible. These marble slabs or tiles have a very good export potential as well as a small but growing local demand.

There is a parallel industry in operation in Sri Lanka for sometime now where similar dimension stones are turned out of granite predominantly for the export market. There are five small and medium scale companies engaged in it some with foreign collaborations with investors from Hongkong, Italy and Japan.

5.5.2. Scope of the Industry

There are several large deposits of marble identified in the Southern Development Area. Some of the known deposits are in Ridiyagama, Meegasara and Weeragasewea close to Ambalantota, about 15 sq. mls in extent. Tissawewa close to Hambantota, about 01 sq. ml. and at Maligawila about 08 sq. mls in extent. Detailed analysis have not been carried out on these deposits to ascertain the grain structure and other properties to confirm their suitability for the production of different types of dimension stones. Potential investors should therefore get these initial investigations carried out before embarking on a project.

5.4.6. Capital Expenditure

5.4.6.1. Machinery & Equipment

Estimated machinery requirements to equip for the shredding process.

| Description of equipment | Qty |
|--------------------------|-----|
| Feeder | 1 |
| Primary crushing unit | 1 |
| Sizing for sub base | 1 |
| Rock shredder | 1 |
| Primary sizing unit | 1 |
| Secondary sizing unit | 1 |
| Belt conveyors | 10 |
| Control panel | 1 |
| 10 tonne trucks | 2 |
| 1 tonne pick up trucks | 2 |

Total estimated cost of machinery and equipment Rs.10 Million.

5.4.6.2. Land & Buildings

| | |
|--|----------------|
| One hectare of land for the processing plant, cost | Rs.0.5 Million |
| Buildings, 600 sq. M at Rs.2,000/sq. M ... | Rs.1.2 Million |

5.4.6.3. Services

| | |
|--|------------------|
| Installation of water supplies ... | Rs. 0.2 Million |
| Installation of electricity supplies (250 KVA) | Rs. 1.0 Million |
| Cost of environmental safeguards | Rs. 0.5 Million |
| Total estimated capital expenditure | Rs.13.5 Million. |

5.4.7. Location

The location for the processing plant should preferably be within one Km of the limestone source. The land should be reasonably flat and have easy access to water and high voltage (440 V) 3 phase electrical supply. Also should have good access to a main road.

5.4.8. Environmental Impact

5.4.8.1. Waste Generated

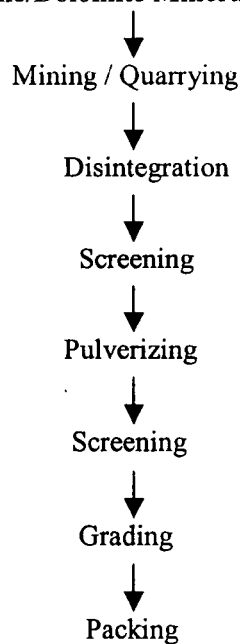
The waste generated would be only the limestone dust, which could be efficiently collected, and used in the paint industry/

5.4.8.2. Environmental Safeguards

Portable plant as the name implies is meant to be moved into sites with ease and thus suitable for working small and scattered deposits. Stationary plant is meant to be more permanently installed at fixed location and therefore more suitable for sites with large deposits of the mineral. There are two kinds of stationary plants. One utilizing the traditional method of crushing and processing, while the other utilizes the newer shredding process.

In the manufacturing process big chunks of limestone / dolomite are fed by a vibrating feeder into the primary crusher, and the output from this crusher pass on in turn to the secondary and tertiary crushers or shredders via mechanical conveyors, where they are progressively reduced to finer particles. The output is screened through different mesh sizes and graded to different particle sizes. Popular grading sizes are: <5 mm, 5-12 mm, 13-20 mm, 21-40 mm.

**Flow Chart for the Production of Limestone Powder
Limestone/Dolomite Mineral Deposit**



5.4.5. Labour Requirement

| | |
|----------------------|----|
| Production Manager | 1 |
| Maintenance Engineer | 1 |
| Skilled Operators | 5 |
| Unskilled Labour | 10 |

5.4. A PROJECT PROFILE FOR THE PRODUCTION OF LIMESTONE POWDER

5.4.1. General Information on the Industry

Limestone and lime are widely used to soil deficiencies such as:

- to neutralize any acidity in the soil
- to destroy objectionable bacteria in the soil
- to increase the permeability of the soil
- to accelerate the decomposition of most organic manures
- to displace ammonia, potash and other substances from their insoluble compounds in the soil and make them available for the plant growth.

In the production of metals like iron, copper and lead from their ores, it is usually important to reduce both the metal and the other constituents of the ore to a molten state so that both may be drawn out of the furnace as fluids. Limestone is extensively used to combine with the silica and alumina present in such ores to form a readily fusible slag which can be drawn out of the furnace as required. Such use of limestone as a flux is quite common on account of their cheapness.

Also it is required as a filler in rubber and paper industry. Fluxing operations in iron, steel and glass melting require limestone in slightly larger sizes, preferably 20-40 mm sizes. Thus there is a demand for powdered or pulverized limestone.

5.4.2. Scope of the Project

The project under consideration here is to establish a limestone crushing facility to produce about 150 tonnes per hour of limestone powder of various grades. Stationary plant with the shredding process is to be established at a site close to the mineral deposit.

5.4.3. Market

Markets are both local and foreign, for use in several industries such as the paint, glass and paper industry.

5.4.4. Production Process

The basic production process is to crush large blocks of limestones / dolomite into small stones, gravel and sand. There are two main types of plant often used for this process;

- Portable Plant
- Stationary plant

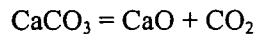
utilizing dolomitic limestone deposits, to cater to manufacturing industries in addition to the building industry.

5.3.3. Market

About 50,000 – 60,000 tonnes of lime are presently produced annually in Sri Lanka. This is mainly used in the building industry. The demand for high purity technical lime for industrial uses such as in paints, fillers, etc., are growing and would be a lucrative market. At present the local demand for technical lime is met from imports.

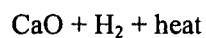
5.3.4. Production Process

When CaCO_3 bearing limestones are heated to a temperature about 800°C in an enclosure (kiln), the limestones decomposes to a white solid substance called quick lime (CaO) and a colourless and odourless gas called Carbon Dioxide (CO_2). The gas escape to the atmosphere leaving the quick lime in the enclosure. The ensuing chemical reaction can be written as:



In other terms, 100 parts by weight of Calcium Carbonate when heated to above 800°C decomposes to 56 parts by weight of quick lime and 44 parts by weight of carbon dioxide.

When water is added to quick lime, slaked lime is produced according to the chemical reaction;



This means that 56 parts by weight of quick lime combines with 18 parts by weight of water to produce 74 parts by weight of slaked lime. This is an exothermic reaction and a large amount of heat is produced.

To produce technical lime, the ordinary lime will have to be purified and manufactured conforming to given specifications.

5.3.5. Capital Expenditure

This require a higher capital expenditure, of about Rs.5 Million, but it could be recovered by way of high markup on the sale of the products.

5.3.6. Recommended Location

Production plant should be located where dolomitic limestone deposits of low magnesium content are available. It is preferable to be away from populated areas.

| PROJECT | INVESTMENT Rs | EMP. OP. | MARKET | POSIBLE AREAS |
|--------------------------------|------------------|----------|---|---|
| PRODUCTION OF LIMESTONE POWDER | 13.5 | 17 | LOCAL & FOREIGN | RAKVANA, THIMBOLKETIYA, A'TOTA, H'TOYA, BU TTALA, |
| PRODUCTION OF DIMENSION STONES | 50 | 25 | ITALY, JAPAN, USA, AUSTRALIA, BELGIUM, MIDDLE EAST, | RIDIYAGAMA, MEEGASARA, A'TOTA, H'TOTA |

5.3. A PROJECT PROFILE FOR THE PRODUCTION OF LIME

5.3.1. General Information on the Industry

Lime production dates back to antiquity and is one of the oldest technologies in the Island. Lime in one form or another has been in use in the mans daily life. The largest consumer of lime is the building industry; which uses lime directly, in masons lime and motar and wall finishing. Naturally occurring raw materials used for lime production in Sri Lanka are:

- Miocene Limestone
- Coral
- Shell
- Calcite
- Dolomite

Of these the Miocene limestones should be reserved for the cement industry and the calcite for the ceramic industry. Coral and shell deposits are very limited and are depleting fast. Off shore and on shore upto 300 meters, mining of lime is banned for environment protection and control of sea erosion. This leaves only the dolomite and dolomitic limestones for any future expansion in the lime industry.

5.3.2. Scope of the Industry

The project under consideration is comparatively a moderately large scale project, to manufacture about 5,000 tonnes of technical lime per year

5.2.2. Quality of Limestone Reserves

Chemical Analysis of Different Types of Limestones Reserves

| Chemical Constituents | Percentages in different Limestones Types | | | | |
|--------------------------------|---|--------|---------|----------|---------|
| | Shell | Coral | Miocene | Dolomite | Calcite |
| SiO ₂ | 1.15 | 2.00 | 0.82 | 0.75 | Tr |
| Al ₂ O ₃ | 0.41 | 3.40 | 0.52 | 0.27 | Tr |
| Fe ₂ O ₃ | 0.33 | 0.50 | 0.08 | 0.05 | |
| CaO | 54.89 | 51.50 | 54.20 | 31.01 | 55.23 |
| MgO | 0.02 | -- | 0.70 | 21.78 | -- |
| L O I | 43.15 | 43.68 | 43.68 | 46.10 | 43.83 |
| Total | 99.95 | 101.08 | 100.00 | 99.96 | 99.06 |

Source: Economic Geology 1955 – J W Herath

5.2.3. Products and Uses of limestones

Limestone is an often used material in a large number of products and processes. Important areas of usage are:

- a) Cement Industry
- b) Building Industry – lime plaster
- c) Agriculture
- d) Metallurgical Processes
- e) Paints (Wall paints)
- f) Glass, Ceramics and Allied Industries
- g) Paper Industry
- h) Calcium Carbide

5.2.4. Possible Industries Based on Limestone

Following are identified as viable industries based on Crystalline limestone, and are presented with Project Profiles drawn up on them.

- 1) Production of kiln lime
- 2) Production of limestone powder (pulverization) & Agrigates
- 3) Dimension Stones.

because, limestone / dolomite and sea water, the only raw materials required for this process are available in abundance.

All dolomite deposits are found at or near the surface in readily accessible level so that simple quarrying or open cast mining is all that is required. The capital required for its exploitation is small, and mining for dolomite has potential for employment generation. Dolomite with its numerous applications has a good export potential.

Accurate records of present production of dolomite are not available, but is estimated to be about 10,000 tons a year. This material is largely used as crushed dolomite in agriculture and in ceramics and allied industries. It is also used in the manufacture of lime, building stones and as a flux in the iron melting industry. It could also be processed to produce refractories.

Dolomite occurs in the Southern Development Area at the following locations with the known extents as shown in the table below.

Marble Deposits Located in the Southern Development Area

| Ref. Topographical 1" Map | No. of outcrops Mapped | Main Location | Approx. Extent of outcrops in sq.miles |
|----------------------------|------------------------|---|--|
| Rakwana | 17 | Udagama Kolonna | 10 |
| Thimbolketiya | 13 | Tenketiya Maduwanwela Ketagalara | 05 |
| Ambalantota | 09 | Ridiyagama Meegasara Weeragaswewa | 15 |
| Hambantota | 01 | Tissawewa | 01 |
| Buttala | 01 | Maligawila | 08 |
| Rathnapura (South East) | 03 | Gangodakumbura | 02 |
| Haputale (South) | 03 | Ratmalawinna | 04 |

Source: Geological Survey and Mines Bureau

been going on for over 20 years, especially in the Hungama and Thenna areas. The shell bed is recovered by quarrying after scraping off the overburden. Thin beds are not exploited at present. These deposits too are fast depleting and the industry has no scope for expansion.

d) Calcite

Calcite deposits occur in some areas in the island and the best known as in the Balangoda area. Calcite deposits upto now are used in the ceramic industry and the resources available are small and of extreme purity. These deposits should not be used for low value uses like lime burning but be reserved for the expansion of the ceramic industry, which has promise of better returns as an export product.

e) Dolomite/Magnesite/Crystalline Limestone

The main magnesium minerals are;

| | | | | |
|---|-----------|-----------------------------|-------|-----|
| - | Dolomite | CaMg(CO ₃) with | 22% | MgO |
| - | Magnesite | MgCO ₃ with | 47.6% | MgO |
| - | Brucite | Mg(OH) ₂ with | 69% | MgO |

Dolomite consists of a double carbonate corresponding to CaCO₃, MgCO₃. Pure dolomite contains 54.3% CaCO₃ and 45.7 MgCO₃. However, in actual occurrences in nature, the constituent proportions could vary over a wide range.

Dolomite and dolomitic limestone deposits occurring in Sri Lanka are entirely confined to the belt of crystalline limestone (marble) deposits of Precambrian age. They occur inter banded with other rock types such as quartzites, charnockites and gneisses, as discontinuous but well defined bands. The deposits cover a very wide area, extending from as far north as Vavuniya, through Kurunegala – Kandy area, to the southern region near Ambalantota. The best known deposits occur in the Kandy, Matale, Nalanda, Habarana, Kandarawa, Ratnapura, Balangoda, Badulla and Welimada areas. Generally the deposits are of variable composition varying from a dolomite limestone to a dolomite.

The inferred reserves of dolomite (18-22% MgO) in Sri Lanka are over 500 million tones, and they are confined to the belt of marble (dolomite) in the central hill country. Dolomite with a magnesium content of 18-22% is of common occurrence.

Sri Lanka does not have economic deposits of magnesite MgCO₃, although a small occurrence has been identified at Randeniya (Wellawaya). Sea water magnesite is produced in many countries where it is not available from other sources. Production possibilities of sea water magnesite in Sri Lanka are promising

Economic deposits of Miocene limestones are not found in the Southern region. It is best that the available Miocene Limestones are reserved for the manufacture of cement.

b) Coral Deposits

Coral deposits are found at various points along the coast of the island. They are not of great importance except as a raw material for the manufacture of lime, mostly for the building industry. In field investigations it has been revealed that coral deposits occur from about 2.5 Km south of Ambalangoda (Akurala area) to Rekawa, about 35 Km east of Matara. The deposits consist of loosely packed finger or stick coral with heavy blocks of massive coral. The lime manufacturing industry is heavily concentrated in the following areas;

- Akurala
- Seenigama - Hikkaduwa
- Mihiripenna – Talpe area
- Ahangama – Midigama area
- Kamburugama – Madiha area
- Rekewa

In the Akurala, Hikkaduwa and Rekawa areas, until recent years, most of the corals have been mined off the offshore coral reefs. But now as the mining of offshore reefs are banned all have turned to the inland coral deposits and the mining has increased. The ban on mining extends to 300 meters inland from the coastline. Coral deposits are not of uniform thickness. The average depth of inland coral deposit is about 3 meters. In rare instances it could attain a depth of about 6 meters. These deposits are fast getting depleted and expansion of coral mining should not be encouraged. Another objectionable feature is that the coral mining degrade the environment.

c) Shell Beds

Shell beds are known in a number of localities along the coastal stretches of Sri Lanka. The largest of them, extending from Hungama to Bundala, a distance of 40 Km. Shell beds occur mostly close to the existing lakes and lagoons. The thickness of the beds generally decrease away from the lakes and lagoons. The thickness and the lateral extent of the shell beds are highly variable from place to place. Thicknesses ranging from a few cm. To about 3 meters have been observed, although they seldom exceed 1 meter, assuming an average bed thickness of 0.6 m for the Hungama area, it is estimated that the deposit contains about one million tones of shell material.

Chemical analysis of a sample obtained from Hatagala area shows: SiO₂ - 1.15%, Al₂O₃ - 0.41%, FeO - 0.33%, CaO- 54.89%, MgO- 0.2%, and loss in ignition 43.10%. Mining of shell in this area has

5.2. LIMESTONES

5.2.1. Occurrence

The term limestone is applied in a very broad sense to many forms of calcium carbonate, each with distinct physical properties and occurring in nature as varieties of rocks. Limestones vary very much, both in texture and composition. Some are hard, massive and break with a splintery or conchoidal fracture, whereas the others are crystalline rocks composed of crystals of calcite having granular texture and white in colour. There are still others having dull chalk like appearance. All limestones, in addition to its principal constituent, Calcium Carbonate, contain small proportions of alumina, silica, magnesia and iron oxide, with still smaller proportions of oxides of sulphur, phosphorous etc. The pure varieties of limestone contain 99% calcium carbonate. In nature limestones can also occur with clay, sand, iron oxide, magnesia and bituminous matter.

Marbles are limestones which have acquired a granular or crystalline texture and are composed of minute calcite interspersed with coloured veins of other minerals with flakes of talc and mica. The term "marble" is also used for various unaltered limestones which are capable of taking a high polish and are being used as decorative stones.

Marl is the term applied for friable earthy materials having a natural mixture of Calcium Carbonate and clay.

In Sri Lanka commercial deposits of limestone occur in about 5 main forms. They are:

- a) Miocene Limestone
- b) Coral deposits
- c) Shell beds
- d) Calcite
- e) Dolomite / Magnesite / Crystalline Limestone

a) **Miocene Limestone**

Sedimentary limestone deposits of Miocene age are best developed in the Jaffna Peninsula where they occur as a hard compact limestone, with calcium carbonate content well over 95%. These deposits which extend to appreciable depths continue as far as Puttalam along the North-Western coastal belt of the island. The overburden at some points is over 30 metres thick. The chief impurities in these limestone deposits are varying amounts of clay, silica and traces of magnesia. The two cement factories at Puttalam and Kankasenthurai depend on these deposits for their limestone requirements. The proven reserves of Miocene in the region is about 100 million tones, sufficient for a period of about 30 years at the production rate of about 2 million tones of cement per annum. The inferred reserves in the area is very much larger than the proven reserves.

Chapter 5

MINERAL RESOURCES

5.1. MINERAL RESOURCES IN THE SOUTHERN DEVELOPMENT AREA

The mineral resources known to be available in the Southern Development Area are:

- 1) Limestones. CaCO_3 of different forms;
 - a) Crystalline/Dolomitic
 - b) Magnesite/Calcite
 - c) Corals
 - d) Shell
- 2) Silica. SiO_2 of different forms:
 - a) Vein Quartz
 - b) Silica Sand
 - c) Chalcedony
- 3) Serpentinite
- 4) Iron - Limonitic
- 5) Industrial Clays
- 6) Graphite
- 7) Mica
- 8) Feldspar
- 9) Wollastonite
- 10) Allanite / Zircon
- 11) Garnet / Ilmenite / Thorianite
- 12) Gold / Gemstone
- 13) Building materials / Gravel

Source: Geological Survey & Mines Bureau.

Of the different kinds of minerals occurring in the Southern Development Area, most are not yet identified as reserves. That means, not measured or proved mineral raw materials which could be economically exploited. Two of the minerals identified as occurring in appreciable quantities and of desirable quality and thus possessing the potential to generate viable industries based on them are:

- Limestones
- Vein Quartz

- i) Dried Catharanthus leaves
- ii) Dried Catharanthus roots
- iii) Extracts from Catharanthus leaves and roots.

There is no known domestic market for these products. Potential export markets are;

For the dried leaves and roots - Pakistan, USA, EEC and Canada.

For the concentrated extracts - USA and Canada.

The current market prices for the dried roots about Rs.20/= kg and dried leaves Rs.9/kg.

4.4.3. Production Process

Harvesting can commence about 9 months after planting, when the whole plant is uprooted. The plants will then be transported to the processing centre, where it will be washed and sun dried after separating into roots and leaves.

The dried roots and leaves could be exported as they are or could be further processed by extracting the concentrates.

All operations from harvesting to drying would be carried out manually. For the extraction and concentration of active ingredients the following plants would be used.

- i) Crusher of capacity 100 Kg./hr. of dried roots or leaves
- ii) Extractor of capacity 100 Kg/5 hrs
- iii) Concentrator of capacity 100 l/hr.

4.4.4. Labour Requirements

About 30 labourers would be required for harvesting and transporting of the crop of one hectare. Harvesting can be done one hectare per day.

Additionally the following operators would be required for the extraction process.

- i) Crusher - 2 Operators
- ii) Extractor - 3 Technicians
- iii) Concentrator - 2 Technicians

4.3.6.2. Buildings

An open type shed with cemented floor and floor area of about 600 sq. metres would be adequate. Estimated cost of buildings – Rs.1,200,000/=.

4.3.6.3. Land

About 100 hectares of land preferably leased at the rate of about Rs.200/- per hectare per year, total Rs.20,000/= per year.

4.3.7. Recommended Location

On the coastal belt of Hambantota District where adequate extents of otherwise unproductive land is available.

4.3.8. Environmental Impact

Waste generated would be the dry sheath of aloe leaf about 0.5 tonnes per hectare, and the waste water after washing of knives and containers.

Waste sheath has no commercial value and could be composted to fertilizer and fed back to the land.

No extra need be taken for pollution control.

4.4. A PROJECT PROFILE FOR THE GROWING AND PROCESSING OF CATHARANTHUS ROSEUS (MINIMAL)

4.4.1. Scope of the Project

A project could be established to grow *Catharanthus Roseus* commonly known as Minimal, on a commercial scale and process the plant to marketable products. This plant grows well in sandy soils, without much attention, and would suit less fertile areas of the Dry Zone, such as in the Hambantota. At least 10,000 hectares of otherwise barren lands suitable for this plant could be found in the Southern Province. It has got its common name Minimal because it is often found grown profusely in cemeteries.

About 100 hectares under crop would sustain a profitable medium scale industry geared for the export market. The derivatives of this plant are in demand in the preparation of cancer controlling drugs.

4.4.2. Market

Marketable products with good export potential, that could be processed from this plant are;

4.3.4.2. Processing of Leaves

At the processing centre the leaves will be manually processed to, Aloe Juice and Aloe Gel.

Aloe Juice is obtained when a leaf is cut transversely close to the stem and held vertically over a tray. The yellowish juice flows out from the pericycle associated with vascular bundles. This juice is very bitter in taste and has an unpleasant odour. The yield of the juice varies both with season and locality. Yields are markedly higher during the dry season. Yields of about 300 litres per hectare may be expected. The juice, on sun drying, gives a golden yellow or chocolate brown crystalline or amorphous waxy mass, which is known as “aloes” or crude “aloes”. One hectare of Aloe will yield about 100 Kg. “aloes” per crop (one a year). The market price of powdered aloes is US\$ 7 / Kg.

The market price of aloin is US \$ 20/Kg. On processing “aloes” to aloin there is at least a 50% loss in weight.

The residual Aloe leaf may be used for the preparation of gel (Aloe Vera) by slitting the leaf longitudinally and removing the gel from the green outer covering of the leaf. The average yield of gel is about 25 tonnes per hectare.

4.3.5. Labour Requirements

By staggering the harvesting, to section by section, it would be possible to distribute the work uniformly round the year. About 30 labourers full time would be required for harvesting of the leaves, transport to the processing centre and the manual extraction of juice and gel, and subsequent processing.

4.3.6. Capital Expenditure

4.3.6.1. Plant & Equipment

- | | |
|---|----------|
| - 4 Wheel Agri Tractors with plough and trailer | - 1 No. |
| - Water pumps 2” | - 1 No. |
| - Tables with stainless steel tops | - 2 Nos. |
| - Stainless steel trays and containers | - 1 lot |
| - Mammoties and cutting knives | - 1 lot |
| - 5 tonne truck | - 1 No. |

Total estimated cost of Plant
& Equipment – Rs.1,500,000/=.

in the dry zone, and would provide a better return from this type of land than any other crop. The poor soils of the dry zone coast, such as around Hambantota, where little else thrives would represent maximal utilization of land. The cultivation of this crop is well suited for small investor as it requires low capital input and low technology. About 100 hectares under crop will sustain a profitable medium scale industry, geared for the export as well as the domestic market.

4.3.3. Market

Aloe Juice and Aloe Gel are extremely used locally in various medicinal preparations and shampoos. Thus there is a substantial domestic market for these products. Sri Lanka currently import about 10 tonnes of Aloe products annually.

Drying the aloe juice result in crude “aloes” the active ingredient of which is aloin. Aloin is extracted from aloes in an extraction process wherein about 75% of the aloin in aloe juice is recovered.

The major use of aloes and its products are as cathartic laxatives.

Aloe Gel is well established for its use in medicinal products as well as in the cosmetic industry. Its uses may be classified as follows –

- a) Moisturizer
- b) Biostimulant
- c) Anti-inflammatory agent
- d) Mild bactericidal agent.

Thus there is a good demand for aloe products in the developed countries such as USA, EEC countries, and Japan.

4.3.4. Production Process

4.3.4.1. Cultivation

Aloe plant grows on the poorest of soils, has low water requirements and tolerate salinity. It could be grown on marginal lands close to the sea in the dry zone. Propagation is carried out through root suckers. Plants may be placed in rows 1 metre apart and each row 1 meter broad containing 3 plants abreast, each row being 300 mm from the next. This arrangement will facilitate harvesting. The preparation of soil need not exceed 200 mm in depth as the root system of the plant is very shallow. Inter cultures may be required from time to time. Water should not be allowed to lodge near the plant as this plant is not water loving.

The plant is ready for harvesting in two years, at though the best yields are obtained in the third year. Repeat harvesting can be done once a year for about ten years. Harvesting is carried out by lopping off the leaves of the mature plant. Harvested leaves will be transported to the processing centre.

Project Profiles drawn up for the following Business Ventures will follow.

1. Growing and Processing of Aloe
2. Growing and Processing of Minimal (Catharanthus Roseus).

4.3. A PROJECT PROFILE FOR THE GROWING AND PROCESSING OF ALOE

4.3.1. General Information on the Industry

The Aloe belong to the family Liliaceae and sub-family Asphodelodeae. There are about 180 species of aloe, most of them indigenous to East and South Africa and from there introduced to the America, Europe and Asia. The earliest commercial use of the plant was as a laxative drug, aloin, prepared from the dry exudates of the leaves, called "aloes". The plant was cultivated for this drug as early as the 4th century BC. The Aloes have been classified into commercial groups based on the characteristics of the crude "aloes" they produce. These "aloes" arise from a mixture of species of Aloe, and only one such species, Aloe vera Linn, is found in Sri Lanka. The immediate source of this plant is India.

The plant which is called "komarika" in Sinhalese, is widespread on the coasts of northern Sri Lanka, especially in the Jaffna peninsula and Mannar, where it is found growing wild, thriving on the beaches of lagoons. The plant is also reported to be growing wild on the West coast at Kalpitiya and the Southern coast near Hambantota.

It is said that the plant was first introduced to the Jaffna peninsula to be grown in fields as a repellent to insect pests. The plant is also a popular medicinal herb, commonly grown in Sri Lankan households as a potted plant for its soothing leaf-gel which is used for treating burns and eye infections. This use is not restricted to Sri Lanka only, as Aloe vera gel obtained from varieties of Aloe is used in folk medicines of many African and Asian nations. In modern times the gel termed Aloe Vera is widely used in the cosmetics industry as a moisturizer and in Sun-burn lotions. The roots of the aloe plant is used in medicinal preparations for colic.

4.3.2. Scope of the Project

A Project could be established to grow Aloe Vera Linn, commonly called Aloe, on a commercial scale, and process its leaves to produce aloe juice, and aloe gel, also called Aloe Vera. The aloe juice could be sun dried to produce "aloes" or crude "aloes". Aloin, the active ingredient could be extracted from "aloes" of Aloe juice.

The Aloe Vera gel would be a useful by-product especially if markets could be found.

There is no commercial scale cultivations of Aloe at the moment. The plant Aloe vera, grows well in the poorest of soils, has low water requirements and tolerance for salinity. It can be grown satisfactorily on the sea coast of the dry zone with little agricultural inputs. It suits well for marginal lands

Chapter 4

MEDICINAL PLANTS

4.1. GENERAL INFORMATION ON MEDICINAL PLANTS

Many species of plants are known to have very valuable medicinal properties, different plants and their derivatives having different but specific healing properties. These medicinal plants are predominantly native to countries in the tropics, and have been in use in the traditional practices of medicine in these countries, since very early times. Likewise, in India and Sri Lanka too these plants are widely used in the traditional Ayurvedic system of medicine. Since of late, much research on these well known medicinal plants had been carried out in the West and their active ingredients isolated and identified. These are increasing trends in the use of natural active ingredients, extracted from plants, in the formulation of drugs. Thus there is a fast growing demand in the developed countries for selected herbal extracts or the raw herbs.

Among the naturalist lobbies in the West, there is a growing awareness and demand for health foods like herbal vitamin supplements, herbal teas etc., and personal requisites like soaps, shampoos, hair creams, tooth pastes and skin lotions, made with natural ingredients. These trends are catching up fast and the future for medicinal herbs and herbal extracts are very promising.

Not only in the developed countries, even in Sri Lanka, there is a growing preference for natural ingredients based preparations as remedies for common ailments and toilet requisites.

4.2. VIABLE BUSINESS PROJECTS WITH MEDICINAL PLANTS

Several well known medicinal plants grow wild in the Southern Province, the climatic and soil conditions being very favourable for them. Thus there is good potential for growing and processing of these plants on a commercial scale.

Medicinal plants, identified as viable for commercial exploitation in the Southern Province are;

| Common Name | Botanical Name |
|-----------------------|------------------------|
| - Aloe | - Aloe Vera Linn |
| - Minimal | - Catharanthus Roseus |
| - Senna (Senehe Kola) | - Cassia Angustifolia |
| - Katuwelbatu (Sin) | - Solanum Xanthocarpum |
| - Ranawara (Sin) | - Cassia Auriculata |
| - Godakaduru | - Strychnos Nux Vomica |

INVESTMENT OPPORTUNITIES IN SOUTHERN REGION

(AGRICULTURAL RESOURCES BASED)

| Project | Products | Investment (Rs. Mill) | Emp. Opportunities | Potential Markets |
|---|--------------------------------------|--------------------------|-----------------------|--|
| PROCESSING OF CEREALS & LENTILS | FLAKED PRODUCTS FOR EXPORT | 7 | 15 | MIDDLE EAST, MALDIVES, EEC COUNTRIES |
| GROWING & PROCESSING OF ALOE (KOMARIKA) | ALOE JUICE ALOE GEL | 1.5 | 7 F.T 30 (P.T) | USA, EEC, JAPAN |
| GROWING & PROCESSING OF CATHARANTHUS ROSEUS (MINIMAL) | DRIED LEAVES & ROOTS, EXTRACTS | 3.15 | 7 F.T. 30 (P.T) | PAKISTAN, USA, EEC & CANADA |
| GROWING & PROCESSING OF LEMONGRASS | LEMONGRASS OIL | 2.1 | 7 F.T 20 (P.T) | WORLDWIDE |

INVESTMENT OPPORTUNITIES IN SOUTHERN REGION

(AGRICULTURAL RESOURCES BASED)

| CULTIVATION/PROCESSING PROJECT | TOTAL COST/RS. EXCLUDING LAND & BUILDING (FOR 01 HEC.) | NET PROFIT FOR 1 ST HARVESTING YEAR/ RS. | TIME PERIOD FOR ECONOMICAL HARVESTING (WITHIN YEARS) | MOST SUITABLE DISTRICTS |
|--------------------------------|--|---|--|--|
| PINEAPPLE CUL. | 92,435.00 | 18,635.00 | 01 | MONARAGALA |
| MANGO CUL. | 4,110.00 | 298,310.00 | 05-08 | MONARAGALA & HAMBANTOTA |
| ORANGE CUL. | 197,360.00 | 279,100.00 | 04 | MONARAGALA |
| BANANA CUL. | 125,000.00 | 144,660.00 | 02 | GALLE, MATARA, H'TOTA, MO'GALA, RATHNAPURA |
| PAPAW CUL. | 133,950.00 | 127,500.00 | 02 | MONARAGALA & HAMBANTOTA |
| PASSION CUL. | 161,255.00 | 236,685.00 | 02 | GALLE, MATARA, HAMBANTOTA, MONARAGALA |
| GRAPES CUL. | 7000,000.00 | 310,000.00 | 02 | HAMBANTOTA (WEERAWILA) |
| FRUITS PROCESSING | 1,356,850.00 | 846,395.00 | 01 | GALLE, MATARA, H'TOTA, MO'GALA, RATHNAPURA |

| District | Yala 1999 | | | | | | | |
|-------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Cultivated | | | | Harvested | | | |
| | Major Scheme | Minor Scheme | Rainfed | Total | Major scheme | Minor Scheme | Rainfed | Total |
| Galle | - | 121 | 14,147 | 14,267 | - | 115 | 13,298 | 13,412 |
| Matara | 3,426 | 3,537 | 9,026 | 15,988 | 3,323 | 3,360 | 8,484 | 15,167 |
| Hambantota | 17,860 | 1,947 | 860 | 20,667 | 16,954 | 1,817 | 836 | 19,608 |
| Monaragala | 3,305 | 1,896 | 99 | 5,300 | 3,206 | 1,801 | 93 | 5,100 |
| Rathnapura | 1,776 | 7,371 | 3,488 | 12,636 | 1,723 | 7,003 | 3,279 | 12,005 |
| SDA Region | 26,367 | 14,872 | 27,620 | 68,858 | 25,206 | 14,096 | 25,990 | 65,292 |

Source - Statistical Abstract - 2000

Courtesy: Southern Development Authority

Cont.

| District | Maha 1998/99 | | | | |
|--------------|--------------|--------------|------|--------------|--------------|
| | Green Gram | Cow Pea | Dhal | Gingelly | Ground Nuts |
| Galle | - | - | - | - | - |
| Matara | 5 | 1 | - | - | - |
| Hambantota | 3,467 | 1,325 | - | 1,117 | 815 |
| Monaragala | 3,027 | 1,504 | - | 812 | 1,795 |
| Total | 6,499 | 2,830 | | 1,929 | 2,610 |

Courtesy: Southern Development Authority

**Paddy Extent Cultivated and Harvested by Irrigation Scheme and District,
Maha 1998/99 – Yala 1999**

| District | Maha 1998/99 Hectares | | | | | | | |
|-------------------|-----------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| | Cultivated | | | | Harvested | | | |
| | Major Scheme | Minor Scheme | Rainfed | Total | Major scheme | Minor Scheme | Rainfed | Total |
| Galle | - | 124 | 16,879 | 17,003 | - | 124 | 16,869 | 16,992 |
| Matara | 3,889 | 3,596 | 9,663 | 17,148 | 3,889 | 3,596 | 9,662 | 17,147 |
| Hambantota | 18,095 | 4,040 | 1,271 | 23,407 | 18,089 | 4,037 | 1,270 | 23,395 |
| Monaragal | 5,106 | 5,212 | 3,668 | 13,987 | 5,106 | 5,211 | 3,665 | 13,982 |
| Rathnapura | 2,049 | 8,525 | 5,104 | 15,678 | 2,049 | 8,484 | 5,063 | 15,595 |
| SDA Region | 29,139 | 21,497 | 36,585 | 87,223 | 29,133 | 21,452 | 36,529 | 87,111 |

Source : Statistical Abstract - 2000
Courtesy: Southern Development Authority

3.5.3.1.3. Machinery and Equipment

- Vibrating Sifter with air blast
 - De hulling cum germ removing machine
 - Stainless Steel Pressure Cooker
 - Flaking Machine with stainless steel rollers and receiving trays
 - Electric or Gas Fired toasting machine
 - Baby boiler, oil fired, with standard accessories
 - Stainless steel trays, bins, ladles etc.
 - Weighing machine
 - Bag Stitching machine
 - Packaging machine
 - Two Trucks one 10 t and one 5 t
- Two estimated cost of machinery & Equipment Rs.7,000,000/=

3.5.4. Labour Requirements

| | |
|-------------|----|
| Managers | 1 |
| Supervisors | 2 |
| Operators | 12 |

3.5.5. Potential Markets

Potential markets will be; Middle East, Maldives, EEC Countries.

3.5.6. Export Assistance

Export Development Board has widened its services in this area and valuable information on export potential could be obtained.

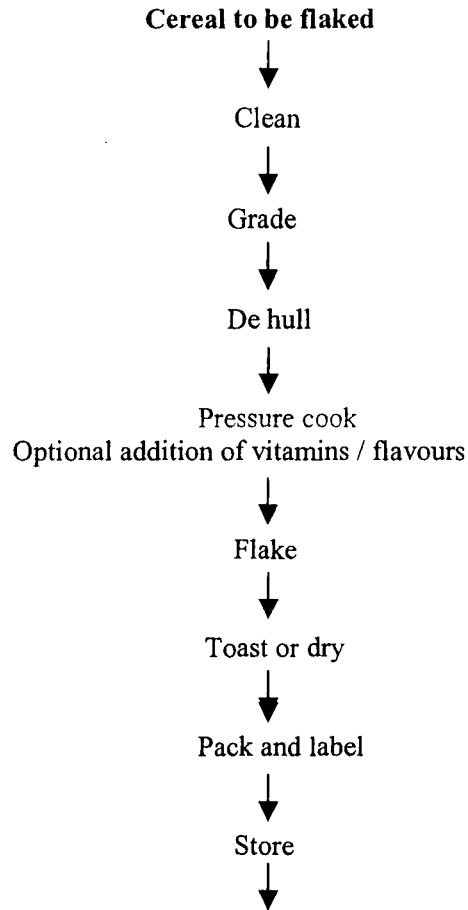
3.5.7. By-Products and Waste Utilisation

In the Southern Province, the major unutilized by-products are rice husk and saw dust. In the past, coir dust was a major problem. However, recent exports of coir dust as a growth medium for indoor plants to many foreign countries have completely transformed the economy of the coir industry. No more is it discarded as a waste and the exports are ever increasing. In addition, the demand from European countries for natural carpets made of coir fibre in place of wollen carpets of the past has increased the value of both white and brown fibre.

Rice husk can be effectively utilized as a source of energy. The Calorific value of rice husk is about 3500 cal/kg which is half that of coal. The heat energy from the rice husk can be used for furnaces instead of firewood. In many rice mills the husk is burnt in ordinary open hearth furnaces and a major share of the energy is lost. Fluidized bed gasifiers and driers for par-boiling and drying of paddy should be introduced in all commercial milling complexes in the area. Such a step will improve the quality of rice, cut down the electrical energy consumption of and reduce the milling losses

Proposed plant capacity is 1,200 kg. of flaked products per 8 hr. shift.
Process flow chart will be as follows.

Process Flow Chart for Flaking of Cereals



3.5.3. Capital Expenditure

3.5.3.1.1. Land

About 1 Acre of land would be adequate.

Estimated cost Rs.200,000/=.

3.5.3.1.2. Buildings

500 sq. metres of open type building with cemented floor would be required. Estimated cost of buildings Rs.1,000,000/= at Rs.2,000/= per sq. metre.

Estimated.

| | |
|---|--------------|
| Cost of installing electricity | Rs.100,000/= |
| Cost of installing water supply | Rs. 50,000/= |
| Waste treatment and environment safeguard | Rs. 10,000/= |

3.5. A PROJECT PROFILE FOR THE PROCESSING OF CEREALS & LENTILS

3.5.1. General Information on the Industry

The rice processing industry is the largest and single largest agro-based industry in existence in the country. In the Southern Province alone 240,000 metric tons of paddy per annum are processed. The milling industry at present converts paddy to rice and produces whole grains, brokens, bran and husk. The broken rice grains are not usually separated but sold along with the whole grains. The bran is sold as poultry feed and the husk is either thrown away or partly used to fire the boilers in the par-boiling of paddy.

A rice based food industry is a viable proposition in this sector. The raw material is available in abundance and the technology and local expertise are there.

Several varieties of Cereals and Lentils are grown in the Southern Province. Rice is by far the most predominant, followed by corn and green gram. Presently these cereals and lentils are hulled and sold as whole grains which are mostly boiled and consumed, rice forming the staple diet of the people of Sri Lanka. A very small percentage of rice is presently further processed and sold as flour and instant food recepies like the instant hopper mixture, etc.

Flaked products could be manufactured from all varieties of cereals. These flaked products could be the basic ingredients in the formulations of breakfast cereals and several varieties of confectionery.

The consumption of flaked rice or cereals is not well established in Sri Lanka even though these are very popular breakfast supplements in Europe, USA and even in India. Thus if properly exploited flaked products of cereals could have a good export market.

Southern Province is a surplus area for cereals. Following cereals, suitable for conversion of flaked products are estimated to be available in the quantities shown. The surplus component is available for the production of flaked products for export.

| | |
|------------|----------------|
| Rice | 500,000 tonnes |
| Green gram | 4,800 tonnes |

3.5.2. Scope of the Project

Several projects could be established in the Southern Province to purchase the cereals and lentils from the primary growers and process them for the market. The project envisaged here is to manufacture flaked products out of rice and varieties of grams and packed them to suit the market shelves.

3.4.4.3. Cost of Plant & Machinery

Equipment for the Canning Line

- Fruit Washing Machine
- Fruit Pulper
- Fruit Dicer
- Exhauster
- Retort
- Boiler
- Jacketed Tilting Pans – Stainless Steel
- Canning Machine
- Fruit Juice Extractor
- Pasteurizer – Plate Type
- Bottle Capper
- Can Cooler

Equipment for the Drying & Dehydrating Line

- Cutting Tables
- Solar Drier
- Hot Air Blast Drier, Drum Drier etc.
- Stainless Steel Blanching Trays or Pans

Common Equipment

- Weighing Machine
- Polythene Sealer
- Labeling Device
- Mini Laboratory Equipment
- Transport Vehicles

| | |
|--|------------------|
| Estimated cost of Machinery & Equipment would be about | Rs. 15,000,000/= |
| Cost of installation of electricity | Rs. 200,000/= |
| Cost of water supply | Rs. 30,000/= |
| Cost of environment safeguards | Rs. 200,000/= |

3.4.5. Potential Markets

Potential markets for the Canned or Dried Fruits / Vegetables, Juices and Pulps would be the substantial domestic market and foreign markets in the EEC countries, Middle East and Maldives.

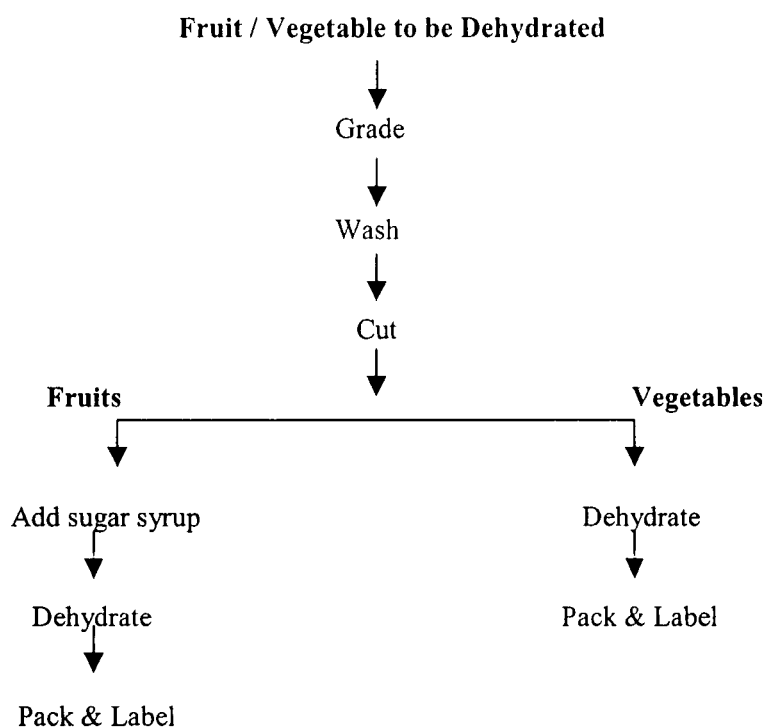
3.4.6. Environmental Impact

Waste generated would be peels, seeds and rejects of fruits and vegetables which are all bio degradable. Quantity of waste would be about 15%.

The waste could be if necessary, processed fruit vinegar, cattle feed or could be composted to fertilizer and fed back to the plantation.

The flue gasses from the boiler would be led off through a tall chimney, and the waste water led off to a covered soakage pit.

Flow Chart for the Dehydration of Fruits / Vegetables



3.4.3. Labour Requirements

| | |
|---------------------|--------------------------|
| Managers | 1 |
| Supervisors | 2 |
| 2 Canning process | 15 persons, semi skilled |
| Dehydrating Process | 5 persons, semi skilled |

3.4.4. Capital Expenditure

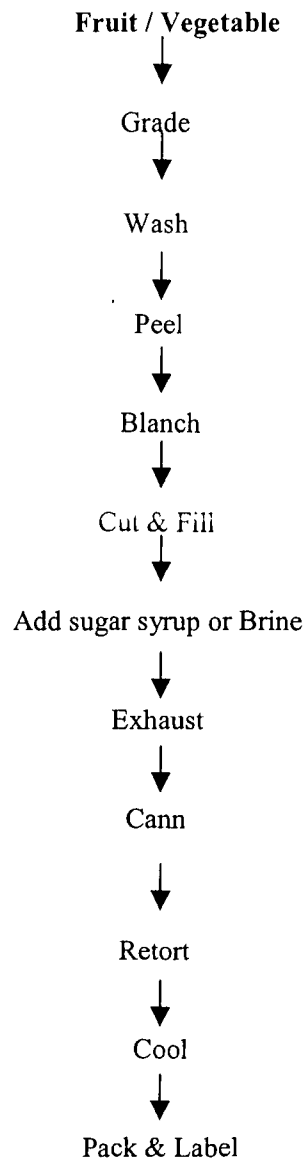
3.4.4.1. Cost of Land

For the processing plant about ½ acre plot of land would suffice. This would cost about Rs.50,000/=. For the establishment of a plantation, 50 hectares of land if leased on a 30 year lease would cost about Rs.50,000/= per annum.

3.4.4.2. Cost of Buildings

An open type building of about 8 x 30 metres = 240 x sq. meters (at a cost of about Rs.2,000/= per sq. metre) costing about Rs.480,000/= is considered adequate for the processing plant.

Process Flow Chart for Canning of Fruits / Vegetables



- Jams and Jellies
- Fruit Juice Concentrates
- Cordials
- Canned Fruits and Vegetables
- Sun Dried Vegetables
- Dehydrated Fruits and Vegetables
- Fruit or Vegetable Purees/Pastes
- Sauces and Chutneys

The raw materials for processing, which would be fresh fruits and vegetables to be purchased from a network of organized outgrowers. Additionally some farms may be established by the investor, to supplement the bought crop, in shortage areas. Recent surveys have shown surplus crop in the following varieties of fruits and vegetables available in localities like Deniyaya, Embilipitiya, Moraketiya, Tangalla, Hambantota and Wellawaya.

Fruits and Vegetables estimated to be presently available in the Southern Province.

| Fruits | Un 1000s | Vegetables | Metric Tons |
|---------------|-----------------|-------------------|--------------------|
| Banana | 4,000 | Beans | 5 |
| Papaw | 500 | Tomatoes | 2,500 |
| Pineapple | 3,000 | Melon (Komadu) | 9,000 |
| Mango | 78,500 | Ash Plantain | 14,500 |
| Oranges | 2,500 | Cucumber | 3,500 |
| Limes | 22,000 | Bandakka(Okra) | 8,000 |
| Passion Fruit | 500 | Bitter Gourd | 5,500 |
| | | Brinjals | 10,000 |

Source: ARTI

3.4.2. Production Processes and Plant Capacity

The production processes could generally be as shown in the flow charts, with minor variations depending on the type of crop and the market.

The planned capacity of the plant would be for 10 tonnes of finished products per month.

Recommended locations for the Processing and Canning plant would be Mirijjawela, Suriyawewa, Padalangala.

3.3.7. Potential Markets

Potential markets for fresh fruits and vegetables would be Maldives, Middle East, EEC countries.

3.3.8. Investments and Returns

Average Investment required and the expected profitability of different types of crops could be summarized as follows.

Summary of Costs and Income per hectare of Crop in Rupees.

| Crop | Cost/Ha Rs. | Yield/Ha Kg. | Price/Kg Rs.Ex.farm | Sales Rev. Rs. | Net Ret. Rs. |
|-----------|----------------|-----------------|------------------------|-------------------|-----------------|
| Cantaloup | 112,710 | 25,000 | 15.00 | 375,000 | 262,290 |
| Baby Corn | 25,450 | 750 | 50.00 | 37,500 | 12,050 |
| Okra | 25,000 | 8,000 | 8.00 | 64,000 | 39,000 |
| Gherkin | 66,300 | 10,000 | 12.50 | 125,000 | 58,700 |
| Tomato | 30,150 | 8,000 | 10.00 | 80,000 | 49,850 |
| Mango | 10,950 | 25,000 | 2.50 | 62,500 | 51,550 |
| Pineapple | 40,000 | 50,000 | 5.00 | 250,000 | 210,000 |
| Banana | 75,950 | 18,050 | 10.00 | 180,500 | 104,500 |
| Papaya | 17,350 | 5,450 | 7.50 | 40,875 | 23,525 |

Source: Dept., of Agriculture

3.3.9. Environmental Impact

Environmental impact is minimal. Waste generated are mostly rejects of fruits / vegetables and are all bio degradable, and could be converted to compost and fed back to the farm. Alternatively the waste could be converted to animal feed.

3.4. A PROJECT PROFILE FOR THE PROCESSING OF FRUITS AND VEGETABLES

3.4.1. Scope of the Project

The facility to be established is for the processing and packaging, in appropriate containers, such as cans, bottles, satchels etc., of, fruits and vegetables for export as well as for the domestic market. The final products envisaged are;

3.3.5. Labour Requirements

| | |
|-------------------|---------|
| Farm: Supervisors | 3 Nos |
| Labourers | 75 Nos. |

Processing unit:

| | |
|-------------|---------|
| Supervisors | 2 Nos |
| Labourers | 10 Nos. |

3.3.6. Capital Expenditure

3.3.6.1. Cost of Land:

50 hectares of land if purchased outright would cost about Rs.7,500,000/=

50 hectares of land if leased on a 30 year lease would cost about Rs.50,000/= per annum.

3.3.6.2. Cost of Buildings:

An open type building of about 6 x 30 metres = 180 sq. metres (at a cost of about Rs.2,000/= per sq. metre) costing about Rs.360,000/= is considered adequate for the processing plant.

3.3.6.3. Cost of Machinery & Equipment

Farm Machinery & Equipment

| | | |
|--|---|---------|
| - Farm Tractor with plough and accessories | - | 1 No. |
| - Water pumps 3" | - | 2 Nos. |
| - Hand Tools | - | 10 sets |
| - Crop Sprayers | - | 2 Nos. |
| Total estimated cost Rs.1,200,000/= | | |

Machinery & Equipment Required for the Processing Unit

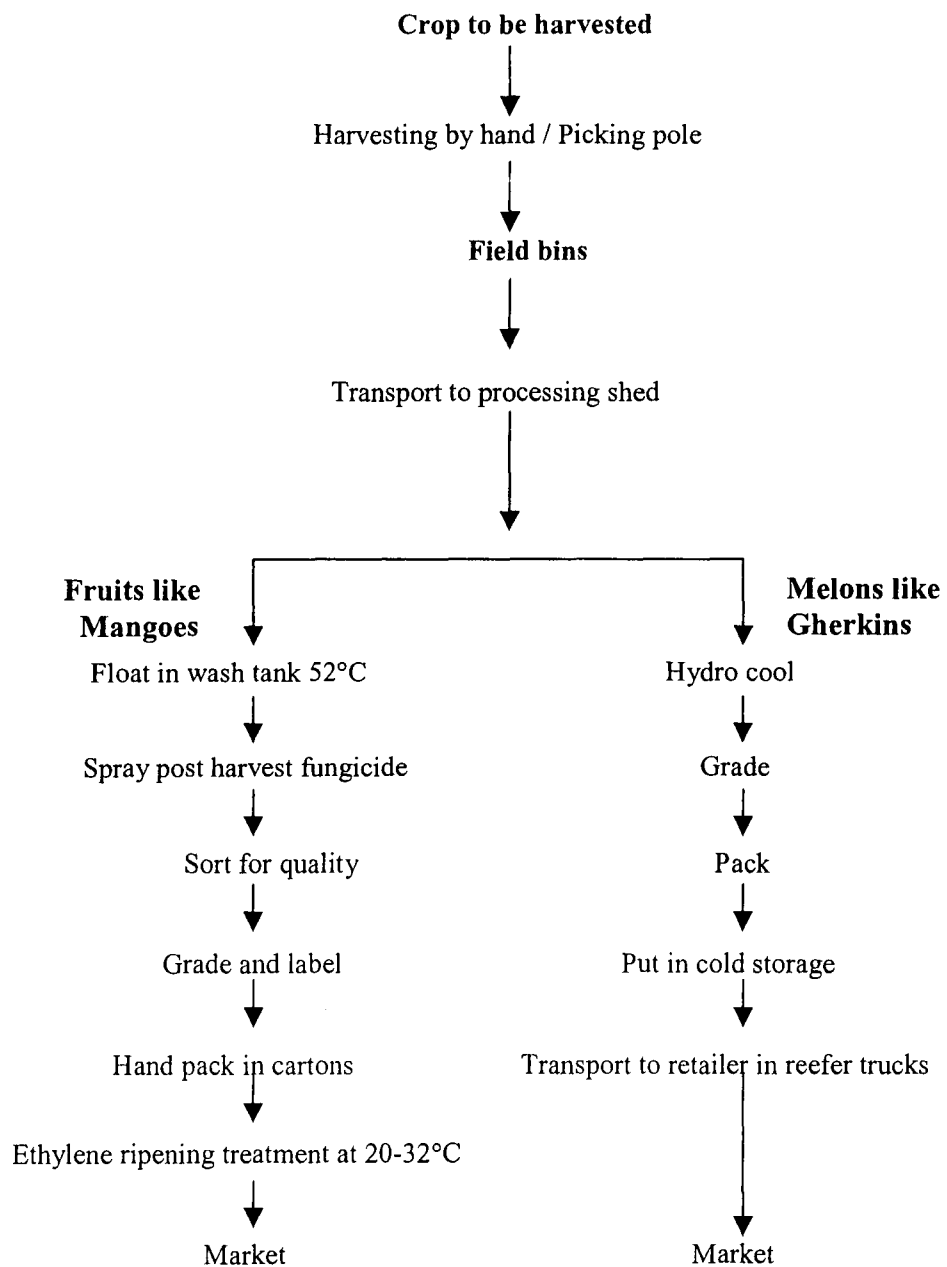
- Water pumps
- Hydro coolers
- Refrigeration System for 10 tonnes of material
- Washing tanks
- Handling equipment
- Weighing machine
- Labeling device
- Reefer truck 5 tonne capacity
- Chemical sprayers
- Ethylene treatment equipment

Total estimated cost Rs.3,000,000/=

3.3.4. Selection of the Degree and the Type of Processing

All fruits and vegetables harvested would be sold fresh. In this situation the degree of processing required would be washing, sorting, preserving and packing for transport. If however, the transport is to be over long distances, suitable short term preservation techniques, such as cold room storage or the application of inhibitors will have to be resorted to. If the crops have to be preserved for still longer periods before final consumption or required to be transported over difficult conditions different but appropriate processing techniques would have to be adopted.

Process Flow Chart for Post Harvest Handling



Potential Fruit and Vegetable crops that could be selected fall into two categories; short term and long term crops. The selection will be based on several parameters like the climate, the inputs required like irrigation, and the profitability.

1. Short term crops, are those that would be ready for harvesting in about 45 – 60 days, such as Gherkins, Okra, Baby Corn, Cantaloupe etc.
2. Long term crops, are those that would require over six months to several years to harvest, such as Papaya, Banana, Pineapple, Mango, Cashew, etc.

Of the possible different kinds of fruits and vegetables, the preferred varieties for selection, with proven success for commercial exploitation are;

| | | |
|-----------|---|---|
| Papaya | : | Solo Hawaii |
| Mango | : | Kartha Kolombu, Villard, Alphonso, Sensation, Hayder, Tommy Atkin and Kent. |
| Banana | : | Kolikuttu (Apple Banana) and Ambul |
| Pineapple | : | Kew and Smooth Cheyen |
| Cashew | : | |
| Okra | : | |
| Gherkin | : | |
| Baby Corn | : | |
| Tomato | : | Tilina and Marklob |
| Melons | : | Honey dew and Galia. |

3.3.2. Selection of Suitable Land and the Scope of the Farm

The land to be selected will primarily depend on the chosen crop and its input needs. The extent of the land to be used will depend on the scale of the operation to be established and the type of organization to be adopted, viz a vis, entire crop to be self grown or to adopt the principle of operating a nucleus farm and a network of outgrowers. The land suitable for this type of ventures are the state land available in the newly developed irrigation projects.

3.3.3. Recommended Location of Plant

Appropriate location for the fresh Fruit / Vegetable Processing Plant would be in the midst of the growing areas, but with good road access. Recommended locations would be Tuncame and Middeniya.

1. Cultivation of high value Fruits and Vegetables for export as well as for the local consumption, in fresh state.
2. Processing of Fruits and Vegetables collected from outgrowers for export and for local consumption.
3. Integrated projects incorporating cultivation and processing of fruits and vegetables.
4. Collection, processing and packeting for the market shelves, of grains like rice and different kinds of lentils produced in the region.

Project Profiles drawn up for the following industrial ventures will follow:

1. Cultivation and Processing of Fresh Fruits and Vegetables
2. Processing of Fruits and Vegetables (Canning and Dehydration)
3. Processing of Cereals and Lentils (Flaked Products)

3.3. A PROJECT PROFILE FOR THE CULTIVATION AND PROCESSING OF FRESH FRUITS AND VEGETABLES

3.3.1. Scope of the Project

The project would be to grow, harvest and process, high value fresh fruits / vegetables for export, as well as for the local market. The land area under crop to be about 50 hectares, the minimum extent considered viable for an export oriented agri-business. An investor could select any crop or a combination of crops as desired. The extent of the land under crops too could be stretched if so desired.

The types of crops that could be considered and its expected yields are;

| Type of Crop | Expected Yield Kg./ha. |
|---------------------|-------------------------------|
| Banana | 18,000 |
| Gherkin | 10,000 |
| Mango | 25,000 |
| Melon | 25,000 |
| Okra | 8,000 |
| Tomato | 8,000 |
| Baby Corn | 750 |
| Pineapple | 50,000 |
| Papaya | 5,500 |

Source: Dept., of Agriculture

Output products would be, processed and packed fresh fruits / vegetables suitable for export markets.

A viable production capacity for the plant would be about 8,000 to 12,000 sq. meters of dimension stones / tiles per month, working two shifts.

5.5.3. Market

The world over, the demand for natural stones as decorative coverings for the walls and floors are increasing at a rapid rate. Affluent societies appreciative of good living are demanding these materials in their houses. Even in Sri Lanka this trend is clearly visible.

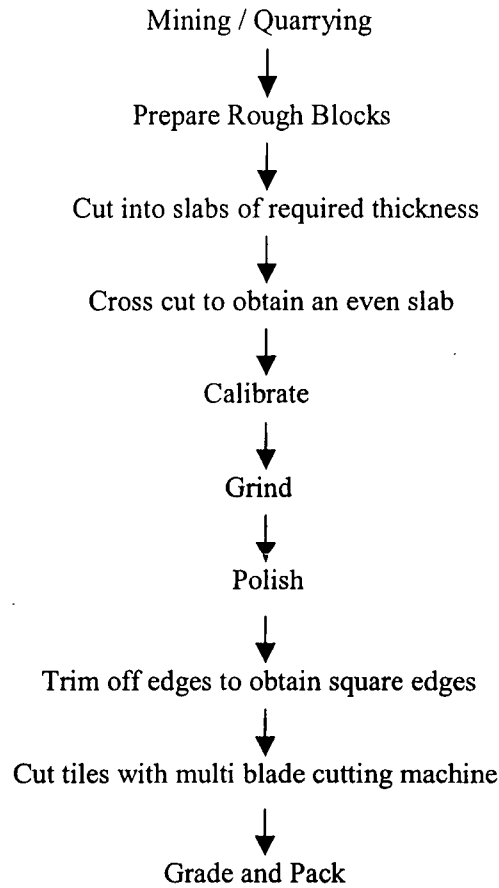
Marble tiles are more suitable for walls and not so much for the floor, due to its poor wear resistance. In the export field there is demand for both rough and polished granite / marble blocks and finished tiles. The market for rough stone blocks are in Italy, Japan and USA. The market for more value added, finished tiles and slabs are in; USA, Australia, Belgium, Middle East and Singapore. Italy dominates in this trade both as importer of rough stones and as exporter of finished tiles. India, China, Spain and Portugal are other major producers of granite / marble tiles.

5.5.4. Production Process

In the mining process the marble outcrops are cut into rough blocks of 7 to 10 cubic meters each. These blocks will be moved on to the stand by Block Carrier through the Block Transfer Trolley. After fixing on the Block Carrier, they are loaded into the Block Cutting Machine, which in one single operation could process the block into a number (up to 10) of strips of constant thickness and width, by two gangs of symmetrically perpendicular diamond disc blades. The thickness and width of the marble tiles will be determined according to the given specifications of the final product.

- Uniform strips are cut to regular rectangular shape in the automatic squaring machine for the convenience of subsequent processing
- The strips, after block cutting and squaring are loaded onto the width gauging machine, to be calibrated to the specified dimensions.
- The strips are then processed directly through the continuous polishing line to be calibrated to the required thickness. The tile after polishing will present a shining face.
- The length of the tile is then trimmed by the squaring machine.
- The width gauging machine will then calibrate the width of the tile in accordance with the tolerances laid down in the customer specifications.
- The tiles are then buffed in the automatic buffing machine, washed in water and dried and packed for the market.

Process Flow Chart for the Production of Dimension Stones



5.5.5. Labour Requirements

| | |
|--------------------------|----|
| Production Manager | 1 |
| Asst. Production Manager | 1 |
| Maintenance Engineer | 1 |
| Skilled workers | 8 |
| Unskilled Workers | 12 |

5.5.6. Capital Expenditure

5.5.6.1. Machinery & Equipment

Machinery & equipment estimated as required:

| Description of equipment | Qty |
|---------------------------------|-----|
| Automatic block cutting machine | 1 |
| Block transfer trolley | 1 |
| Standby block carrier | 4 |
| Automatic squaring machine | 3 |
| Free roller table | 5 |
| Width gauging machine | 2 |
| Automatic polishing machine | 1 |

| | |
|--|-------|
| Overhead gantry crane 25 tonnes | 1 |
| Waste chip case | 5 |
| Wooden pallets for tiles | 50 |
| Hand polishing machine | 1 |
| Rails for block carrier & block transfer | 1 set |
| Fork lift truck 3 tonnes | 1 |
| Motor Vehicles: 50 tonne trucks | 2 |
| 10 tonne trucks | 2 |
| 01 tonne pick up trucks | 1 |

Total estimated cost of machinery and equipment Rs.50 Million.

5.5.6.2. Land and Buildings

About one hectare of land will be required for the worksite which is estimated to cost approximately Rs.0.5 Million
Buildings requirements would be about 600 sq.m.
Estimated cost of buildings at Rs.2,000/= per sq. M. Rs.1.2 Million
Marble outcrop will be leased with a royalty payment to the state.

5.5.6.3. Utilities

| | |
|---|------------------|
| Estimated cost of water supply | Rs. 0.2 Million |
| Estimated cost of electricity supply 600 KVA | Rs. 3.0 Million |
| Estimated cost of waste treatment & Environment safeguards | Rs. 1.0 Million |
| Total estimated capital expenditure | Rs.56.0 Million. |

5.5.7. Recommended Location

Recommended location for the processing plant is within 1 Km from the Marble deposit to be exploited. The land should be reasonably flat with easy access to ample water supply and high voltage (440 V) 3 phase electrical supply.

5.5.8. Environmental Impact

5.5.8.1. Waste Generated

Waste generated would be the off cuts and the dust, about 0.8% by weight of production and the waste water after washing and machine cooling.

Off cuts could be used for turning out handicrafts and ornamental items. Any leftover could be burnt for lime.

Dust collection could be used in paint industry.

5.5.8.2. Environmental Safeguards

Dust emission to the environment must be controlled by efficient dust collection. Noise generated must be minimized.

All water after use must be collected in a sedimentation tank before release to waterways.

5.6. VEIN QUARTZ

5.6.1. Occurrence of Vein Quartz; Locations and Extents

Vein Quartz is one of the relatively pure forms of silica, occurring in nature. Other silica bearing minerals in this category are; rock crystal, SiO₂ in the form of unconsolidated sands, and as consolidated rock such as quartzite and sandstone.

Several deposits of good quality Vein Quartz have been identified, and many of them are located in the Southern Sector as shown in the table below. (also see map Fig.7.1.)

VEIN QUARTZ RESOURCES IN THE SOUTHERN SECTOR

| Topographical 1" Sheet | No. of Locations Mapped | Main Location | Approximate Extent of the Vein in MLS |
|------------------------|-------------------------|----------------|---------------------------------------|
| Ratnapura (SE) | 05 | Ekkarall | 06 |
| Haputale (S) | 04 | Mahakarametiya | 03 |
| Thimbolketiya | 04 | Mahagama | 04 |
| K'gama (W) | 09 | Tanamalwila | 10 |
| Morawake | 01 | Panakaduwa | 0.5 |
| Ambalantota | 04 | Hadawinna | 02 |
| Hambantota (W) | 03 | Weligalla | 1.5 |

Source: Geological Survey and Mines Bureau

5.6.2. Chemical Composition of Vein Quartz

Some of the Vein Quartz deposits have been chemically analysed and the average composition of its major constituents are as listed below. The samples have been analysed for silica, alumina and total iron contents.

| | | | | |
|--------------------------------|---|------|---|-------|
| SiO ₂ | : | 99.2 | - | 99.6% |
| Al ₂ O ₃ | : | 0.3 | - | 0.7% |
| Fe ₂ O ₃ | : | 0.02 | - | 0.08% |

Source: Report on Vein Quartz survey, Ambalamana Estate, Galaha, Kandy (GSMB).

Above values indicate that these silica deposits are relatively of a high grade. However, because the quality of deposits could vary from place to place, detailed analysis of identified deposits must be carried out to confirm their suitability for the purpose, before embarking on a project.

Certain trends are becoming apparent, regarding silica raw materials such as the demand for increasingly pure materials, and the growing use of finer feeds. However, cost or cost effectiveness is almost always the governing factor in the selection of raw materials. Whilst a manufacturing may demand a higher purity silica, availability and cost will dictate whether or not the tighter specification is absolutely necessary whether a lower grade material will suffice after all.

Three characteristics which may affect the performance of a specific silica form in a given application are its mineralogy, chemistry and physical properties.

5.7. INDUSTRIAL POTENTIAL OF VEIN QUARTZ

Considering the relative purity and abundance of occurrence of Vein Quartz located in the Southern Sector, it would be feasible to manufacture several intermediate products based on Vein quartz as its main raw material.

1. **High mark-up Glass**
 - a) Glass Fibre; three major forms are possible:
 - i) Glass wool
 - ii) Continuous filament glass fibre
 - iii) Optical glass fibre
 - b) Special Glass; two major groups are possible:
 - i) Domestic glassware
 - iii) Scientific glasses
 - c) High Performance Glass; for several end uses.
2. **Fused Quartz; following industries could be identified:**
 - a) Vitreous Silica
 - b) Calcined Quartz
 - c) Micronised Silica
 - d) Ferro-silicons.
3. **Quartz Crystals; three products could be identified:**
 - a) Natural Quartz Crystals
 - b) Lascas
 - c) Synthetic (cultured) Quartz Crystals.

5.7.1. High Mark-up Glass

Specifically selecting only the high mark-up glass, the common glass products like sheef glass and glass containers are being intentionally left out, as these could more economically be manufactured out of our more easily available silica materials like the silica sand deposits found in the Nattandiya area. The use of vein quartz is encouraged only in areas where other low grade materials are not good enough.

Each of the three types of glass fibres identified above services a different end-use market. The different requirements for each end use dictate different methods of production. Glass wool is used as an insulating medium, in acoustics, thermal and electrical applications. The continuous filament glass fibre is used in a number of reinforcement applications including plastics, rubber and cement. Optical glass fibre is increasingly used in modern day communication work to transmit light pulses.

The special glass industry is essentially concerned with domestic and scientific glassware, such as consumer tableware, television tubes, fibre optics, lenses and laboratory glassware. This sector consists of a very large number of different and often localized markets.

Interest in high-performance glass has soared with the advent of new applications, such as optical fibres and photo masking for integrated circuits. Some of the main applications of high performance glass seen to becoming in the future are:

- High transmission optical fibre
- Fibre optics for laser surgery
- Optical integrated circuit
- Thin-film glass memory
- Glass substrate for solar cells
- Glass substrate for memory disk
- Glass substrate for flat information display
- Glass plate for photo mask
- Ceramic-glass composite for multi-layered micro-circuit board
- New high-strength glass
- High class porous glass
- Artificial human body elements.

5.7.2. Fused Quartz

Fused (or so-called vitreous silica) is manufactured by the fusion of very high quality quartz / silica in various electric arc and electrical resistance furnace configurations. The fusion of silica at high temperatures above 172°C, converts the crystalline raw material into an amorphous glass form, which possesses entirely different properties than that of its parent material. To maintain the high purity of the fused material, all the unfused or partially fused crystalline material, usually in the form of the high temperature cristobalite phase, must be removed from the fused ingots.

The fused ingots are then crushed to powder and processed for different uses.

High purity, high resistance to thermal shock and high temperatures, low thermal conductivity and minimal thermal expansion are the properties which promote the use of fused silica in various heat treatment and industrial applications. The thermal expansion of fused silica is $5 \times 10^{-7} / ^\circ\text{C}$. So fused silica is not subject to the internal stresses which result from rapid and extreme temperature changes that can destroy other materials. This property makes the material suitable for use in furnaces where extremes of temperatures are experienced and dimensional stability is an important asset. Its high purity confers a degree of chemical neutrality and produces a very high refractory property for use in temperatures exceeding 1650°C . The high purity makes the material also highly sought after as an inert filler and extender in various resins employed in the electronic industry. Its low thermal conductivity is also beneficial in its use as a heat insulator in the form of tiles and foam bricks.

Major applications of Fused Quartz are:

- i) In semi-conductors, making use of its dielectric property
- ii) As gasfire radiants, making use of its resistance to high temperature and thermal shock
- iii) In mould coatings, making use of its resistance to high temperature and low thermal expansion
- iv) In metal channeling, making use of its non wetting property
- v) In refractories, making use of its resistance to very high temperatures and thermal shock and its minimal thermal expansion.

5.7.3. Quartz Crystals

During the mid 1970s the quartz crystal industry experienced a boom owing to its increased demand from the electronics communication equipment and the watch industry. This demand got further accelerated later on, with the sphere of usage of quartz crystals expanding to include more products such as microprocessors, colour television optical applications etc. Although the traditional areas of utilization of quartz / silica have been in construction, glass, ceramics, abrasives, etc., the future focus is on electronics applications of quartz crystals and industrial applications of fused quartz.

Piezoelectric Effects in Quartz:

When a suitable electrical signal is applied to a quartz wafer it vibrates at a characteristic resonance frequency. This piezoelectric effect in quartz renders it suitable for use as resonators in a multitude of applications ranging from timing signals in watches to microprocessors. It has military, aerospace and commercial applications.

Optical Applications:

Natural electronic grade quartz crystal was the leading form of quartz used by the electronics industry until the early 1970s., but cultured quartz has since become dominant, except for specialist applications. Certainly natural quartz is still being used for optical applications where large pieces of quartz are required, as producers of cultured quartz still have some problems producing this large sized material.

The crystalline properties of quartz are used in applications such as quartz wave plates, Brewster windows and prisms, birefringent filters, and turning elements for laser optics.

The supply of natural optical quartz is limited worldwide. Natural quartz crystals in the form of lascas is, however still required as a feed stock in the manufacture of cultured quartz.

Cultured quartz is produced in an autoclave using a hydrothermal process. Essentially the growth of quartz crystals involves dissolving small chips of quartz and allowing them to grow on prepared plates.

As perceived by the industry, cultured quartz is advantageous in that higher yields are produced from a given amount of raw material, it is easier to process because a more uniform crystal is produced, and it has a much more dependable supply.

World production capacity of cultured quartz is estimated at 2,000 tonnes excluding the eastern block countries. It is also estimated that USA and Japan each account for 40% of the production while the balance is from Europe and Brazil. It is understood that cultured quartz is manufactured in Russia and Bulgaria too.

The Growth of a Culture

Basically the growth of quartz crystals involves dissolving small quartz chips and allowing them to grow on prepared seed plates.

The manufacturing process involved is the Hydrothermal process and the crystal growth takes place in an autoclave.

The autoclave is a vertical steel cylinder comprised of an upper and lower chamber separated by a baffle plate.

Small chips of pure but unfaced quartz (lasca) is placed into an open mesh wire basket and lowered into the lower half of the vessel.

In the upper half of the autoclave the seed plates are arranged and it is around these that the cultured quartz crystals develop.

The seed plates are slices of natural or cultured quartz of known crystallographic orientation, which determine the characteristics of the cultured crystals.

Hence by changing the type of seed plate used it is possible to produce different types of cultured crystals, which in turn will produce quartz wafers with different vibration frequencies.

When the nutrient quartz and the seed plates are in position a solution of sodium carbonate or sodium hydroxide is poured into the vessel so that approximately 80% of the internal space is taken up within the autoclave.

The vessel is then sealed with a high pressure closing valve and heat is applied by means of electric heating elements, and the pressure is also increased. The temperature is built up to approximately 400C in the bottom chamber and the upper chamber is maintained at 30-40C lower. The pressure in the vessel varies with the size of the vessel but can reach 40,000 psi in a 10" diameter autoclave. The key factor in the growth of the crystals is the temperature difference between the upper and lower chambers. The lascar dissolve in the lower half and the temperature difference sets up convection currents that carry the saturated solution upwards into the seed chamber, through the intermediary baffle plate. As the solution reaches the cooler upper half, the solution becomes supersaturated and the dissolved quartz in the solution is deposited onto the seed in a crystalline form. The cool solution then sinks to the lower chamber and the cycle is repeated continuously building up the cultured quartz crystals.

The growth cycle may take anything from 25 to 100 days to complete depending on the nature of the solution (carbonate or hydroxide), the temperature difference, the size of the autoclave, and other variables. The production capacity of the autoclave depends on cycle length and internal diameter but may be estimated to be 30 kilos of quartz from a 6" internal diameter and 100 kilos, from a 10" bore (with a growing cycle of 27 days). The number of wafers which can be made out of one kilo of cultured quartz depends on the frequency of the wafer to be produced but can be estimated as being from 1,000 to 1,500.

Further Processing

The processing of quartz crystal into frequency control components follows the same course no matter whether natural or cultured quartz is used.

Before the crystals are cut they are examined for physical defects, accepted crystals are oriented to the required axes by x-rays and set in a saw frame.

The cuts must be precisely oriented and are usually made with a diamond or silicon carbide slurry saw.

Crystals are further dimensioned to a wide variety of specifications by employing surface grinders and rounding equipment.

The blanks then progress through a series of lapping stages; automatic lapping systems ensure high production rates, but finishing by hand must still be used on many blanks.

Optically finished blanks are mounted on bases and after cleaning and etching the electrodes are plated and the crystals undergo final frequency adjustment.

The unit is then sealed in a suitable holder. This is the finished quartz crystal unit and is then ready for use in an electronic circuit.

5.7.4. Manufacturing Technology

The process technologies and the equipment required for the manufacture of above products based on quartz, are mostly of very recent origin and are not yet available in Sri Lanka. Thus it is not practically possible to provide further information on manufacturing processes and other relevant technical information within the scope of this report. However, the available information on these products are presented here to give an indication of the potential of the opportunities that could be exploited. All entrepreneurs interested in this sector of industries are advised to seek foreign technical collaborations to obtain the necessary manufacturing technology and also the channels for marketing of the products.

INVESTMENT OPPORTUNITIES IN SOUTHERN REGION (MINERAL RESOURCES BASED) cont.

| PROJECT | INVESTMENT Rs | EMP. OP. | MARKET | POSSIBLE AREAS |
|--------------------------------|------------------|----------|---|---|
| PRODUCTION OF LIMESTONE POWDER | 13.5 | 17 | LOCAL & FOREIGN | RAKVANA, THIMBOL KETIYA, A'TOTA, H'TOYA, BUTTALA, |
| PRODUCTION OF DIMENSION STONES | 50 | 25 | ITALY, JAPAN, USA, AUSTRALIA, BELGIUM, MIDDLE EAST, | RIDIYAGAMA, MEEGASARA, A'TOTA, H'TOTA |

Chapter 6

CHEMICALS

(Sea Water and Salt Based Industry)

6.1. INTRODUCTION

Sri Lanka has enormous reserves of sea water right round the country and constitutes the main chemical resource for the Southern Province. This asset could be exploited for the development of several industries. Though sea water is available unrestricted right round the island, it is only at a few selected locations on the coastal belt that the environment is conducive to its economic exploitation. Several locations on the coastal belt of Hambantota are gifted with the requisite conditions that favours the economic exploitation of sea water for its vast wealth of chemicals. Other such locations in the island are, Elephant Pass, Palavi and Puttalam. Sea water has the added virtue of being an inexhaustible resource.

The manufacture of Salt (NaCl) by solar evaporation of sea water has been a traditional industry in the Southern Province from ancient times. Archaeologists have discovered that there were salterns in the vicinity of Kirinda several hundred years ago.

Though the salt industry is hundreds of years old, it is very disheartening to note that this industry has not developed in Sri Lanka, as much as it has developed in other countries in the region, such as India and Pakistan.

The main reason for the lack of progress of the sea water and salt based chemical industry is the low priority this industry has been given by the governments since independence. It is also very sad to note that even now, when Southern Province development is a priority item in the Government's agenda, the sea water and salt based chemical industry has not been given much priority.

Considering the fact that the Southern Province is not endowed with large mineral deposits and high extents of cultivable land, one of the very few options for the development of the Southern Province is the establishment of a sea water and salt based chemical industry.

The mother liquor, left behind after crystallization of salt, commonly known as bittern, for its bitter taste, could be further processed to produce Epsom Salt (Magnesium Sulphate), Magnesium Hydroxide Magnesia (Magnesium Oxide), and precipitated Gypsum. These primary products from sea water may be used as raw materials for the manufacture of a variety of other products.

6.2. VIABLE INDUSTRIES BASED ON SEA WATER

6.2.1. Primary Industries Commencing with Sea Water

Manufacture of Solar Salt or Common Salt is one of the primary industries based on sea water. Solar Salt could further be processed to produce;

- a) Refined salt
- b) Iodized salt

6.2.2. Secondary Industries Commencing with Solar Salt

Based on Solar Salt derived from sea water, several secondary industries could be established to produce the following main products;

- a) Caustic Soda
- b) Chlorine
- c) Hydrochloric Acid
- d) Bleaching Powder

And the following byproducts;

- a) Gypsum
- b) Ferric Chloride
- c) Zinc Chloride

6.2.3. Secondary Industries Commencing with Bittern

Bittern or the mother liquor left behind after the crystallization of salt could be further processed to produce;

- a) Epsom Salt ($\text{MgSO}_4, 7\text{H}_2\text{O}$)
- b) Magnesium Hydroxide ($\text{Mg}(\text{OH})_2$)
- c) Precipitated Gypsum ($\text{CaSO}_4, 2\text{H}_2\text{O}$)
- e) Magnesium Oxide (MgO)

Project Profiles drawn up for all these industries will follow.

6.3. A PROJECT PROFILE FOR THE MANUFACTURE OF SALT USING SEA WATER

6.3.1. Scope of the Project

The project as proposed, is to manufacture the following products making use of the sea water.

- a) Solar Salt 25,000 tonnes per annum
- b) Refined Salt 5,000 tonnes per annum
- c) Iodized Salt 20,000 tonnes per annum

Note: 'a' will provide the raw materials for 'b' & 'c'.

6.3.2. Market

For the last two years, there has been a shortage of common salt in the local market, and the shortfall had been met from imports. About 25,000 tonnes of common salt per annum had been imported during this period. Thus there is justification for new investments in salterns and salt processing industries.

The solar salt component in the proposed project is for use as raw material in secondary processing industries, such as Caustic Soda production. Because of the prevailing ban on the sale of non-iodized salt for human consumption, it will not be possible to sell ordinary solar salt in the local market.

Iodized salt is for sale in the local market where it has a very good demand. As a means of combating the iodine deficiency among the people, the law requires that only iodized salt be sold for human consumption.

For the refined salt, good export markets could be found in addition to the substantial domestic market available.

6.3.3. Production Process

6.3.3.1. Solar Salt

Solar salt is produced by solar evaporation of sea brine in a saltern. A saltern consists of large ponds constructed on the ground in a reasonably flat low lying area close to the sea. The bulk of the capital expenditure in a saltern is for this construction work. The crop of salt, crystallized and deposited in the ponds are harvested by manual collection. The raw salt thus collected, are transported by tractor to a central stoprage area and stored in prism shaped heaps.

6.3.3.2. Refined Salt Manufacture

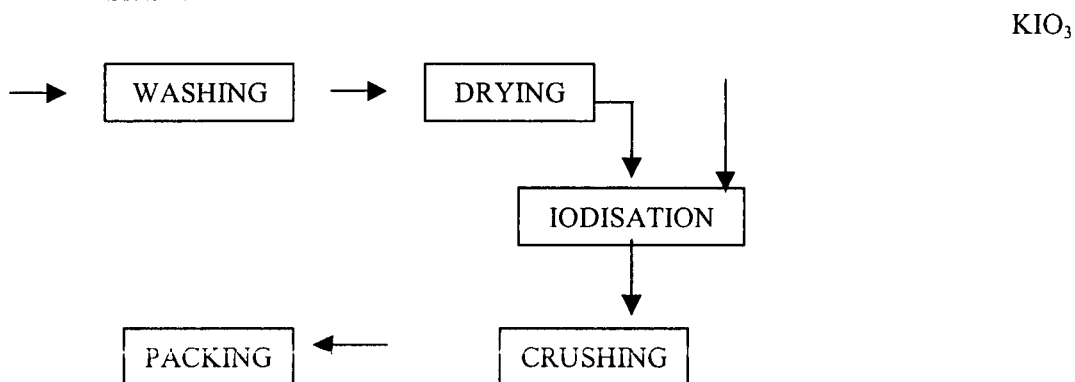
Crude solar salt is dissolved in fresh water to obtain a saturated solution of salt (NaCl) and left in sedimentation tanks for suspended impurities to settle down. Afterwards the clear liquid is led out and a measured quantity of an aqueous solution of Barium Chloride is added to it. Sulphate ions will precipitate as Barium Sulphate and will be removed as a slurry. To the clear liquid left, an aqueous solution of Sodium Hydroxide is added and Magnesium ions will precipitate as Magnesium Hydroxide and removed as a slurry. The aqueous solution of purified Sodium Chloride left is allowed to evaporate forming crystals of pure Sodium Chloride. This is then dried, ground, graded and packeted for the market, for sale as table salt.

If iodized table salt is required, a desired amount of Potassium Iodate is mixed to the table salt before grinding.

6.3.3.3. Iodized Salt Manufacture

Crude solar salt is washed and dried. It is mixed with a predetermined quantity of Potassium Iodide or Iodate and ground. The product is then weighed and packed for the market.

PROCESS FLOW CHART FOR THE MANUFACTURE OF IODIZED SALT.



6.3.4. Labour Requirements

6.3.4.1. Solar Salt Manufacture

About 200 permanent employees including office staff, skilled production workers and unskilled labourers. About 300 seasonal workers for salt collection and transfer in the salt collection seasons.

6.3.4.2. Refined Salt Manufacture

About 60 permanent skilled and unskilled workers

6.3.4.3. Iodized Salt Manufacture

About 150 permanent skilled and unskilled workers.

6.3.5. Capital Expenditure

6.3.5.1. Machinery and Equipment

a) For the Solar Salt Manufacture

| Item | Qty |
|---------------------------------------|-----|
| Pumps 8" | 03 |
| Pumps 6" | 05 |
| Pumps 4" | 12 |
| Pumps 3" | 12 |
| Tractors with Trailers | 10 |
| Weighing Equipment (Cup scales) | 05 |
| Weigh Bridge | 01 |
| Front end Loader (loading & stacking) | 01 |
| Hand Tools (mammoties, spades etc.) | |
| As required | |

b) For the Refined Salt Manufacturer

| Item | Qty. |
|---|-------------|
| Crude salt dissolving column | 01 |
| Chemicals dissolving tanks | 02 |
| Sedimentation tanks | 01 |
| Evaporators | 02 |
| Centrifuges | 01 |
| Dryers | 01 |
| Grinding mill (Hammer type) | 02 |
| Grader/Sieve stoker | 01 |
| Weighing & Packing plant | 01 |
| Conveyor system (vertical & horizontal) | 01 |
| Pumps 2" | 03 |

c) For the Iodized Salt Plant

| Item | Qty. |
|------------------------------|-------------|
| Crude Salt Washing unit | 02 |
| Drier – Solar | 03 |
| Drier – Firewood/Furnace oil | 01 |
| Mixing Plant – for Iodine | 03 |
| Crushers | 03 |
| Weighing & Packing Plant | 01 |
| Pumps 2" | 05 |

6.3.5.2. Summary of Capital Expenditure – in Rs. Millions

| Classification of Expenditure | Solar Salt Plant | Refined salt Plant | Iodized Salt Plant |
|--------------------------------------|-------------------------|---------------------------|---------------------------|
| Land | 10 | 00.5 | 01 |
| Building | 50* | 03 | 05 |
| Plant & Equipment | 50 | 10 | 20 |
| Energy installation | 01 | 00.25 | 01 |
| Water supply | 00.5 | 01 | 01 |
| Waste Treatment | 01 | 00.5 | 00 |
| Environment | | | |
| Safeguards | 02 | 01 | 01 |
| Total Cost | 114.5 | 16.25 | 29 |

This includes the cost of civil work in the construction of the Salterns

6.3.6. Recommended Locations

Recommended locations are:

- a) Karagam Lewaya; a low lying marshy land located 3 Km from the Hambantota town along the Hambantota – Ambalantota main road. The raw material, sea brine is abundantly available as the sea is only a few hundred yards away.
- b) Palatupana, about 500 hectares of land is available close to the Palatupana salterns of Lanka Salts Ltd., ideally suited for constructing a large saltern. Easy access to the sea for brine is available.

6.3.7. Environmental Impact

6.3.7.1. Waste Generated & Alternative Uses for Waste

a) Solar Salt Manufacture

The only waste produced is “Bitterns”, the mother liquor left after the collection of salt. This is bitter in taste, due to its high Magnesium content, hence the name bittern. Bittern is an aqueous solution, mainly of Magnesium Chloride ($MgCl_2$) Magnesium Sulphate ($MgSO_4$) and Potassium Chloride (KCl). One tonne of salt produced results in one tonne of bittern of 29°Be.(density)

Bittern could be made use of, to manufacture the following by-products:

- i) Epsom Salt ($MgSO_4 \cdot 7H_2O$)
- ii) Precipitated Gypsum ($CaSO_4 \cdot 2H_2O$)
- iii) Magnesium Hydroxide ($Mg(OH)_2$)
- iv) Schoenite ($KCl, MgSO_4$)

b) refined Salt Manufacture

i) Solid waste produced are:

- $BaSO_4$ slurry, about 100 t/A. could be utilized to recover Barium Sulphate (chemical compound) approximately 100 t/A.
- $Mg(OH)_2$ slurry, about 70 t/A. Could be utilized to recover Magnesium Hydroxide, (chemical compound). Approximately 75 t/A.
- Mud slurry, about 600 t/A, to be led to waste.

c) Iodized Salt Manufacture

No appreciable waste.

6.3.7.2. Environmental Pollution Safeguards

a) Solar Salt Manufacture

Sea brine stored in various parts of the salterns could percolate down and contaminate ground water supplies. This could be minimized by making the saltern beds impervious to brine by depositing a layer of clay on the beds.

Bitterns should preferably be used to recover the by-products listed above, which will have a good market demand, and the further processing would be profitable. However, if the bitterns are not to be further processed, it should be pumped back in to the sea, to prevent it affecting the ground water and the vegetation in the vicinity.

Past experience is that, salterns have not caused environmental pollution problems of any serious nature.

b) Refined Salt Manufacture

Barium Chloride used in the salt refining process will result in Barium Sulphate in the solid waste generated, which will be a pollutant. Barium Sulphate is a valuable material in surface coating metal fillers. Hence it would be economical to recover same. If Barium Sulphate is recovered, the resultant solid/liquid effluents are not pollutants and may safely be disposed into land fills. If not, it could be pumped back to the sea or a lagoon close by.

d) Iodized Salt Manufacture

This process does not generate any appreciable pollutants.

6.4. A PROJECT PROFILE FOR A CHLORO CAUSTIC PLANT

6.4.1. Scope of the Project

The project as proposed, is to utilize crude salt or solar salt as the main raw material and produce the following chemical products on a commercial scale. The proposed chemical products and planned production rates area:

| Product | Planned Production Rate In tones per annum |
|----------------|---|
|----------------|---|

Main Products:

| | |
|----------------------|--------|
| a) Caustic Soda | 25,000 |
| b) Chlorine – liquid | 5,000 |
| c) Hydrochloric Acid | 5,000 |
| d) Bleaching Powder | 5,000 |

By-products

| | |
|--------------------|--------|
| a) Chemical Gypsum | 10,000 |
| b) Ferric Chloride | 2,000 |
| c) Zinc Chloride | 2,000 |

6.4.2. Market

There is very good demand for all these products in the local market. Present domestic requirements are met from imports. As at present there is no commercial scale production of these items locally. To be viable the production costs should be maintained below the import prices and be of comparable quality.

If products of acceptable quality at competitive prices are produced, it would be possible to find even export markets for the products.

6.4.3. Production Process

6.4.3.1. Caustic Soda/Chloride

There are three different processes available for the manufacture of Caustic Soda based on the method of electrolysis adopted such as;

- i) Mercury Process
- ii) Diaphragm Process
- iii) Membrane Process

6.4.4. Labour Requirements

About 300 employees in all categories will be required

6.4.5. Capital Expenditure

Of the three processes available for the manufacture of Caustic Soda, based in the method of electrolysis;

- i. Mercury Process
- ii. Diaphragm Process
- iii. Membrane Process

Machinery & Equipment required for each process would differ slightly. However the main plant items are:

| Item of Equipment | Quantity |
|------------------------------------|----------|
| Pumps | 1 |
| Brine saturator | 1 |
| Precipitator | 1 |
| Filter | 1 |
| Fine purifier | 1 |
| Electrolyser | 1 |
| Recycle brine dechlorinator | 1 |
| Chlorine cooler | 1 |
| Chlorine drier | 1 |
| Chlorine Compressor | 1 |
| Chlorine liquifier | 1 |
| Hydrogen cooler | 1 |
| Caustic evaporator | 1 |
| Caustic cooler | 1 |
| Hydrochloric furnace | 1 |
| Hydrochloric absorber | 1 |
| Storage tanks for | |
| i. Caustic soda | 1 |
| ii. HCl | 1 |
| iii. Cl ₂ | 1 |
| Cylinders to store Cl ₂ | 2 |

Summary of Capital Expenditure:

| | |
|--|------|
| Manufacture of Caustic Soda – Project 1 | (P1) |
| Manufacture of Chlorine – Project 2 | (P2) |
| Manufacture of Hydrochloric Acid – Project 3 | (P3) |
| Manufacture of Bleaching Powder - Project 4 | (P4) |

| Item of Expenditure | Estimated Cost In Millions Rupees | | | |
|---------------------|-----------------------------------|------|------|------|
| | Projects P1 | P2 | P3 | P4 |
| Plant & Equipment | 155 | 30 | 20 | 15 |
| Buildings | 15 | 3 | 3 | 2 |
| Land | 2 | 0.5 | 0.5 | 0.5 |
| Energy Installation | 10 | 3 | 1 | 1 |
| Water | 5 | - | 3 | - |
| Water Treatment | 3 | - | - | - |
| Cost of Environment | | | | |
| Safeguards | 5 | - | - | - |
| Working Capital | 55 | 10.5 | 7.5 | 6.5 |
| Total Cost | 250 | 47.0 | 35.0 | 25.0 |

6.4.6. Recommended Location

This project being one, for further processing of Solar salt produced in a normal saltern, it could be established in one of two ways. As an extension project of a saltern project, utilizing a part of the raw salt output of the saltern as inputs to the project or as a separate project to use purchased raw salt from one or more existing salterns as inputs. In the former case it would be feasible to build the plant for this project at the same site as the saltern. In the later case it would be feasible to build the plant at a site adjacent to or close to the saltern supplying the raw salt for processing.

6.4.7. Environmental Impact

6.4.7.1. Waste Produced & Possible Alternative Uses

| Waste Produced | Possible products From waste | Approx. Qty. t/A |
|--|---------------------------------|---------------------|
| BaSO ₄ Slurry | BaSO ₄ | 800 |
| Mg(OH) ₂ Slurry | Mg(OH) ₂ | 800 |
| CaCO ₃ Slurry | CaCO ₃ | 500 |
| Mud from salt primary washing – led to waste | | |
| Plant washings – led to waste | | |
| Effluent Chlorine gas – scrubbed | | |
| Effluent Hydrochloric Acid gas – scrubbed | | |

6.4.7.2. Environmental Pollution Safeguards

In a Chloro Caustic plant, invariably there would be some gaseous and semi solid effluents. These could be minimized by efficient gas absorption methods and efficient solid recovery methods. Moreover there are proven technologies to minimize environmental pollution problems associated with Chloro Caustic plants.

6.5. A PROJECT PROFILE FOR THE MANUFACTURE OF USEFUL BY-PRODUCTS FROM BITTERN

6.5.1. Scope of the Project

Proposed project is to utilize Bitterns, the mother liquor manufacture the following products. To be economically viable the production capacity of the plant should be planned for quantities shown against the items.

| Proposed Product | Proposed Output in t/A |
|---|------------------------|
| i. Precipitated Gypsum ($\text{CaSO}_4, 2\text{H}_2\text{O}$) | 1,000 |
| ii. Magnesium Hydroxide $\{\text{Mg}(\text{OH})_2\}$ | 1,000 |
| iii. Magnesium Oxide (MgO) | 500 |
| iv. Epsom Salt ($\text{MgSO}_4, 7\text{H}_2\text{O}$) | 2,000 |

6.5.2. Market

Precipitated gypsum can be easily converted to Plaster of Paris of very high quality. This Plaster of Paris (P.O.P.) has a ready market in Sri Lanka in the ceramic industry. Also, the P.O.P. can be used to make surgical P.O.P. for use in hospitals.

$\text{Mg}(\text{OH})_2$ can be used as a good heat insulant. Also it could be used as a raw material in the manufacture of refractories, and commands a good demand on this account.

MgO has a ready local demand in the rubber industry. It fetches about Rs.175/per Kg. In the local market.

Epsom Salt has a demand in the Pharmaceutical trade.

6.5.3. Production Process

Production Process Flow Diagrams for each of the products are shown.

6.5.4. Labour Requirements

6.5.4.1. Precipitated Gypsum Manufacture

Total manpower requirement will be around 50 including Plant Manager, Factory Engineer, Administration, Sales and Production staff.

6.5.4.2. Magnesium Hydroxide Mg(OH) Manufacture

Same as above, however if both Gypsum and Magnesium Hydroxide are to be produced in the same plant, about 30 additional employees would be required to handle the additional work.

6.5.4.3. Magnesium Oxide (MgO) Manufacture

Additionally about 20 employees would be required to run the MgO Plant.

6.5.4.4. Epsom Salt MgSO 7HO) Manufacture

Additionally about 30 employees will be required for the Epsom Salt unit.

6.5.5. Capital Expenditure

6.5.5.1. Plant & Equipment

Precipitated Gypsum Manufacture

| Item of Equipment | Quantity |
|-----------------------------------|----------|
| Low density bittern storage tank | 1 |
| Continuously stirred tank reactor | 1 |
| Thickener | 1 |
| Lime slurrier | 1 |
| Filter press | 1 |
| Drier | 1 |
| Ball mill | 1 |
| Packing plant | 1 |
| Pumps – 3" | 2 |
| 2" | 4 |
| 1" | 5 |

b) Magnesium Hydroxide Mg(OH) Manufacture

Same as for the Gypsum plant

c) Magnesium Oxide MgO Manufacture

In addition to above equipment will require;

Calcining furnace 1 No.

d) Epsom Salt Plant

| Item of Equipment | Quantity |
|------------------------------------|----------|
| Low density bittern storage pond | 1 |
| Evaporation area | 1 |
| High density bitterns storage pond | 1 |
| Cooling tower | 1 |
| Primary cooler | 1 |
| Cooling Crystallizes | 1 |
| Magma tanks | 1 |
| Basket centrifuge | 1 |
| Solar / forced draft drier | 1 |
| Packing Plant | 1 |
| Pumps – 3" | 2 |
| 2" | 4 |
| 1" | 6 |

6.5.5.2. Summary of Capital Expenditure – In Rs. Millions

| Item of Expenditure | Gypsum | Mg(OH) Plant | MgP Plant |
|-----------------------------------|-------------|-----------------|------------|
| Plant & Equipment | 8 | 8 | 3 |
| Buildings | 2 | 2 | 1 |
| Land | 0.5 | 0.5 | 0.2 |
| Energy (Electricity) | 1.5 | 1.5 | 0.2 |
| Water | 0.5 | 0.5 | 0.1 |
| Water Waste Treatment | 0.5 | 0.5 | -- |
| Cost of Environment Safeguards | 1 | 1 | 0.3 |
| Total Cost | 14.0 | 14.0 | 4.9 |

Note: MgO project cannot exist independent of the other two projects.

6.5.6. Recommended Location

The plant complex should be located in or adjacent to a large saltern in order to receive adequate quantities of bitterns for further processing. Ideally this project could be one component of an integrated saltern project.

If the intention is to establish this project as an extension of an existing saltern, then, establishing this project adjacent to Mahalewaya saltern at Hambantota would be feasible.

6.5.7. Environment Impact

6.5.7.1. Waste Generated and Alternative uses from Waste Products

Waste water containing very fine particles of Gypsum and Magnesium Hydroxide will be produced. This will be non toxic. The quantity will be four times the total quantity of Gypsum and Magnesium Hydroxide produced.

Filtrate containing around 10% KCl is produced as waste. This liquid could be used as a liquid fertilizer.

6.5.7.2. Environment Pollution Safeguards

The plant does not produce pollutants. It produces a very thin waste water containing around 100 ppm. Very fine particles of $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ and $\text{Mg}(\text{OH})_2$ both of which are non-toxic. However in the plant there should be provision to coagulate and flocculate these fine particles so that they could be separated and removed. The water which will then contain around 100 ppm. Of Potassium, Sodium, Chloride and Sulphate could be sent to a soakage pit or it would be better to send it back to the sea.

The filtrate containing 10% KCl could be sold as liquid fertilizer or concentrated to crystallize out KCl and sold as solid fertilizer.

COASTAL LINE LENGTH BY DISTRICT

| District | Length k.m |
|--------------|------------|
| Galle | 73 |
| Matara | 48 |
| Hambantota | 151 |
| Total | 272 |

Source: Southern Province in figures - 2000

Courtesy: Southern Development Authority.